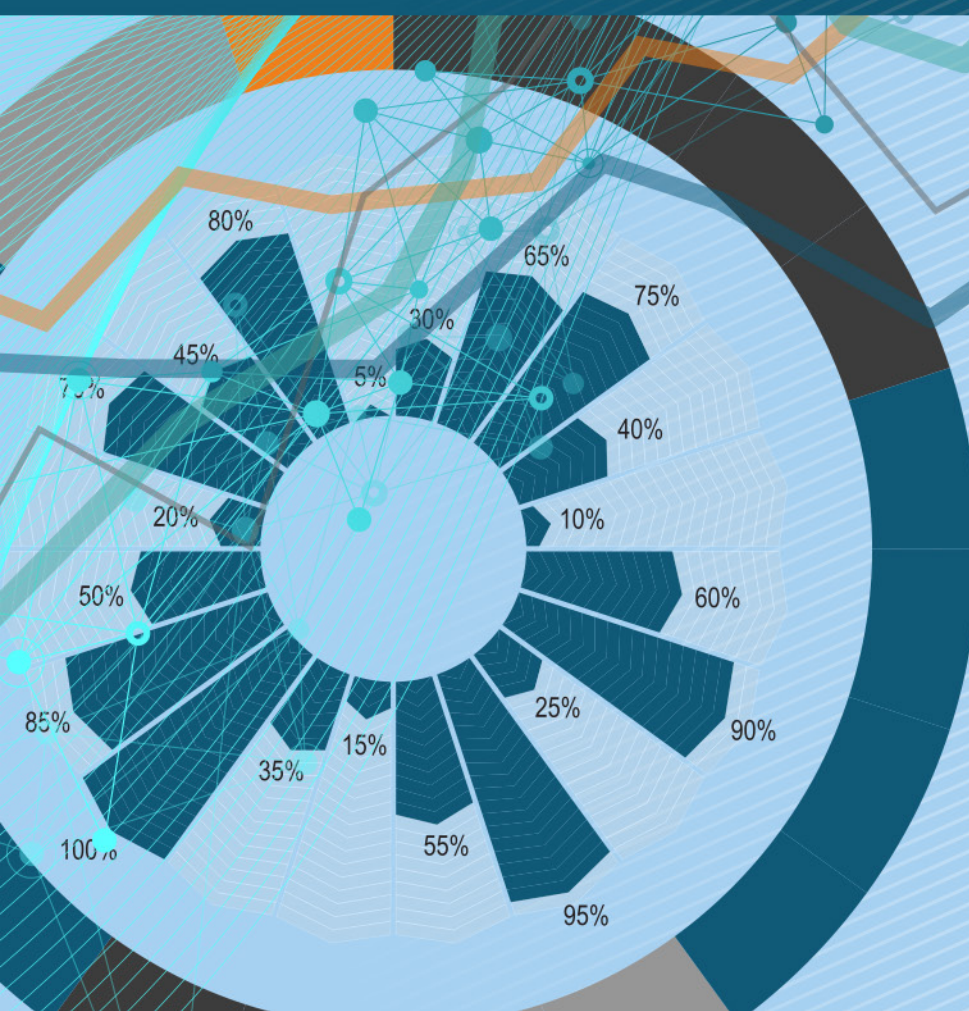# JOURNAL OF REGIONAL AND INTERNATIONAL COMPETITIVENESS

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JOURNAL OF REGIONAL AND INTERNATIONAL COMPETITIVENESS

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Systematic process analysis: digitalisation of the economy in terms of the political economy approach

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ORIGINAL ARTICLE

Abstract. With the rapid development of information technologies, digitalisation is becoming a key factor in socio-economic development. However, the process of digital transformation involves a number of challenges, including changes in the nature of interaction between economic actors, transformation of reproduction chains, and redistribution of economic interests. At the same time, the issue of a comprehensive analysis of digitalisation in terms of a political economy approach remains insufficiently studied in the scientific literature. This research concerns with the digital transformation of the economy through the prism of political economy analysis. It allows us to identify the mechanisms of changes in economic interests, transformation of social reproduction structure and changes in the system of distributive relations. The political economy approach provides an opportunity to analyse the role of the state, corporations, and society in the process of digital transformation, examine the emerging economic imbalances associated with digital inequality, capital concentration and income redistribution in the digital economy. The purpose of the study is to comprehensively examine the processes of economy digitalisation in terms of the system-integrative analysis. The research considers the political economy approach in the context of digitalisation, the interests of key participants in the digital economy, transformation of reproduction chains, distribution relations, assessment of the impact of digital technologies on labour relations, and economic policy. The research methodology is based on the system-integrative approach, methods of logical, criterion, comparative, and structural-functional analysis. The main results of the study indicate the redistribution of economic interests, changes in the structure of social reproduction and the mechanisms of state regulation in terms of the digital economy. Indeed, digital transformation requires active state participation in the formation of digital institutions, regulation of new economic relations, and ensuring digital sovereignty. The practical application of the results obtained is possible in the development of digital transformation strategies.

Keywords: digital economy; digital infrastructure; digital environment; digitalisation of the industry; political economic approach; transformation of reproductive chains

Introduction

The modern economy is undergoing large-scale structural changes under the influence of digitalisation, affecting all spheres of economic activity. The introduction of digital technologies is changing traditional models of production, distribution, exchange, and consumption requires reconsideration of key economic patterns. The digitalisation of the economy causes a change of the capital structure, and an increase data and information technology influence, and the growth of intangible assets. The transformation of economic processes is accompanied by changes in reproduction chains. It is manifested in the transition to platform business models, labour automation, digital division of resources, and changing regulatory mechanisms. Moreover, it provides both new opportunities for economic growth and structural imbalances related to the redistribution of capital, changes in the labour market and the concentration of data on the large digital

platforms.

Therefore, the political economy approach becomes the most important tool of analysis considering a multi-level structure of interests (individual and state), the fundamental interrelationships between different subjects of the economic system, their interests and mechanisms of their realisation in the conditions of digital transformation.

Political economy analysis focuses on the economic interests of participants and on the mechanisms of their behaviour. Digitalisation is changing the balance of power between the state, corporations, and society, increasing competition for control over data, and redistributing profits to the owners of digital platforms. These processes require the development of new regulatory mechanisms capable to ensure the economic sustainability, digital sovereignty, and equitable distribution of resources.

The object of the study is the process of economy digitalisation through the prism of the political economy approach, impact of digital technologies on changes in socio-economic relations within the reproduction cycle.

The purpose of the research is to study the processes of economy digitalisation in the system-integrative approach.

The objectives of the research are as follows:
– to consider the characteristics of the political economy approach;
– to explore the interests of the participants using the example of key sectors of the national economy;
– to compile and analyse the interrelationship of interests at different levels;
– to study the political economy approach in terms of reproduction chains transformation;
– to assess the effectiveness of political economy approach.

The methodological basis of the research is built based on the general scientific principles of system-integrative approach, methods of logical, criterion, comparative, structural and functional analysis. Correlation and regression modelling and empirical analysis based on statistical data, international reports and national strategies for the digitalisation of the economy are used contextually. The sample covers data from the State Statistics Service of the Russian Federation and China, analytical materials of the World Bank and the European Union, data of Russian and foreign research centres.

Main Part

The political economy approach

The global economy digitalisation requires a comprehensive analysis of economic processes. The political economy approach provides unique tools for such analysis. It allows us to study the interests of various actors, i.e. individuals, corporations, society, and the state. The digital economy is a new form of economic activity. It concerns with the issues digitalisation effect on national and state economic systems. In political economy, the interests of different levels, such as the individual, corporation, society and the state, play a key role in formation of economic policy [4]. Indeed, these interests provide the vector of the national development.

Features of the approach

According to the classical political economy, the interests of the individual, corporations, and society play a crucial role in formation of the economic policy and determines the vector of national development. A. Smith in his work "Research on the Nature and Causes of the Wealth of Nations" emphasised the economic development as the private interests of subjects contribute to the general welfare through competition and free market mechanisms [12]. D. Ricardo focused on the distribution of income between the main economic classes – workers, capitalists, and landowners. According to him, the structure of society has a significant impact on economic processes and the formation of a national development strategy [10]. J.-B. Say considered production in terms of the effective functioning of the economy, including state institutions [11]. The growing digitalisation and globalisation of the economy ensures the particular importance of the hierarchy of individual and national interests and their relationships with state and public interests. Indeed, this interaction provides the formation of the main economic strategies at all levels.

A political economic analysis in terms of the socio-economic interests and digital transformation allows ones to study the specifics of distributive relations. However, the interests of economic entities can be not only overlapping, but also contradictory. It provides the basis for economic and social tension. Therefore, the main focus will be on the analysis of interests at different levels, their interaction, the impact of these interests on the national development of key industries in the digital economy.

Economic interests of the participants

Individual interests in terms of political economic analysis

The fundamental level of analysis in political economy is the interests of individuals. It plays a key role in determining economic behaviour and decision-making. In the political economic context, individual interests are associated with maximising personal gain, wide range of factors, such as well-being, access to resources, working and living conditions, opportunities for self-development, and participation in public life [9].

The participants socio-economic interests allow us to identify specific mechanisms of interaction between the state, business, and society, as well as identify key factors influencing the development of individual sectors of the economy. In our opinion, the differentiated analysis contributes to more accurate forecasting of macroeconomic trends, assessment of the effectiveness of public policy, and identification of structural imbalances. Digitalisation, innovation, and changes in consumer behaviour transform industry processes in different ways. It requires industries specification and allows us to develop optimal management strategies and adapt to new economic realities.

Finance. In the financial sector, digital technologies ensure the convenience and security of financial transactions. The main digital solutions are digital mobile banking, contactless payment systems, and a fast payment system.

Mobile banking applications allow ones to make payments, transfers, and other transactions without visiting a bank. According to the Central Bank of the Russian Federation, in 2022, the share of non-cash payments in retail trade exceeded 70%. It indicates the widespread use of digital financial services among the population[1].

Education. In the digital economy, individuals can be focused on improving their opportunities through access to educational and professional resources. High-quality education determines the possibilities of personal and professional growth.

The Russian higher education system has been actively developing in recent years. According to Rosstat, there were 741 higher education institutions in the country in 2022; 4.2 mln students enrolled. The national project "Education" plans to establish 25 innovative university campuses by 2030. It will improve the accessibility and quality of educational services [9].

Electronic educational platforms such as "Rossiyskaya Electronnaya Shkola" and "Moskovskaya Electronnaya Shkola", "Electronniy Dnevnik", "Moye Obrazovaniye" are being actively introduced, providing access to interactive educational materials and contributing to improving the quality of education[2].

Healthcare. In the healthcare industry, digital solutions are aimed at improving the quality of medical services and increasing their accessibility. Innovative digital solutions include: the introduction of robotic surgeons, smart prosthetics systems. Artificial intelligence provides the remote diagnosis and comprehensive treatment. Big data processing systems and user's personal card are being implemented.

System "Ediniy cifrovoy kontur v zdravoohranenii na osnove edinoj gosudarstvennoj informacionnoj sistemy v sfere zdravoohraneniya" ensures the integration of medical information systems and remote interaction between doctors and patients. According to the Ministry of Health of the Russian Federation, by 2023, more than 70% of medical organisations will use electronic medical records. It will improve the

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[1] *National Payment System: results of 2022. Central Bank of the Russian Federation. Source: https://www.cbr.ru/statistics/nps/psrf (accessed on 07.01.2025)*
[2] *Top 20 Russian online educational platforms, 2022-2023. Source: https://brandanalytics.ru/blog/top-20-education-2022-2023 (accessed on 12.01.2025)*

effectiveness of diagnosis and treatment[3].

Transport. In the transport industry, digitalisation is aimed at improving the safety and efficiency of transportation. Current digital solutions include: smart roadside assistance systems, unmanned vehicles, real-time traffic monitoring programmes automatic fare payment, online vehicle tracking.

Intelligent traffic management systems, such as the Automated Traffic Management System, can optimise traffic flows and reduce traffic jams. In Moscow, the introduction of such systems has reduced the average travel time by 12% and the number of traffic accidents by 15%[4].

Science and Scientific Services. The digitalisation of science helps accelerate research and increase its effectiveness. National repositories of scientific data provide researchers with access to large amounts of information. The Nationalnaya Electronnaya Biblioteka platform provides access to millions of scientific publications and documents. It contributes to the development of scientific research and knowledge exchange[5].

The interests of corporations and companies

Indeed, the corporations and companies are very important subjects of economic activity. The interests of corporations include the desire to increase profits, expand market positions, reduce costs, and maximise shareholder value [5]. In terms of digital economy, companies monetise data, create digital platforms, and develop new business models based on the use of digital technologies.

The political economic analysis of corporate interests also highlights the importance of strategic resource management. In the digital economy, data is becoming a key asset; the companies try to use it for improvement of their competitive position.

Industry. In industry, digitalisation optimises the production processes and product quality. The use of Internet of Things (IoT) technologies allows ones to collect data from equipment in real time. It promotes timely maintenance and reduces operational interruptions. The Manufacturing Execution Systems (MES) integrate data from various sources, ensuring transparency and control at all stages of production. Artificial intelligence predicts demand and optimises the supply chains.

In 2025, Severstal, Cherepovets, Vologda region, Russia implemented an AI analytics system based to forecast equipment failures. It reduces company repair costs by 10% and increased productivity by 5%[6]. In 2025, Severstal announced the launch of AI automated quality inspection system for rolled metal products[7].

Agriculture. Digital technologies in agriculture are aimed at increasing yields and sustainability of agricultural production. The use of unmanned aerial vehicles (UAVs) and satellite monitoring allows to control crops and soil. Farm management systems collect and analyse large amounts of data to optimise resources. Artificial intelligence is used to predict weather conditions and detect plant diseases.

In Russia, Cognitive Pilot company has introduced a fully unmanned AI cab-less tractor for autonomous navigation[8].

Construction. In the construction industry, digitalisation helps to increase the accuracy and efficiency of projects. Building information modeling (BIM) technologies allow ones to construct digital models of objects by integrating data on construction and materials. Drones and sensors data collection ensures monitoring of construction processes. Artificial intelligence is used to optimise work schedules and manage resources.

For instance, the construction company PIK, Moscow, Russia has implemented BIM technologies in its

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[3] *The results of the transition to electronic medical records in 2023. Source: https://www.rosminzdrav.ru/news/2023/12/31/itogi-emk (accessed on 08.01.2025)*

[4] *Intelligent transport systems have reduced accidents on the roads. Source: https://www.comnews.ru/content/235937/2024-10-28/2024-w44/1008/intellektualnye-transportnye-sistemy-snizili-avariynost-dorogakh (accessed on 11.01.2025)*

[5] *TNational Electronic Library: About the project. Source: https://rusneb.ru/about (accessed on 05.01.2025)*

[6] *Severstal has implemented the technology of intelligent analysis of business processes. Source: https://severstal.com/rus/media/archive/2020-11-03-severstal-vnedrila-tekhnologiyu-intellektualnogo-analiza-biznes-protsessov (accessed on 05.01.2025)*

[7] *Artificial intelligence in production: what tasks can be entrusted to neural networks. Source: https://www.eg-online.ru/article/489532 (accessed on 07.01.2025)*

[8] *TDigitalisation in the agro-industrial complex of Russia. Source: https://www.tadviser.ru/index.php/Статья:Digitalization_in the Agroindustrial Complex_Russia (accessed on 10.01.2025)*

projects. It reduced construction time by 20% and costs by 15%[9].

Trade. In trade, digital solutions improve supply chain management and raise customer satisfaction. Warehouse Management Systems (WMS) use data to optimise the placement of goods and logistics. Big data analysis predicts demand and manage inventory. Artificial intelligence improves customer service and personalisation.

X5 Retail Group, Russia uses big data analytics to optimise product range and pricing. It causes a 5% increase in sales in 2024[10].

Finance. In the financial sector, digitalisation increases the security and efficiency of operations. Blockchain technologies ensure transparency and immutability of transactions. Big data analysis assesses credit risks and detect fraud. Artificial intelligence is used in algorithmic trading to provide personalised financial recommendations.

Sberbank, Russia implements AI system to assess customer creditworthiness. In 2023, it reduced application processing time by 30% and default rates by 20%. In 2023 Sberbank earned an additional 350 bn RUB due to the integration of AI into all business processes[11].

The IT Sector. In the IT sector, digital technologies are the foundation of innovation and development. Cloud services provide scalable resources for data storage and processing. Big data is analysed to identify trends and make informed decisions. Artificial intelligence is used in software development, cybersecurity, and the design of new products and services. However, it increases inequality and capital concentration, and requires additional regulatory mechanisms.

For instance, Yandex, Russia uses artificial intelligence in its services, such as Yandex.Search for and Yandex.Navigator, providing users with personalised and accurate information[12].

Ozon, Wildberries, VKontakte, and Sberbank corporations are actively using big data to design platform ecosystems. It allows them to control significant market shares and generate additional revenue through the use of digital technologies[13].

Therefore, digitalisation in various sectors of the economy increases efficiency, reduces costs and provides new business opportunities.

However, in terms of the political economy approach the special attention is paid to the interaction of corporations and the state. In terms of the digital economy, the government mostly has to regulate digital monopolies and protect consumer rights. At the same time, the interests of corporations and the state are often contradictory. The state strives to ensure the distribution of resources and the protection of public interests, while corporations focus on maximising their profits and reducing regulatory costs [5].

The interests of the State

At the highest level of the hierarchy of interests are public and state interests. They play an important role in shaping a long-term strategy for the development of the digital economy. According to the political economic analysis, the interests of the state are to ensure economic sustainability, social justice, and the protection of national sovereignty in the context of global digital transformation. Government interests include regulating digital markets, protecting citizens personal data, and developing digital infrastructure accessible to the population. However, access to digital technologies and resources is unevenly distributed. Therefore, the special attention is paid to protecting public interests in the context of digital inequality.

Education. Distance learning systems are being actively implemented. According to the Ministry of Education of the Russian Federation, by 2024 it is planned to supply all schools in the country to high-speed Internet. It will ensure equal access to digital resources for all students [1].

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[9] *Digital architecture, or BIM modeling in construction. Source: https://www.mos.ru/news/item/68340073 (accessed on 07.01.2025)*

[10] *Analytics in the X5 range: data becomes a business asset. Source: https://www.interfax.ru/business/2024/07/22/876543 (accessed: 13.01.2025)*

[11] *Artificial intelligence in finance. Source: https://developers.sber.ru/help/gigachat-api/ai-in-finance (accessed on 01.02.2025)*

[12] *Intelligence to help. Source: https://www.kommersant.ru/doc/7327008 (accessed on 10.02.2025)*

[13] *Who can become the leader of the global platform economy now. Source: https://www.rbc.ru/industries/news/666185c29a794797dcc32d8f (accessed on 05.02.2025)*

Government services. Digitalisation of public services significantly increases their accessibility and efficiency. The Gostech platform is an example of a unified digital infrastructure providing citizens with access to various government services, including healthcare, science and education, public transport, construction, housing and communal services[14].

In addition, state interests are related to maintaining national sovereignty in terms of the growing globalisation. Many states have challenges relating to the influence of transnational corporations controlling key segments of the digital economy. Therefore, the development of national digital security strategies and protection against cyber threats jeopardizing national economic and social stability plays an important role.

Interrelation of interests at different levels

Political economic analysis involves a deep understanding of the interrelationships between interests at different levels, from the individual to national ones. These interests do not always correspond, and their intersections often result in economic and political conflicts. For instance, national interests in ensuring the social justice may conflict with the interests of corporations in their attempts to maximise profits through the use of inexpensive labour or the introduction of technologies reducing the number of jobs.

Moreover, additional difficulties arise due to conflicts of interest in economic relations. The government regulates digital corporations to prevent the monopolisation of markets and ensure the security of citizens personal data. Indeed, digital corporations may resist such measures [14].

In addition, active state participation in the digital services market can cause a conflict of interests, since the state becomes both a regulator and a market participant. It can provide unequal competition conditions.

At the societal level, digitalisation also causes the conflicts of interest. For instance, the digital technologies in various spheres of life can contribute to economic development. Simultaneously, they can increase digital inequality between different social groups and regions. This can increase the social tension [7].

At the same time, the interaction of these interests determines the overall economic dynamics and sets the vector of the nation's development. In the context of digitalisation, the state and public interests should play a leading role in shaping economic policy aimed at ensuring sustainable development and social justice. The state should act as a mediator, able to coordinate the interests of all participants in the economy and develop conditions for their interaction within the framework of a unified development strategy.

Transformation of reproduction chains political economy approach in terms of digital economy

The reproduction process in the political economy approach is a central element of political economic analysis. It covers the entire chain of movement of a social product – from production to consumption. In the traditional economy, the production is closely related to physical goods and services at various stages of the economy [6]. However, in the context of digitalisation, the role of intangible assets such as data, information and technology are becoming increasingly important. The digital economy is transforming traditional production and exchange models, providing new opportunities for optimising production through automation and real-time data.

For instance, the introduction of the Internet of Things (IoT) into production. IoT allows enterprises to monitor production resources and processes in real time. It increases efficiency and reduces costs. The reproduction process in the digital economy also effects on the design of new types of goods and services based on digital technologies. It expands the possibilities of exchange and consumption[15].

Digitalisation and distribution relations

The digitalisation of the economy has a significant impact on distributive relations and reproduction process. The political economy approach emphasises the allocation of generated value between different population groups and economic sectors as the most important element of socio-economic development [3]. In the digital economy, data and information are becoming the main object of distribution. Platforms such

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[14] *Gostech platform. Source: https://platform.gov.ru (accessed on 10.01.2025)*
[15] *Digital transformation: the Eurasian and international context. Eurasian Development Bank. Source: https://fci.eabr.org/upload/ EDB_Digital-Transformation_2024-04-15_web.cleaned.pdf (accessed on 05.01.2025)*

as Yandex, Google, Amazon, gain control of these key resources, form new forms of monopolisation, and concentrate the capital.

According to political economic analysis, digitalisation changes the nature of distributive relations and establish new forms of inequality. Access to digital resources and technologies is unevenly distributed both between and within different countries. It requires the development of new mechanisms for regulating and redistributing. For instance, digital platforms monopolisation increases economic inequality, as a small number of companies control most of the data. It allows them to make super profits through exploiting digital technologies.

Exchange and consumption in the digital economy

The digital economy changes the production and distribution, and transforms exchange and consumption. In a traditional economy, the exchange process involves the physical transfer of goods and services from producer to the consumer. In the context of digitalization, exchange is increasingly provided through digital platforms and online markets. It simplifies access to goods and services. For instance, e-commerce developing rapidly. The volume of global e-commerce sales in 2024 will amount to $ 6.3 trln USD. It is 8.76% more than in 2023[16].

Indeed, digitalisation simplifies exchange and forms the new forms of interaction between the consumers and producers. For instance, the sharing platforms Uber, Airbnb, and Delimobile allow consumers to interact directly with each other without intermediaries. It changes traditional models of consumption and income distribution[17]. A political and economic analysis of these processes provides a deeper understanding of economic mechanisms transformation, social relations, consumption, and exchange.

Labour relations and labour force reproduction

The key element of the reproductive approach is the analysis of labour relations and labour force reproduction. In political economy, labour occupies a central place; the production of tangible and intangible goods is provided through it. In the digital economy, labour relations are undergoing significant changes. On the one hand, automation and robotisation cause the reduction of traditional jobs, especially in manufacturing and transportation. On the other hand, digitalisation provides new jobs in high-tech sectors and software development.

According to political economic analysis, digitalisation changes the structure of employment and the nature of labour force reproduction. The employees have to adapt to new working conditions, acquire new skills and engage in flexible forms of employment, such as freelancing or working on digital platforms. This provides new challenges for social security and labour rights protection, as traditional labour regulation mechanisms frequently cannot compete with the rapid changes occurring in the digital economy.

For instance, employees aim for equitable wages, better working conditions, and social security, while entrepreneurs and capital owners are focused on increasing profits and optimising costs. These interests often conflict with each other providing the social conflicts. In the digital age, these contradictions may worsen due to automation and digitalisation of workplaces as many employees are forced to adapt to new conditions or lose their jobs due to the replacement of their work functions by robots and artificial intelligence. An example of the transformation of employment by industry is shown in Fig. 1-2.

Agriculture, forestry, and fisheries. During the period 2017-2023, employment in this industry showed a steady downward trend: from 4,294 mln people in 2017 to 4,020 mln people in 2023. The decrease (about 6.4% in 7 years) is due to several factors:

– Automation and digitalisation. Precision farming technologies, unmanned tractors, and crop management systems has reduced the need for manual labour.

– Optimisation of agricultural holdings. Large agricultural companies use modern production

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[16] *Global e-commerce trends 2024 in numbers. Source: https://www.proresultat.com/mirovie-trendi2024-v-cifrah (accessed on 07.01.2025)*

[17] *The economics of separation: how sharing platforms work. Source: https://b2b.oooeos.ru/articles/ekonomika-razdeleniya-kak-rabotayut-platformy-po-sovmestnomu-potrebleniyu (accessed on 07.01.2025)*

management systems. It reduces the demand for unskilled labour.

Figure 1. The number of employed by type of economic activity on average per year, thousands of people
Source: https://eec.eaeunion.org/comission/department/dep_stat/union_stat/current_stat/labour_market/series (accessed on 10.01.2025)

– Urbanisation and out-migration. The young working-age population prefers to work in cities. It reduces the supply of labour in agriculture.

Construction. Construction employment fell from 5.285 mln people in 2017 to 4.913 mln people in 2023; a decline is 7%. However, the industry is gradually recovering after a collapse in 2020 (4.666 mln). Major trends are as follows:

– The growth of housing construction. Government programmes to support mortgages and investments in infrastructure projects stimulate demand for construction services.

– Automation and digitalisation. The introduction of BIM technologies (Building Information Modelling) and automated project management systems increases productivity, but reduces the demand for low-skilled labour.

– Labour shortage. In 2022-2023, there was a shortage of qualified personnel in the construction industry due to the outflow of migrants.

Transportation and warehousing. Employment in the sector grew steadily from 6.210 mln people in 2017 to 6.528 mln people in 2023 (+5.1%). Growth factors:

– The growth of online commerce and logistics. The increase in e-commerce causes the higher demand for warehousing and logistics services.

– The development of transport infrastructure. The launch of new highways, the modernisation of rail and air contribute to the jobs growth.

– Digitisation and automation. The logistics management systems, unmanned vehicles, and intelligent warehouses reduces the need for low-skilled labour. However, it increases demand for IT specialists and engineers.

Employment in trade decreased from 11.586 mln people in 2017 to 11.286 mln people in 2023 (-2.6%). However, recently some stabilisation has been observed. Influencing factors:

– The rise of e-commerce. Online trading reduces the need for traditional stores and staff. However, it forms new jobs in the IT sector and logistics.
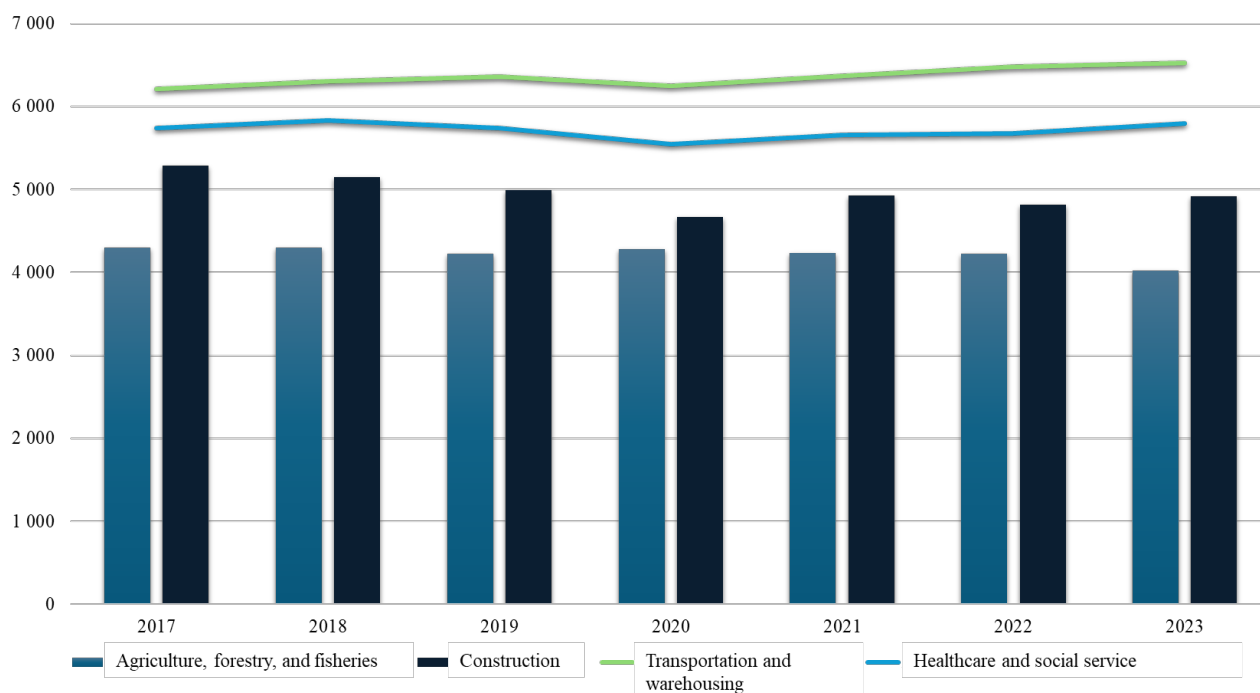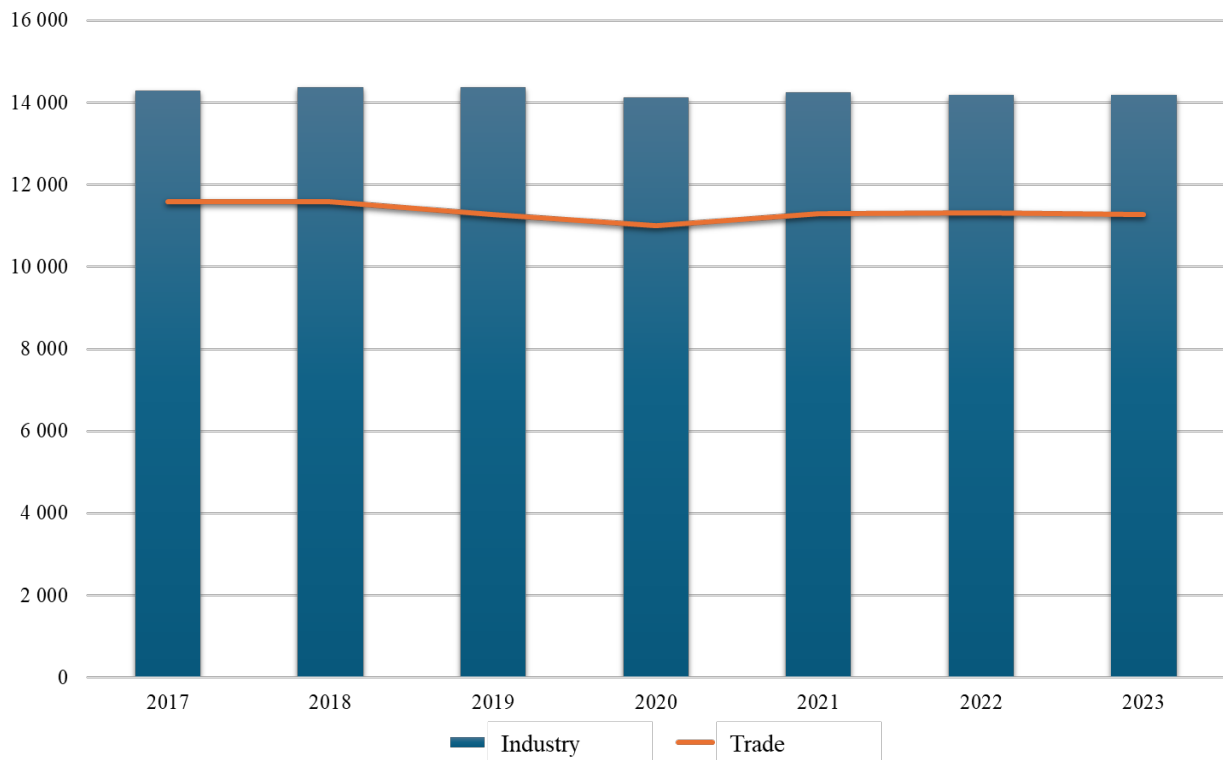
Figure 2. The number of employed by type of economic activity on average per year, thousands of people
Source: https://eec.eaeunion.org/comission/department/dep_stat/union_stat/current_stat/labour_market/series (accessed on 10.01.2025)

– Optimisation of retail networks. Large retail chains automate processes (for example, they introduce self-service cash desks). It reduces the need for the employees.

– Post-pandemic recovery. After collapsing in 2020 (10.999 mln), the market has gradually recovered to 2019 level. It shows the recovery in consumer demand.

Employment growth is the key trend during the period under study. The total number of employed in the economy increased from 71.116 mln people in 2020 to 73.636 mln people in 2023. It shows the recovery of the labour market after the pandemic-related crisis. Trends by industry:

– Reduction of employment in agriculture. The number of employees in agriculture, forestry, and fisheries decreased from 4,294 mln people in 2017 to 4,020 mln people in 2023. It can be result of automation of production and reduction of labour demand.

– Industrial stability. The number of employees in the industrial sector remained relatively stable, decreasing slightly from 14.299 mln people in 2017 to 14.191 mln people in 2023. However, there is a slight increase in employment in the manufacturing industry in 2023 (10.279 mln). It can indicate the industry's adaptation to new economic conditions.

– Growth in the field of IT and scientific activity. Employment in the Information and Communications industry increased from 1.296 mln people in 2017 to 1.430 mln people in 2023. A similar growth is observed in the professional and scientific activity segment (from 2.296 mln to 2,850 mln people). It confirms the trend towards digitalisation and an increase in demand for highly qualified personnel.

– Employment growth in education and healthcare. The number of employed in education increased from 6.908 mln people (2017) to 7.148 mln people (2023); in healthcare – from 5.739 mln to 5.798 mln due to the modernisation of social infrastructure and increased funding.

The data indicate structural changes in the economy caused by digitalisation, automation, and labour demand. The growth in high-tech industries and the expansion of social services demonstrate a strategic shift towards knowledge and innovation. The development of digital technologies helps to increase the flexibility

of the labour market, gives new opportunities for employment and self-realisation. However, it also requires adaptation and changes in traditional employment models.

A detailed comparison of the reproduction chains and their transformation within the framework of the political economy approach in terms of the digitalisation of the economy is presented in Table 1.

Table 1 – Transformation of the reproduction chains of the political economy approach in terms of economy digitalisation

Reproductive chains	Market economy	Information economy	Digital economy
The state of extended reproduction	Moderate extended reproduction	Moderate expansion through data and IT	Accelerated extended reproduction
The ratio of living and materialised labour	The predominance of materialised labour	The importance of information technology	The prevalence of intellectual labour and AI
Dynamics of the production factors	The predominance of material factors of production (labour, means of production). Low proportion of the information component (no more than 5%)	Significant growth of IT, knowledge as a resource. High proportion of information component >90%	Accelerated growth of digital technologies
Knowledge and skills	Moderate growth in the IT sector	Accelerated growth of IT competencies	Rapid growth of digital and information skills
The ratio of consumption and accumulation	Rationalisation of accumulation and consumption	Active data accumulation	Optimisation of consumption quality
The principles of Pareto	Cost-benefit imbalance	Imbalance due to data concentration	Cost-benefit imbalance minimisation
The scale of goods consumption	Moderate consumption of labour products	Increased consumption of information products	Accelerated consumption of digital goods
The law of diminishing returns	Inadequate development of production factors	The impact of network effects on productivity growth	Increasing returns to scale
The law of value	The exchange is proportional to the cost	Increasing the cost of intangible goods	Cost reduction through digital platforms
Market equilibrium			
	Restoring the disturbed equilibrium (supply, demand, price, competition)	Balancing through IT and data	Fast and variable recovery through the digital solutions
The prevailing type of economic relations	Market changes in terms of supply and demand	Hierarchy within the considered level (manager, firm, regional economy, national economy, global economy)	The platform type of economic relations (the economic system of the consumer, producer, communication core)

Reproductive chains	Market economy	Information economy	Digital economy
Leadership in the economy	Atomic market (small enterprises and companies)	Large enterprises	Small and flexible advanced enterprises
The ratio of producer and consumer influence	Shift depending on market conditions	The dominant of commodity producer	The dominant of consumer
Changing the sectoral structure of the economy	The predominance of key sectors of the economy	The predominance of high-tech sectors of the economy	Emphasis on the digital component

Source: Authors

The qualitative state of extended reproduction

Within the framework of a market economy, the expanded reproduction of a social product occurs at a moderate pace. This is due to traditional production factors such as labour and capital limit the opportunities for rapid growth. According to World Bank data, in 1990-2010, the average annual growth in global GDP was 2-3%[18]. This is an indicator of stable, but not rapid growth.

However, in an information economy reproduction is accelerating. An example is the telecommunications sector; it grew significantly in the 1990s and 2000s due to digitalisation and the spread of the Internet. It causes an accelerated economic growth[19].

The digital economy demonstrates accelerated and expanded reproduction; the technological innovations allow companies and governments to effectively increase production capacity. Digital platforms such as Amazon or Alibaba show rapid growth in production and sales due to the scalability of technology. For instance, the annual growth of global e-commerce has been more than 15% since 2015[20].

The ratio of living and materialised labour

The traditional market economy is dominated by materialised labour associated with the production of physical goods and services. Information technology changed this ratio in the 1990s with the introduction of automated control systems and computer technology into production. For instance, the share of information technology in production processes has grown by an average of 5% per year since the late 1990s [15].

In the information economy, the role of intellectual labour is increasing; however, materialised labour remains significant. Companies are starting to use databases, information systems, and IT infrastructure to improve production management and increase efficiency.

The digital economy enhances this process, as the intellectual component of labour, including artificial intelligence (AI), begins to determine the decision-making matrix. The share of intellectual labour in the economy is growing rapidly, as digital technologies require qualified specialists working with big data, AI, and automation. For instance, research shows that 60% of global labour productivity growth in the 2020s is due to the introduction of AI and automation[21].

Dynamics of the ratio of production factors

In a market economy, the growth of information technology was moderate, especially before the 2000s, when IT was mainly an ordinary tool in production. The material component predominates. The share of the information component is less than 5%. However, in the 2000s, information technology began to emerge as a

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[18] *World Development Report. Source: https://documents1.worldbank.org/curated/ar/630651468337159625/pdf/437380WDR0RUSS0 8B00PUBLIC0020090rus.pdf (accessed on 10.10.2023)*

[19] *Prospects for the development of the global economy: symptoms and treatment. Source: https://www.imf.org/~/media/Websites/ IMF/imported-flagship-issues/external/russian/pubs/ft/weo/2016/02/pdf/textr.ashx (accessed on 24.12.2023)*

[20] *Li, S.M. Electronic commerce in China. The CAREC program. Source: https://www.carecprogram.org/uploads/Session-5.2-E_ commerce-in-PRC-Seung-Min-Lee-ru.pdf (accessed on 01.07.2024)*

[21] *Prospects for the development of the global economy: symptoms and treatment. Source: https://www.imf.org/~/media/Websites/ IMF/imported-flagship-issues/external/russian/pubs/ft/weo/2016/02/pdf/textr.ashx (accessed on 24.12.2023)*

critical factor of production, especially in services, telecommunications, and finance.

In the information economy the share of the information component is significantly dominated by more than 90%[22]. The companies invest in R&D to improve products and services. It has become particularly evident in healthcare and finance.

The digital economy shows accelerated growth in the share of digital technologies. The factors of production in the digital economy are related to the use of artificial intelligence, blockchain technology, and internet platforms. The share of digital technology in production is growing. For instance, in 2021, companies' spending on AI technologies increased by 40% year-on-year [15].

Knowledge, skills, and the structure of human capital

Information technology knowledge and skills are moderate growing in a market economy. Moreover, traditional jobs such as manufacturing and agriculture continue to dominate in the most countries. However, in the 2000s, the demand for IT professionals increased. According to the studies, IT job in the US have increased by 7-8% annually since 2000[23].

In the information economy, IT skills are very important. Employees should have knowledge of data analysis, programming, and information systems management. In developed countries, the demand for such skills has increased 1.5 times in the last 10 years [2].

In the digital economy, accelerated growth in digital knowledge and skills is becoming a key driver. Businesses are increasingly focused on employees capable of working with the latest digital technologies such as machine learning and data analytics. As of 2021, 80% of all new jobs in the technology sector require digital skills [15].

The law of consumption and accumulation

The law of consumption and accumulation regulates the balance between the consumption of resources and their accumulation for further use. In a market economy, this balance is rationalised through capital accumulation and improved quality of investment. Traditional approaches to accumulation involve the preservation of significant resources for sustainable growth in the future ensuring stable consumption. For instance, in OECD countries, the ratio of savings to consumption has remained relatively stable at the level of 30-35% of GDP over the past decades [9].

In the information economy, the role of accumulation and consumption is changing significantly due to the increasing importance of data. Companies are actively accumulating information to use it in the future to develop new products or improve existing ones. Data becomes a reusable resource, optimising accumulation and accelerating consumption. For instance, the cloud technology accumulate data and provide services based on big data, such as analytics and forecasting.

In the digital economy, there is an optimisation of the ratio of accumulation and consumption in terms of the quality of consumption. Digital platforms allow products to be adapted more quickly to market and consumer needs, reducing the time and material costs of accumulating resources. For instance, software subscription models such as Software as a Service (SaaS) allow consumers to pay only for features used. It improves the quality of consumption without the need for significant investment in savings.

Manifestation of Pareto principles efficiency

In a market economy, there is often an imbalance between inputs and outputs. For instance, traditional industries can be inefficient due to high resource and energy costs. According to the studies, up to 30% of production resources may be spent inefficiently[24].

In the information economy, this imbalance is increased due to the concentration of data in large companies. Large players such as Google, Telegram accumulate huge amounts of data. It allows them to

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dominate the market and make super profits, while small companies cannot compete effectively. This intensifies the cost-benefit imbalance, requiring the development of new mechanisms for regulating and redistributing the resources.

The digital economy, on the other hand, helps to minimise the imbalance between costs and outcomes. Digital solutions such as automation and artificial intelligence enable businesses to significantly reduce costs, increase efficiency, and maximise the impact of their investments. Automation of warehouse operations at Amazon, where the use of robots reduced logistics costs by 20% and accelerated order processing [13].

The extent of consumption of benefits

The scale of goods consumption in a market economy is characterised by a moderate level of consumption of labour products. It increases in proportion to the growth of household incomes. It shows stable consumption of material goods such as food, clothing, and cars. In 2020, according to the World Bank, the average global consumption per capita is about $ 12,000 USD per year[25].

In the information economy, the scale of consumption is increasing due to the growing consumption of information goods such as software, content, communication services, and data. An example is the growth of digital content consumption. Therefore, according to PwC, the global digital media market will exceed $ 450 bn USD by 2025[26].

Law of diminishing returns

The law of diminishing returns, stating each additional unit of a resource in a market economy yields a diminishing return, is particularly evident in traditional industries. For instance, in agriculture or industry, the additional use of land or machinery results in lower marginal productivity. According to the statistics, the growth of production in most countries slows down, especially after reaching a certain level of capital investment[27].

This law is weaker in the information economy due to the influence of network effects. An example is the mobile app industry, where the more users connect to a platform, the more value it gains for each new entrant. Network effects minimise diminishing returns through increasing returns to scale.

In the digital economy, the law of diminishing returns is weakened even further by the scalability of digital products. Increasing returns to scale is becoming a key aspect of digital platforms, as adding new users and data increases the value of the platform for all participants, leading to greater impact. For instance, in a number of industries, notably China's automotive industry, digital services (including software, sensors, AI) generate the largest share of surplus value. China plans to have about 30 % car companies' revenues coming from services by 2030. Therefore, increased use of digital services in manufacturing of China is much higher on advanced manufacturing. It includes world leadership in robotic applications; China already has 1/3 of the world's inventory (more than twice the USA have). In addition, Chinese companies dominate the supply of 5G equipment. It also affects the growth of data-driven services[28].

The Law of value

The law of value concerns with the exchange of goods in proportion to their value and remains relevant in a market economy. An example is industrial production. Here the value of goods is strictly proportional to the costs of raw materials, labour, and capital.

In the information economy, this law is more complicated because of the intangible nature of many

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[25] *World Development Indicators 2020. Source: https://databank.worldbank.org/source/world-development-indicators (accessed on 10.01.2025)*

[26] *Global Entertainment & Media Outlook 2021–2025. Pricewaterhouse Coopers. Source: https://www.pwc.com/gx/en/industries/tmt/media/outlook.html (accessed on 10.01.2025)*

[27] *Agricultural perspectives of the OECD-FAO 2016-2025. Food and Agriculture Organization of the United Nations. Source: https://openknowledge.fao.org/server/api/core/bitstreams/c15588f4-5f1b-434e-89da-bc8a6e2b84da/content (accessed on 10.01.2025)*

[28] *The 13th Five-Year Plan – China's transformation and integration with the world economy: opportunities for Chinese and foreign businesses. Source: http://www.iberchina.org/files/2017/kpmg-13fyp-opportunities-analysis-for-chinese-and-foreign-businesses.pdf (accessed on 10.01.2025)*

goods, such as data or software. The value of intangible assets often depends on the market value of information and network effects.

In the digital economy, the cost of goods is significantly reduced through digital platforms minimising transaction costs and provide mass access to products. For instance, due to the digital platforms such as the App Store, the cost of software has dropped significantly over the past 20 years, allowing millions of users worldwide to access innovative products at lower prices.

Changing the reproductive world

In a market economy, the disturbed balance is restored through market mechanisms: demand, supply, price, and competition.

Digitalisation and information technology transformed the basis of the economic system. The reproduction process in the digital economy is characterised by the acceleration of all stages: production, distribution, exchange, and consumption in a shorter time and at lower cost.

An example of this is the adoption of cloud technologies allowing companies to produce, store, and share information with minimal time and resources.

The predominant type of economic relationship

In a market economy, the predominant type of economic relations is market changes of conjuncture within the framework of supply and demand.

In the information economy, a hierarchy emerges: manager, company, regional economy, national economy, global economy.

The digital economy is characterised by a platform type of economic relations: consumer, producer, and communication core ecosystems.

An example of such an ecosystem is the My MTS app. It topped the ranking of Russian ecosystem apps in 2023 with 68.1 % in analysts' assessments. It provides centralised access to various services including detailed cost analysis and forecasting of future spending[29].

Leadership in the economy

In a market economy, the predominant atomistic market is small businesses and companies. Entrepreneurial initiative promotes the development of small forms of business. Consequently, there will be a formation of large enterprises.

Large and major enterprises form a base of the analogue economy

In a digitised environment, small, agile, cutting-edge enterprises predominate. In early 2025, China's DeepSeek demonstrated the importance of small, agile, and innovative enterprises in the digital economy. Founded in 2023, DeepSeek, with a team of 200 employees and a $ 6 mln USD budget, has developed an advanced AI model comparable to products from large Western corporations. In 2024, the company released the third version of its chatbot. It resulted in daily visits to their website increased from 280 thousand to 6.2 mln indicating a high demand for their product[30].

The correlation of producer and consumer influence

In a market economy, a shift of interest based on supply and demand conditions. When demand begins to dominate, there is a producer market.

In the conditions of modern market information economy there is the dominance of the commodity producer. The consumer chooses the market offers.

Indeed, in the digital economy production is customer-centric one.

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[29] *Statistics: The rating of Russian ecosystem applications was led by My MTS and Sberbank Online. Source: https://entermedia.io/news/statistika-rejting-rossijskih-ekosistemnyh-prilozhenij-vozglavili-moj-mts-i-sberbank-onlajn (accessed on 10.01.2025)*
[30] *What is DeepSeek and why it violates the order in the AI sector. Reuters. Source: https://www.reuters.com/technology/artificial-intelligence/what-is-deepseek-why-is-it-disrupting-ai-sector-2025-01-27 (accessed on 28.01.2025)*

Changes in the sectoral-industry structure of the economy

The predominance of basic key industries in a market economy.

The information economy is shifting towards high-tech and knowledge-intensive industries.

In a digital economy, the emphasis is on the digital component: high-tech industries are acquiring a digital element.

In 2022, Rostelecom was actively developing digital platforms and ecosystems, generating big data in the Russian segment of the Internet[31].

Conclusion

The modern digital economy is a complex and dynamic system with different levels of economic interests, from individual to macroeconomic and government policies. The analysis in terms of the political economy approach allowed us to identify the key features of socio-economic processes transformation under the influence of digitalisation.

Therefore, digitalisation entails changes in all spheres of the reproduction process. Manufacturing is becoming more intellectualised, dominated by intangible assets, including data and information technology. The distribution of economic benefits is increasingly dependent on digital platforms concentrating a significant part of value. It provides the implementation of new regulatory mechanisms. Exchange and consumption are also undergoing changes: traditional supply chains are shrinking and digital platforms are becoming the main intermediaries between producers and consumers.

Moreover, the digital economy is characterised by a number of key transformations: accelerated expanded reproduction, the prevalence of intellectual labour and artificial intelligence, accelerated growth of digital technologies and skills, optimisation in favour of consumption quality, minimisation of cost-benefit imbalances, accelerated consumption of digital goods, increasing returns to scale, etc. Cost reduction and fast, variable recovery through digital solutions contribute to a platform type of economic relationship. This causes to small and flexible advanced enterprises domination and centralises the consumer. The focus of the economy is shifting towards digitalisation, providing new opportunities for growth and development.

The political economy analysis paid particular attention to changes in labour relations. Digital transformation is boosting employment in high-tech sectors. However, it reduces the interest to the traditional forms of labour and increases the unequal distribution of jobs and incomes. Under these conditions, state policy should be aimed at adapting the education system, social security, and the labour market to the new economic realities.

An important component of the digital economy is changing the role of the state in economic regulation. On the one hand, the state acts as a regulator of digital platforms, balancing their commercial interests with the public good. On the other hand, the state is actively introducing digital technologies into the management systems. It increases the efficiency of public service provision and contributes to the formation of digital sovereignty.

The analysis of the political economy aspects of digitalisation concerns with reconsideration of the digital economy, traditional pricing, competition, and regulatory mechanisms. The growth of network effects and the monopolisation of data are shifting the centre of economic power, forming challenges for competition and social justice. In this regard, issues of redistribution of digital income and ensuring equal access to digital resources are of particular importance.

Hence, according to the political economic analysis of digital transformation, the key task of modern socio-economic policy is to coordinate the interests of various economic actors: individuals, corporations, society, and the state itself. The optimal combination of market mechanisms and government regulation can become the basis for the sustainable development of the digital economy capable to ensure both economic growth and social stability.

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[31] *Platforms for connecting people and their deeds, meanings and things. Source: https://issek.hse.ru/news/832629300.html (accessed on 28.01.2025)*

AUTHOR'S CONTRIBUTIONS
Elena E. Irodova – conceptualization; supervision.
Alexey M. Sokolov – writing – original draft.

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Data metrics in modern digital marketing

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ORIGINAL ARTICLE

Abstract. The article defines the stages of digital marketing and highlights modern metrics for choosing data analysis tools. Currently, mobile Internet accounts for 80% of the total Internet traffic in the Russian Federation. The research emphasises the components of effective media planning, including return on investments, target audience, increasing brand awareness, and costs optimising. According to the statistics, there are different approaches to increasing sales of new trademarks (brands) via the mobile Internet. The research considers the issues of calculating the market share of a trading company, advertising voice among the voices of other brands, and calculating the advertising budget for promoted similar budgets of other companies. The paper proves the validity of the formula expressing the equilibrium in a market with several players. The social networks, messengers, digital television, and neural networks replace the traditional advertising channels. It provides the reduction of brand forgetting time. Moreover, the traditional advertising impact on the target audience is losing its effectiveness. The considered mathematical model of the advertising response redistribution shows the inverse dependence of the share of the advertising voice depending on the number of the promoted product in the company's product line. Other data metrics allow ones to increase sales profits in addition to the main advertising strategy of the enterprise through geographic information systems (coverage radius), customer comments, and reviews on marketplaces and digital cinemas. The use of big data technologies transforms the methodology of effective advertising. It applies the econometric laws providing a "target funnel" for product promotion and Nevertheless, it requires large budgets to maintain the promoted brands. Therefore, the marketing services of enterprises investigate market segmentation and assess the advertising budgets of competitors. It maximises the effectiveness of an advertising campaign following the entry of competing companies into the same market. Hence, the share of the regional or global market of the promoted product is proportional to the advertising budget relative to the total budget of the entire market. The funding for the promotion of a new brand for well-known purposes is an analytical dependence of Peckham. The individual share of the advertising vote (out of 100% of votes for new brands) analytically depends on the company's historical market share and the number of the new brand for the reporting period (1, 2, 3, etc. years). The individual share of the advertising voice is a dimensionless random variable depending on the relative frequency of the brand over the previous period. The integral calculus in advertising forecasting provides marketers with a powerful tool for analysing data and making informed decisions. Such models include the Bass and the Adstock models. Probability metrics are important tools for assessment of advertising campaigns effectiveness and making strategic decisions. They allow ones to consider the uncertainties and randomness characteristic of consumer behavior. Moreover, the game theory is a powerful tool for analysing and developing advertising strategies. It allows companies to consider the behavior of competitors, respond to changes in the market environment, and make informed decisions. The use of game theory helps to minimise risks and maximise the benefits of advertising campaigns, ensuring sustainable business development.

Keywords: digital marketing; media planning; online advertising; advertising optimisation; data metrics; mathematical modelling

Introduction

The purpose of the study is to define and initialise the metrics of advertising campaigns in terms of the digital marketing perspective. The main objectives are to examine various data metrics in target audience allocation, study Peckham's formula – a mathematical model for optimising advertising share, propose trends of studying of advertised product effectiveness through big data technologies.

Media planning is the process of developing a strategy for placing advertising messages in various media channels to achieve the company's marketing goals. The main goal of media planning is to maximise the effectiveness of the advertising budget by reaching the target audience properly.

The main stages of media planning:

1 Market and target audience analysis. This stage involves market research, analysing the requirements and preferences of the target audience. It is important to understand the potential buyers of a product or

service, their interests, habits, etc.

2 Setting goals. The goals may involve increasing brand awareness, boosting sales, attracting new customers or strengthening the loyalty of existing ones. They should be specific, measurable, achievable, relevant, and time-bound (SMART).

3 The choice of communication channels. Depending on the target audience and objectives, the most appropriate channels for advertising distribution are selected. These can include television, radio, press, outdoor advertising, internet (contextual advertising, social networks, banner advertising), mobile applications, and other platforms.

4 Budget development determines the optimal allocation of funds between different channels. It considers the cost of advertising, possible additional costs, such as the development of creative materials, analytics, and performance monitoring

5 Development a media plan: a detailed plan of advertising placement is developed with specific dates, times, and places of advertising messages. The media plan includes publication schedule, number of impressions, frequency of audience contacts, etc.

6 Implementing the plan: after the media plan approval, the implementation stage begins. Advertising materials are placed in accordance with the developed schedule, their effectiveness is monitored and, if necessary, adjustments are made.

7 Monitoring and assessment of the results. An important part of media planning is to constantly monitor the implementation of the plan and analyse its effectiveness. Various metrics such as a media outreach, click-through rate (CTR), conversion rate, etc. are used to assess the success of the campaign.

The advantages of competent media planning:

1 Maximising return on investment (ROI): efficient use of the advertising budget allows ones to achieve greater results at lower costs.

2 Target audience: the right choice of advertising channels and formats helps to deliver the message to the people really interested in it.

3 Increasing brand awareness: regular presence in the media space helps to strengthen the company's image and increase its popularity among consumers.

4 Cost optimisation: competent allocation of resources helps to avoid unnecessary expenditure.

Therefore, media planning plays a key role in the success of any advertising campaign. It requires deep analysis, strategic thinking, and constant monitoring of results to ensure maximum ROI.

However, the numerical assessment of media planning indicators have been relevant in Russia since the 2000s [11]. To optimise spending on advertising campaigns, retailers used both their own financial capabilities and the budgets of regional representatives of the Western brands. At that time, the advertising media channels were television, outdoor advertising, news papers, and radio. The Internet in Russia started e-mailing and advertising in social networks. The advertising market has been transformed greatly. Indeed, Aliexpress initiated the sales into the Internet. Nowadays, the monopoly services: Ozon, Yandex, Sber, etc. have their own ecosystems. Moreover, the monopolists share the digital market. It was boosted by the COVID-19 pandemic. However, the digitalisation of marketing communications is affected by the contextual advertising, search engine advertising, smartphone apps, computer games, etc. By the end of 2020, Russians have already increased the total turnover through mobile apps to $1.33 bn USD (25% of total purchases). People are in overall communication. Digital wellbeing today correlated with the challenge of protecting a person's personal space. In 2021, the share of mobile Internet in Russia reached 81% (against 19% for other devices)[1]. Therefore, the promotion of goods and services through smartphone applications is becoming more and more relevant.

However, digital marketing and sustainable development emerge new trends and innovations as companies increasingly realise the importance of environmental and social responsibility towards citizens. Therefore, many studies have analysed trends indicating significant changes in consumer preferences towards environmentally friendly products and socially responsible behaviour. The paper provides examples of several international campaigns illustrating successful efforts to promote sustainable development. It discusses the

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[1] *The mobile economy of Russia. Source: https://www.tadviser.ru/index.php (accessed on 19.10.2024)*

role of digital technologies in achieving sustainability goals and emphasises the necessity of integrating sustainability issues into corporate digital strategies [9]. One of the trends in digital marketing is the carbon footprint indicator to save biological resources. However, this approach is controversial but effective one: Aeroflot and Avito implement those indicators on their sales page.

Some researchers use psychological approaches in media planning. Indeed, people eventually forget a picture or text they have seen. To strengthen the stimulus signal of a media carrier there is a practice to repeat it again at the moment of forgetting [8]. The method based on forgetting coefficients as the target function of minimising advertising costs. The approach to mathematical modelling.

The scalar product of vectors method is the basic one in terms of feedback metric for the film and television industry. For instance, the several users rate a film from 1 to 10. Therefore, we introduce a point on the Cartesian plane with abscissa – the number of positive ratings for the film 1. On the ordinate axis we will mark the number of positive ratings for film 2. If we construct two radius vectors with ends at the constructed points, the measure of polarity (quality) of the films is the scalar product between these radius vectors, or by the cosine between them. The closer the cosine is to zero, the higher the polarity, and the closer the cosine is to one, the lower the polarity. We can use the similar metric for the entertainment sector, feedback assessment, in service and tourism, banking and medical activities, education, etc.

Another approach in defining the metric is to apply geographic coordinates (GIS-metric). The distance between points on the earth's surface is approximately the same as the Euclidean distance between currents on a plane. Among the tasks of performance assessment with this metric is the distance from the property to the metro station in large cities, to railway and bus stations, major motorway routes. In this case, the value of the object directly depends on the distance. In the topic of our study another form of distance is more important – the radius of a circle with the centre in the studied point of capital growth to nearby objects. Coverage of residential buildings from Yandex.Market or Ozon parcel delivery point. E-businesses of such companies use geodata to promote their goods and delivery services within a given radius of service coverage. The Russian Presidential Academy of National Economy, St. Peterburg, Russia conducted geometrics research for Gazprom during the construction of the Lakhta Centre. The geo-location of the centre within a radius of 10 km was used for the development of transport infrastructure (metro stations, railway overground stations, airport, motorways), social infrastructure, and housing for the employees. They include the construction of the Ust-Luga seaport, the satellite town of Yuzhny, the relocation of industrial enterprises from the outskirts of the city to the Leningrad region, etc.

Main part

The fundamental research on the dissemination of advertising as information on a product or service interested Russian scientists in the 90s of the last centuries. Media planning has two important objectives: optimisation of advertising placements in terms of reach (the share of the target audience expressed as a percentage) and in terms of placement cost (monetary value of the contract per unit of time) [18, 6]. We understand optimisation as the efficiency of the advertising campaign (to get the maximum increase in sales during the advertising campaign period for a minimum of added funds).

At the first stage of planning it is difficult to compare such a process with optimisation in a mathematical point of view, because many components of the advertising industry are stochastic (in essence, random variables or random processes).

However, some studies consider the mathematical problem of assessing the effectiveness of advertising campaigns. Based on the analysis of world experience and empirical data, we designed the mathematical models to predict the level of awareness of a brand. It substantiates the use of heuristic search methods as the most appropriate tool for processing sociological survey data, in terms of the principles of complex systems behaviour [12]. Moreover, it is an effective tool for providing the econometric analysis of advertising response data (real purchases). This tool is effective only with a large number of trials (more than 100 sales). The errors e of any linear model are $y=a_0+a_1x+e$ distributed according to a normal law, which is asymptotic for any other distribution. There are usually a large number of players in the market, so the distribution of advertising does

not spread linearly. Rather, it is a non-linear process. However, there is a different approach.

Popular advertising channels since 2015 include browsers, instant messengers, games, smartphone apps, and social networks. The Peckham method is used to numerically assess the advertising budget of a new brand with the share of the advertising voice S(k) as the product of the coefficient α (taken at the level from 1.5 to 2, a dimensionless value) by the intended share of sales X(k). It is proposed as a limited function with parameter n – the ordinal number of the new brand in the product line presented in formula (1) [18, p.51]:

$$S\left(k\right) = \frac{\alpha \cdot k^{n-1} \cdot (1-k)}{1-k^n} \tag{1}$$

The advertising budget according to formula (1) depends on the constant k – the market share of the previous product of the specified company. Number n is the number of the current brand from all the brands of this seller. By the type of function, it is a power function. This function is resistant to variable changes and is easily differentiated or integrated in composing more complex models based on the theory of differential equations.
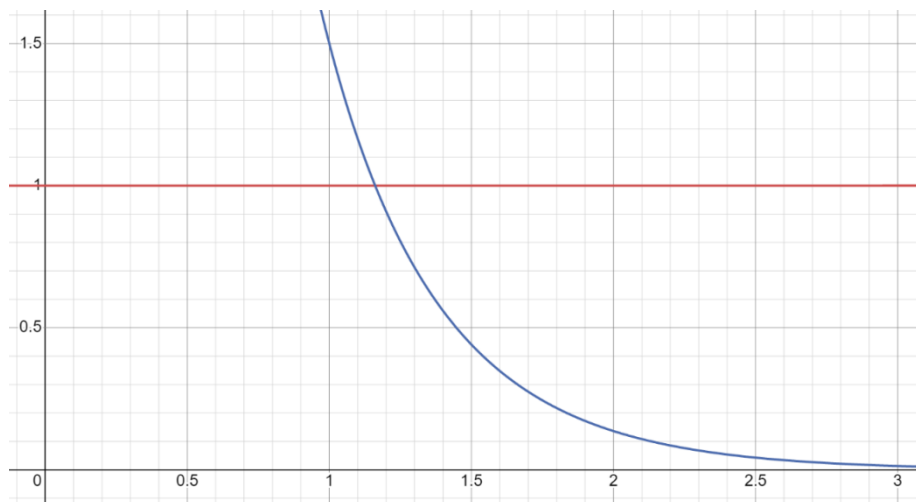
Figure 1. Advertising voice share S(n,k). k=0.1

The considered mathematical model shows the inverse dependence of the share of the advertising voice depending on the number of the promoted product in the company's product line. One of the main goals of marketing is to optimise (minimise) the advertising budget through reaching the largest possible target audience.

Media planning optimization is divided into two groups:

Group 1. Maximising the share of advertising voice S or effective reach G or average contact frequency f or projected profit P;

Group 2. Minimising the advertising budget of R at maximising one of the indicators specified in paragraph 1.

We calculate the S values for practical values from the source [1] for advertising several services promoted through mobile applications. The values of the share S(k) of the advertising voice of a company producing "black" household appliances with a market share k=0.1 for products already sold with numbers n of the product line being sold (it takes natural values from 1 to 10) have the graph shown in Figure 1. For more significant brands with a high k market share (from 0.5 to 0.9), the result will be different (Figure 2).

According to Figure 2, the share of advertising voice is higher the younger the company is as the market prefers new brands; for the monopolists (with a market share of 0.5), the share of advertising voice is achieved at a lower cost than for newcomers in this market segment. The schedule allows ones to minimise the cost of an advertising campaign for major players. Therefore, we examine the extremum function on the interval [0.5;0.9]. The extremum points are the points shown in Table 1. The table shows the values of the function S(n) for these different n.

Figure 2. The share of the advertising voice S(k, n) for k>0.5, n is a natural number, the Peckham formula
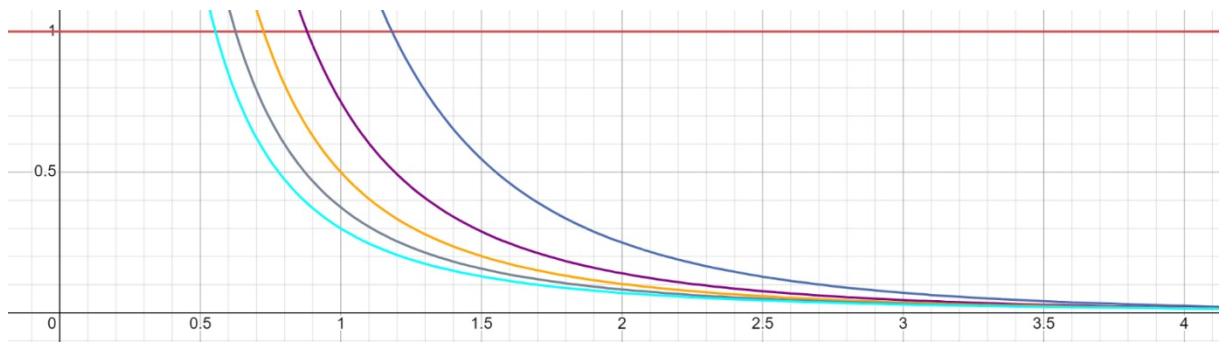*Source: Author*

Table 1 – Maximum values of the function S(n, k) – the share of advertising voice according to the Peckham formula

n	1	2	3
k	0.50	0.61	0.69
S(n,k)	1.5	0.59	0.33

Source: Author

According to the calculated values of the function for a new brand, the voice share will be much higher (within 1.5) than for newly released product lines (less than 0.2). Moreover, it requires large budgets to maintain the promoted brands. In this case, the marketing services of enterprises investigate market segmentation and assess the advertising budgets of competitors. It maximises the effectiveness of an advertising campaign following the entry of competing companies into the same market.

Indeed, the owner of a new brand can maintain its market share, as long as the share of advertising voice should be equal to the share of advertising budget in the volume of competitors' advertising budgets. We obtain equality (2):

$$V = \frac{X}{1 - X} \sum_{j=1}^{m} V_j \qquad (2)$$

According to [5], the advertising budgets for the promotion of smartphones of four well-known brands on the mobile network were obtained: V1=\$ 30 mln USD, V2=\$ 17 mln USD, V3=\$ 10 mln USD, V4=\$ 12 mln USD. However, over the past 3 years, for the first and second companies, this is product No. 3 (n=3); for the third company this is brand No. 2 (n=2); the fourth company is entering the market for the first time (n=1). Using formula (1), we calculate the value of the share of sales for company No. 3: X3=X(3;0.61)=0.1877. The economic issue of this coefficient is as follows: when promoting a new product, the company will gain a market share of similar products in the region of 18.77%. To find out the reasonable size of the advertising budget for the promoted project No. 3, we use formula (2) $V = \frac{X^3}{1 - X^3}(V_1 + V_2 + V_4) = 13{,}63$. However, there is

an error in the equation. In this case, the savings will amount to about \$ 3.63 mln USD. The relative margin of error will be 5%. This is confirmed by similar calculations in [5, 7].

Formulation of the inverse problem: based on the data of the advertising budgets of the selected company and the advertising budgets of three competing companies, we find the share of sales (increase) in relative terms. For these purposes, we consider formula (2) as an equation with respect to the variable X (share of sales). The advertising budgets are shown in Table 2:

Table 2 – Parameters of the equation of balance of advertising budgets to identify the share of sales of the target enterprise

№	Advertising budget, $ mln USD	Share of sales, X
1	30	0.43478

№	Advertising budget, $ mln USD	Share of sales, X
2	17	0.24638
3	10	0.14493
4	12	0.17391
amount	69	1

Source: Author

Equation (2) provides an analytical solution as a rational equation with respect to the variable X: the share of sales out of the total number of smartphones sold will be proportional to the advertising budget for promoting this model. This is symbolically expressed by formula (3):

$$X = \frac{V_j}{\sum_{i=1}^{m} V_i}$$ (3)

The sum of all the shares calculated by formula (3) will be equal to one (100%). This proves the validity of formulas (1) and (2).

Further research in this area uses risk theory in media planning [17]. Apparently, the risk here is considered stochastic; the amount of profit from an advertising campaign is a random variable. However, the complexity of calculations increases to the extent; it is easier to order the development of a media plan from a specialised company, for example, Yandex. Direct. In this case, the company independently predicts the outcome of the advertising campaign using artificial intelligence services for a fixed amount.

We have reviewed functional modelling in advertising. Integral calculus is a more complex tool. Integral calculus is a powerful mathematical tool applied in various fields of science and technology, including economics and marketing. In the context of advertising forecasting, this method is used to assess changes in indicators such as sales volume, demand level, audience response to advertising campaigns, etc.

The main aspects of using integral calculus in advertising forecasting are as follows:

1 Assessment of the accumulated effect of advertising. Advertising has a cumulative effect – its impact accumulates timely. The integral allows ones to calculate the total reaction of the audience to an advertisement over a certain period of time. For instance, if the function f(t) describes the daily change in the level of interest in a product under the influence of advertising, then the integral of this function over time will show the total interest over a period of time [16].

2 Forecasting sales volume. The volume of sales often depends on the intensity of the advertising campaign. Using data on previous campaigns and related functions, ones can build a model forecasting future sales based on planned advertising activities. The integration of these functions will make it possible to obtain the projected sales volume for a certain period [2].

3 Optimisation of advertising budgets. Integral methods help to determine the optimal distribution of advertising budgets between different channels and advertising formats. By analysing the effectiveness of each advertising activity through integrals, it is possible to maximise the profits through a balance between costs and results [3].

4 Product lifecycle modelling. The product lifecycle has several stages: introduction, growth, maturity, and decline. Integral calculus allows ones to model these stages and forecasr sales behavior at each stage. For instance, to calculate the integral of a function describing the demand for a product in order to estimate the total revenue over the entire lifecycle [10].

5 Assessment of seasonal fluctuations. Many goods and services are subject to seasonal fluctuations in demand. Therefore, we can use the harmonic functions and Fourier series. The integrated approach allows ones to consider these factors and adjust forecasts to assess real market conditions. For instance, to integrate a function in terms of the seasonal fluctuations for more accurate results.

The Bass and Adstock models can serve as examples of the use of integral calculus in advertising. The Bass model is a differential equation describing the spread of innovation. It uses integrals to calculate the cumulative number of new product buyers. The ordinary differential equation of Bass is represented in

formula (4).

$$\frac{dF}{dt} = p(m - F(t)) + q\frac{F(t)(m - F(t))}{m} \tag{4}$$

where F(t) is the cumulative number of accepted innovations on time t, m is the total number of potential users (market capacity), p is the innovation coefficient (coefficient of external influence), and q is the imitation coefficient (coefficient of internal influence).

The innovation coefficient p reflects the proportion of consumers accepting a new products independently of others due to external factors such as advertising, promotion, and PR. These people tend to try new things independently. The imitation coefficient q shows the proportion of consumers accepting a new product under the influence of other people already using this product. The more people accept the product, the stronger is the social pressure and desire to join the majority. The Bass model helps companies to forecast the sales growth rate of a new product based on initial conditions and parameters p, q, and m. However, data collection is usual for model use. It is necessary to collect historical data on sales of similar products or conduct preliminary market research to estimate the values of the parameters p, q, and m; parameter selection is also in use. It includes data collecting, the coefficients p and q, and the market capacity m. This can be done manually or using statistical methods such as the least squares method. When the parameters are determined, we can use the model to forecast the future sales. Therefore, we solve a differential equation with respect to F(t) and determine the rate of adoption of a novelty S(t) at each moment in time. Analysis of the results: the forecasts are compared with real data to verify the accuracy of the model. In case of insufficient results, we can repeat the steps of parameter selection and forecasting. The Bass model remains one of the most important tools in the arsenal of marketers and product managers. It allows ones to accurately forecast the sales dynamics of new products and make informed decisions about marketing and promotion strategies. Despite its limitations, this model continues to be relevant and useful for many companies attempting to successfully introduce their innovative offers to the market. However, the model is difficult to calculate and requires the specialised software [3].

The Adstock model's ad response feature suggests exposure to an advert persists for some time after the advert has been completed. The integration of this function provides an assessment of the long-term effect of an advertising campaign. The ad response function, known as the Adstock model, is a mathematical approach to assessing the impact of advertising on consumer behavior. This model is based on the assumption that the effect of advertising persists and gradually weakens over time. The Adstock model allows ones to consider the residual effects of past advertising efforts and forecast future consumer behavior. The main components of the Adstock model are as follows: residual memory; the rate of decay (forgetting of an advertising message), the level of advertising impact determines how strongly current advertising efforts affect consumers (expressed as frequency of impressions, audience reach, or other indicators), and the half $T_{(1/2)}$-life – the time it takes for the initial effect of the advert to be halved. The model is given by the recurrence equation:

$$A_t = E_t + \lambda A_{t-1} \tag{5}$$

where is the A_t – current level of exposure to advertising, E_t – the exposure level, A_{t-1} – the previous. Therefore, we can calculate the current value of the advertising impact. The advantage of this model is the ease of calculation even in a simple spreadsheet [14].

Probabilistic metrics in advertising are diverse and used in statistical probability, game theory, and Markov processes. Statistical relationships are obviously the most popular in the marketing environment as they are easily understood by any professional. Customisations and definitions in digital marketing and advertising are based on these relationships. Probabilistic metrics play an important role in advertising, assisting in evaluating the effectiveness of advertising campaigns and making informed decisions. Generally, probabilistic approaches allow ones to consider the uncertainty and randomness inherent in consumer behaviour and markets. Click-Through Rate (CTR) is one of the main metrics in digital advertising showing the probability of a user clicking on an ad; it is calculated as the ratio of clicks to user impressions. A high CTR

level indicates the attractiveness and interest in the message. Another metric, the CR conversion probability, assesses the probability of performing the targeted action (conversion) by the user after interacting with an ad. CR is calculated as the ratio of the number of conversions to the number of clicks or to the number of impressions. Return Probability RP assesses the probability of a user returning to a site or app after a first visit; it is the ratio of the number of returns to the total number of new visitors to the site or app. The probability of repeat purchase RPP is the number of repeat customers to the total number of all customers. A high probability indicates customer loyalty and satisfaction with a purchase or service. Indeed, over the last 2-3 years, more and more companies are using reward cards, subscriptions, and apps to retain loyal customers. There are also assessments of negative phenomena in advertising: churn probability, abandonment probability, and other metrics [19].

Game theory is a model popular in the domestic school of marketing. This branch of optimisation methods came into science back in the last century, but has only become widespread in the modern economy in the last 10 years. Companies use game theory to analyse the behaviour of their competitors and develop strategies to take a leading position in the market. For instance, two companies may choose different strategies to promote their product: one may focus primarily on television and the other on digital platforms. Game theory can help determine the strategy most beneficial depending on competitor's actions. Companies can use game theory to determine the optimal price for their products. For instance, one company cuts its price, another company is required to decide whether it should also cut its price or keep it the same. The payment matrix will help ones to assess the consequences of each option implementation. The choice of promotion channels (television, radio, Internet, social networks, etc.) can also be analysed in terms of game theory. Companies can consider the most effective channel combinations in terms of competitors and the preferences of the target audience. Game theory can help companies decide on partnerships or alliances with other companies. The payment matrix will show the option of cooperation resulting in the best results for all participants [4, 20, 15].

Moreover, there are probabilistic chains. The Markov chain is used to describe transitions between states (for example, a customer goes from a state of "not aware" to a state of "aware"). By integrating the transition probabilities, it is possible to predict the dynamics of audience behaviour.

Conclusion

According to research results, the following conclusions can be drawn:

1 The share of the regional or global market of the promoted product is proportional to the advertising budget relative to the total budget of the entire market – formula (3); the market share is not a random variable; the amount of financing for the promotion of a new brand for well-known purposes: the share of the advertising voice and the advertising budgets of competitors is an analytical dependence of Peckham – formula (2) with a relative margin of error in the region of 5%; the amount of financing is not a random variable; the individual share of the advertising vote (out of 100% of votes for new brands) analytically depends on the historical market share of the company and the number of the new brand for the reporting period (1, 2, 3, etc. years);

2 The individual share of the advertising voice is a dimensionless random variable depending on the relative frequency of the brand over the previous period; it is linked to sales statistics [13].

3 The integral calculus in advertising forecasting provides marketers with a powerful tool for analysing data and making informed decisions. This method allows ones to consider many factors affecting the effectiveness of advertising campaigns and make more accurate forecasts. It causes cost optimisation and increased return on investment in advertising. Such models include the Bass and the Adstock models.

4 Probability metrics are important tools for assessment of the effectiveness of advertising campaigns and making strategic decisions. They allow ones to consider the uncertainties and randomness characteristic of consumer behavior, more accurately predict the results, and optimise advertising budgets.

5 Game theory is a powerful tool for analysing and developing advertising strategies. It allows companies to consider the behavior of competitors, respond to changes in the market environment, and make informed

decisions. The use of game theory helps to minimise risks and maximise the benefits of advertising campaigns, ensuring sustainable business development.

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CONFLICT OF INTEREST
The author declares no conflict of interest.

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The system of criteria for assessing the effectiveness of the Russian Federation climate adaptation as a basis for the country's competitiveness in the Eurasian and global space

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ORIGINAL ARTICLE

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Abstract. Nowadays, the intensification of the negative dynamics of climate change on the planet continues. This trend indicates a clear lag in adaptation measures to global climate change. However, many international efforts in this regard (for example, the Paris Climate Agreement) are primarily declarative in nature. In this regard, the adoption of the Climate Doctrine of the Russian Federation in 2023 was a very important in terms of the problems of adaptation to climate change on 1/7th of the Earth. Nevertheless, the macroeconomic and microeconomic advantages of climate adaptation determine the long-term national competitiveness. The purpose of this study is to develop a system of criteria for assessing the effectiveness of climate adaptation in the Russian Federation as a basis for the country's competitiveness in the Eurasian and global space. The novelty of the obtained results based on the requirements of the Climate Doctrine of the Russian Federation, a new approach to assessing the effectiveness of adaptation of the national economy to climate change, designed to ensure as a basis for country competitiveness in the Eurasian and global space. The practical significance of the results obtained concern with the possibility of their use in the development of approaches to assessing the effectiveness of national economy adaptation to climate change in accordance with the requirements of the Climate Doctrine of the Russian Federation to ensure country competitiveness.

Introduction

Climate change is one of the most serious challenges of the XXI century. According to the Climate Doctrine of the Russian Federation, they 'go beyond scientific discussions and represent a complex interdisciplinary problem, covering environmental, economic, and social aspects of sustainable development of the Russian Federation'[1].

Today the negative dynamics in climate change on the planet remain (Fig. 1)[2], indicating a clear lag in climate adaptation measures to the ongoing changes [3] both for national and global economy.

However, people concerned about the increasing number of scientifically substantiated 'evidence of human economic activity, primarily associated with greenhouse gas emissions and increasingly affects the

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[1] *Decree of the President of the Russian Federation on Oct. 26, 2023 No. 812 "On Approval of the Climate Doctrine of the Russian Federation". Source: http://publication.pravo.gov.ru/document/0001202310260009 (accessed on 01.01.2025)*
[2] *GISS Surface Temperature Analysis. Source: https://data.giss.nasa.gov/gistemp/graphs_v4/ (accessed on 01.01.2025)*

climate'[3].

Moreover, many international documents aimed at prevent the global warming. However, they are mainly declarative in nature. This is particularly evidenced by the criticism[4] of the Paris Climate Agreement (Fig. 2).

In this regard, the adoption of the Climate Doctrine of the Russian Federation in 2023 was a very important in terms of the problems of adaptation to climate change on 1/7th of the Earth.

Nevertheless, the macroeconomic and microeconomic advantages of climate adaptation determine the long-term national competitiveness.
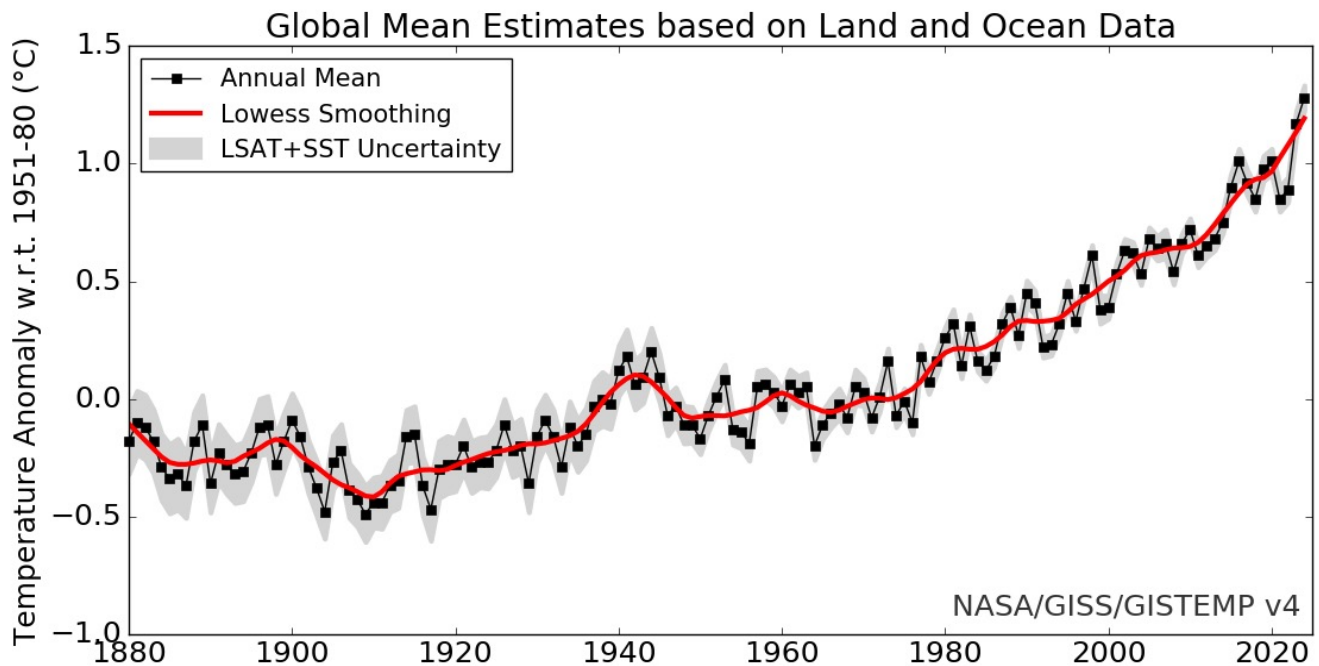

Figure 1. Increase in the Earth's surface temperature, 1880s-2020s

Source: NASA[5]

Therefore, to implement the Climate Doctrine of the Russian Federation effectively, ones need to develop approaches to assessing the effectiveness of the goals and objectives formulated in the doctrine. These goals aimed at addressing the problems of adaptation to climate change predetermined the relevance of the research topic.

The purpose of the research is to form a system of criteria for assessing the effectiveness of climate adaptation in the Russian Federation as the basis for the country's competitiveness in the Eurasian and global space.

Methods

The methodological basis of the research was formed by well-known scientific works devoted to the problems of climatic adaptation. The following papers were considered: Klaptsov V.M. [1], Nikolaev N.P. [2], Porfiryev B.N., Terentyev N.E., Zinchenko Yu.V. [3], Gasho E.G.[6], Serebritsky I.A. [4], Tarasova O.S. [6], Shelomentsev A.G., Goncharova K.S. [5], etc.

The methodological basis of the research was also formed by actual information and analytical materials

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[3] *GISS Surface Temperature Analysis. Source: https://data.giss.nasa.gov/gistemp/graphs_v4/ (accessed on 01.01.2025)*

[4] *Decree of the President of the Russian Federation on Oct. 26, 2023 No. 812 "On Approval of the Climate Doctrine of the Russian Federation". Source: http://publication.pravo.gov.ru/document/0001202310260009 (accessed on 01.01.2025)*

[5] *At COP21, the world agreed to increase emissions. Source: https://climateandcapitalism.com/2015/12/13/cop21-world-agrees-to-increase-emissions (accessed on 01.01.2025)*

[6] *Gasho, E.G. (2019). Priorities for climate adaptation in megacities: people, nature, technology. Source: https://clck.ru/3LSHBb (accessed on 01.01.2025)*

devoted to the problems of adaptation to climate change[7,8,9,10] etc.
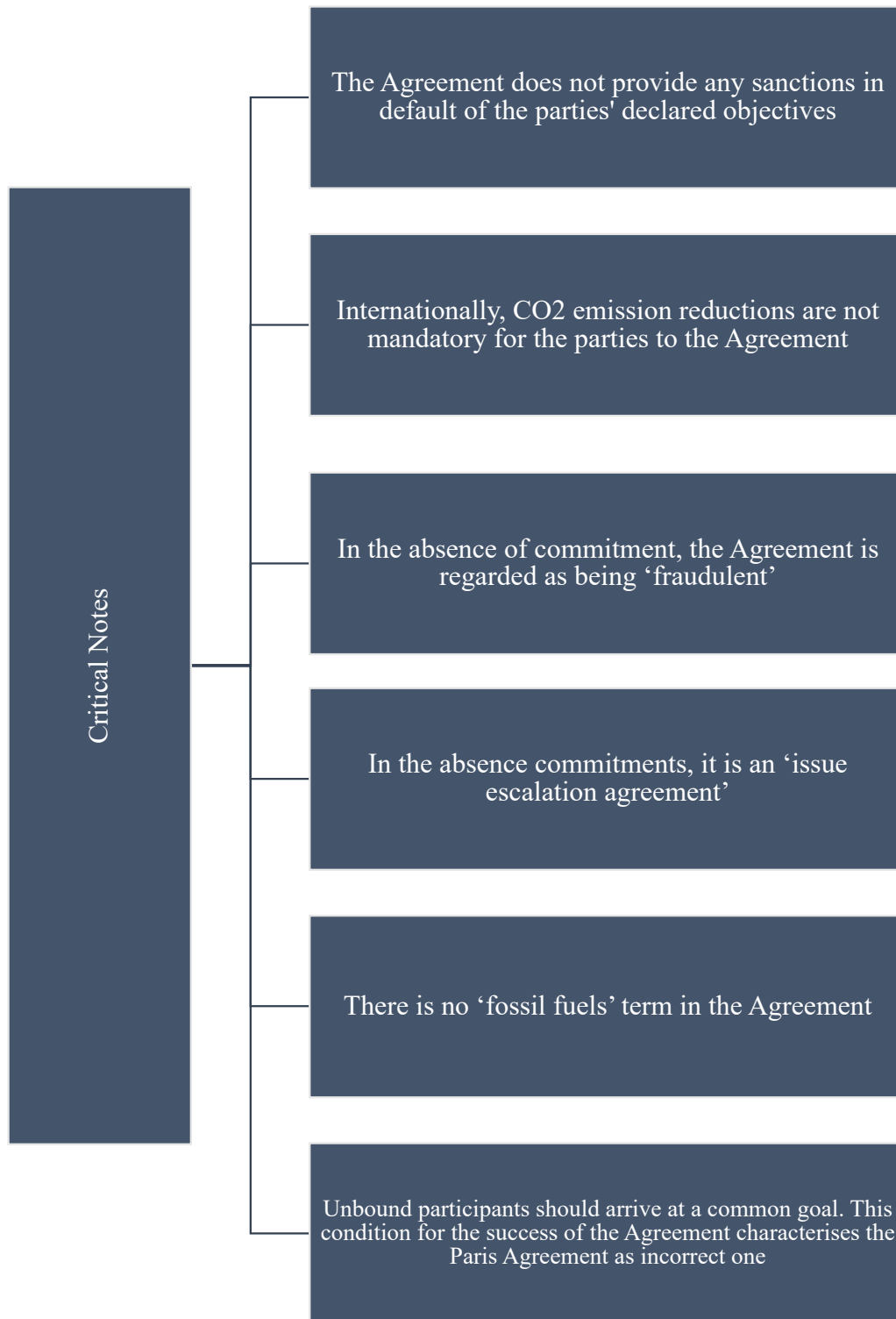
Figure 2. The criticism of the Paris Climate Agreement

Source: Authors

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[7] *Adaptation to climate change is a process, not a timely event. Source: https://www.vedomosti.ru/ecology/climate/ articles/2022/11/11/949904-adaptatsiya-k-izmeneniyam-klimata-eto-protsess-a-ne-razovoe-meropriyatie (accessed on 01.01.2025)*

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[9] *Adaptation to climate change. Source: https://www.un.org/ru/climatechange/climate-adaptatio (accessed: 01.01.2025)*

[10] *Adaptation to warming: what's wrong with the current climate agenda. Source: https://www.forbes.ru/society/487300-adaptacia-k-potepleniu-cto-ne-tak-s-sovremennoj-klimaticeskoj-povestkoj (accessed on 01.01.2025)*

The Climate Doctrine of the Russian Federation approved by Decree of the President of the Russian Federation No. 812 on October 26, 2023 was considered.

Results

Analysing the Climate Doctrine of the Russian Federation, we identify the areas of fundamental and applied scientific knowledge in terms of the climate and related fields (Fig. 3). They determine personnel training (including advanced training and professional retraining) as one of the issues to climate change adaptation.

Figure 3. The areas of fundamental and applied scientific knowledge in terms of the climate and related areas based on the Climate Doctrine of the Russian Federation
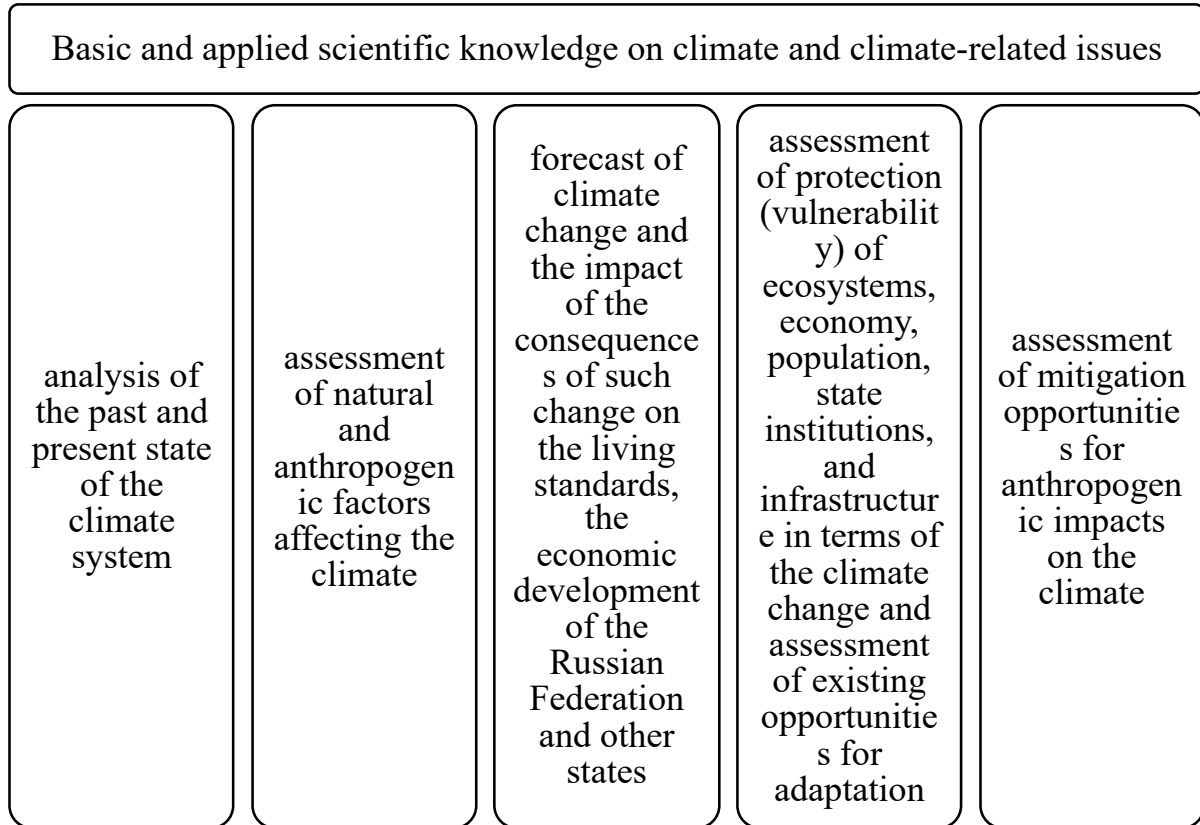
Source: Authors

Therefore, the areas of scientific knowledge highlighted in Fig. 3 are the basis for both further scientific research in terms of the climate adaptation and for training in various activities.

The algorithm for analysing climate change based on the use of fundamental and applied scientific knowledge in terms of the climate (Fig. 3) to address the problems of climate adaptation provided for by the Climate Doctrine of the Russian Federation is presented in Fig. 4.

The main issues of global climate change and the main approaches to their solution, provided by the Climate Doctrine of the Russian Federation, are presented in Fig. 5.

Indeed, the National Goals of the Russian Federation for the period up to 2030 and for the perspective up to 2036, defined by the Decree of the President of the Russian Federation on 07.05.204 No. 309[11], the goal of achieving environmental well-being as one of the two new national goals in comparison with the previously adopted National Development Goals of the Russian Federation for the period up to 2030, defined by the Decree of the President of the Russian Federation on 21.07.2020 No. 474[12] (Fig. 6) are the key long-term factors of the Russian Federation security. In combination with the problem of global climate change as one of the priorities of the country's domestic and foreign policy, they show their urgency and relevance.

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[11] *GISS Surface Temperature Analysis. Source: https://data.giss.nasa.gov/gistemp/graphs_v4/ (accessed on 01.01.2025)*
[12] *GISS Surface Temperature Analysis. Source: https://data.giss.nasa.gov/gistemp/graphs_v4/ (accessed on 01.01.2025)*

Based on the analysis of the goals (Fig. 7), objectives (Fig. 8), and principles (Fig. 9) of the country's climate policy defined by the Climate Doctrine of the Russian Federation we substantiated the system of criteria for assessing the effectiveness of addressing climate adaptation problems to ensure the country's competitiveness in the Eurasian and global space (Table 1).
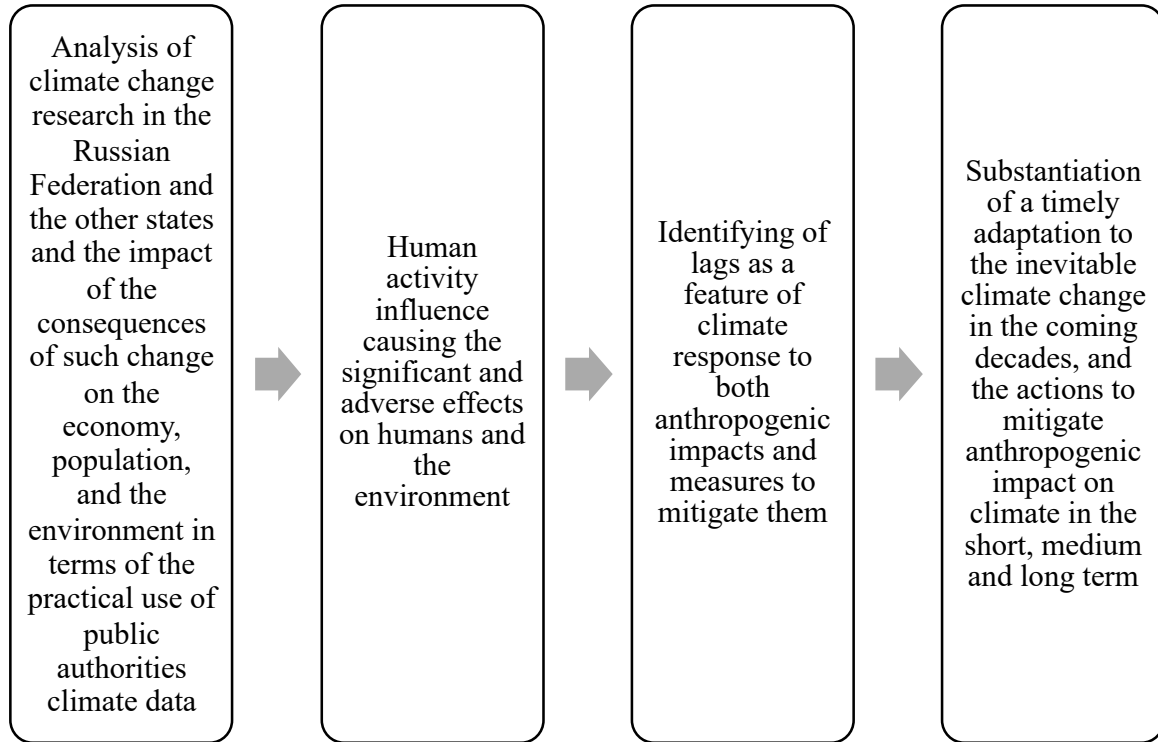
Figure 4. The algorithm for analysing climate change based on the use of fundamental and applied scientific knowledge in terms of the climate to address climate adaptation problems in accordance with the Climate Doctrine of the Russian Federation
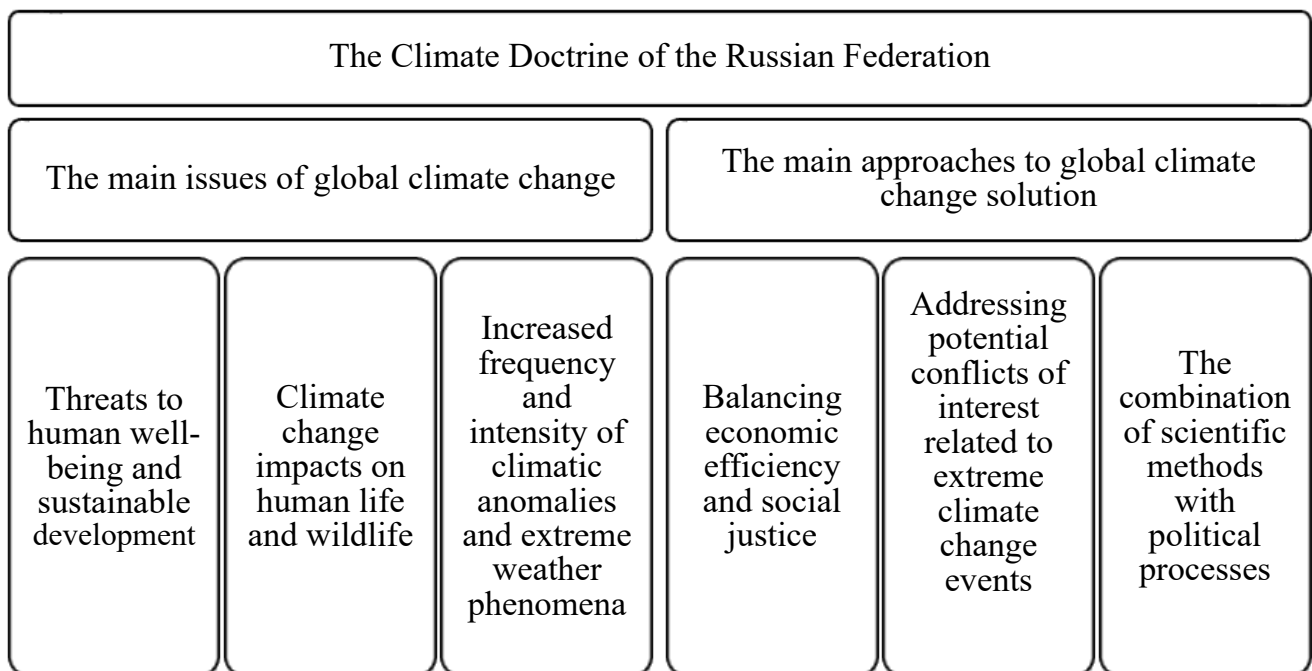
Source: Authors

Figure 5. The main issues of global climate change and the main approaches to their solution, provided by the Climate Doctrine of the Russian Federation

Source: Authors

Goals	
until 2030	until 2030 and in the perspective until 2036

A	
protection, health and well-being of people	protection, health and well-being of people, family support

B	
opportunities for self-realisation and talent development	development of the individual's potential, talents, upbringing of a patriotic and socially responsible personality

C	
comfortable and safety environment	comfortable and safety environment

D	
effective labour and successful entrepreneurship	**ecological well-being**

E	
Digital transformation	sustainable and dinamic economy

F	
	technological lidership

G	
	digital transformation of state and municipal governance, economy, and social sphere

Figure 6. The composition of the National Development Goals of the Russian Federation for the period until 2030 and for the perspective until 2036

Source: Authors

Figure 7. The Russian Federation climate policy objectives defined by the Climate Doctrine of the Russian Federation
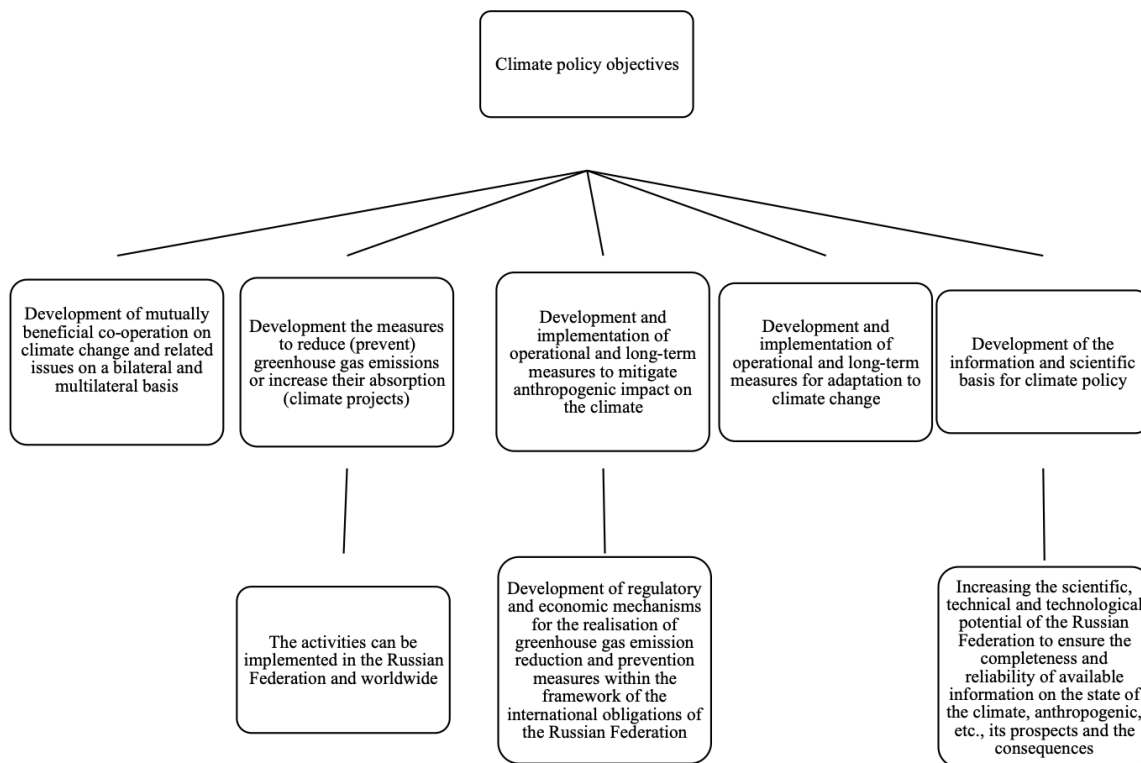
Source: Authors

Figure 8. The composition of the country's climate policy objectives defined by the Climate Doctrine of the Russian Federation

Source: Authors

The basic principles of climate policy

The global nature of the Russian Federation's interests with regard to climate change and the impact of its consequences on socio-economic development

Prioritising national interests in the development and implementation of climate policy

Transparency of climate policy

The actions both at the domestic and international level co-operation involving the Russian Federation on issues related to climate change

Comprehensive assessment of possible economic, social, environmental, etc. losses and benefits associated with climate change, including the long term

Scientific justification of governmental climate measures

Balancing actions to ensure sustainable development

Thoughtful planning and implementation of measures to adapt the population, economy, and environment to the adverse effects of climate change

Technology neutrality of governmental climate measures

Figure 9. The basic principles of climate policy defined in the Climate Doctrine of the Russian Federation
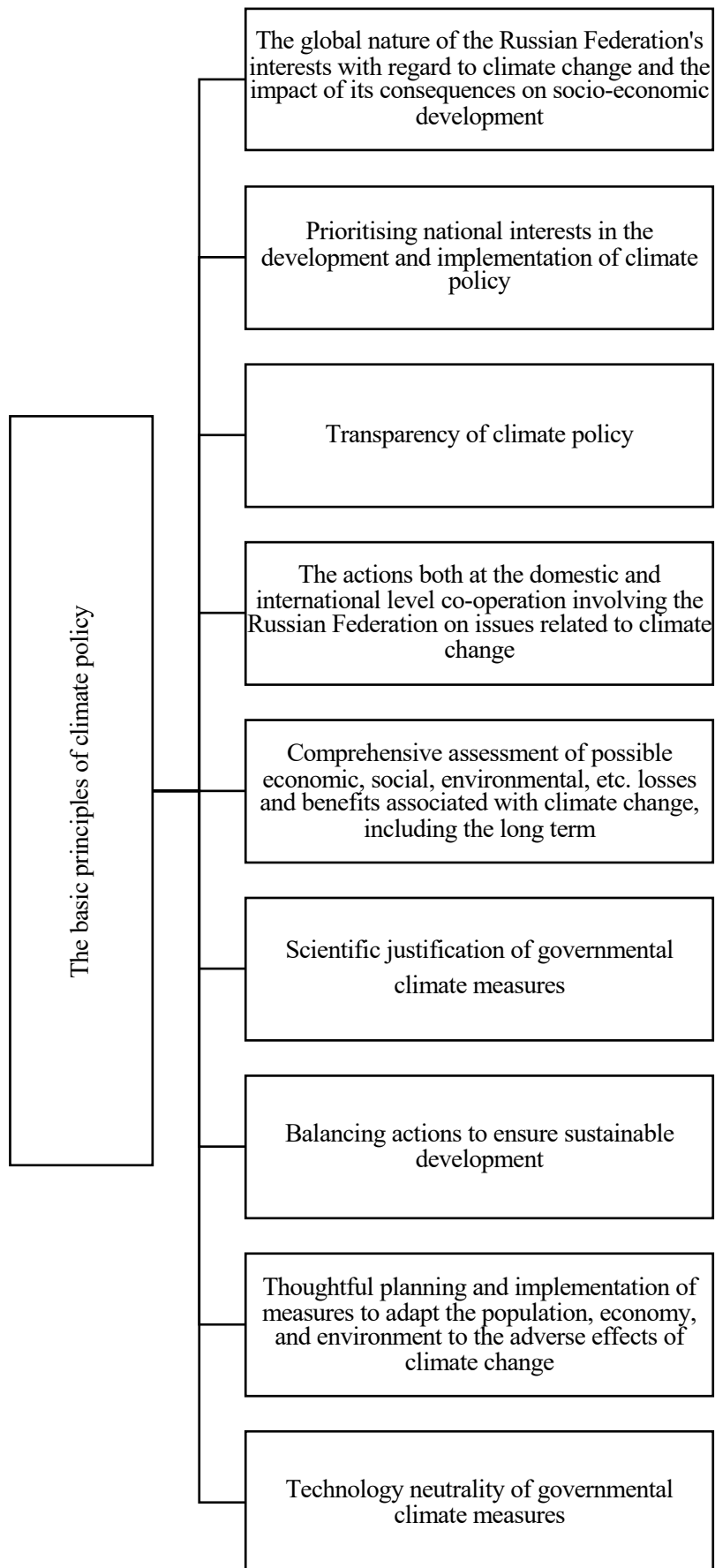*Source: Authors*

Table 1 – The results of substantiation of criteria system for assessing the effectiveness of addressing climate adaptation in terms of the Climate Doctrine of the Russian Federation to ensure the country's competitiveness in the Eurasian and global space

No.	Criterion	Model type	Model symbols	Note
1	Criterion for assessing the effectiveness of the key long-term goal of the Russian Federation climate policy	$AEG = Q_A/Q_{Em}$ (1)	where AEG is an assessment of the effectiveness of the key long-term goal of the Climate Policy of the Russian Federation, Q_A is the absorbed volume of anthropogenic greenhouse gas emissions, Q_{Em} is the total anthropogenic greenhouse gas emissions.	The criterion can be used as a generalised criterion for assessing the effectiveness of climate change adaptation issues
2	The criterion for assessment the effectiveness of addressing the issues of the Russian Federation climate policy	$AEAO = E_p \times E_{m1} \times E_{m2} \times E_{m3} \times E_c$, (2)	Where AEAO is an assessment of the effectiveness of addressing of the Russian Federation climate policy objectives E_p is an assessment of the effectiveness of scientific, technical, and technological potential of the Russian Federation to ensure the completeness and reliability of information on the state of the climate, anthropogenic and other impacts, its current and future changes and their consequences; E_{m1} is an assessment of the efficiency of the development and implementation of operational and long-term climate change adaptation measures; E_{m2} is an assessment of the efficiency of mechanisms for implementing measures to reduce and prevent greenhouse gas emissions and their absorption; E_{m3} is an assessment of the efficiency of measures to reduce (prevent) greenhouse gas emissions or increase their absorption;	The criterion allows us to assess the effectiveness of addressing the Russian Federation climate policy objectives in general and for each of the set objectives separately. Each of the considered performance assessment indicators (E_p, E_{m1}, E_{m2}, E_{m3}, E_c) is the ratio of the actually achieved level of the climate policy to the required level as it defined by the Climate Doctrine of the Russian Federation

No.	Criterion	Model type	Model symbols	Note
			E_c is an assessment of the efficiency of developing mutually beneficial co-operation on climate change and related issues on a bilateral and multilateral basis.	
3	Criteria for assessing the effectiveness of the implementation of the Russian Federation climate policy	$EDA(t)= a \times ICS_{ED}(t)+$ $b \times PNI_{ICP}(t)+$ $c \times CT_{CP}(t)+$ $d \times DA_{CC}(t)+$ $e \times OC_{PNL}(t)+$ $f \times SV_{GM}(t)+$ $g \times BA_{SDNE}(t)+$ $h \times PM_{AECC}(t)+$ $j \times TN_{GMC}(t),$ (3)	where $E_{DA}(t)$ is a general criterion for assessing the effectiveness of climate adaptation in terms of a general approach to the dynamics of achieving climate change adaptation goals, $ICS_{ED}(t)$ is a private criterion for assessing the dynamics of the impact of climate change consequences on the socio-economic development of the Russian Federation; $PNI_{ICP}(t)$ is a private criterion for assessing the dynamics of compliance with the priority of national interests in the development and implementation of climate policy; $CT_{CP}(t)$ is a private criterion for assessing the dynamics of clarity and transparency of the Russian Federation climate policy; $DA_{CC}(t)$ is a private criterion for assessing the dynamics of action activity both at the domestic level and in the framework of international co-operation on climate change-related issues; $OC_{PNL}(t)$ is a private criterion for assessing the dynamics of overall control of possible economic, social, environmental, and other losses and benefits in terms of climate change; $SV_{GM}(t)$ is a private criterion for assessing the dynamics	The criterion for assessing the effectiveness of the implementation of the principles of the Russian Federation climate policy based on the principles of the Russian Federation climate policy allows us to assess the effectiveness of addressing the climate adaptation issues, develop a general approach to assessing the dynamics of achieving the goals of adaptation to climate change.

No.	Criterion	Model type	Model symbols	Note
			of the scientific validity of government climate action; BA_{SDNE} (t) is a private criterion for assessing the dynamics of balancing actions to ensure sustainable development of the national economy; PM_{AECC} (t) is a private criterion for assessing the dynamics of planning and implementing measures to adapt the population, economy, and environment to the adverse effects of climate change; TN_{GMC} (t) is a private criterion for assessing the dynamics of the implementation of technology-neutral state climate measures. a is a weight coefficient of the private criterion for assessing the dynamics of the impact of climate change consequences on the socio-economic development of the Russian Federation; b is a weight coefficient of the private criterion for assessing the dynamics of compliance with the priority of national interests in the development and implementation of climate policy; c is a weight coefficient of the private criterion for assessing the dynamics of transparency of the climate policy of the Russian Federation; d is a weight coefficient of the private criterion for assessing the dynamics of action both at the domestic level and within the framework of international co-operation on climate change-related issues	

No.	Criterion	Model type	Model symbols	Note
			e is a weight coefficient of the private criterion for assessing the dynamics of comprehensive consideration of possible economic, social, environmental, and other losses and benefits associated with climate change; f is a weight coefficient of the private criterion for assessing the dynamics of the scientific validity of the state's climate measures; g is a weight coefficient of the private criterion for assessing the dynamics of balancing actions to ensure sustainable development of the national economy; h is a weight coefficient of the private criterion for assessing the dynamics in planning and implementing measures to adapt the population, economy, and environment to the adverse effects of climate change; j is a weight coefficient of the private criterion for assessing the dynamics of implementation of technology neutrality of state climate measures.	

Source: Authors

Conclusions

Hence, the conducted research has allowed us to substantiate the system of criteria for assessing the effectiveness of addressing climate adaptation problems in terms of the Climate Doctrine of the Russian Federation. It designed to ensure the competitiveness of the country in the Eurasian and global space and includes the following:

- criterion for assessing the efficiency of achieving the key long-term goal of the Russian Federation climate policy as the ratio of the absorbed volume to the total volume of anthropogenic greenhouse gas emissions;

- a criterion for assessing the effectiveness of addressing the issues of the Russian Federation climate policy as a product of efficiency assessments: development tent of scientific, technical, and technological potential of the Russian Federation to ensure the completeness and reliability of information on the climate; anthropogenic and other impacts on the climate; its changes and the consequences; development and implementation of operational and long-term measures for adaptation to climate change; mechanisms for implementing

measures to reduce and prevent greenhouse gas emissions and increase their absorption; measures to reduce (prevent) greenhouse gas emissions or increase their absorption; development of beneficial cooperation on climate change and related issues on a bilateral and multilateral basis. Additionally, each of the efficiency assessment indicators included in the criterion for assessing the effectiveness of addressing the issues of the Russian Federation climate policy can be represented by the ratio of the actually achieved level of addressing the issue of climate policy to the required level of addressing the issues defined by the Climate Doctrine of the Russian Federation;

- a criterion for assessing the effectiveness of the implementation of the Russian Federation climate policy principles. It is a weighted additive model containing: a private criterion for assessing the dynamics of the impact of climate change consequences on the socio-economic development of the Russian Federation; a private criterion for assessing the dynamics of observing the priority of national interests in the development and implementation of climate policy; a private criterion for assessing the dynamics of clarity and transparency of the Russian Federation climate policy; a private criterion for assessing the dynamics of activity both at the domestic level and within the framework of international co-operation on issues related to climate change; a private criterion for assessing the dynamics of possible economic, social, environmental, and other losses and benefits in terms of the climate change; a private criterion for assessing the dynamics of the scientific validity of government climate action; a private criterion for assessing the dynamics of balancing actions to ensure sustainable development of the national economy; a private criterion for assessing the dynamics of planning and implementing measures to adapt the population, economy, and environment to the adverse effects of climate change; a private criterion for assessing the dynamics of the implementation of technology-neutral state climate measures.

The practical significance of the results obtained concern with the possibility of their use in the development of approaches to assessing the effectiveness of national economy adaptation to climate change in accordance with the requirements of the Climate Doctrine of the Russian Federation to ensure country competitiveness.

Further steps to develop a reasonable system of criteria for assessing the effectiveness of addressing climate adaptation problems in terms of the Climate Doctrine of the Russian Federation include substantiation of approaches to assessing the effectiveness of addressing climate adaptation issues, formation of effectiveness criteria considering the objectives of the Russian Federation climate policy, geographical and other specifics of addressing climate change problems, requirements for the processes of climate policy implementation and requirements for the activities of the Russian Federation.

CONFLICT OF INTEREST
The authors declare no conflict of interest.

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Service and innovative special economic zones: advantages of localising international investments

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ORIGINAL ARTICLE

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Abstract. The article highlights the trend of a global sectoral shift in the localisation of foreign direct investment projects of multinational corporations from manufacturing to the service sector. Indeed, in terms of the global production it occurs mainly due to the innovative segment of the service sector. The access to highly qualified labour resources, investments in the reliable technological infrastructure, a favourable institutional environment determine the sustainable development of the segment. The research substantiates the procedure for concentrating the foreign direct investment in terms of the key elements of the national innovation system: strategic planning of technological development, infrastructure of scientific and technological initiative, research and development, and innovations. Moreover, to optimise limited resources, it identifies the expediency of implementing a policy of encouraging foreign direct investment through the special economic zones based on the global value chains and integrated into the national socio-economic context. However, the zonal policy should ensure stable business environment for residents, advanced infrastructure and competitiveness, prerequisites for embedding national companies in the global value chains, and the global investment trends. The research also defines the types of the most economically attractive special economic zones in the service sector, provides the best conditions for the localisation, their priority sectors, competitive advantages, and factors for sustainability increasing at the global and macro-regional levels.

Keywords: special economic zones; service sector; manufacturing sector; servicification; foreign direct investment; innovation potential; global value chains

Introduction

Both export-oriented and non-export-oriented economic growth can be stimulated by (1) the development of the manufacturing sector, (2) development of the service sector (based on the innovation segment), or (3) their cooperative development [1,2]. Indeed, until 2008, the economic growth was provided by the development of the manufacturing industry. However, since 2008, the world economy has exhibited an increase in the geographical concentration of manufacturing and a decrease in the growth of manufacturing exports. Nowadays, the export of services plays an increasingly important role [3]. Currently, both sectors determine the trend and growth rate of the global economy.

Main Part

Servicification of global production

As a result of production fragmentation within global value chains (GVC), the global production is becoming more dependent on the high-value-added service sector. The 'servicification' of production activities occurring in the global economy may be compared with the information and communication technology (ICT) revolution of the 1990s [7].

Nowadays, the value added generated by the services sector accounts for almost 1/3 of the total exports

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[1] *Transition Report 2024-25: Navigating industrial policy. Source: https://www.ebrd.com/transition-report-2024-25 (accessed on 20.01.2025)*

[2] *Transition Report 2023-24: Transitions big and small. Source: https://www.ebrd.com/news/publications /transition-report/ transition-report-202324.html (accessed on 20.01.2025)*

of manufacturing products. Meanwhile, ICT and financial services have the highest percentage in developed countries, followed by logistics services in developing countries [3]. Furthermore, in 2023, service sector-related business processes ('incorporated services') such as research and development (R&D), logistics, marketing, IT support accounted for about 55-60% of total employment in industrial companies (an increase of 10-15% compared to 2000)[3].

The value added in the manufacturing industry per employee is higher in developed countries, due to their focus on maintaining and retaining highly skilled innovation processes within their global value chains. They include R&D, product design, after-sales service, and marketing. At the same time, developed countries are outsourcing or automating labour-intensive production processes. i.e. assembly. As a result, the products at their pre- and post-production stages usually have increased added value. It forms the smile curve as a parabola with higher values at the beginning and at the end of the process and lower values in the middle of the process in the distribution of added value across global supply chains[4].

Stimulating the transition to production services

Increasing the productive potential of the economy does not require large-scale management or regulatory improvements. These changes are often geographically limited to special economic zones (SEZs) with minor institutional improvements of the economy. The required machinery and technology can be imported or obtained by attracting foreign direct investors; an access to the global market can be achieved through liberalisation of goods trade.

However, now this approach is not effective in transition to the servicification of production activities. Innovations in the manufacturing increase the demand for specific types of services. Moreover, robotics, additive technologies, and automation reduce the advantages of having a large number of low-skilled workers [2]. Global innovation services (information and communication services and business process outsourcing services) require: (1) skilled labour; (2) capital investments and investments in technology development (private foundations); (3) reliable infrastructure, strong economic institutions, and a favourable business environment (public foundations)[5].

The liberalisation of trade in services in terms of SEZ will provide benefits in terms of stimulating the servicification of production at the initial stage. However, the transition to higher-value-added services will require higher investments in technology and the transformation of zonal policy in terms of integrating SEZ into the national and global economic context [4].

Foreign direct investment as a key factor of global production servicification process

The policy of encouraging foreign direct investment (FDI) is an important part of national investment and industrial policy. It is implemented by most countries through investment promotion agencies. These organisations attract foreign investment into the country and contribute to the localisation of foreign companies on the domestic market. Indeed, the policy of encouraging FDI is focused on stimulating their development. We can assess the dynamics of FDI projects by sector in terms of international investors (Figure 1, Table 1).

Nowadays, the service sector dominates in FDI. The average share of FDI projects related to the provision of services in the total volume of FDI projects for the period 2003-2023 was 52% in number (2003: 41%; 2023: 58%), 47% in value (2003: 27%; 2023: 51%). At the same time, the service sector differs from the extractive and manufacturing sectors by a noticeable increase in both the number and cost of new FDI projects. For instance, the average annual growth rate of new FDI projects in the service sector in 2003-2023 was 3.26 percentage points higher than that of the manufacturing sector in terms of the number of projects and 3.96 percentage

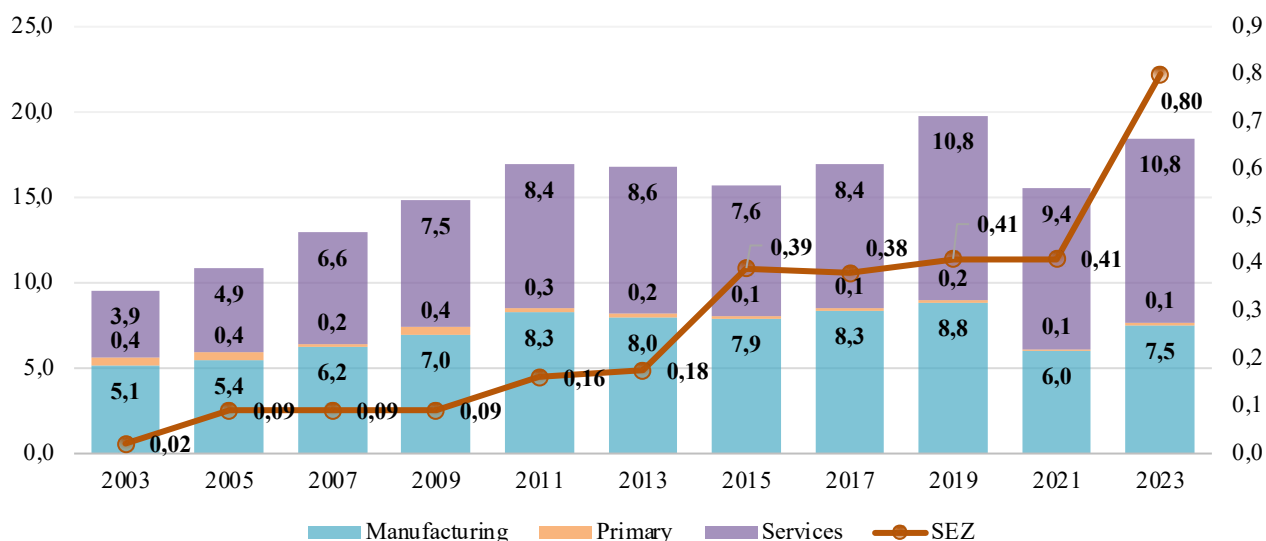points higher in terms of the projects cost.

Figure 1. Greenfield FDI projects by sector in terms of SEZ, 2003-2023, thousand projects
Source: World Investment Report[6]; Global Free Zones of the Year 2024[7]

Table 1 – Merged indicators of dynamics and structure in terms of the number and cost of greenfield FDI projects by sector, 2003-2023

Indicator / Sector	Average value of one project, $ mln USD	The share of the number of sector projects in the total number of projects, %	The share of the value of sector projects in the total value of projects, %	Average annual growth rate of the number of projects, %	Average annual growth rate of project value, %
Total	56.84	100.00	100.00	+3.38	+2.95
Primary	317.40	1.58	8.13	-5.19	-5.06
Manufacturing	54.95	46.80	44.96	+1.92	+2.41
Services	50.90	51.62	46.91	+5.18	+6.37

Source: World Investment Report[8]

Therefore, we analyse the dynamics of the number and cost of FDI projects by specific service type (Figure 2, Table 2).

Table 2 – Merged indicators of dynamics and structure in terms of the number and cost of greenfield FDI projects by service type, 2003-2023

Indicator / Sector	Average value of one project, $ mln USD	The share of the number of projects by type of service in the total number of sector projects, %	The share of the value of projects by type of services in the total value of sector projects, %	Average annual growth rate of the number of projects, %	Average annual growth rate of project value, %
Total services	50.90	100.00	100.00	+5.18	+6.37

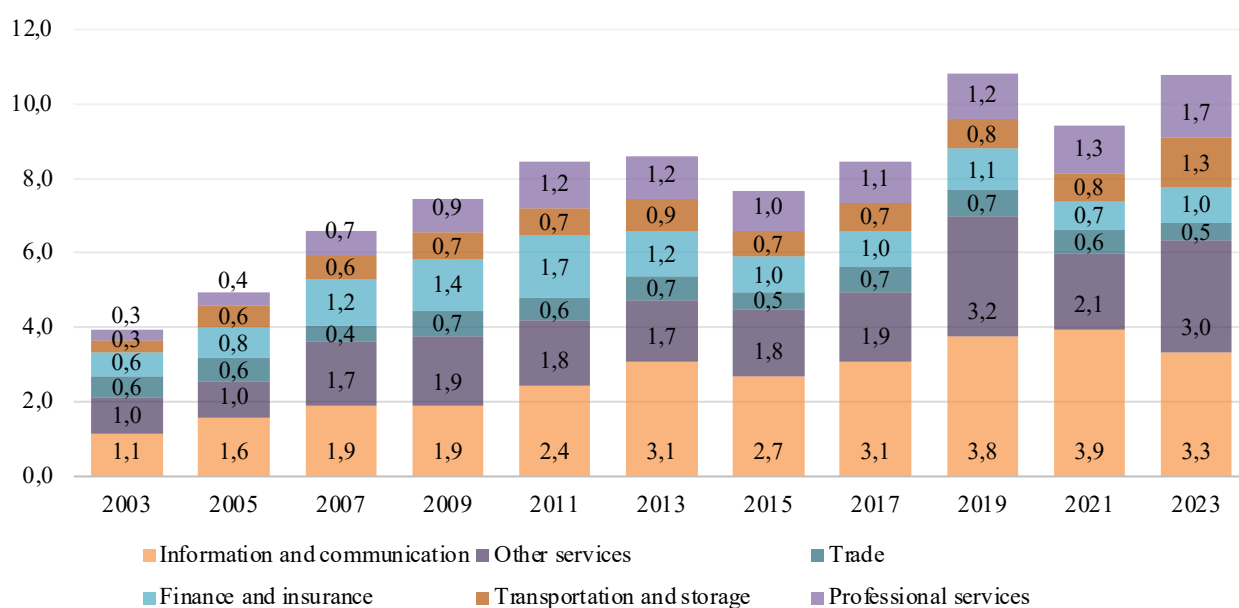| Indicator / Sector	Average value of one project, $ mln USD	The share of the number of projects by type of service in the total number of sector projects, %	The share of the value of projects by type of services in the total value of sector projects, %	Average annual growth rate of the number of projects, %	Average annual growth rate of project value, %
Information and communication	24.74	32.76	16.47	+5.54	+7.01
Finance and insurance	26.82	14.24	7.95	+2.03	+0.50
Professional services	9.68	12.03	2.37	+9.56	+9.32
Transportation and storage	60.26	9.30	11.20	+7.34	+3.56
Trade	35.28	7.86	5.50	-0.86	+0.58
Other services	122.50	23.80	56.52	+5.73	+8.14

Source: World Investment Report[9]

Figure 2. The number and cost of greenfield FDI projects by service type, 2003-2023, thousand projects
Source: World Investment Report[10]

On average, in 2003-2023, the most of the FDI projects were implemented (we do not consider other services[11]) in ICT (average share: 33%; 2003: 29%; 2023: 31%), financial (average share: 14%; 2003: 17%; 2023: 9%), professional (average share: 12%; 2003: 7 %; 2023: 16 %), logistics (average share: 9%; 2003: 8 %; 2023: 12 %), and trade (average share: 8%; 2003: 15%; 2023: 4%) services. Meanwhile, the number and cost of FDI projects in professional, logistics and ICT services are increasing rapidly; the financial and trade services sector has the lowest growth rate compared to the above-mentioned types of services.

[9] *United Nations Conference on Trade and Development (UNCTAD). Source: https://unctad.org/topic/investment/world-investment-report (accessed on 18.01.2025)*

[10] *United Nations Conference on Trade and Development (UNCTAD). Source: https://unctad.org/topic/investment/world-investment-report (accessed on 18.01.2025)*

[11] *They include the following ones: energy and gas supplies, water and waste disposal, construction, accommodation facilities, real estate management, administration and support activities, education, healthcare, recreational services, etc.*

Therefore, the effectiveness of the implementation of FDI projects in the rapidly developing ICT services sector largely depends on the technological potential and resources of the state. The technological (innovation) capabilities of a country are determined by the national innovation system and its key elements: (1) strategic planning of technological development; (2) infrastructure of the scientific and technological initiative (STI); (3) R&D; (4) innovation[12].

Strategic planning of technological development allows the state to determine the general trends of technological development supported by framework programmes, guidelines, standards, and regulations. Strategic planning involves assessing the state of the innovation ecosystem in terms of innovative entrepreneurship, digital technologies, analysis of statistical data, etc.

The STI infrastructure implies stable and affordable energy supply, reliable functioning of transport and mobile networks, and stable high-speed Internet connection. Moreover, knowledge and human capital are becoming particularly important in the digitalisation era. It is necessary to have the appropriate skills and knowledge to use new applications and products, develop new technologies or adapt imported technologies for special purposes.

R&D includes fundamental and applied research, the innovations and design of the unique new devices, methods, compositions, processes, etc. performed by universities, research institutes, or public and private companies [6].

Innovations are the practical implementation of ideas providing the introduction of new goods or services to the market. They are directly related to commercialisation of goods, services, production processes, and sales strategies.

Resource support for the proper functioning of key elements of the innovation system is quite difficult to implement for the country's economy. However, it is successfully implemented by states within the framework of zonal policy in the territories of scientific and technological parks – innovation special zones[13] [1].

The policy of encouraging foreign direct investment is very important for the structural changes in the innovative services sector. However, countries should revise strategic documents, reforms the public administration and legislation, etc. These will have the positive impact on direct investment, including SEZ.

The role of SEZ in the servicification of global production

Investments in SEZ show the condition of the global economy. According to FDI Markets, in 2023, 45% of foreign direct investment projects were implemented out of the total number of FDI (software development, information technology, business and finance services) projects. It is 25% higher than 20% in 2019[14].

Renewable energy is the largest sector of foreign direct investment in SEZ projects. According to FDI Markets, more than $18.6 bn USD was invested to those in 2023. However, it was lower the record high of $61.6 bn USD investments in renewable energy sources in 2022. On the other hand, in 2023, more FDI was announced in FEZs in several sectors than a year earlier, including metals ($13.2 billion), chemicals ($10 billion), automotive ($4 billion), coal, oil and gas ($2.8 billion) and communications ($2 billion). The communications services sector shows an increase in the number of data processing centers established in SEZs worldwide.

Transnational corporations (TNCs) play a key role in the global investment to the service sector. It is presented in Table 3.

Table 3 – TNCs characteristics in the service sector, 2019-2023

Year Criterion	2019	2020	2021	2022	2023
Number of TNCs, units	24	24	25	24	25

[12] *Global cooperation in science, technology and innovation for development. Source: https://unctad.org/system/files/official-document/dtlinf2024d1_en.pdf (accessed on 20.01.2025)*

[13] *Park, D. The Role of Science, Technology and Innovation Policies in the Industrialization of Developing Countries. Lessons from East Asian countries. Source: https://www.unido.org/sites/ default/files/files/2022-02/STI_Policies.pdf (accessed on 20.01.2025)*

[14] *The Crossborder Investment Monitor. Source: https://www.fdimarkets.com/ (accessed on 20.01.2025)*

Criterion \ Year	2019	2020	2021	2022	2023
Industry	Business Services, Computer and Data Processing, Transport and storage, Health care services, Construction, Telecommunications, Trade, Real Estate, E-Commerce				
Home country of parent company	United Kingdom, Germany, Denmark, Ireland, Spain, Italy, China, Netherlands, Republic of Korea, Singapore, United States, France, Japan				
Average value of transnationality index, %	54.76	51.14	54.72	56.67	54.70

Source: World Investment Report[15]

To save the resources, the country attracts foreign direct investment from large service TNCs through adapting the policy of SEZ formation[16].

First, SEZ should ensure the economic risks reducing for residents and advantages for investors. Secondly, the SEZ should include the infrastructure and competitive preferential regime with a gradual reduction in fiscal incentives. Third, SEZs should be integrated into the local economy to ensure the introduction of local suppliers of goods and services into TNCs global value chains. Fourth, SEZs should provide preferential market access in terms of the country's integration into the trade blocs. Fifth, the SEZ should follow the global investment trends, especially, in terms of renewable energy sources agenda.

We distinguished 2 types of SEZ in the service sector: service SEZs: the residents provide the economic activities related to the provision of services; innovative SEZs: attracting of innovative companies through infrastructure establishment, including the areas with the use of Internet of Things. Therefore, we can highlight priority sectors (PS), competitive advantages (CA), sustainability efficiency factors (SEF) of service and innovative SEZs at the macro–regional and global levels. According to the Global Free Zones of the Year rating (GFZ) they are as follows:

Service SEZs. Globally, two SEZs are ranked top the GFZ rating: Dubai Multi Commodities Centre (DMCC) (UAE) and America Free Zone (AFZ) (Costa Rica) (Table 4).

Table 4 – The top ranked service SEZs globally according to the GFZ

Rating criteria	DMCC (winner)	AFZ (high scores)
PS	- gemstones sector; - energy sector; - gaming sector; - Artificial Intelligence and blockchain technology sector (including cryptocurrency sector).	- artificial intelligence sector; - cybersecurity sector.
CA	- high cooperation opportunities due to the presence of a critical mass of companies supplying goods and services with high added value (there are more than 24 thousand residents operating in the SEZ); - advanced infrastructure in the field of high technologies (a large cryptocurrency center has been created in the SEZ).	- location near Costa Rica's international airport, universities and the capital city of San Jose; - ecosystem of leading technology companies (including well-known ones: Hewlett Packard, Bosch, Amazon и IBM and new ones: ServiceNow и Databricks).

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[15] *United Nations Conference on Trade and Development (UNCTAD). Source: https://unctad.org/topic/investment/world-investment-report (accessed on 18.01.2025)*
[16] *FDI Intelligence (2024). Source: https://www.fdiintelligence.com/rankings-and-awards (accessed on 20.01.2025)*

Rating criteria	DMCC (winner)	AFZ (high scores)
SEF	- continuous monitoring of carbon emissions within the SEZ, providing assistance to residents in developing a decarbonization strategy; - creation of a Sustainable Development Center for the purpose of developing, promoting and implementing environmental innovations.	- large-scale implementation of robots into everyday processes (cleaning, security, etc.); - implementation of artificial intelligence technologies (including chatbots) in the order processing system and internal financial transactions; - use of backup generators to ensure data security and uninterrupted power supply to residents.

Source: Global Free Zones of the Year 2024[17]

At the macro-regional level, the following SEZs are among the winners of the GFZ ranking: Middle East – Dubai Multi Commodities Centre (DMCC) (UAE) and Dubai World Trade Centre (DWTC) Authority (UAE); Asia-Pacific Region – Waigaoqiao Free Trade Zone (WFTZ) (China) and The Chongzuo Area of Guangxi Pilot Free Trade Zone (CAGPFTZ) (China); Americas – America Free Zone (AFZ) (Costa Rica) and Cayman Enterprise City (CEC) (UK – Cayman Islands) (Table 5).

Table 5 – The top ranked service SEZs at the macro-regional level according to the GFZ

Rating criteria	Winner	High scores
PS	Middle East	
	DMCC	DWTC
	–	- web 3 sectors; - blockchain sector; - artificial intelligence sector.
	APR	
	WFTZ	CAGPFTZ
	- logistics sector; - biomedical sector.	- logistics sector; - manufacturing sector.
	North and South America	
	AFZ	CEC
	–	- legal services sector; - blockchain sector; - precious metals sector.
CA	Middle East	
	DMCC	DWTC
	–	- location in the central area of the emirate (infrastructure-supported exhibition and office space); - special emphasis on supporting small family businesses.
	APR	
	WFTZ	CAGPFTZ

Rating criteria	Winner	High scores
	- high cluster opportunities (there are over 10 thousand residents with foreign investments operating in the SEZ); - trade and investment relations with 227 countries and regions (2023 – total volume of foreign trade – $160 billion; volume of attracted foreign investment – $2.1 billion); - biomedical ecosystem of companies (including Beigene, Boston Scientific и Insilico Medicine).	- location near the Chinese-Vietnamese border – orientation in foreign trade towards ASEAN countries (large residents: Wanjia и Liangwei); - services in the field of facilitation of cross-border transactions using the yuan, as well as risk management for companies working with ASEAN.
	North and South America	
	AFZ	CEC
	–	- dynamic technology infrastructure; - streamlined process for companies and their employees to relocate to the Cayman Islands (including fast-track immigration and work permits); - focus on education and training initiatives.
	Middle East	
	DMCC	DWTC
	–	- creation of a comprehensive online portal for residents to provide services; - adjustment of SEZ strategies to increase the financial transparency of their activities.
	APR	
	WFTZ	CAGPFTZ
SEF	- continuous modernization of the biomedical ecosystem, including: optimization of the product registration process; provision of services to residents for laboratory testing of their products.	- creation of an international logistics hub for the purpose of developing cross-border cooperation.
	North and South America	
	AFZ	CEC
	–	- development of strategy and implementation of decarbonization initiatives (including solar-powered lighting, green and park walls and increased energy efficiency in buildings).

Source: Global Free Zones of the Year 2024[18]

Innovative SEZs. Globally, two SEZs are ranked top of the GFZ rating: Nanning Area of Guangxi Pilot Free Trade Zone (NAGPFTZ) (China) and Dubai Silicon Oasis (DSO) (UAE) (Table 6).

[18] *FDI Intelligence (2024). Source: https://www.fdiintelligence.com/rankings-and-awards (accessed on 20.01.2025)*

Table 6 – The top ranked innovative SEZs globally according to the GFZ

Rating criteria	NAGPFTZ (winner)	DSO (high scores)
PS	- digital economy sector; - modern financial processes sector; - advanced manufacturing processes sector.	- various innovative sectors (unmanned vehicles, smart cities, etc.).
CA	- creation of a cluster for the production of memory semiconductors; - development and support of internal research and development programs.	- comprehensive support for innovative activities (scientific institutions, technological sites); - specialized infrastructure and programs for startups (Dubai Technology Entrepreneur Campus; acceleration, mentoring, networking and venture financing programs from a $136 million fund).
SEF	- a program for attracting and retaining personnel; - a comprehensive program for energy-saving infrastructure provision.	- specialized personnel reserve; - implementation of environmental innovations in infrastructure provision in SEZ (for example, solar panels for power supply of facilities).

Source: Global Free Zones of the Year 2024[19]

At the macro-regional level, the following SEZs are among the winners of the GFZ rating: Middle East – Dubai Silicon Oasis (DSO) (UAE) and Masdar City Free Zone (MCFZ) (UAE); Europe – Krakow Technology Park (KTP) (Poland) and Liverpool City Region Innovation and Freeport Zone (LCR) (UK); Asia-Pacific Region – Nanning Area of Guangxi Pilot Free Trade Zone (NAGPFTZ) (China); North and South America – ZPE Ceara Free Zone (ZPE) (Brazil) and Zona Franca Metropolitana (ZFM) (Colombia) (Table 7).

Table 7 – The top ranked innovative SEZs at the macro-regional level according to the GFZ

Rating criteria	Winner	High scores
PS	Middle East	
	DSO	MCFZ
	–	- life science sector; - cleantech sector; - intelligent systems sector.
	Europe	
	KTP	LCR
	- life science sector; - ICT sector; - future mobility sector.	- life science sector; - critical materials sector; - robotics and artificial intelligence sector.
	North and South America	
	ZPE	ZFM
	- cleantech sector.	- information technology sector; - outsourcing sector.

[19] *FDI Intelligence (2024). Source: https://www.fdiintelligence.com/rankings-and-awards (accessed on 20.01.2025)*

Rating criteria	Winner	High scores
CA	Middle East	
	DSO	MCFZ
	-	- a robust digital infrastructure for residents (including the Khazna Data Center); - programs aimed at facilitating the creation of innovative companies (including Prepaire Labs and Attentive Science).
	Europe	
	KTP	LCR
	- programs for joint development of Industry 4.0 technologies by residents; - programs for cooperative interaction between startups and current residents of the park.	- integrated innovative SEZ and free port; - cross-sectoral research, investment and cooperation (including Tritax Symmetry, MiraStar, Harworth Group, TriRx and Astra Zeneca).
	North and South America	
	ZPE	ZFM
	- location near the port, dedicated infrastructure for utilities; - integration of innovations into the current activities of the SEZ (investments in automation, video monitoring, etc.).	- advanced physical and digital infrastructure (including Scala Data Centres and Odata Colombia); - location in the Bogotá metropolitan area.
SEF	Middle East	
	DSO	MCFZ
	–	- programs to support innovations in the field of climate technologies.
	Europe	
	KTP	LCR
	- implementation of projects in the field of digital innovation, automation and green transformation (31 investment projects for a total of 253 million euros were implemented in the park in the first half of 2024; Stryker Poland Manufacturing and SBS Technology became residents of the park).	- creation of training programs to develop skills in the field of artificial intelligence, the Internet of Things to solve decarbonisation problems; - a program to support environmental investments.
	North and South America	
	ZPE	ZFM
	- investments in renewable energy sources such as solar and wind power plants.	- certified as a carbon neutral site.

Source: Global Free Zones of the Year 2024[20]

Service and innovative SEZs could provide their residents the opportunities of participation in global value chains in terms of global business environment.

Conclusions

The advantages for resident SEZ companies of such service and innovative FEZs operating on the basis of GCS are due to a number of effects generated by such zones, among which the following are of the greatest importance.

Competitiveness impact on the manufacturing and related services. The GVC positively correlates with the growth of domestic added value of both developed and developing countries. Moreover, the relationship between the TNCs in GVCs and the growth in value added of economy productive sector of related services (i.e., installation, customisation, maintenance, repair, etc.) increases. According to V. Kummritz, 1% grow in GVC increases the internal value added ranging 0.1-0.6%; labour productivity by 0.3% [5]. He also determines GVS advancement of national enterprises, including the levels of cooperative inter-company interaction and personnel qualifications, and the technological level. Their systemic effect increases the competitiveness of the manufacturing sector both within and outside the SEZ and helps strengthen the positions of national companies in terms of the GVC.

The impact on structural change in post production services. Based on the assumption of manufacturing productivity growth being directly related to economic growth, the significant indicators of structural changes in the economy are the share of manufacturing in GDP, their growth rates, and the share of value added in manufacturing. According to R. Stöllinger, there is a positive relationship between the structural changes characteristic of manufacturing and integration into the GVC: the calculated Stöllinger coefficient suggests an increase of 1 percentage point in the GVC concerns with an increase in the share of the manufacturing industry by 0.1% [10]. Moreover, the impact of participation in the GVC on structural changes in the economy of a particular country, including those related to the development of high-valuegenerating services – design, R&D, supply chain logistics, and marketing – varies depending on the state measures to ensure the sustainable integration of national companies into the GVC. These measures concentrate the resources within certain areas. It is typical for the SEZs. In general, GVS provides broader opportunities for enhancing the production capacity. However, the participation in GVS does not provide the large-scale structural changes; the result depends on the positions of enterprises in a particular country, mainly occupied within GVS, the quality of products, etc.

Impact on environmental sustainability. According to G. Peters, there is a following twofold causal relationship: on the one hand, the participation of national companies in the GVC has a (mostly negative) impact on the environment, on the other hand, environmental policy also affects the companies activities within the GCC, introducing requirements to improve the environmental safety of production [9]. Chinese economists B. Meng and W. Tang highlight the relevance of reducing carbon emissions through access to GVC and point out it more difficult for companies do not adhere to a carbon neutrality policy[21] [8]. Indeed, emission level requirements can be introduced by the SEZ administrations and provided the procedure for obtaining the SEZ resident status.

It is necessary to consider the ability of TNCs to contribute country economic development through SEZs. Moreover, country FDI depends on various mechanisms, including innovative TNCs SEZs in GVC. The most important are the dissemination of know-how and their transfer to national enterprises; the acquisition of specialised skills by employees of national enterprises through inclusion in TNC training programs; and the development of strong inter-company cooperative relationships. The combination of these mechanisms largely determines the location of TNCs FDI. However, to have a long-term positive impact on economic development, the presence of TNCs as residents of the SEZ in the host country should use the mechanisms of knowledge transfer, acquisition of valuable skills, and cooperation out of the SEZ.

Moreover, the effectiveness of a development strategy based on service and innovative SEZs in GVS depends both on the quantity and the quality of TNCs FDI. However, quality concerns with TNCs investment motives, targets, autonomy, the ability of national enterprises to associate with the presence of TNCs (knowledge, skills, technologies, managerial know-how, etc.). Hence, a rational policy in terms of service and innovative SEZs based on GVC should prioritise integrating of the national companies.

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[21] *Global Value Chains and Industrial Development: Lessons from China, South-East and South Asia.* Source: *https://www.unido. org/sites/default/files/files/2018-06/EBOOK_GVC.pdf (accessed on 20.01.2025)*

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The role of public-private partnership in stimulating the innovative development of industrial enterprises in the digital economy

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ORIGINAL ARTICLE

Abstract. The anti-Russian restrictions on the supply of high-tech goods provides the relevance of achieving the country's technological independence in terms of digital technologies. It ensures the Russia's technological independence and requires active business participation in domestic innovation and development. The research examines the theoretical foundations of public-private partnership and innovative development through the literature analysis, introduces the author's definition of these concepts, and considers different approaches to the definition of public-private partnership and innovative development, as well as their advantages and disadvantages. We define the potential of public-private partnership to ensure technological independence in terms of digital technologies and active business participation in domestic innovation and development. Indeed, the research considers the dynamics of public-private partnership projects in the Russian regions and new interactive tools to attract investment and develop domestic technologies. We define the objectives of achieving the "digital maturity" of key sectors of the economy and social sphere by 2030. Hence, the research analyses the factors of low demand for public-private partnership mechanisms in the development of digital technology projects, reveals its main challenges and constraints, and draws the necessary conditions for its successful implementation.

Introduction

The anti-Russian restrictions on the supply of high-tech goods provides the relevance of achieving the country's technological independence in terms of digital technologies. Therefore, the cooperation of the public and private sectors within the framework of a public-private partnership is the urgent governmental task to ensure technological independence, the possibility of commercialising domestic research and development, accelerate the technological development of Russian companies, and increase the competitiveness of their products in the market. The Russian federal project "Digital Economy of the Russian Federation / Digital Technologies" forms favourable conditions for IT startups, supports domestic companies, and develops high-tech areas such as quantum communications and 5G through grants, venture financing, preferential loans, leasing, methodological support, acceleration, etc. Indeed, high-tech areas development is provided by large Russian technology companies[1].

The purpose of the research is to analyse the potential of public-private partnership (PPP) in the context of ensuring Russia's technological independence in terms of digital technologies. The study aims at exploring the advantages and disadvantages of PPP and identifying the main challenges and constraints associated with its implementation.

Main part

The analysis of literary sources shows a variety of definitions of public-private partnership (PPP). The choice of interpretation depends on the specifics of market relations and legislation in each country. The

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[1] *Digital Economy of the Russian Federation. Source: https://digital.gov.ru/ru/activity/directions/878 / (accessed on 30.10.2024)*

term Public-Private Partnership (PPP) appeared in the UK in the 1980s. In Germany, this form of agreement is called "offentlich-private Partnerschaft". In France and Spain PPP are "partenariat public-prive" and "colabaracion publico privada", respectively [8].

Russian scientists A.S. Zhidkov and Yu.A. Koskina considers PPP as the provision of public services by the private sector in cooperation with government agencies [17]. However, they provided a brief description of the process and did not specify some important aspects of the PPP.

A.A. Spiridonov, Chairman of the General Council of the Center for the Development of Public-Private Partnership, considers PPPs in two aspects. Firstly, PPP is defined as formal business cooperation between the private sector and the state, not only in the economic sphere, but also in other areas of public life. Secondly, PPP is considered as cooperation between business and government in the implementation of socially significant national projects [13]. However, A.A. Spiridonov's approach shows its simplicity and insufficient elaboration of various aspects.

V.G. Varnavsky considers PPP as a legally formalised interaction between the state and business in terms of state and municipal property, as well as public services for the implementation of socially significant economic projects [14]. V.G. Varnavsky focuses on the various outcomes of the agreements and the private sector representatives entitled to become parties to the agreements. However, insufficient attention is paid to the private sector and its risks.

The IMF considers PPPs to be the combination of public and private capital aimed at improving public property management and the delivery of social services using an optimal and efficient risk management mechanism, as opposed to traditional public procurement[2].

According to the Federal Law No. 224-FZ "On Public-Private Partnership, Municipal-Private Partnership in the Russian Federation and Amendments to Certain Legislative Acts of the Russian Federation" on July 13, 2015, Public-private partnership (PPP) and municipal-private partnership (MPP) are legally formalised cooperation between a public partner (state or municipality) and a private partner for a certain period of time, based on resource pooling and risk sharing. This partnership aimed at attracting of private investment in the economy, increasing the availability of goods, works and services to state and local authorities, and their quality improving[3].

Therefore, PPP is a form of interaction between the state and the private sector aimed at the implementation of socially significant projects and programmes, as both parties participate in the process, share the risks and benefits.

Nevertheless, the domestic science highlights the insufficient conceptual definition of innovative development.

Table 1 – The interpretations of the category "Innovative development"

Author	The author's interpretation
Glazyev S.Yu. [7]	Innovative development is a strategy of advanced development involving the activation of innovative potential and ensuring scientific and technological leadership in terms of the fifth and sixth technology revolution.
Yakovets Yu.V., Kuzyk B.N. [16]	Innovative development is a strategy of innovative breakthrough based on the concentration of efforts of the people, the state, and business on the development of fundamentally new, competitive technologies and products, innovative renewal of critically outdated production facilities, increasing the role and responsibility of the state for the development and dissemination of new generations of equipment and technologies, effectiveness of integration processes, and promoting the innovation activity of entrepreneurs, scientists, designers, engineers, the younger generation in

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[2] *Public-Private Partnerships. International Monetary Fund (2016). Source: https://www.imf.org/external/pubs/ft/fandd/2001/09/gerrard.htm (accessed on 31.10.2024)*

[3] *Federal Law No. 224-FZ "On Public-Private Partnership, Municipal-Private Partnership in the Russian Federation and Amendments to Certain Legislative Acts of the Russian Federation" on July 13, 2015. Source: https://ivo.garant.ru/#/document/71129190/paragraph/276642:0 (accessed on 31.10.2024)*

Author	The author's interpretation
	the coming decades.
Afendikova E.Yu. [1]	The innovative development of the economic system as a system process based on knowledge and innovation promotes competitive advantages and increases well-being through the interests of all the participants. Indeed, the management of the innovative development of the economic system is based on patterns, approaches, and principles.
Buzgalin A.V., Kolganov A.I. [4]	Innovative development is a new path to new goals with the help of new (but largely already available) means with the priority of developing human qualities ("economics for man").
Didenko D.V. [5]	The "innovative" development model implies: 1) a constant experiment to form, verify the effectiveness and selection for mass reproduction of technological and institutional innovations within the same socio-economic system; 2) innovative modernisation accompanied by a revolutionary change in technological structures and socio-economic institutions determining the trajectory of global techno-economic development.
Egorova A.A. [6]	Innovative development is the process of transition to an innovative type of economy through continuous and purposeful search, preparation and implementation of innovations improving the efficiency of public production.
Voeikov M.I. [15]	Innovative development includes the design of new equipment, technologies, the search for new management techniques, the development of human potential based on highly developed scientific, cultural, and educational items. Moreover, innovative development consists in the social and humanitarian aspects of human activity, the personal preservation ("conservation") and reproduction.
Batukova L.R. [3] [16]	Innovative development is a category defining the model of the industrial sector reproduction within a single economic territory. The innovative development of an economic territory is a system of balanced economic, institutional, and social relations allow ones: (a) to form and implement the necessary scientific and technological groundwork; (b) to implement an innovative replacement of production and technological chains; (c) to reorganize the structure of economic relations, thereby ensuring the sustainable development of society and its economic system.

Source: Author

S.Yu. Glazyev considers innovative development through the prism of technological structures. He suggests stimulating innovative development by activating innovation potential and achieving scientific and technological leadership in critically important for the fifth and sixth technological orders industries. This approach focuses on high-tech manufacturing and includes nanotechnology, biotechnology and other similar areas of the material production. Education, healthcare, and science play a secondary role; their task is to train qualified specialists to improve labour efficiency in key sectors of material production.

A.V. Buzgalin, A. Kolganov consider the innovative development in the paradigm of a socio-humanistic framework and the human development. They use the term "The economics for humankind" not "Man for Labour", considering under "The economics for humankind":

1) the priority in the development of human qualities;

2) focus on ensuring social background providing creative motivation and equality of opportunities;

3) increasing of free time for the development of human qualities, and reducing the time of reproductive labour for ensuring life;

4) design of fundamentally new technologies focused on the development of human qualities, social and natural recreation, rather than the growth of material wealth.

According to "The economics for humankind", measurement of the results should concern with the Human Development Index and the Environmental Performance Index, rather than GDP or production.

The basis of this approach is the consideration of innovations and technologies applied to the social sphere. For example, there are innovations in science, culture, education, healthcare, recreation of society and nature; the sphere of material production is secondary one.

Consequently, innovative development of a region depends on innovative processes in its territory. However, the regional innovative development is also determined by the level of technological development of the region's leading industries, support from local authorities, and the availability of resources for the practical implementation of innovative ideas.

However, innovations can be successfully implemented with a limited number of resources. Therefore, for the successful innovative development of the region, it is necessary to consider all aspects and opportunities available.

The specification of critical analysis approach to understanding innovative development at the macroeconomic level is as follows:

- Insufficient attention to the social and public aspects of innovative development. The focus is only on formation of a new high-tech economic structure might provide the imbalances and inequalities in society.

- The relevance of regional aspects of the innovative development. However, the regional economic potential, infrastructure, and cultural characteristics are not considered. It may result in an uneven distribution of resources and opportunities for innovative development.

- The emphasis is on adjusting current innovation processes at the enterprise level. However, the long-term strategic goals and priorities of innovative development are not considered. It may result in fragmentation and inconsistency of innovation processes.

- Optimising the innovation development trajectory for the entire economy requires a comprehensive approach. It considers the interaction between the public and private sectors, and international partners, etc.

According to E.Yu. Afendikova, innovative development is a systematic process based on knowledge and innovation. It provides competitive advantages and improves well-being through the interests of all participants. However, this process has a lot of challenges and limitations requiring the critical analysis. Overcoming these problems requires active government involvement in supporting and stimulating innovative development.

To ensure the long-term prosperity and well-being of all participants in the economic system, innovative development should be based on the principles of justice, equality, and sustainability. It is important to provide equal access to education, technology, and resources for all citizens, regardless of their social status and geographical location.

According to Didenko D.V., innovative development model consists of two key aspects:

Firstly, innovative development is a continuous process of experimentation, evaluation of effectiveness, and selection of technological and institutional innovations for their subsequent mass implementation within the existing socio-economic system.

Secondly, innovative development involves modernisation based on innovation accompanying by radical changes in technological structures and socio-economic institutions. It determines the trends of global technical and economic development.

The implementation of such a development model requires a high degree of coordination between the various participants in the process.

However, constant changes and innovations can decrease the stability and sustainability of the socio-economic system, cause crisis, etc.

B.N. Kuzyk and Yu.V. Yakovets consider innovative development in terms of the large cycles ("long waves") discovered by N.D. Kondratiev [12] and V.I. Vernadsky and P. I. Sorokin ideology of the humanistic noospheric civilization [16]. Based on the theory of foresight and planning methodology of N.D. Kondratiev, the authors identify the following priority areas of innovation and technological breakthrough:

- revival and advanced development of the high-tech sector, including the military industrial complex;

- transformation of the energy sector, transition to an energy-efficient type of reproduction, development of fundamentally new technologies for energy generation, transmission, and use;

- innovative transformation of the consumer sector allows the innovative breakthrough to saturate the

market with environmentally friendly domestic food, high-quality industrial goods, medicines, services, etc.

A.A. Egorov defines innovative development as a process of transition to an innovative type of economy through a constant and targeted search, development and implementation of innovations contributed to improving the efficiency of production.

Moreover, many researches consider innovative development in terms of design of new equipment, technologies, management techniques or personal development through highly developed fields of science, culture, and education. It includes the social and humanitarian aspects of human activity, the preservation and reproduction of human beings [15].

Furthermore, the researches consider innovative development as a model of reproduction of the industrial sector, including a system of balanced economic, institutional and social relations. It allows ones to implement scientific and technological developments, advance the production chains and reorganise the economic relations [3].

Hence, innovative development is a process aimed at the long-term prosperity and well-being of all participants in the economic system. It involves creating appropriate conditions for even distribution of benefits, considers the interests of different groups, and preserves natural resources for future generations. Indeed, all industries should be developed in terms of innovative activity. It may provide a formation of the competitive cluster but do not provide the innovative development of the economy as a whole.

PPPs play an important role in the development of the digital economy. It incorporates the state and private sector efforts to address challenges and realise large-scale projects. Indeed, PPPs contribute to:

1. Investments in infrastructure and technology development;
2. Improving the quality and accessibility of services;
3. Employment generations and stimulating economic growth;
4. Promote competition and reduce government spending.

Moreover, PPP mechanism is an alternative to privatisation – the state retains ownership of strategic and socially significant facilities, and businesses expand opportunities by investing in long-term and stable assets. It becomes possible through the niche theory by recognising the diversity of ownership forms and the rational distribution of entitlements between the stakeholders. On the one hand, combining government assets with private sector resources, such as investment, management, motivation etc., results in synergies and more efficient utilisation of society's potential, particularly for large projects. On the other hand, the practical implementation becomes possible due to the transition from understanding property as a monolithic object to considering it as a package of powers distributed throughout the process participants[4].

According to the rating of the Russian Federation regions on the level of PPP development for 2023, published by the Ministry of Economic Development, Moscow ranks first with a planned investment of 369 bn RUB. It is followed by the Nizhny Novgorod and Leningrad regions with investments of 153 bn and 115 bn RUB, respectively.

Table 2 – Dynamics of PPP projects implementation in the regions of the Russian Federation

Regions of the Russian Federation	Assessment of dynamics, score	Investments in PPP projects, mln RUB	
		Planned	Presented
Moscow	100.0	369,390	108,960
Nizhny Novgorod region	68.9	153,428	75,033
Leningrad region	55.0	114,961	59,922
Perm Krai	36.4	96,964	39,687
Rostov region	29.6	62,940	32,206

[4] *Ministry of Economic Development of the Russian Federation. Public-private partnership. Source: https://www.economy.gov.ru/ material/departments/d22/gosudarstvenno_chastnoe_partnerstvo/reyting_subektov_rossiyskoy_federacii_po_urovnyu_razvitiya_ gchp_za_2023_god.html?ysclid=m33a7vs4ci163716140 (accessed on 31.10.2024)*

Regions of the Russian Federation	Assessment of dynamics, score	Investments in PPP projects, mln RUB	
		Planned	Presented
Tomsk region	23.9	50,071	26,071

Source: Ministry of Economic Development of the Russian Federation. Public-private partnership, 2023[5]

The Moscow region and St. Petersburg are leaders in terms of accumulated experience in implementing PPP projects; it concerns with the number of successfully completed projects.

The leading positions of Moscow, Nizhny Novgorod, and Leningrad regions are due to the launch and successful implementation of major infrastructure projects in 2023. In Moscow, the investment stage was completed and the 'Severniy doubler of Kutuzovsky Prospekt' highway was launched with over 68 bn RUB of investments. Furthermore, agreements were concluded and other facilities worth over 300 bn RUB were commissioned. In Nizhny Novgorod region the following major concession agreements were concluded: a highway – Gagarin Prospect doubler (2-4 stages) with investments over 64 bn RUB and DHW facilities over 42 bn RUB. In the Leningrad region a concession agreement was concluded for a latitudinal high-speed railway over 110 bn RUB of investments.

Housing and communal services and energy supply are the leaders in the implementation of PPP projects with more than 2,700 agreements. They are followed by education and science with 200 agreements, culture and recreation with 125 agreements, and transport infrastructure with 117 agreements[6].

Globally, the PPP mechanism is actively used to make virtually non-funded socially significant infrastructure projects cost-effective ones. Indeed, PPPs act as the effective tools for addressing the challenges of the country's economic development through direct and indirect socio-economic effects in infrastructure construction. Moreover, PPP contributes to GDP growth by generating new jobs, developing modern technologies, and improving the quality of life, in addition to increasing the investment activity of economic entities and macroeconomic indicators [11]. The planning horizon of 15 years, each ruble invested in an infrastructure project will ensure two rubles of indirect and three rubles of direct effects. Russian business can participate in many large infrastructure projects requiring formidable investments through PPP development.

In the future, we can expect an increase in the share of large infrastructure PPP projects implemented by a consortium of unaffiliated companies rather than by a single investor. Perhaps the expansion of PPPs will reduce. Nowadays, other attractive to investors instruments of cooperation with the state such as a state or municipal offset contract with counter investment obligations are emerging in Russia.

The goals of achieving 'digital maturity' of key economic and social sectors by 2030 are defined by Presidential Decree No. 474 "On the National Development Goals of the Russian Federation for the period up to 2030" on 21 July 2020. According to these amendments, information technology, including software, various telecommunications equipment and data centres, as well as government information systems, may be subject to PPP/MPP concession agreements.

Indeed, PPP projects in the digital technology sector can now be implemented under PPP/MPP and concession agreements. However, this mechanism is still not widespread in domestic practice.

The low demand for PPP mechanisms in the development and implementation of digital technology projects is due to several factors: Firstly, this mechanism was originally designed to attract private investment in infrastructure projects, rather than for government innovation programmes. Secondly, the mass launch of digital PPP projects requires a comprehensive approach to improving and developing the current legislation, rather than the fragmentary one existing today. Although, the majority of regional digital transformations are implemented, there are many legislative obstacles to the participation of municipalities in PPP digital projects.

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[5] *Ministry of Economic Development of the Russian Federation. Public-private partnership. Source: https://www.economy.gov.ru/ material/departments/d22/gosudarstvenno_chastnoe_partnerstvo/reyting_subektov_rossiyskoy_federacii_po_urovnyu_razvitiya_ gchp_za_2023_god.html?ysclid=m33a7vs4ci163716140 (accessed on 31.10.2024)*
[6] *Towards PPP: how Russian infrastructure is looking for partners. Source: https://www.rbc.ru/industries/ news/6710fb819a7947b6738f56aa (accessed on 11.04.2024)*

Thirdly, each new digital PPP project requires the development of a regulatory environment to ensure the functioning of the information system. It causes the delays of the project implementation [2].

Conclusion

Hence, the main vulnerabilities in the public-private partnership (PPP) mechanism are as follows:

1. Risk of losing control over strategic assets: transferring ownership of strategic and socially important assets to the private sector may result in the loss of state control over these assets.

2. Corruption and conflict of interest: the involvement of private companies in the management of state assets may create conditions for corruption and conflict of interest between officials and business.

3. Uneven distribution of benefits: PPPs may result in unequal distribution of benefits from the utilisation of public assets between the state and the private sector.

4. Limiting access to resources: restrictions on access to public resources for the private sector can slow economic growth and innovation.

5. Dependence on foreign investors: the involvement of foreign investors in PPPs can make a country's economy dependent on external factors and reduce national security.

Therefore, despite the potential opportunities and advantages of PPPs in digital technologies, their low relevance in domestic practice is due to a number of factors, including the initial focus on infrastructure projects, the requirement for a comprehensive approach to legislation, and the complexity of establishing a regulatory environment for each new project. To successfully introduce PPPs in digital projects, it is necessary to remove legislative obstacles. It may increase the investment attractiveness and accelerate projects implementation.

CONFLICT OF INTEREST
The author declares no conflict of interest.

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Analysis of economics and management of crop and livestock husbandry production in Kazakhstan

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ORIGINAL ARTICLE

Abstract. Crop production and livestock husbandry sector are key branches of Kazakhstan's agro-industrial complex. They play an important role in ensuring food security and economic stability of the country. The relevance of the study is due to the need to identify factors affecting the efficiency and sustainable development of these industries in terms of the global climate change, economic instability, and growing demand for agricultural products. Although there are significant achievements in production volumes, regional disparities, infrastructure deficiencies and technological gaps persist, hindering the development of these industries. An analysis of the current state of crop and livestock production shows a decrease in gross output in 2023 due to rising production costs, unfavourable climatic conditions, and economic factors. Indeed, Turkestan, North Kazakhstan, Kostanay, and Akmola have advanced crop production. Almaty, Turkestan, Akmola, and East Kazakhstan regions have advances livestock production. 2023 had a decrease in gross output, deterioration in per capita indicators, and an increase in livestock mortality. To address the above problems, there is a need to implement the integrated approach including technology modernisation, cost optimisation, and infrastructure development. The research suggests to introduce innovative production methods, increase the level of agronomic and veterinary support, and extra financing and investment into the industry. Moreover, the favourable conditions for the sale of products, improving agricultural policy, and developing government support programs are very relevant issues. An analysis of crop and livestock husbandry production dynamics from 2010 to 2023 revealed key factors affecting the development of industries: climate change, insufficient agricultural technologies, financing problems, shortage of qualified personnel, weak logistics infrastructure, etc. Despite the negative trends in 2023, 2024 shows an increase in livestock husbandry and an improvement in production indicators, such as average milk and egg yield. In crop production, there has been an increase in gross output until 2022; in 2023 its decline is associated with rising costs and unfavourable economic conditions. To ensure the sustainable development of crop and livestock husbandry production in Kazakhstan, it is necessary to focus on the modernisation of industries, the introduction of innovative technologies, professional development, and optimisation of government support. An integrated approach, including the development of strategies to increase profitability and sustainability of production, will help stabilise the economy of these industries and strengthen the country's food security.

Keywords: crop production; livestock husbandry; climate change; food security; agricultural policy; Kazakhstan

Introduction

Kazakhstan's agricultural sector plays a key role in the country's economy, ensuring food security, and

contributing to rural development. Crop production and animal husbandry are the main components of this industry; they form the basis of food production and export potential. Both directions have a significant impact on economic development, providing the country with basic food products and raw materials for the processing industry. However, the development of the agricultural sector is challenged with the climate change, absence of modern technology, limited access to investment, and underdeveloped infrastructure.

The subject of this research is a comprehensive analysis of the economy of crop and livestock husbandry production in Kazakhstan, identifying their current problems and development prospects. The research focuses on the economic and social factors affecting the effectiveness of both industries, the development of recommendations for improving management, and increasing their competitiveness.

Recently, there has been an increasing interest of scientists in the study of economics and management of these industries, due to the need to adapt to global challenges, including climate change, digitalisation, reducing resource dependence, and increasing the sustainability of the agricultural sector. The literature review is aimed at systematising scientific papers on the issues and prospects of crop and livestock husbandry production in Kazakhstan, identifying key approaches and methodologies used in the economic and managerial analysis of these industries.

Scientific publications on crop production focus on its role in providing the population with basic foodstuffs and raw materials for the processing industry. According to research, the industry's potential is significantly limited due to the absence of modern technologies and insufficient infrastructure [31]. Climate change, soil degradation and inefficient use of water resources are key factors negatively affecting the yield and sustainability of the industry. The authors emphasise the urgency to introduce resource-saving technologies and innovations, precision farming and automation of agrotechnical processes. They can increase productivity and sustainability of crop production.

The research in animal husbandry focuses on the analysis of production and economic indicators, its management, and modernisation of the industry. Animal husbandry in Kazakhstan has significant potential due to its natural conditions and extensive pasture lands. However, the outdated technologies for keeping and feeding animals, high mortality rates of young animals, weak integration into global supply chains significantly limit the development of the industry. According to our analysis, efficiency improvement is possible through the introduction of digital management systems, including animal health monitoring, rational use of feed, and automation of production processes.

Modern research highlights the importance of government regulation and support of the agricultural sector. The development of crop production and animal husbandry requires attracting investments, improving the subsidy system, and forming the favourable conditions for innovation [5]. Special attention is paid to issues of sustainable development, including maintaining ecological balance and ensuring biosafety.

According to Tyupakov K.E., Batrakova N.V., Mertins Yu.V., «a precision agriculture system is being actively introduced into global agricultural production. It includes two subsystems – precision agriculture and precision animal husbandry. The use of such agricultural production technology in the crop industry allows agricultural producers to increase gross production, increase profitability, and reduce unit costs. Precision agriculture is an agricultural production system aimed at optimising agrotechnological processes in the crop industry through automatic control and regulation of agricultural machinery and equipment based on data from information and analytical analysis of production with minimal environmental impact» [31].

Indeed, Kadomtseva M.E., Neufeld V.V. consider «the main directions of modernisation of agriculture and its sub-sectors in terms of the large-scale introduction of digital technologies. Global experience shows that digitalisation of crop production provides a significant increase in yields while reducing costs and environmental damage due to the selective use of machinery and fertilizers. This is achieved through the most rational, «targeted» use of each unit of resources (machine hours of machinery, kilograms of fertilizers applied) based on a large amount of information about complex processes occurring in soils and plants. The issues of increasing the efficiency of crop production based on the use of precision farming technologies are closely related to the need to overcome constraints such as low-quality field work, non-compliance with agricultural techniques, limited use of plant protection products, low efficiency of fertilizers, drawing up

technical charts for crops regardless of the potential of fields, the use of outdated technologies, insufficient productivity of new crops, absence of qualified personnel, high costs due to poor consideration of natural and climatic conditions» [13].

According to Oleinik A.N. et al. «the main ways to increase the efficiency of crop production are as follows: 1) the use of intensive crop cultivation technology; 2) the use of advanced technology, anti-erosion measures; 3) modernisation of the material and technical base by improving tractors, combines, etc.; 4) compliance with consumption standards for raw materials; 5) improvement of the on-farm mechanism of financial incentives. Therefore, currently agriculture continues to be one of the most important sectors of both the national and global economies and is included in the list of main issues considered at the state level. High-quality, timely and comprehensive implementation of measures aimed at improving crop production can make it more efficient, and, subsequently, increase the profits from the sale of the products. This will have a positive impact both on the functioning of the organisation as a whole and on the country's economy» [24].

According to Alekseeva S.N., Volkov G.A., «to introduce a new crop into crop rotation, it is necessary to lay down production experience using this crop, including various schemes of chemical plant protection, the optimal composition of agricultural aggregates necessary for growing this crop. The profitability of growing a crop after harvesting determines the economically profitability for the organisation. Currently, the priority areas of strategic and innovative development can increase the volume and quality of products in a relatively short time, reduce production costs, and ensure a quick return on investment in the development and assimilation of innovations» [6].

According to Aimurzina B.T., Kamenova M.Zh., Bektenova D.Ch., «an increase in the inflow of investment into agriculture is one of the financial factors of agricultural development. In this regard, the authors forecast the growth of agricultural production by 2027» [1].

As it was noted by Ibrishev N.N., Kalguova R.Zh., Ayypova T.A., «to implement precision farming technology, it is necessary to consider the costs of navigation system equipment, software, and personnel» [12].

Nurzhanova G.I., Kasenova A.Zh., Suleymanov R.E. dwell on «the growth of livestock husbandry production. It is associated with the successful implementation of its lending programmes. In households, the output of gross livestock production shows significantly positive trends – by 39%; in crop production – by 18% in 2019 compared to 2015» [23].

According to Shaikanova N.K., Kaigorodtsev A.A., Apysheva A.A., «to improve the quality characteristics of farm animals and increase livestock productivity on this basis, increase the utilisation of production capacities of dairy processing enterprises, it is advisable to consolidate small farms, including family farms, combining them into agricultural cooperatives with a significant number of animals» [26].

As stated by K.G. Ibraimov, «the new conditions require volumes of domestic investments for the complete replacement of agricultural machinery during the planned period are compared with the planned ones. If the available funds, together with the bank loans, are insufficient to achieve this minimum, there is a reason to contact the authorities to provide assistance from the national fund» [11].

According to Narynbayeva A.S., Amirova M.A., Bespaly S.V., «the additional monetary income from 1 hectare could be provided through the use of a unique method of wheat cultivation» [21].

Tusayeva A.K., Uteev B.Zh., Nurgozhaev A.S. study «the process of digitisation of land plots. It is very well implemented in the Almaty region. It simplifies the paperwork for farmers when applying for industry subsidies in the future» [30].

According to Saiganov A.S., Chabatul V.V. «the costs of innovation in the food industry do not meet the real needs of the industry in ensuring sustainable innovative development and expanding the production of fundamentally new competitive products. Investing in innovative projects will be a priori more effective in regions or enterprises with high investment attractiveness» [25].

As stated by Aitkhozhayeva G.S., «calculating the integral indicator of agricultural land efficiency should include the volume of sales of agricultural products in monetary terms, since this indicator characterises the volume of cash flows received as a result of land use» [2].

According to Aitkhozhayeva G.S., Anarbayev E.A., Nilipovsky V.I., «the agro-industrial complex is

the main industry of the Turkestan region, providing the population with essential food products, having significant export potential. Therefore, the rational use of agricultural land is of strategic importance for the region» [3].

However, conforming to Kashakova G.A., Rustembayev B.E., Aimurzinov M.S. «the processing of meat and milk is very important. Therefore, it is necessary to finance equipment leasing on a budgetary basis» [15].

As stated by Akhmetova V.Ya. and Galikeeva R.N. «the digitalisation of the agricultural sector eliminates its disadvantages associated with a long production and technological cycle, natural and climatic risks, large crop losses during cultivation, harvesting, and storage. It allows ones to quickly monitor acreage, update field maps to set up navigation systems, and reduce theft of property, fuel, plant protection products, and seed materials» [4].

In consonance with Kurnosova V.S. and Azatyan H.S., «increasing the economic efficiency of livestock husbandry production in agricultural sector of the Krasnodar Krai allows ones to modernise the technical base and increase production efficiency. However, it also provides the population of the region and the country with high-quality agricultural products» [19].

As stated by Kuraeva A.N. et al., «addressing of these problems requires consolidating the efforts of district and regional governments to promote and support the cooperative movement, find incentives for medium-sized businesses, cooperation with the small suppliers of agricultural raw materials, and training specialists» [18].

According to Buyarova A.V. and Buyarova V.S., «there are many unresolved problems in the poultry industry significantly hinder the competitiveness of products. They are as follows: high cost of resources used (feed, energy resources, feed additives, breeding products), including related to the devaluation of the national currency. It followed by an increase in the cost of eggs and poultry meat, a decrease in company profitability, a shortage of breeding products, a weak material and technical base of organisations engaged in breeding work and, as a result, its low level. As a result, the technological processes of poultry farming are disrupted and it is impossible to conduct extended reproduction. It also causes the high dependence on imports of hatching eggs, day-old chickens, technological equipment, veterinary drugs, and disinfectants. Therefore, food security is being threatened, and the cost of poultry products is increasing» [9].

Nechaeva M.L., Antonova D.A., Shkileva N.P., consider the following «measures to increase production capacity are as follows: 1. The introduction of the highest quality feed into the diet to increase productivity; 2. Search for new sales channels; 3. Improving the quality of animal husbandry conditions. Moreover, to improve the resource potential factor, we propose the following measures: 1. The use of resource-saving technologies; 2. Participation in government programmes for additional financing; 3. The introduction of technologies ensuring the environmentally safe production of livestock products» [22].

As stated by Tsyguleva M.I., Karagodina D.A., Fedorova O.A., «the successful addressing the problems of cattle breeding development is ensured by the rationalisation of production management, strengthening the effectiveness of its economic methods, and preventing the use of material, labour, and financial resources in agricultural organisations» [28].

By Chernov V.A., «regions with free soil areas suitable for pastures, haymaking and growing animal feed should be allocated for the cultivation of large-horned dairy cattle. Therefore, deforestation for livestock farms will not be required. Zones with preferential taxation and tax incentives can be established in these regions» [10].

In consonance with Shulenbayeva F.A., Okutaeva S.T., Madenova K.M., «many factors affect the volume of meat production: livestock husbandry and its productivity – offspring yield, average live weight of livestock; feed quality, feeding ration, care and maintenance of livestock; genetic potential, etc. Using econometric methods, we investigated the influence of some factors on the formation of others. The following are considered as the main ones: the number of cattle, the availability of feed in farms, the yield of offspring, the average live weight of livestock sold» [27].

According to Kazhieva Zh.Kh. and Agumbayeva A.E., the one of the issues of regional livestock husbandry development is low labour productivity, as a result of small-scale production. To improve the

labour productivity, it is necessary to increase the level of capitalisation (mechanisation) in agriculture. It is impossible without investment capital and working capital. Therefore, retained earnings or borrowed funds provided by the financial sector can be used as a source of financing. These measures stimulate the growth of the financial sector and the accumulation of wealth within the country» [16].

Belgibayeva A.S., Mukhanova A.E. and Smagulova Zh.B., dwell on «the introduction of innovations in dairy farming. It is hampered by limited financial resources of agricultural producers for systematic development of innovations, as well as low motivation of external investors caused by low profitability of investments in dairy farming cattle breeding» [8].

In consonance with Kydyrbaeva E.O., Baydybekova S.K., Tolamisova A.G., «raising cattle is the main goal of animal husbandry. It provides the agro-food market with necessary and affordable food products: milk and meat. To increase the production of livestock husbandry products, agricultural enterprises strive to form the conditions conducive to the growth of the number of cattle» [20].

According to Kamysbaev M.K., Moldashev A.B., Berdykulova G.M., «the destabilisation of the global economy, rational diversification of production, improvement of inter-economic relations, and effective government support are the basis for a sustainable strategy for the economic development of agricultural producers, ensuring an increase in profits and profitability» [14].

As stated by Kazhieva Zh.Kh., «to develop farms, preferential financing is also provided with a loan term of up to 15 years and a remuneration rate of up to 4%. The successful implementation of this programme will increase the efficiency of regional livestock husbandry production and addressed the problems hindering the development of the industry» [16].

According to Amirbayev S., «direct subsidies allocated to reduce the cost of livestock husbandry products (including beef) are not enough to equalise the competitive advantages of domestic products compared with imported analogues. It determines the preservation of a high share of its imports» [7].

As stated by Turisbekova G. and Aitmukhanbetova D. «to achieve a balanced development of meat production and processing of meat products in the future, it is necessary to form a cluster. Cluster integration in the meat processing industry will increase the demand for meat and ensure the utilisation of production capacities of meat processing enterprises» [29].

According to Akimbekova G.U., Baymukhanov A.B., Kaskabaev U.R., «the economic effect of using the dairy herd management system is formed by changing the qualitative and quantitative indicators of the dairy farm through additional production due to preclinical diagnosis of diseases; reducing the cost of veterinary drugs; saving the cost of keeping cow calves; reducing the duration of the service period; saving seed consumption for artificial insemination, etc.» [5].

A literature review shows Kazakhstan's significant agricultural potential, including fertile lands and a variety of climatic zones. However, both industries have systemic problems such as outdated technologies, absence of investment, and changing climatic conditions. The research also highlights the importance of government intervention to modernise infrastructure, support farmers, and introduce modern agricultural technologies.

The purpose of the research is to conduct an in-depth analysis of crop and livestock husbandry production, identify key problems and factors determining their development, propose strategies aimed at increasing the sustainability and modernisation of the industry.

Therefore, we studied the following issues:

– The dynamics and structure of crop and livestock husbandry production, the analysis of statistical data for the period 2010-2024.

– Identification of agricultural producers' key problems.

– Assessment of the impact of economic, social, and environmental factors on the development of both industries.

– Development of practical recommendations for improving the efficiency of crop and livestock husbandry management.

The results of the analysis could develop effective strategies and programmes to increase the

competitiveness and sustainability of crop and livestock husbandry production. It will contribute to strengthening the agricultural sector, the development of the economy, ensuring food security and stable rural development.

Methods

The following methods were used in the study:

– Statistical analysis. We used statistical data to study the dynamics of crop and livestock husbandry production. We analyse the time series of key indicators were, including the gross output of industries, their share in GDP, productivity per unit area of agricultural land and per capita. We used the official data of the Committee on Statistics of the Republic of Kazakhstan and the Ministry of Agriculture for the period from 2010 to 2023.

– Graphical visualisation. We used it for visual presentation of the research results (graphical visualisation methods, the construction of time series, diagrams, and cartographic data display). It allows us to identify regional differences and trends in the development of industries.

– Factor analysis. We used it to identify key factors affecting crop and livestock husbandry productivity. We considered the quality and availability of resources, the level of mechanisation, climatic conditions, investments, personnel policy, and technology. This method made it possible to quantify the contribution of each factor to the overall result.

– SWOT analysis. We use SWOT analysis to identify strengths and weaknesses, opportunities and threats in each of the industries. We identify low labour productivity, insufficient technological equipment, personnel shortages, market price instability, and changing climatic conditions.

– Comparative analysis. A comparative analysis of crop and livestock husbandry production indicators in various regions of Kazakhstan has revealed imbalances in the development of industries and assessed the effectiveness of their functioning in various climatic and economic conditions.

– The modelling method. We used regression and trend analysis models to forecast the dynamics of industry development. It allows us to assess the impact of various factors on the development of crop and livestock husbandry production, and propose optimal management strategies.

Results

The analysis of the dynamics of gross crop and livestock husbandry production in the Republic of Kazakhstan in 2010-2023 shows significant fluctuations requiring the detailed analysis to identify the causes of their occurrence and develop effective response measures. During the period under study, there was a general increase in gross output in both crop and livestock husbandry production. However, in 2023 there was a significant decline.

According to Figure 1, gross crop production in Kazakhstan shows steady growth in 2010-2022. However, there is a decline in 2023. It correlates with the issue of current management model sustainability. The reasons for this decline may be related to both climatic conditions and insufficient diversification of production. It causes the vulnerability of the industry to external and internal challenges. Indeed, in 2023, the maximum indicators of gross crop production were recorded in Turkestan, North Kazakhstan, Kostanay, and Akmola regions (Figure 2). It confirms the existence of regional differences in production efficiency. The lowest results are in Mangystau, Ulytau, Atyrau, and West Kazakhstan regions (Figure 3). It highlights the urgency of the regional approach in planning and supporting agricultural production.

The analysis of gross output per capita (Figure 4) and per 100 hectares (Figure 5) confirms the general growth trend until 2022. However, the decline in 2023 raises concerns about the long-term sustainability of production. It also indicates the urgency of production and investment strategies; the use of new technologies could ensure long-term segment profitability.

The cost of crop production per 100 hectares (Figure 6) recorded a moderate increase until 2022. However, there was a decline in 2023. This may indicate inefficient use of resources or negative economic factors, such as rising prices for agricultural materials and energy resources. The cost reduction in 2023 is also due to a reduction in production volumes and a review of production capacities.

At the same time, the physical volume index (Figure 7) and the cost of agricultural products sold (Figure 8) confirm Kazakhstan's crop and livestock husbandry production are fluctuating. These fluctuations can be caused by both external economic factors (for example, price fluctuations in global agricultural markets) and internal problems, including imperfect infrastructure and production technology.

A similar situation is observed in livestock husbandry (Figure 11). Gross livestock husbandry production also tended to increase in 2010-2022. However, there was a decline in 2023. It could be caused by livestock deaths, decreased productivity, etc. The decrease in meat and wool production, livestock husbandry deaths (Table 1 and Figure 12) require an in-depth analysis of the current livestock husbandry farming conditions and the development of more effective management methods.

The decrease in the cost of meat sold (Figure 15) and the increase in livestock husbandry mortality in 2023 are also indicate on the instability of the industry. According to Table 2, livestock husbandry deaths in 2024 increased compared to the previous year. It provided reducing of livestock husbandry productivity.

Nevertheless, in 2024 there was an improvement in the number of livestock husbandry and poultry (Figure 17). It may indicate attempts to stabilise the situation in the livestock husbandry sector. Moreover, the productivity of dairy cattle and poultry, despite general fluctuations, continues to increase (Figure 18). It indicates the successful application of some management and technological practices.

Therefore, the challenges in crop and livestock husbandry production in Kazakhstan in 2023 require an integrated approach. Our scientific research aimed at eliminating these negative trends. To ensure sustainable growth and increase the competitiveness of agricultural sectors, it is necessary to make changes to the existing management system, introduce innovative technologies and develop new strategies to stimulate the production process in a changing external and internal economic environment.
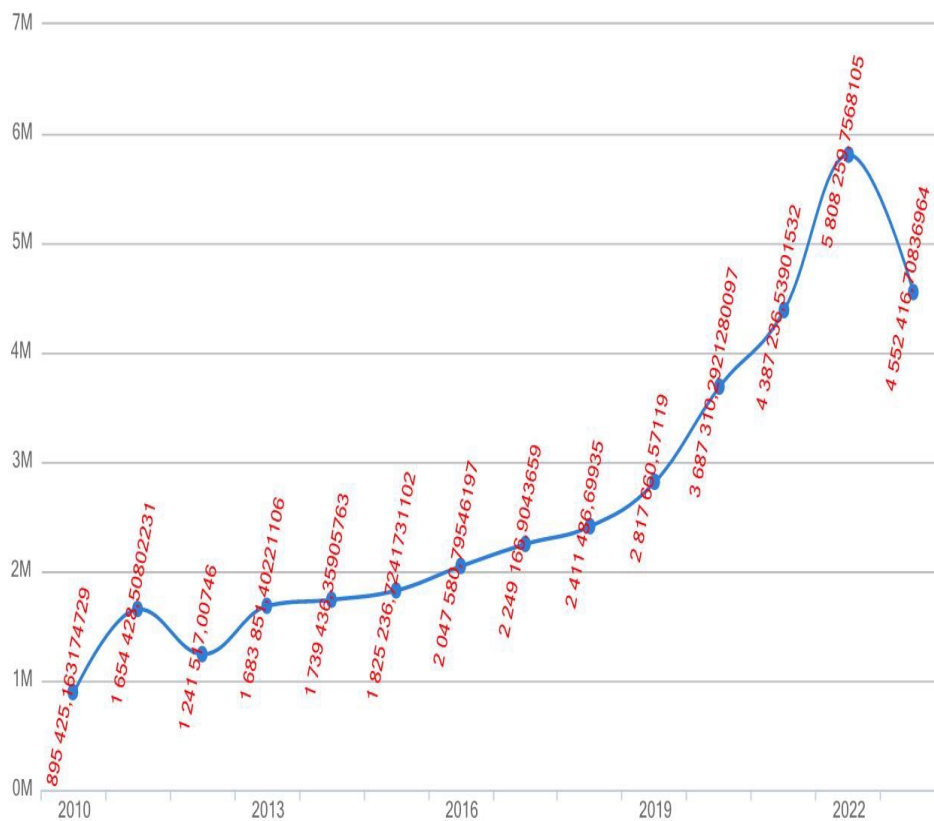

Figure 1. Gross crop production of the Republic of Kazakhstan, 2010-2023
Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan[1]

According to Figure 1, the gross crop production of the Republic of Kazakhstan has increased significantly

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[1] *Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Source: https://stat. gov.kz/ru / (accessed on 10.01.2025)*

in 2010 2022. However, there was a significant decrease in 2023. The analysis of the gross crop production of the Republic of Kazakhstan in 2010-2023 shows significant growth. However, there was a significant decrease in 2023.

According to Figure, in 2023, maximum indicators of gross crop production in the Republic of Kazakhstan were recorded in Turkestan, North Kazakhstan, Kostanay, and Akmola regions.
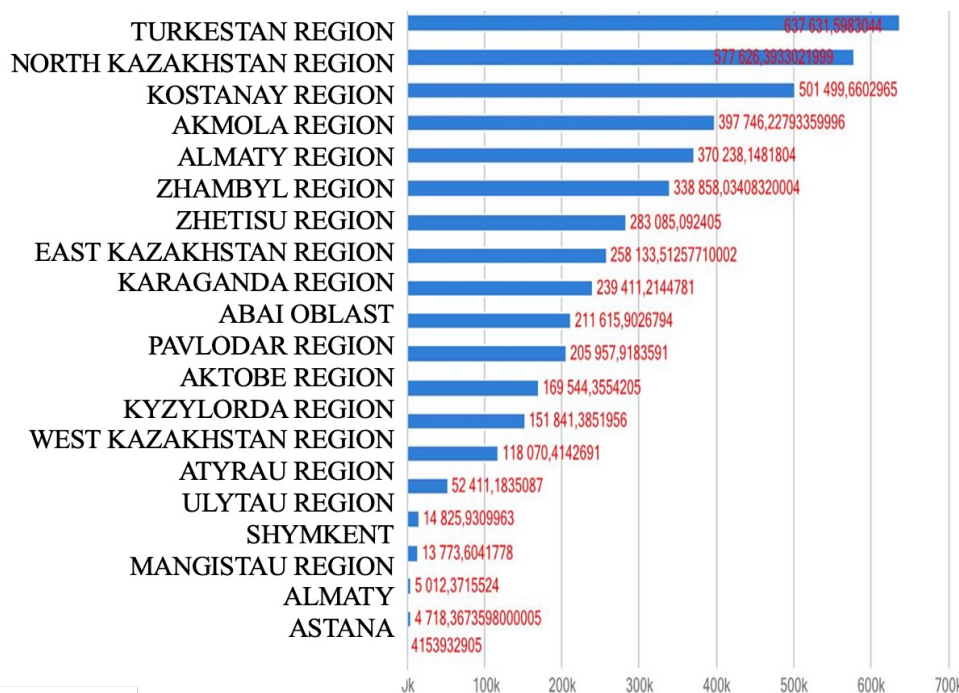

Figure 2. Gross crop production of the Republic of Kazakhstan in Almaty, Shymkent, and Astana, 2023
Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan[2]

According to Figure 3, in 2023, the minimum indicators of gross crop production in the Republic of Kazakhstan were recorded in Mangystau, Ulytau, Atarau, and West Kazakhstan regions.
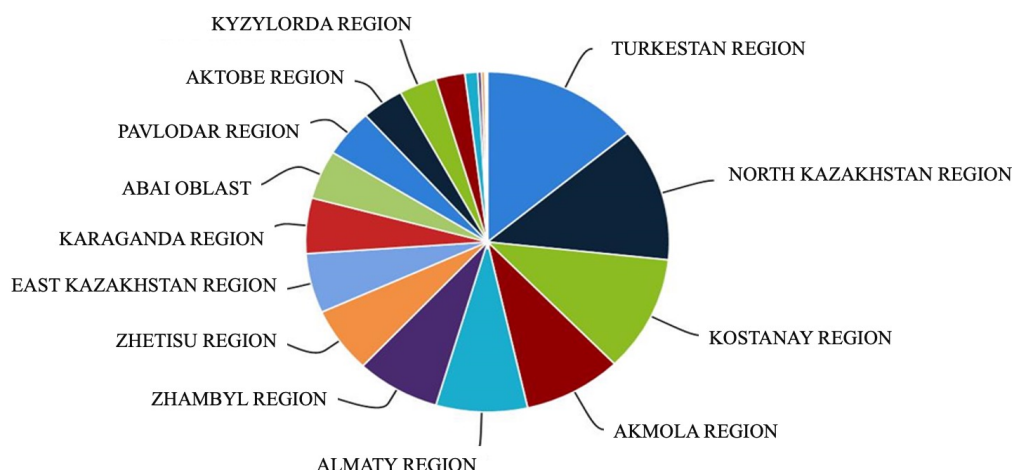
Figure 3. Gross crop production of the Republic of Kazakhstan in Almaty, Shymkent, and Astana, 2023
Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan[3]

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[2] Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Source: https://stat. gov.kz/ru / (accessed on 10.01.2025)

[3] Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Source: https://stat. gov.kz/ru / (accessed on 10.01.2025)
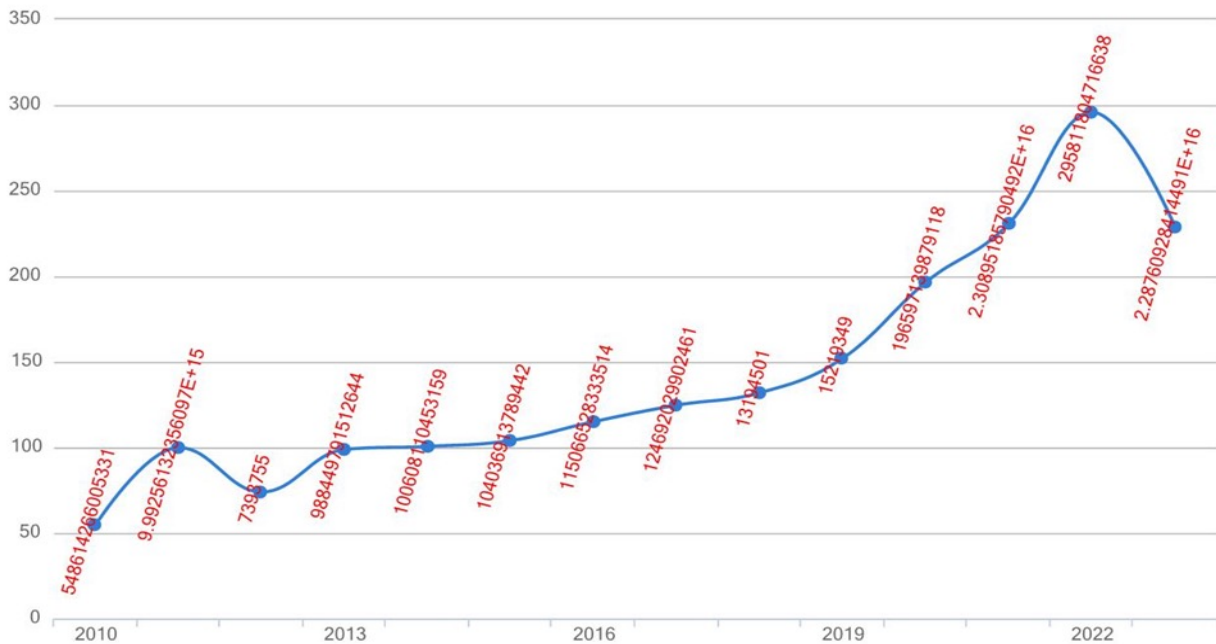
Figure 4. Gross crop production per capita in the Republic of Kazakhstan, 2010-2023
Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan[4]

According to Figure 4, the gross crop production per capita in the Republic of Kazakhstan increased in 2010-2022. However, there was a significant decrease in 2023.
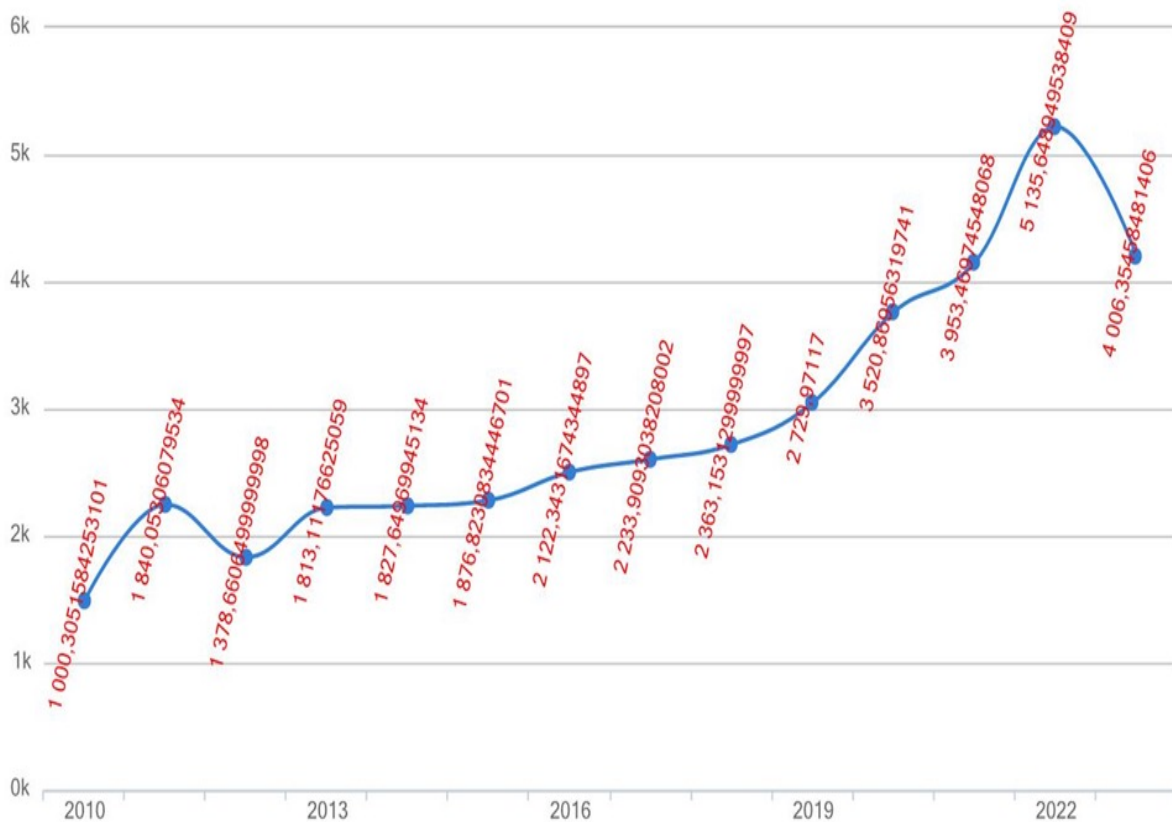

Figure 5. Gross crop production per 100 hectares in the Republic of Kazakhstan, 2010-2023
Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan[5]

According to Figure 5, the gross crop production per 100 hectares in the Republic of Kazakhstan increased in 2010-2022. However, there was a significant decrease in 2024.

Figure 6 shows a slightly increase in the cost of crop production per 100 hectares in the Republic of Kazakhstan in 2001-2021. However, there was a significant increase in 2022 compared to previous periods. In 2023, there was a decline compared to the previous year.
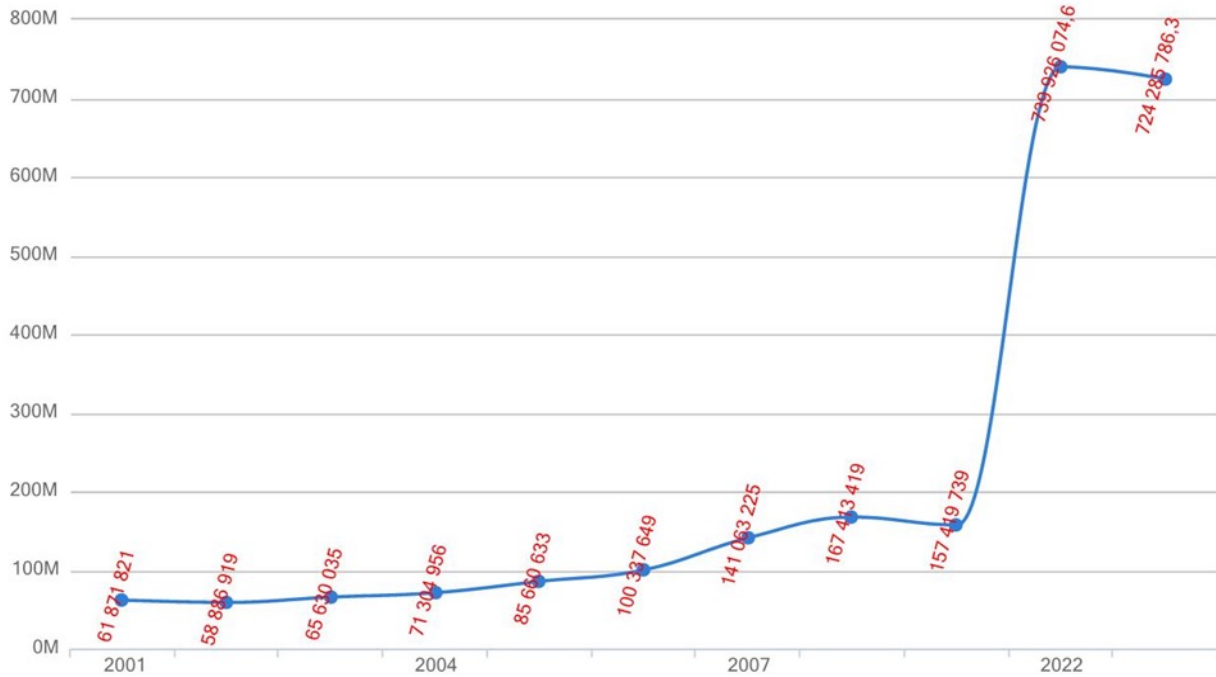

Figure 6. Costs of crop production per 100 hectares in the Republic of Kazakhstan, 2001-2023
Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan[6]
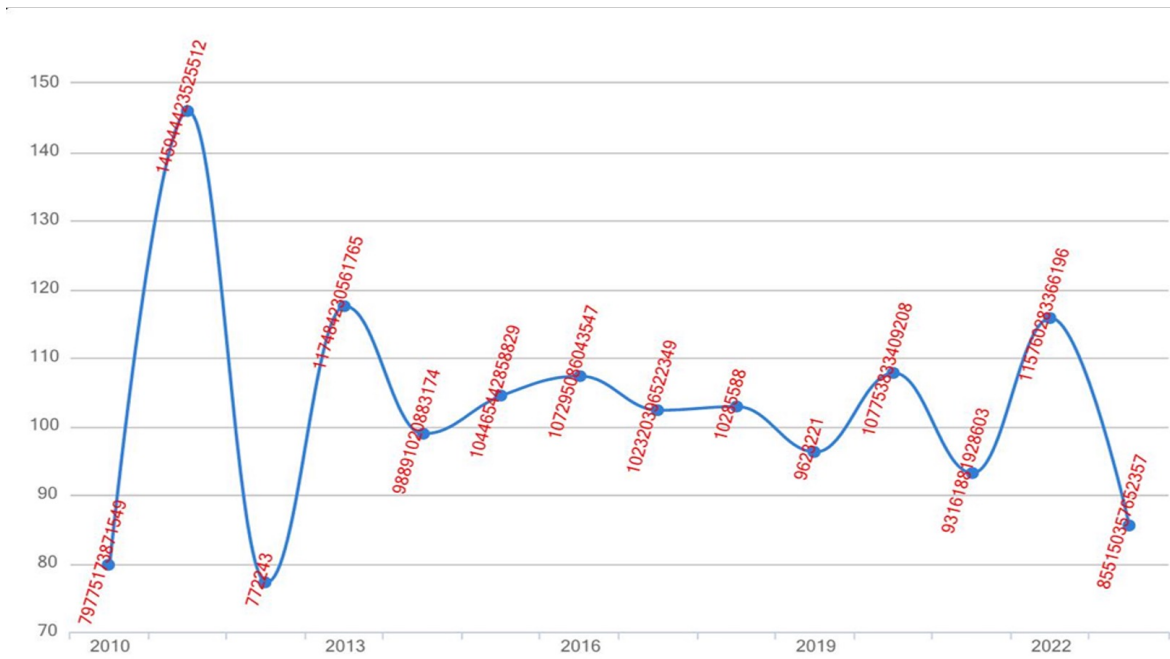

Figure 7. Index of physical volume of crop production in the Republic of Kazakhstan, 2010-2023
Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan[7]

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[6] *Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Source: https://stat. gov.kz/ru / (accessed on 10.01.2025)*

[7] *Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Source: https://stat. gov.kz/ru / (accessed on 10.01.2025)*

Figure 7 shows the oscillatory trend for the index of crop production physical volume in the Republic of Kazakhstan as it increases and decreases periodically. However, it increased slightly in 2023 compared to 2010.
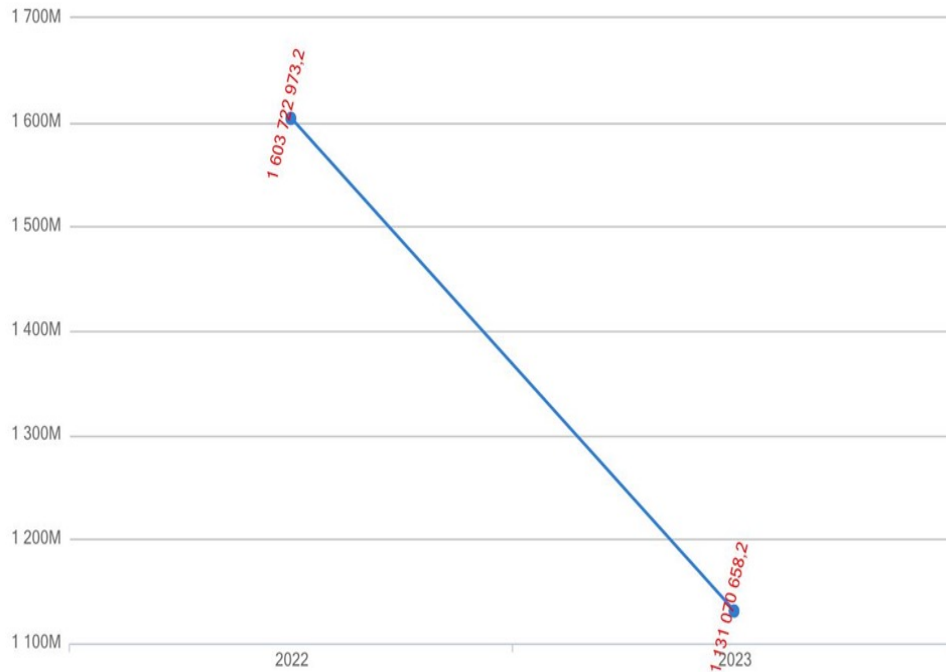

Figure 8. The cost of agricultural products sold in the Republic of Kazakhstan, 2022-2023
Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan[8]

Figure 8 shows a decrease in the cost of agricultural products sold in the Republic of Kazakhstan in 2023 compared to 2022.

Figure 9 shows the largest volume of crop production services in Zhambyl, Almaty, Kostanay, Atyrau and West Kazakhstan regions.
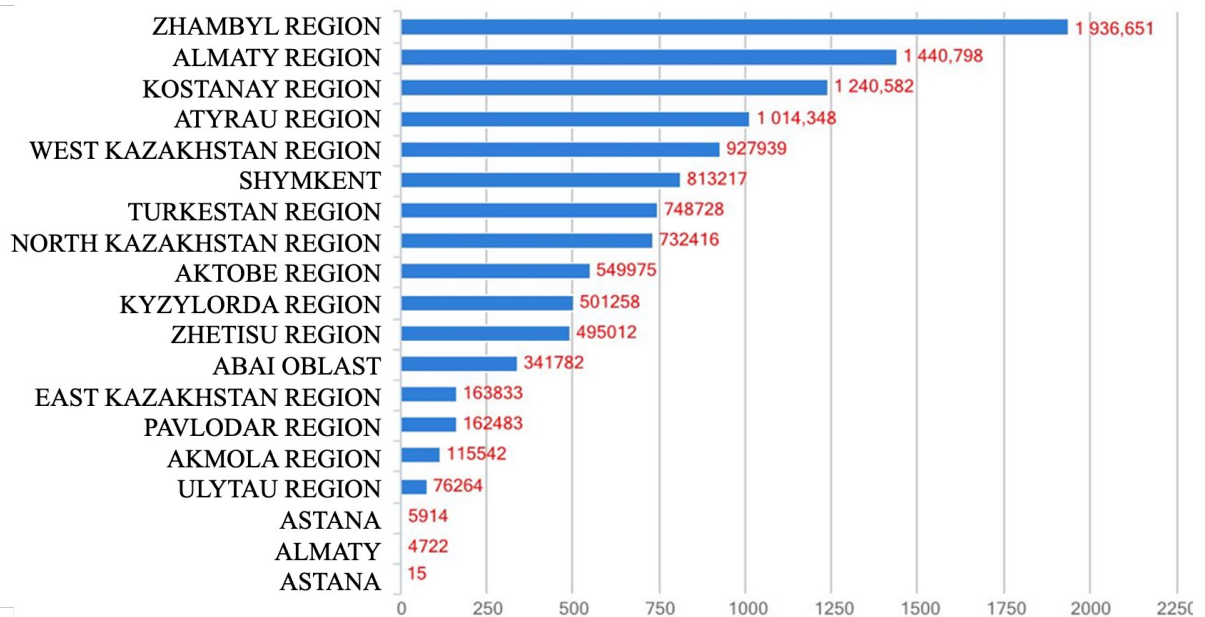

Figure 9. Services in crop production in Almaty, Shymkent, and Astana, the Republic of Kazakhstan, 2023
Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan[9]
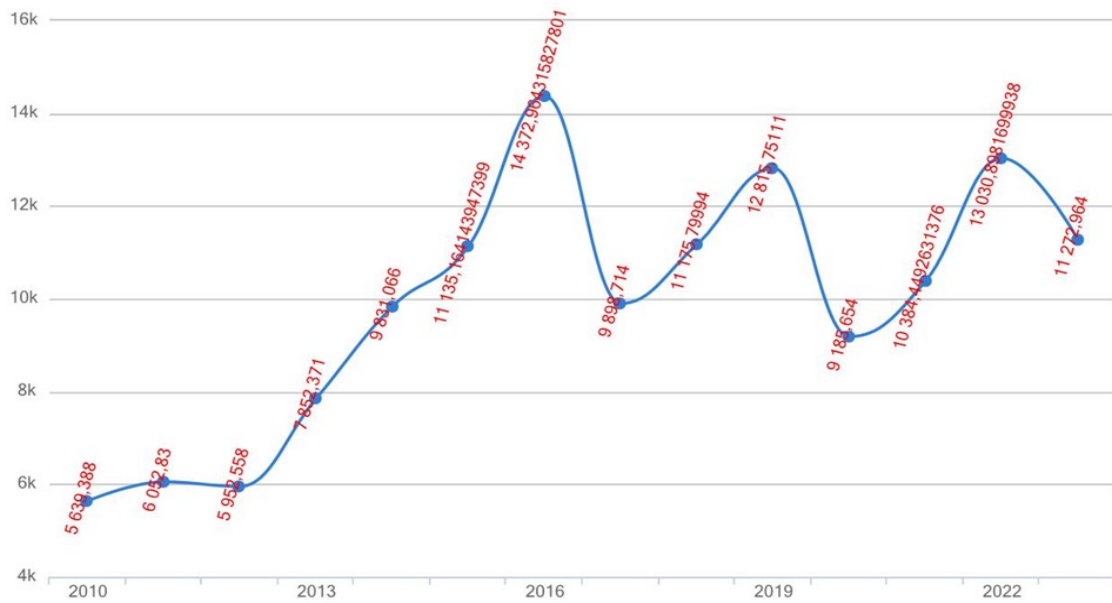
Figure 10. Services in crop production in Kazakhstan, 2010-2023
Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan[10]

Figure 10 the oscillatory trend for the index of crop production volume of services in the Republic of Kazakhstan as it increases and decreases periodically. However, it increased slightly in 2023 compared to 2010.

Figure 11. Gross livestock husbandry production of the Republic of Kazakhstan, 2010-2023
Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan[11]

Figure 11 shows an increase of the gross livestock husbandry production of the Republic of Kazakhstan in 2010-2022. However, it decreased in 2023.

Figure 12 an increase in the gross livestock husbandry production per capita in the Republic of Kazakhstan in 2010-2022. However, it decreased in 2023.

Figure 11 shows an increase of the gross livestock husbandry production per capita of rural resident of the Republic of Kazakhstan in 2010-2022. However, it decreased in 2023.

Figure 12 shows an increase in the gross livestock husbandry production per 100 hectares in the Republic of Kazakhstan in 2010-2022. However, it decreased in 2023.

Figure 15 shows a decrease in the cost of 1 hundredweight of meat sold (in live weight) in the Republic of Kazakhstan. However, it increased in 2023 compared to 2022.
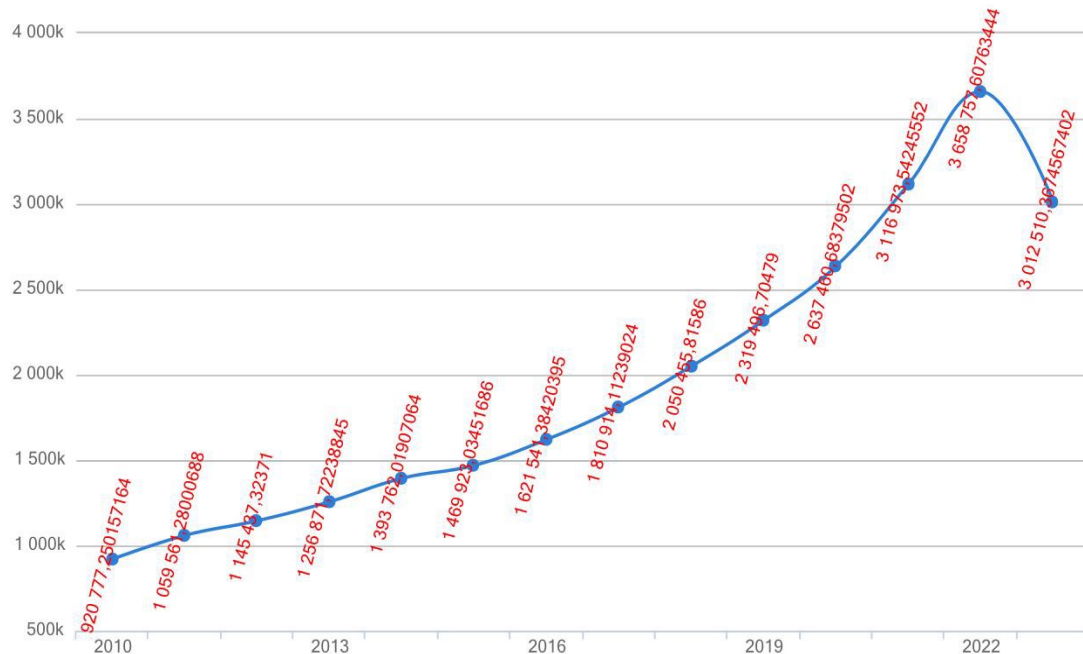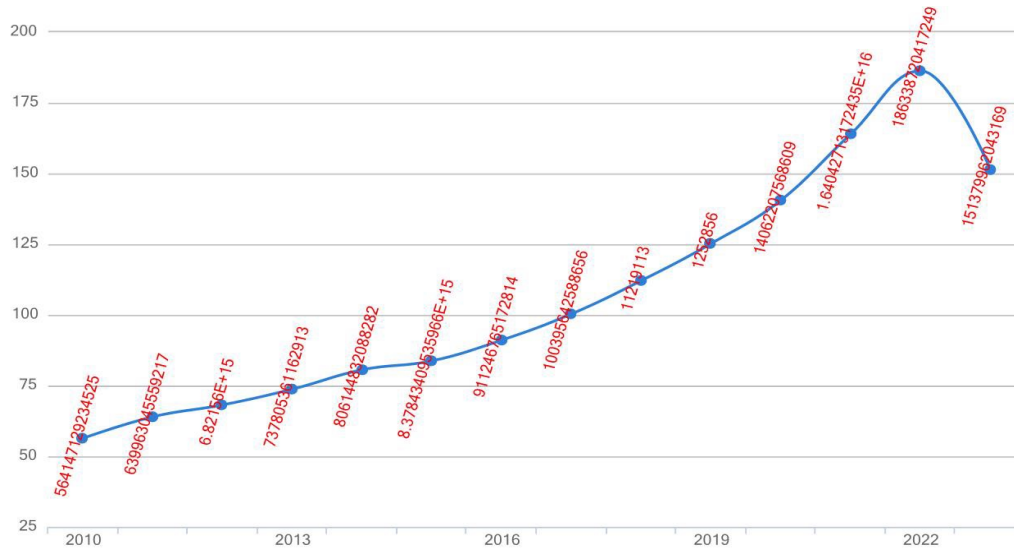

Figure 12. The gross livestock husbandry production per capita in the Republic of Kazakhstan, 2010-2023
Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan[12]
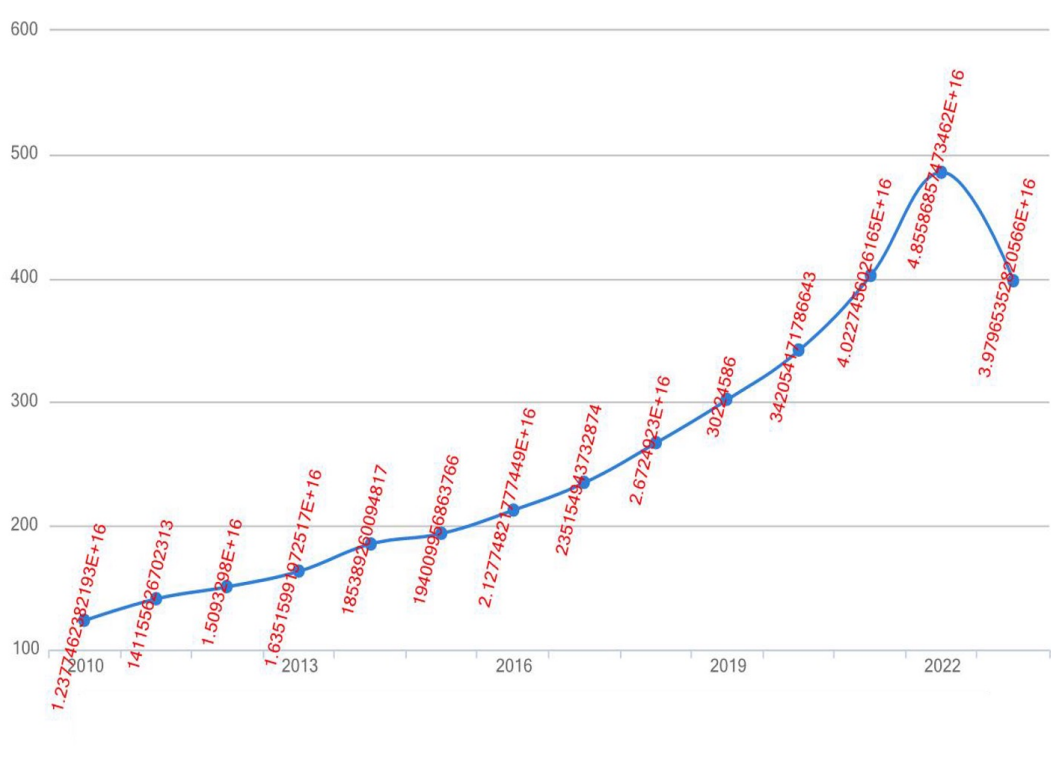
Figure 13. The gross livestock husbandry production per capita in the Republic of Kazakhstan, 2010-2023
Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan[13]

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[12] *Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Source: https://stat. gov.kz/ru / (accessed on 10.01.2025)*

[13] *Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Source: https://stat. gov.kz/ru / (accessed on 10.01.2025)*

Figure 14. The gross livestock husbandry output per 100 hectares of agricultural land
Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan[14]
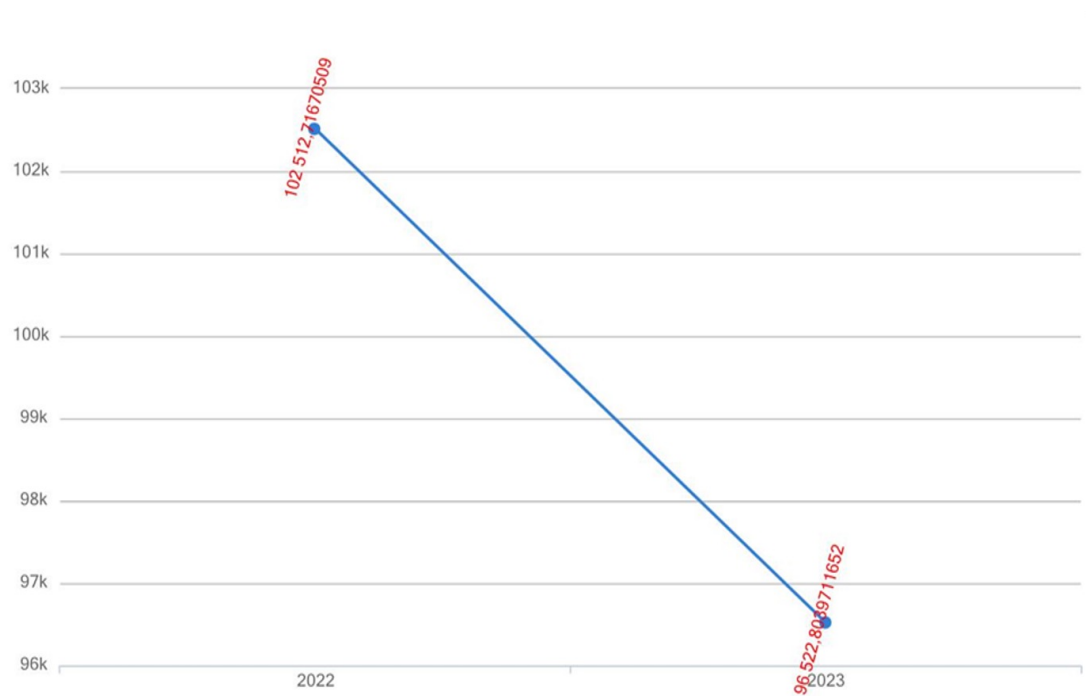
Figure 15. The cost of 1 hundredweight of meat sold (in live weight) Kazakhstan, 2022-2023
Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan[15]

**Table 1** – Production of certain types of livestock products in the Republic of Kazakhstan, 1990-2023

Years	Meat (live weight), thousand tons	Meat (dead-weight), thousand tons	Milk, thousand tons	Eggs, million pieces	Wool, thousand tons	Karakul, thousand pieces
1990	2,633.7	1,559.6	5,641.6	4,185.1	107.9	1,821.4

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[14] *Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Source: https://stat. gov.kz/ru / (accessed on 10.01.2025)*

[15] *Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Source: https://stat. gov.kz/ru / (accessed on 10.01.2025)*
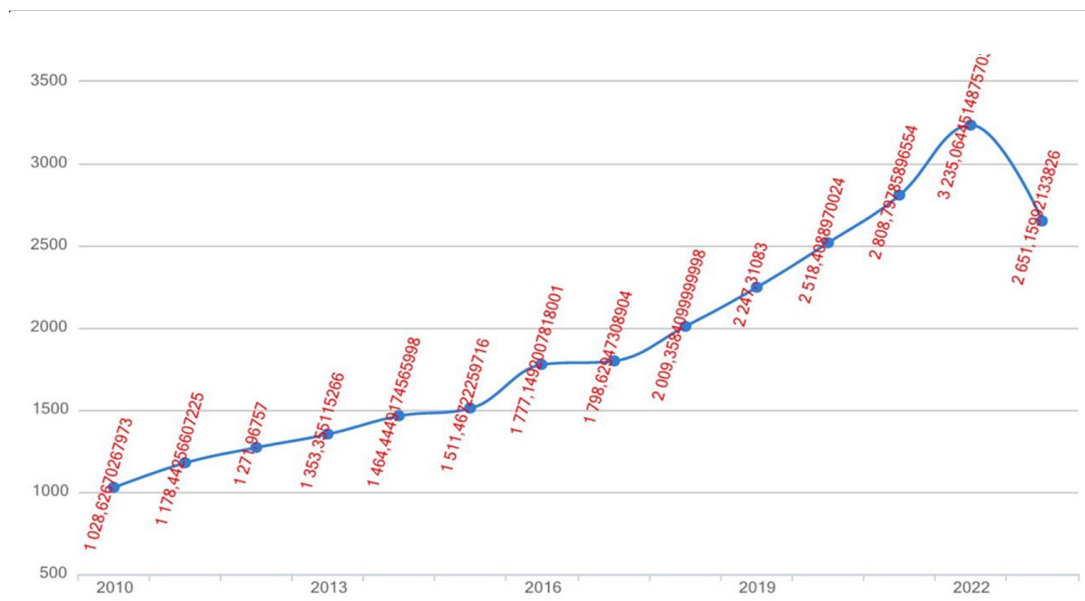
Years	Meat (live weight), thousand tons	Meat (dead-weight), thousand tons	Milk, thousand tons	Eggs, million pieces	Wool, thousand tons	Karakul, thousand pieces
1995	1,773.8	984.8	4,619.1	1,840.8	58.3	1,145.2
2000	1,054.1	569.4	3,730.2	1,692.2	22.9	129.9
2005	1,252.0	675.9	4,749.2	2,514.0	30.4	191.9
2010	1,501.2	834.4	5,381.2	3,720.3	37.6	49.4
2015	1,651.1	931.0	5,182.4	4,737.0	38.0	7.1
2020	2,058.5	1,168.6	6,051.4	5,065.8	40.2	1.3
2021	2,162.2	1,231.1	6,247.2	4,838.1	41.2	2.1
2022	1,799.1	1,044.7	3,354.6	4,526.7	35.6	0.5
2023	1,920.3	1,120.0	3,472.9	4,420.6	36.6	0.3

Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan[16]

**Table 2** – Livestock deaths in the Republic of Kazakhstan, 2023-24

	Cattle			Sheep		
	in total			in total		
	2024	2023	2024 as a percentage by 2023	2024	2023	2024 as a percentage by 2023
	20,118	13,038	154.3	31,975	25,083	127.5
	Goats			**Pigs**		
	in total			in total		
Republic of Kazakhstan	2024	2023	2024 as a percentage by 2023	2024	2023	2024 as a percentage by 2023
	2,124	1,188	328.5	26,577	20,619	128.9
	Horses			**Camels**		
	in total			in total		
	2024	2023	2024 as a percentage by 2023	2024	2023	2024 as a percentage by 2023
	8,099	3,019	268.3	371	433	85.7

Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan [17]

According to Table 1, the production of the following livestock products decreased in 2023 compared to 1990: meat (in live weight), meat (in slaughter weight), wool, caracul, etc.

According to Table 2, in 2024, compared with 2023, the number of livestock increased: cattle, sheep, goats, pigs, horses.

According to Figure 16, the gross livestock production by regions and large cities of the Republic of Kazakhstan in 2023 has maximum values in the following regions: Almaty, Turkestan, Akmola, Abai, East Kazakhstan.

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[16] *Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Source: https://stat. gov.kz/ru / (accessed on 10.01.2025)*

[17] *Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Source: https://stat. gov.kz/ru / (accessed on 10.01.2025)*
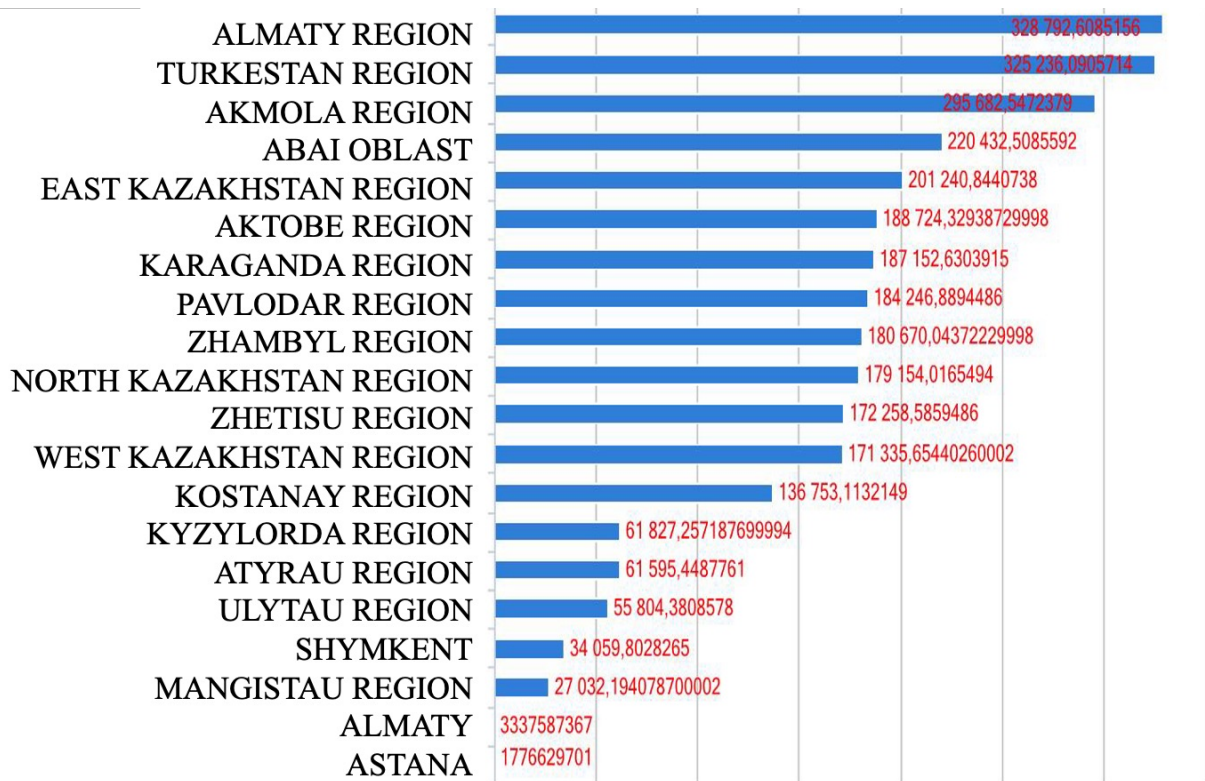
Figure 16. Gross livestock production by regions and major cities of the Republic of Kazakhstan in 2023
Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan[18]

According to Figure 17, the number of livestock and poultry in the Republic of Kazakhstan as of July 1, 2024 is higher than in 2023 for the following types of livestock: poultry, horses, sheep and goats, cattle.
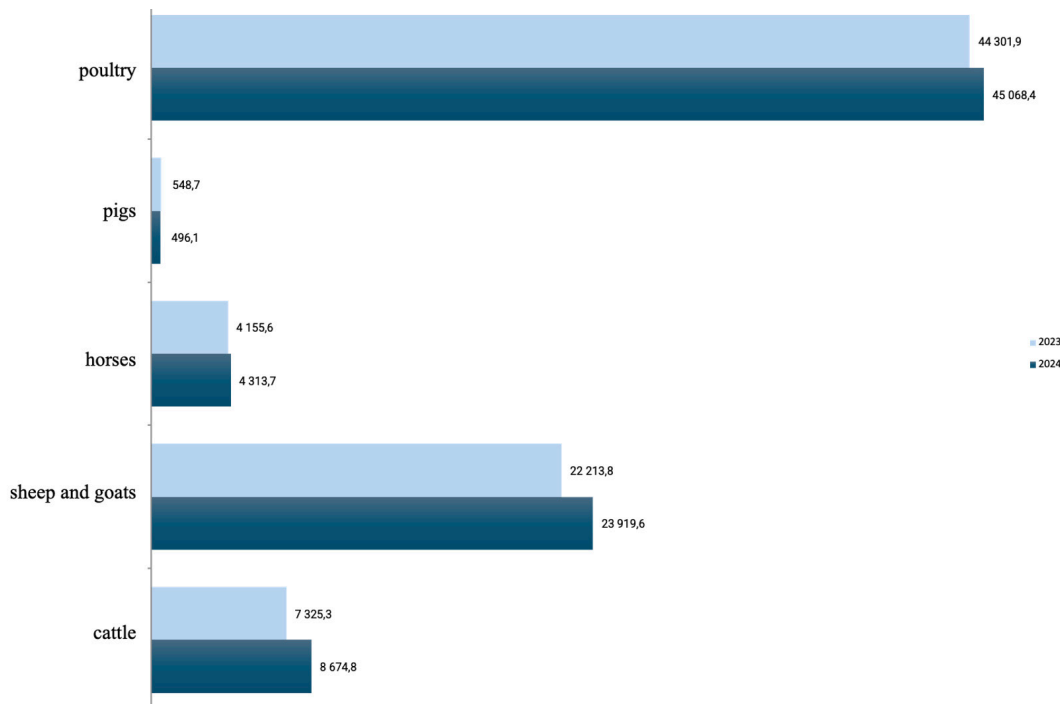
Figure 17. The number of livestock and poultry in the Republic of Kazakhstan as of July 1, 2024
Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan[19]

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[18] *Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Source: https://stat. gov.kz/ru / (accessed on 10.01.2025)*
[19] *Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Source: https://stat. gov.kz/ru / (accessed on 10.01.2025)*

Figure 18. Productivity of livestock indicators in the Republic of Kazakhstan in January-July 2024
Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan[20]

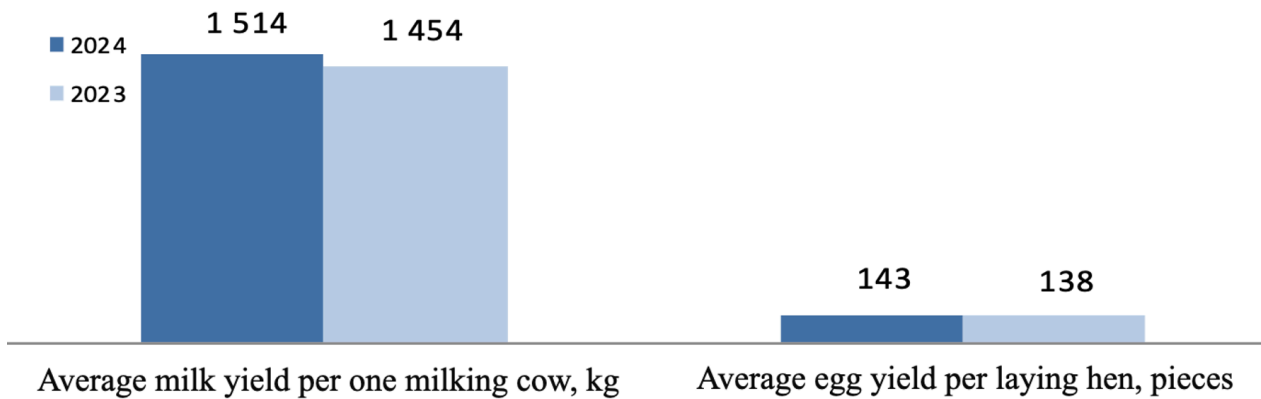According to Figure 18, the productivity of livestock indicators in the Republic of Kazakhstan (average milk yield per dairy cow, average egg yield per laying hen) on July 1, 2024 is higher than on the same date of the previous year.

Discussion

Kazakhstan's economy, as a key element of Central Asia, includes critical sectors such as crop production and animal husbandry as a basis of the country's agriculture. These industries not only influence domestic economic development, but are also of strategic importance for food security, social stability, and exports. Despite the positive dynamics of production growth in recent years, 2023 revealed certain negative trends, such as a decrease in gross output in both industries. This article provides a comprehensive analysis of the economy and management of crop and livestock production in Kazakhstan, emphasises the external and internal factors influencing their development, a strategy for sustainable growth of these industries using SWOT analysis.

Issues of crop production and animal husbandry. However, Kazakhstan's crop production and animal husbandry are challenged. In crop production, despite the steady growth of gross output in 2010-2022, 2023 was the year of decline in terms of these indicators. The main challenges include climate change, insufficient water availability, and fluctuating product prices. It affects the sustainability of the sector. Similar trends are in animal husbandry. It is confirmed by a decrease in gross output and an increase in livestock mortality in 2023. The challenges are related to the low level of veterinary services, insufficient food supply, and the deterioration of pastures.

External factors affecting crop production and animal husbandry. External factors such as climate change, global price fluctuations for agricultural products, and international sanctions have a significant impact on the development of crop and livestock husbandry production in Kazakhstan. Climate changes, including droughts and extreme weather conditions, worsen conditions for agriculture, in particular, for the cultivation of grain and fodder crops. Fluctuations in world prices for grain and meat provide instability in the domestic market. It can both contribute to growth and decrease in production volumes. The external economic situation and competition in foreign markets also affect the export potential of products.

Internal factors include the level of government regulation, investments in infrastructure, the use of modern technologies, and management in the agricultural sector. In recent years, there has been an increase in government subsidies and support. However, their effective distribution and access for small and medium-sized agricultural producers still remain relevant. The introduction of new technologies and productivity improvements remain priorities for both industries. However, the insufficient level of technological equipment, especially in remote regions, hinders the development of the sector. An important aspect is the improvement

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[20] *Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Source: https://stat. gov.kz/ru / (accessed on 10.01.2025)*

of the logistics infrastructure. It is crucial for ensuring the sustainable supply of agricultural products.

Table 3 – SWOT analysis of crop production and animal husbandry in the Republic of Kazakhstan

Strengths. Kazakhstan has significant natural resources, including vast agricultural lands and pastures. Crop production has good prospects for increasing the production of grain crops such as wheat and barley demanded worldwide. Animal husbandry also has high potential, especially in terms of sheep and cattle breeding.	Opportunities. Increasing government support, attracting investments in agricultural infrastructure, and introducing innovative technologies into crop production and animal husbandry. Development of environmentally friendly production methods and increasing demand for organic products on international markets.
Weaknesses. Insufficient modernisation of industries, problems with water resources and technical equipment slow down the development of agriculture. The absence of effective management systems and low-skilled labour in agriculture also provide barriers to increasing productivity.	Threats. Instability in world markets, climate change, livestock deaths and epidemics of animal diseases can significantly reduce productivity in animal husbandry.

Source: Authors

Development strategy of crop and livestock management. To achieve sustainable growth in crop and livestock production in Kazakhstan, it is necessary to focus on several strategic areas. Firstly, it is the introduction of innovative technologies and improvement of management efficiency. Secondly, infrastructure needs to be improved, especially water supply and irrigation. It will help reduce dependence on climate change. Third, the formation of mechanisms to improve product quality and competitiveness in international markets, including the introduction of certifications for organic products and improved logistics systems. Fourth, increased attention to issues of veterinary safety and improvement of the feed base for livestock.

To implement these strategies, it is necessary to cooperate comprehensively with private investors, scientific institutions, and international organisations. It will integrate best practices and technologies to improve agricultural efficiency in Kazakhstan.

Conclusion

Livestock and crop production in Kazakhstan represent key sectors of the agro-industrial complex, playing a significant role in ensuring food security, socio-economic development, and sustainable agricultural growth. These industries are characterised by a variety of natural and economic conditions. It determines their high regional differentiation. The situation in these industries is closely related to various factors, including climatic conditions, technological equipment, management efficiency, and infrastructure quality. In recent years, Kazakhstan has seen the dynamic development of both industries. However, against the background of positive trends, there are a number of problems requiring an integrated approach and innovative solutions. The purpose of this work is to analyse the current state of the crop and livestock economy in Kazakhstan, identify the main problems, and develop recommendations for their elimination and optimisation of processes in these sectors.

The analysis of the state of the economy and management in the agricultural sector of Kazakhstan, covering both crop production and animal husbandry. It also demonstrates the presence of both positive and negative trends requiring comprehensive measures to improve the situation. Between 2010 and 2022, both industries show the significant growth in gross output. However, a decline occurred in 2023, indicating the need for an in-depth analysis of the causes and effective decision-making.

In crop production, a decrease in gross output was recorded in 2023. It is due to a number of factors, including an uneven distribution of resources across regions, production costs, etc. Nevertheless, the maximum gross output figures were achieved in Turkestan, North Kazakhstan, Kostanay, and Akmola; the minimum values are observed in Mangystau and West Kazakhstan regions. The decrease in gross output per capita and per 100 hectares of agricultural land also reflects a general negative trend in crop production. At

the same time, despite these problems, there is an increase in the volume of services in crop production and positive changes in the cost structure.

The situation in animal husbandry also remains ambiguous: in 2023, there was a decrease in gross output. It also makes it difficult to implement long-term plans to ensure food security. Among the factors influencing the decline in production indicators, there is a high mortality rate of livestock and a decrease in productivity in some regions. There is an increase in the number of individual livestock species and in productivity in dairy and egg production. For instance, on July 1, 2024, the productivity of milk and eggs increased compared to the same period in 2023. It is a positive signal for industry development.

The main areas of improvement in both sectors are the enhancement of management mechanisms, introduction of innovative technologies, infrastructure development, and farm support. To increase the efficiency of crop and livestock production, it is necessary to improve cooperation between producers, optimize processes, and reduce costs. The key point is sustainable environmental regulation. It will ensure the long-term sustainability of Kazakhstan's agricultural sector.

Therefore, to ensure the sustainable development of crop and livestock production in Kazakhstan, a comprehensive reform programme is required. It is extremely important to increase productivity, optimise costs, and improve product quality. It will have a positive impact on the country's economy and provide its international competitiveness.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHORS' CONTRIBUTION

Zhanna R. Ashimova – conceptualization, project administration, writing – original draft.
Amina M. Uristembek – writing – review & editing.
Zhanay J. Abitov – investigation.
Diana Z. Abitova – formal analysis.

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New measures of demographic and family policy in Russia: national and regional aspects

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ORIGINAL ARTICLE

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Abstract. The article describes the depopulation in Russia and the projected demographic characteristics by 2046. Indeed, we distinct the concepts of «demographic policy» and «family policy». However, the theoretical and methodological basis for family demographic policy should be the concept of the institutional crisis of the family. The paper considers the main provisions of the Strategy of Action for the implementation of family and demographic policy, support for large families in the Russian Federation until 2036, the relationship of the Strategy with state programs and national projects, new measures of demographic and family policy in the Russian Federation in 2010-2020. The research provides the projects on Russian Federation Demographic Platform and the pilot regions. Moreover, the research presents the analysis of the total fertility rate in the Central Federal District. Based on the analysis of the Family Policy Concept of the Yaroslavl region, we reveal the main issues of the modern family and consider the mechanisms and resources of concept implementation. The example of the Regional Programme to Increase Fertility in Ivanovo region for 2023-2025 shows the sources of funding for family and demographic policy in the region, the connection with state programmes and its new measures, the classification of support measures for certain categories of women and families. Negative demographic trends necessitate the implementation of a comprehensive and systematic government policy aimed at formation of additional incentives for having children (especially for young families), and tools for comprehensive family support at all stages (marriage, birth and upbringing of children, and the transition to old age, etc). The measures concern with all areas affecting fertility, mortality, life expectancy, living standards for families with children, housing policy, and the territorial (spatial) development of Russia.

Keywords: depopulation; total fertility rate; family demographic policy; issues of modern family functioning; families support measures; Ivanovo region; Yaroslavl region

Introduction

At the beginning of the 21st century Russia is characterised by a steady process of depopulation (population decline) with one of the highest rates of natural decline in the world. In 2000, our country ranked world 6th in terms of population; in 2009 – 8th, and in 2023 – 9th place; according to forecasts, it will rank 13th in the coming years, followed Ethiopia, the Republic of Congo, Egypt, and Mexico.

The country's population has been declining since 1992. In 1999-2002 the natural decline annually exceeded 900 thousand people. From 1992 to 2002, Russia's population decreased by 3.5 mln people. The natural decline was 694.0 in 2004, 720.7 in 2005, 532.5 in 2006, 212.0 in 2007, 702.1 in 2020, 1043.3 in 2021, and 594.6 in 2022. As of January 1, 2023, the population of Russia was 146,447.4 thousand people. And in 2023, the country's population decreased by 0.17% and amounted to 146.2 mln people on January 1, 2024. The negative dynamics has slowed down. For comparison: the country's population decreased by 532.6 thousand people in 2022. The population density in Russia is low; it is 8.53 people per 1 km2. The natural decline in

the country is due to the reproduction regime with low birth and death rates. This situation had developed in Russia by the 1960s. However, for the most developed countries it is the usual one. Migration growth is several times lower than the natural decline. Therefore, there is a decrease in the country's population (Table 1).

Table 1 – Dynamics of the Russian population, thousand people

Year	Population size, 1 January	Born, total	Died, total	Changes over the year		
				common growth	natural growth	migration growth
2020	147,959.3	1436.5	2138.6	-503.6	-702.1	198.5
2021	147,455.7	1398.3	2441.6	-475.6	-1,043.3	567.7
2022	146,980.1	1304.1	1898.6	-532.7	-594.6	61.9

Source: Rosstat[1]

According to A. Vishnevsky and E. Shcherbakov, our country is now entering a long period of unfavourable for its economy demographic changes. The cessation of population growth in Russia, the reduction of the working-age population, its aging, and the increase in the demographic burden on the working-age population will have a negative impact on the development of the economy and the social issues [16]. According to a number of indicators of population reproduction (low birth rate, aging, natural population decline), our country differs little from world developed countries. Indeed, it lags behind in reducing mortality in middle and older ages, especially among men. It causes an increase in natural decline and to the preponderance of the female population over the male, especially in older ages. Excess mortality was recorded during the COVID-19 pandemic [10]. According to P. Semenova, S. Shkiotov, and M. Markin, «super mortality» from coronavirus in 2020-2021, reduction of migration flows, and a special military operation (SVO) were added to a mass relocation of Russians [9].

Russia is undergoing a demographic transition characterised by a decrease in the birth rate, postponement of marriage and childbearing, the transition to low-income and same-generation family models, and an aging population. These processes negatively affect the indicators of natural population growth.

In October 2023 Rosstat has published a demographic forecast until 2046. According to it, by January 1, 2046, the population will amount to 138.77 mln people. The share of the working-age population in 2045 will amount to 57.5% of all people in the country. There will still be more women than men – as of January 1, 2046, there will be 1,138 women per 1,000 men. Life expectancy will rise to 79.83 years in 2045; women's life expectancy will reach 83.24 years. In accordance with the indicators of the demographic forecast, 1.43 mln babies will be born in 2045; the total fertility rate will be 1.663 (the number of children per woman)[2].

To increase the birth rate, reduce mortality, and support families of various types, the state pursues demographic and family policies. These concepts are different ones.

Demographic policy is a purposeful activity of government agencies and other social institutions in regulating the reproduction and migration of the population to preserve or change trends in the dynamics of population size, structure, settlement, etc.

The term «family policy» entered the scientific literature in the 1970s and began to be used as an independent and denoting measures aimed at improving the conditions of family functioning. Family policy is the activity of the state, political parties, public organisations, interest groups, etc., aimed at reviving the family, the family life, etc. It was lost over a long historical path of social development. The main public goal is the return the family of its organically inherent social functions, aimed at strengthening the family as a social institution [3, pp. 216, 218].

Therefore, family and demographic policy have commonalities and differences. Recently, due to their interconnectedness, the term «family and demographic policy» has been used [1; 11].

According to the theory of demographic transition, the transformation of family social institution (the fragility and lack of children of most modern families) initiates depopulation. However, it is an inevitable modernisation; any state attempts to increase the birth rate will be ineffective. A. Sinelnikov considers the theoretical and methodological basis for family and demographic policy as a concept of family institutional crisis recognising the possibility of its overcoming. Indeed, family and demographic policy should reduce the number of divorces and increase the number of legal marriages, the birth rate [11]. There are a lot of studies on demographic changes at the regional level, in terms of healthcare system parameters [13].

Nowadays, both at the federal and regional levels there are measures to support families with children; new approaches are being implemented to support the population (primarily, low-income one).

The research summarises the regional experience of family support. For instance, the experience of the family and demographic policy of the Moscow region, 2016-2022 [1], the Sverdlovsk region [14], the Ivanovo region [2; 4; 8], the effectiveness of family (maternal) capital programme implementation in the Republic of Mordovia [12], student families regional support [7], etc.

Methods

In the study of demographic and family policy measures we used regulatory and legal sources, Rosstat data, data from national projects and government programmes, and information from a meeting of the Federation Council on the implementation of family policy. Additionally, the projects of the Ivanovo and Yaroslavl regions in terms of fertility were the objects of research. We used methods of comparative, statistical, tabular, and graphical analysis.

Results

The analysis of demographic and family policy in the Russian Federation in the 2000s and 2020s showed systematically expanding family support measures; we identified the stages of measures in: 2000-2010, 2010-2021, 2022-2024.

To address the demographic problems and their negative consequences, our state has been implementing active demographic policy measures since the 1980s. In 1981-1987, significant measures were taken to provide financial support to families with children. For instance, the partially paid parental leave for up to 1 year was introduced, a one-time benefit for the birth of the first child (rather than the third, as previously), child benefits were increased, and new benefits were established for working women with the children (additional leave).

In 2006, the Council for Priority National Projects and Demographic Policy was established in Russia. In 2024, 15 national projects were implemented, including «Demography», «Housing and Urban Environment», «Healthcare», «Culture», «Education», «Ecology», etc. On February 29, 2024, the President V. V. Putin in his message to the Federal Assembly announced the launch of new national projects since 2025, including «Family», «Youth of Russia», «Qualified Employees», «Long and Active Life».

In our country, demographic researches are conducted by the Institute of Sociology of the Russian Academy of Sciences, the Research Institute of Statistics of the State Statistics Committee of the Russian Federation, the Department of Labour, Employment, and Social Development of the Ministry of Economy of the Russian Federation, the Centre for Social Demography of the Institute of Socio-Political Research (ISPI RAS), the National Research University Higher School of Economics, etc.

Rosstat publishes the Demographic Yearbook. Scientific journals are published: Demoscope, Demis. Demographic Research (Institute of Sociology of the Russian Academy of Sciences), Demographic Review (National Research University Higher School of Economics), Family in Russia, Population, Family Planning (Russian Association of Family Planning), etc.

In post-reform Russia, 3 All-Russian population censuses were conducted: in 2002, October 9-16 (the slogan of the census is «Write yourself into the history of Russia!»), in 2010 – October 14-25 (the slogan of the census is «Everyone is important to Russia!»), in 2021 – October 15-November 14 (the slogan of the census is «We make the future!»).

Sample demographic surveys have also been conducted. For instance, since the early 90s. Russia Public

Opinion Centre regularly conducts surveys on the reproductive behaviour of the population. Indeed, in May 2023, within the framework of the HSE Basic Research Program, a study on the reproductive intentions of Russians during the socio-economic crises of 2022-2023 was conducted [15].

In 2024, the Council under the President of the Russian Federation for the Implementation of State Demographic and Family Policy was established; it is headed by the Chairman of the Federation Council of the Russian Federation V. Matvienko[3]. In 2024, the Federation Council held parliamentary hearings on the topic 'Actual decisions to support the birth rate: family policy'[4], where the regional family-oriented projects were discussed. In 2023, 85 regions of the Russian Federation approved their own programmes to increase the birth rate, including a wide range of measures[5].

There were adopted following Concepts: in 2001, the Concept of Demographic Development of the Russian Federation for the period up to 2015; in 2007 – the Concept of Demographic Policy of the Russian Federation for the period up to 2025[6]; in 2014 – the Concept of State Family Policy in the Russian Federation for the period up to 2025[7].

Since 2006-2007, a set of demographic and family policy measures in the Russian Federation has been implemented. During this period, the following wages were introduced:

– benefits: one-time benefit for the birth of a child (8,000 RUB); monthly allowance for child care up to 1.5 years (1,500 RUB – for the first child, 3,000 RUB – for subsequent ones; for insured women – 40% of salary, but not more than 6,000 RUB); one-time benefit for the transfer of a child to foster care the family of the adoptive parent, guardian, trustee (8,000 RUB);

– other important payments: birth certificate (10,000 RUB: 3,000 RUB – to a women's consultation, 6,000 RUB – to a maternity hospital, 1,000 RUB – to a children's polyclinic); basic maternity capital for the 2nd child (250,000 RUB) – from the age of 3 to the child for the purposes of: education, housing, funded part of the pension; payment for the work of a foster parent (2,500 RUB per month); child care allowance in a foster family (4,000 RUB per month); compensation for part of the parental fee for the maintenance of children in state and municipal kindergartens;

– other support measures: deductions from income tax (600 RUB per child), provision of housing for orphans and children left parental care; free medical care for pregnant women;

– service to military families: a deferral from military service; a one-time allowance for pregnant wives of those do military service (14,000 RUB); a monthly allowance for those do military service child (6,000 RUB).

In 2024, an Action Strategy was adopted to implement family and demographic policy and support large families in the Russian Federation until 2036. The objectives of this Strategy are as follows[8]:

– preservation of the population by increasing the birth rate, strengthening maternal, child, reproductive health of the population, and promoting the implementation of family-oriented demographic policies in the regions of the Russian Federation in terms of the national and socio-cultural characteristics;

– protection and support of the family as the fundamental basis of Russian society by improving the well-being, quality of life and support in special life situations through establishing the conditions for the harmonious combination of parents work and study with the birth and upbringing of children, the

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[3] On the Council under the President of the Russian Federation for the Implementation of State Demographic and Family Policy: Decree of the President of the Russian Federation dated 09.12.2024 No. 1047. Source: http://www.kremlin.ru/acts/bank/51398 (accessed on 17.01.2025)

[4] Parliamentary hearings. Current solutions to support fertility: family policy. Source: http://council.gov.ru/activity/activities/ parliamentary/149964 (accessed on 17.01.2025)

[5] Svyatenko, I. Senators will promote the implementation of family-oriented projects in the regions. Source: http://council.gov.ru/ events/news/163142/ (accessed on 25.01.2025)

[6] The concept of demographic policy of the Russian Federation for the period up to 2025: Decree of the President of the Russian Federation dated 09.10.2007 No. 1351. Source: http://www.kremlin.ru/acts/bank/26299 (accessed on 17.01.2025)

[7] The concept of state family policy in the Russian Federation for the period up to 2025: Decree of the Government of the Russian Federation on 25.08.2014 No. 1618-R. Source: http://government.ru/docs/all/92699/ (accessed on 17.01.2025)

[8] Action strategy for the implementation of family and demographic policy, support for large families until 2036: Decree of the Government of the Russian Federation (draft). Source: https://mintrud.gov.ru/ministry/programms/11 (accessed on 23.12.2024)

development of family-oriented infrastructure;

– strengthening the institution of family and marriage as a union of men and women based on the preservation and promotion of traditional family values, excluding the ideologies aimed at destroying the values of a strong family, marriage, and children.

The strategy is consistent with the Concept of Demographic Policy of the Russian Federation for the period up to 2025 and the Concept of state family Policy in the Russian Federation for the period up to 2025.

The strategy is the basis for preparation:

– national projects of the Russian Federation: «Family», «Long and Active Life», «Youth and Children», «Personnel», «Infrastructure for Life», «Efficient and Competitive Economy», «Data Economy and Digital Transformation», «Tourism and Hospitality», «Environmental Well-being», «Effective Transport System», «New Technologies for Youth Saving»;

– state programmes of the Russian Federation: «Social Support for Citizens», «Provision of Affordable and Comfortable Housing and Communal Services», «Promotion of Employment», «Development of Culture», «Development of Education»;

– government programmes for the Russian Federation regions, federal, regional projects, projects of local governments, strategic documents of other organisations regarding family and demographic policy, and other documents and projects aimed at supporting the family.

Demographic and family policy measures in the Russian Federation and Russian regions in the 2010s and 2020s are as follows:

– the maternal (family) capital program to families in which the first children were born or adopted since 2020; its annual indexation;

– targeted support for families at the birth of their third or subsequent children since 2013;

– in 2018, a monthly benefit for families with the birth of their first child until they reach the age of 3 years;

– additional support measures for families living in the Far East: a one-time allowance at the birth of the first child and the regional maternal (family) capital with the birth of the second child;

– since 2020, the introduction of targeted payments to families with children of various ages, and subsequently to low-income pregnant women to minimise the risks of poverty;

– regional maternity capital provided by the regional budgets of the Russian Federation, mainly at the birth of the third or subsequent child. In 2023 the regional maternity (family) capital was established in 72 regions of the Russian Federation. The regional maternity capital has been introduced in all regions of the Russian Federation; it can be used to improve housing conditions. In a number of regions, the maternity capital is provided for the repair of housing, the education of children, sanatorium treatment for children, the purchase of a car, agricultural machinery, etc.;

– the formation of an integrated support system for families with children since January 1, 2023: the introduction of a monthly allowance with the birth and upbringing of a child (a single allowance). It combined the existing monthly payments to low-income families and provided during the period from a woman's registration for pregnancy and childbirth up to 12 weeks until her child reaches the age of 17;

– the social contract began to operate in 2013; it became widespread with the introduction of federal co-financing in all regions of the Russian Federation in 2021;

– since 2020 there has been launched a programme for vocational training and additional vocational education for women on parental leave or unemployed and are raising pre-schoolers;

– a programme for providing social benefits for the purchase of housing has been launched for young parents;

– since 2019 a repayment payment of 450,000 RUB has been introduced to help multi-member families applied for a housing mortgage;

– a rural mortgage programme with a reduced interest rate of 3 percent has been introduced;

– lands provided with appropriate infrastructure are being allocated to multi-member families;

– since 2024 the unified approaches to support the multi-member families have been established at the

federal level;

– an important measure to support the families with children has become the formation of conditions for parents to combine family responsibilities with professional ones; first of all for parents with children under the age of 3;

– the waiting list for state and municipal preschool educational organisations has been practically eliminated. On January 1, 2024, the availability of preschool education for children aged 2 months to 3 years was 99.5; for children aged 3 to 7 years – 99.9%.

Support for families raising children with disabilities is expanding:

– the provision of social services to families with children and individual support for families is developing;

– since 2022 a comprehensive system of support for families of participants in a special military operation has been formed;

– a system of family public holidays has been established – Family Day, Mother's Day, Father's Day; 2024 was declared the Year of the Family;

– a system of state awards for families with children is being developed;

– an information and communication campaign are being conducted aimed at popularising and promoting traditional family values, supporting and protecting the family, motherhood, fatherhood, and childhood;

– a system of sports and cultural family events, family forums, and promotions is being implemented at the federal and regional levels;

– since 2024 the subject «My family» for high school students has been introduced;

– since 2013 the All-Russian Day of Legal Assistance to Children has been held annually in all regions of the Russian Federation, etc.

In 2024 the new legal acts were adopted. Moreover, multi-member families have the opportunity of full or partial repay of mortgage lending obligations through government support; since March 1, 2025, the escrow accounts implementation will include the construction of individual residential buildings with the maternity capital funds[9].

In terms of the demographic situation and depopulation, it becomes necessary to establish a special department responsible for the development and implementation of pro-family, youth, and demographic policies.

Regional assistance measures can play an important role in supporting family and demographic policy. Our country consists of 89 regions; they have very different conditions of socio-economic development, financial security, etc. According to T. Ivakhnenko, A. Polbina and S. Sinelnikova-Muryleva, the economic complexity is a significant factor in income inequality. Moreover, it should be considering in developing of socio-economic policy measures. Hence, in regions with more complex economies, the level of income inequality was higher. It is explained by the growing demand for highly skilled labour due to the development of high-tech industries, increased differentiation in wages for high- and low-skilled workers, and migration of highly skilled workers to economically more complex regions [5].

The Russian Federation demographic platform and the classifier of demographic initiatives and practices was introduced. On 24 January 2025, 62 demographic projects and initiatives are presented on the platform. For instance, a pilot project is being implemented to establish multifunctional family centres in the following regions of the Russian Federation: Volgograd, Irkutsk, Kaluga, Novgorod, Novosibirsk, Tula, Orel, and Chelyabinsk[10].

The Association of Organisations for the Protection of the Family implements the project «On the protection of family and childhood». Its mission is to provide a family-oriented environment as a combination of family and childhood infrastructure.

[9] *Svyatenko, I. Senators will promote the implementation of family-oriented projects in the regions. Source: http://council.gov.ru/events/news/163142/ (accessed on 25.01.2025)*

[10] *Demographic platform. RF. Classifier of demographic initiatives and practices. Source: https://demografplatforma.ru/?page_id=2441 (accessed on 24.01.2025)*

The objectives of the Project are to increase the resource capabilities of the family-oriented non-profit sector in the regions; identify the needs of families with children and assess conditions for the realisation of children's rights and interests, family protection, motherhood, fatherhood, and childhood in the regions of Russia; provide a one-stop-shop family support system involving family-oriented NPOs.

There are 25 pilot regions for family resource centres from 7 federal districts: Moscow, Moscow region, Yaroslavl region, Orel region, Ivanovo region, Vologda region, Lipetsk region, Smolensk region, Volgograd region, Rostov region, Krasnodar Krai, Stavropol Krai, Republic of Tatarstan, Penza region, Republic of Mordovia, Republic of Chuvashia, Saratov region, Samara region, Orenburg region, Chelyabinsk region, Khanty-Mansi Autonomous Okrug-Yugra, Omsk region, Krasnoyarsk Krai, Leningrad region, and Arkhangelsk region. The project's target audiences are families with children, including families in difficult situations, as well as managers and specialists of family-oriented non-profit organisations. The estimated cost of the Project is 17,774,202 RUB[11].

The Association of Non-profit Organisations «Za Zhizn!» implements the Accelerator of demographic initiatives «Generatsiya» as a platform project. It is the first intensive programme for the development of non-profit organisations and projects focused on addressing the demographic problems in Russia. The regional demographic project in partnership between government, business, and NPOs serves a criterion for Project success. The acceleration programme will allow the formation of regional subjects of demographic initiatives, change the demographic situation in the regions, ensure natural population growth in the horizon of 2021-2030, etc.

The fertility situation in the regions of Russia using the indicator «total fertility rate» – the number of children born to one woman throughout the fertile period at 15-49 years. This indicator reflects the birth rate compared to the «total fertility rate». It is influenced by structural factors (the proportion of individual socio-demographic groups with different reproductive potential).

According to the analysis of total fertility rate in the regions of the Central Federal District, this indicator is at a level below the limit of simple reproduction, equal to 2.1-2.15 children per 1 woman, or 210-215 children per 100 women. Recently, the lowest level of this coefficient has been in the Smolensk region; the highest one – in the Kostroma region. The coefficient is:

– less than 1.2 – in Belgorod, Bryansk, Vladimir, Ryazan, Tula regions;
– 1,2-1,3 – in Voronezh, Kursk, Lipetsk, Orel, Tambov, Tver regions;
– 1,3-1,4 – in Ivanovo, Kaluga, Moscow, Yaroslavl regions;
– above 1.4 – in Moscow and Kostroma region (Table 2).

Table 2 – Dynamics of the total fertility rate in the regions of the Central Federal District, 2005-2023

Region	2005	2010	2015	2020	2021	2022	2023
Belgorod region	1.177	1.395	1.561	1.238	1.267	1.169	1.12
Bryansk region	1.218	1.422	1.650	1.309	1.280	1.196	1.19
Vladimir region	1.252	1.462	1.730	1.268	1.277	1.156	1.15
Voronezh Region	1.135	1.358	1.517	1.275	1.287	1.232	1.22
Ivanovo region	1.183	1.398	1.629	1.239	1.261	1.367	1.35
Kaluga Region	1.209	1.476	1.836	1.479	1.440	1.336	1.34
Kostroma region	1.334	1.650	1.890	1.464	1.383	1.523	1.55
Kursk region	1.215	1.545	1.716	1.353	1.341	1.290	1.26
Lipetsk region	1.267	1.473	1.700	1.383	1.340	1.203	1.23
Moscow region	1.167	1.367	1.675	1.534	1.460	1.329	1.35
Oryol region	1.203	1.495	1.603	1.272	1.221	1.212	1.17

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[11] *Demographic platform. RF. Classifier of demographic initiatives and practices. Source: https://demografplatforma.ru/?page_id=2441 (accessed on 24.01.2025)*

Region	2005	2010	2015	2020	2021	2022	2023
Ryazan region	1.216	1.437	1.640	1.314	1.236	1.142	1.10
Smolensk region	1.140	1.381	1.522	1.158	1.130	1.080	1.03
Tambov region	1.214	1.344	1.512	1.281	1.284	1.223	1.21
Tver region	1.311	1.520	1.696	1.361	1.311	1.296	1.28
Tula region	1.101	1.309	1.568	1.249	1.224	1.145	1.18
Yaroslavl region	1.254	1.487	1.695	1.364	1.356	1.311	1.32
Moscow	1.065	1.253	1.406	1.473	1.597	1.419	1i.42

Source: Rosstat[12]

The lowest coefficient level in 2023 is in the Vladimir Region (1.15), the highest is in the Kostroma Region (1.55) (Fig. 1).
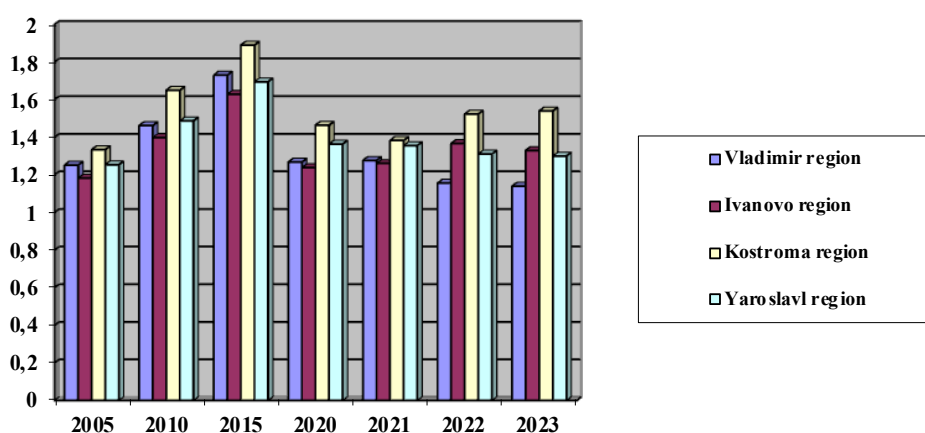

Figure 1. Dynamics of the total fertility rate in the Vladimir, Ivanovo, Kostroma, and Yaroslavl regions
Source: Rosstat[13]

There are regional measures to support families and fertility in two regions: Yaroslavl and Ivanovo regions.

According to The Yaroslavl Region's Family Policy Concept for the period up to 2025, «the current demographic and socio-economic situation requires a structured, intersectoral, and coordinated approach to family policy formation»[14].

An analysis of the situation of families living in the Yaroslavl region revealed the following main problems of family functioning: demographic, socio-economic, socio-pedagogical, medico-social, organisational, and managerial (Table 3).

The family policy measures of the Yaroslavl region are grouped by priority areas and are related to addressing the following issues:

– development of family economic independence, formation the conditions for its social function; regional support for families, including during the birth and upbringing of children; the life-saving function of the family, and ensuring the health of family's members;

– improvement of the mechanisms to support low-income families in better housing conditions, the system of prevention of family issues, juvenile delinquency;

– increasing the value of the family lifestyle, preservation of the moral traditions in family relations and family education;

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[12] *Demographic Yearbook of Russia. 2023: Statistical collection (2023). Source: http://ssl.rosstat.gov.ru/storage/mediabank/Demogr_ejegod_2023.pdf (accessed on 12.01.2025)*

[13] *Demographic Yearbook of Russia. 2023: Statistical collection (2023). Source: http://ssl.rosstat.gov.ru/storage/mediabank/Demogr_ejegod_2023.pdf (accessed on 12.01.2025)*

[14] *On approval of the Concept of Family Policy of the Yaroslavl Region for the period up to 2025: Resolution of the Government of the Yaroslavl Region on December 29, 2014 No. 1408-p. Source: https://yaroslavl-gov.ru/doc/52368 (accessed on 12.01.2025)*

– assistance in the realisation of the educational, cultural, and educational potential of the family;

– ensuring the social protection of low-income families and children[15].

Table 3 – The main issues of family functioning (using the Yaroslavl region as an example)

The main issues of family functioning are as follows:				
socio-economic	demographic	socio-pedagogical	medical and social	organisational and managerial
the difficulties in adapting families with children to the conditions of a market economy, resulting in social inequality, tensions, governmental support.	low birth rate	the decline in the value of the family lifestyle, the weakening of the need for children, the prevalence of divorce, illegitimate births	the insufficient level of parents' responsibility for the health of their children and their own	the absence of a system of timely mutual information between authorities involved in the prevention of cruel treatment of children on identified cases (facts) of violence, including child suicide.
a significant number of families requiring improvement of housing conditions	low proportion of children and youth in the demographic structure of the population	a significant number of children left without parental care due to the deprivation or restriction of their parental rights	low level of population reproductive health (a high level of oncological diseases of the reproductive system in women, female and male infertility)	insufficient development of services for families in difficult life situations;
low level of comfort for families in rural areas	transformation of marital behaviour, later marriage, postponement or refusal of marriage registration	family conflicts	significant number of families requiring state support due to difficult life situations	insufficient number of non-governmental organisations engaged in the provision of social services to families;
	the transformation of reproductive behaviour, postponement of the first child birth,	low level of legal and psychological culture of the family		the insufficient level of popularisation of services, including through the Internet
	an increase in the proportion of children first births in mature parents			an unformulated system of continuing education for specialists working with different types of families

Source: Authors.

The mechanisms of Concept implementation are as follows: regulatory and legal support; information support; human resources; organisational and managerial support.

The resources for the implementation of the Concept are as follows: material, technical and financial support; scientific and methodological support; developed infrastructure for the subjects of family policy.

The regional support measures in the Ivanovo region are as follows: population of the Ivanovo Region decreased by 12% from 2016 to 2023 (from 1,029,838 to 905,900 people). Nowadays, the Ivanovo Region ranks 55th among the regions of the Russian Federation and 16th among the subjects of the Central Federal District in terms of population. The natural population decline in the Ivanovo region over an 8-year period averaged 15,492 people per year.

The reasons for the current trend of natural population decline are the processes of reducing the birth rate (total fertility rate).

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[15] *On approval of the Concept of Family Policy of the Yaroslavl Region for the period up to 2025: Resolution of the Government of the Yaroslavl Region on December 29, 2014 No. 1408-p. Source: https://yaroslavl-gov.ru/doc/52368 (accessed on 12.01.2025)*

The analysis of the total fertility rate dynamics in Ivanovo region shows that the number of births per 1,000 people in Ivanovo region has been decreasing every year since 2016.

In 2023, the overall fertility rate continued to decline, and amounted to 7.2%; it is 3.7% lower than in 2016. The decrease in the total fertility rate is due to the influence of a structural factor (population ageing) and a decrease in the total fertility rate; it shows the general trend of reducing the number of children in the family and postponing the birth of the first child[16].

In 2018-2023, social support in the Ivanovo region had developed as follows:

– strengthening of the demographic component in the general system of social benefits (increased coverage of children with various types of support measures;

– increasing the contribution of government support to poverty reduction.

In 2022, a regional programme was adopted to increase the birth rate in the Ivanovo Region for 2023-2025, and in 2024 it was extended until 2028. The Department of Social Protection of the Population of the Ivanovo region is responsible for the programme implementation[17].

The purpose of the Programme is to increase the birth rate, stabilise the permanent population, reduce the rate of natural population decline, and support families with children. The objectives of the Programme are to increase the birth rate; increase the total fertility rate; strengthen the reproductive health of the population, create motivation for a healthy lifestyle; strengthen the institution of the family, increase the prestige of motherhood and fatherhood, the importance of registered marriage; improve the quality of life of the rural population.

The Programme indicators are: the number of births in the Ivanovo region; the total fertility rate; the number of families under social support measures provided at the expense of federal subsidies.

The total amount of budget financing in the Ivanovo region from the regional budget for measures to support families with children in 2023 increased by more than 2 times compared to 2017 – from 1.3 bn RUB to 2.7 bn RUB[18]. The sources of funding for this programme show its implementation within the framework of interdepartmental cooperation. The most cost-effective programmes are: «Development of healthcare in the Ivanovo region», «Development of education and science in the Ivanovo region», «Social support for citizens of the Ivanovo region», «Providing affordable and comfortable housing for the population of the Ivanovo region», «Development of physical culture and sports in the Ivanovo region». The main part of funding is federal (Table 4).

Table 4 – The sources of financing for the regional fertility increase programme in the Ivanovo region and the results of their development in 2023, thousand RUB

The state programme	Actually spent, 2023 cumulatively	where	
		federal budget funds	regional budget funds
«Development of healthcare in the Ivanovo region»	1,808,800.2	1,519796.0	289,004.2
«Development of education and science of the Ivanovo region»	1,711,264.7	1,638,129.3	71,177.4
«Social support for citizens of the Ivanovo region»	1,684,488.5	1,554,248.9	130,239.6
«Providing affordable and comfortable housing for the population of the Ivanovo region»	1,636,796.9	1,514,995.4	96,070.1

[16] *On approval of the Regional program for increasing the birth rate in the Ivanovo region for 2025-2028: Decree of the Government of the Ivanovo Region on 25.12.2024 No. 662-P. Source: https://www.garant.ru/hotlaw/ivanovo/1790383 / (accessed on 24.01.2025)*

[17] *On approval of the Regional program for increasing the birth rate in the Ivanovo region for 2025-2028: Decree of the Government of the Ivanovo Region on 25.12.2024 No. 662-P. Source: https://www.garant.ru/hotlaw/ivanovo/1790383 / (accessed on 24.01.2025)*

[18] *On approval of the Regional program for increasing the birth rate in the Ivanovo region for 2025-2028: Decree of the Government of the Ivanovo Region on 25.12.2024 No. 662-P. Source: https://www.garant.ru/hotlaw/ivanovo/1790383 / (accessed on 24.01.2025)*

The state programme	Actually spent, 2023 cumulatively	where	
		federal budget funds	regional budget funds
«Development of physical culture and sports in the Ivanovo region»	1,393,972.1	1,311,023.5	82,945.2
«Development of agriculture and regulation of agricultural products, raw materials, and food markets in the Ivanovo region»	444,643.1	420,059.3	24,583.8
«Cultural development in the Ivanovo region»	376,693.7	362,245.3	14,448.4
«Promotion of employment in the Ivanovo region»	58,506.2	57,921.1	585.1

Source: Department of Economic Development and Trade of the Ivanovo region[19]

The object of this Programme in the Ivanovo region are women and families of various types: families with children; young and student families; large families; low-income and single-parent families; families without children; women in a state of reproductive choice[20].

The regional family support measures are as follows:

1. Measures to support pregnant women.

2. Measures to support the birth of children, including measures to support young families.

3. Measures to support large families.

4. Measures to support low-income families.

5. Non-financial measures to support families.

6. Measures to support families in education to increase the accessibility of preschool educational institutions.

7. Measures to support employment of the population.

The most significant financial measure of support is the maternal (family) capital. It might be used to improve housing conditions, provide education to a child (children), form a funded pension for women, purchase goods and services intended for social adaptation and integration into society of children with disabilities.

In the Ivanovo region, regional student (maternity) capital in the form of a certificate in the amount of 1.0 mln RUB for children born after 01.04.2024 has also become a significant measure of support. Moreover, a significant measure of support is the regional student (maternal) capital in the amount of more than 172.3 thousand RUB (in 2024); the first child was born before 31.03.2024 by a mother under 24 in a student family with an average per capita income of less than 29.1 thousand RUB (in 2024). The regional student (parent) capital can be used immediately in full or in parts in the following areas: getting children education, improving housing conditions, receiving a monthly payment in connection with the birth of a child until he reaches the age of 3 years.

Conclusion

Hence, negative demographic trends necessitate the implementation of a comprehensive and systematic government policy aimed at formation of additional incentives for having children (especially for young families), and tools for comprehensive family support at all stages (marriage, birth and upbringing of children, and the transition to old age, etc). The measures concern with all areas affecting fertility, mortality,

[19] *Financing and disbursement of funds under the state programs of the Russian Federation for 2023. Summary report on the implementation of state programs of the Russian Federation in the territory of the Ivanovo region, non-programmatic areas of activity of federal executive authorities as of January 01, 2024. Source: https://derit.ivanovoobl.ru/deyatelnost/gosudarstvennye-programmy/finansirovanie-i-osvoenie-sredstv-po-gp-rf / (accessed on 25.01.2025)*

[20] *On approval of the Regional program for increasing the birth rate in the Ivanovo region for 2025-2028: Decree of the Government of the Ivanovo Region on 25.12.2024 No. 662-P. Source: https://www.garant.ru/hotlaw/ivanovo/1790383 / (accessed on 24.01.2025)*

life expectancy, living standards for families with children, housing policy, and the territorial (spatial) development of Russia.

According to the analysis of the Yaroslavl Region's Family Policy Concept, the main issues of family functioning are demographic, socio-economic, socio-pedagogical, medico-social, organisational, and managerial. This Concept is implemented on the basis of the interrelation of regulatory, informational, personnel, organizational, and managerial support mechanisms. The resources for the implementation of the Concept are material, technical, financial, scientific and methodological support, the developed infrastructure of organizations in terms of family policy.

The regional measures to support families with children is implemented in conjunction with federal support measures. In recent years, these measures have been constantly adjusted; the new approaches to assessing need and providing support to low-income families have been introduced. The measures within the framework of the Regional Programme to increase the birth rate in the Ivanovo region for 2023-2025, 2025-2028 are classified into measures to support pregnant women, at the birth of children (including young families), large families, low-income families include non-financial measures, measures to support families in employment and education.

Our analysis of family and demographic policy financing on the example of the Ivanovo region defines the most costly programmes are the following: «Development of healthcare in the Ivanovo region», «Development of education and science in the Ivanovo region», «Social support for citizens of the Ivanovo region», «Providing affordable and comfortable housing for the population of the Ivanovo region», «Development of physical culture and sports in the Ivanovo region». Indeed, the most of them are funding from the federal budget of the Russian Federation.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHORS' CONTRIBUTION

Alla B. Berendeeva – conceptualization, project administration, writing – original draft.
Olga S. Berendeeva – data curation, investigation.

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Import substitution strategy in the economic policy of Russian regions: historical modern approach

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ORIGINAL ARTICLE

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Abstract. The article analyses the import substitution policy of Russia in different historical periods. The research compares industrialisation and neoindustrialisation as typical models of economic policy in the USSR and modern Russia. Authors use a historical-comparative approach to identify the characteristic features of the economic policies. According to them, Soviet methods are inappropriate in the modern economy due to fundamental changes in socio-economic conditions and the technological landscape. Moreover, nowadays the intensive development based on the introduction of innovations and increased labour productivity replaces the extensive production growth of the past. However, successful import substitution in modern Russia requires imported products replacement and competitive domestic analogues production. The paper highlights the relevance of active government support for innovation, stimulating industrial cooperation, and introducing of effective consumers feedback mechanisms. The analysis of regional experience, in particular, of the Yaroslavl region, demonstrates significant differentiation in the degree of import dependence and the structure of economies. It provides the development of regional import substitution strategies. Therefore, the active introduction of high-tech technologies and artificial intelligence will increase the competitiveness of Russian industry and ensure its technological sovereignty. Hence, integrated approach combining government support, innovation, and adaptation to regional specifics helps implement the import substitution strategy in the Russian Federation.

Introduction

Import substitution in a government policy aimed at replacing imported goods and services with domestic analogues. The purpose is to reduce the country's dependence on external supplies, strengthen the national producers in the international market. According to the Great Russian Encyclopedia, import substitution is "the economic policy of the state aimed at expanding domestic production of products similar to imported ones, which should be ensured by increasing the competitiveness of domestic goods, greater efficiency of domestic producers and the national economy. In general, there are two approaches to import substitution: domestic production growth and import restriction"[1].

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[1] *Import substitution. The Great Russian Encyclopedia. Source: https://bigenc.ru/c/importozameshchenie-a05859 (accessed on*

In foreign studies this strategy has been considered primarily in in terms of developing countries [1]. Moreover, this approach was typical for the mid-twentieth century [4]. For instance, an analysis of import substitution policy in Iran is considered in this context[2]. However, due to global crises, this factor was revised [5] and studied in terms of the BRICS countries experience [2].

Recently, the complicated geopolitical situation provides the scientific interest to import substitution in Russia. Indeed, according to scientometric analysis of publications on Elibrary.ru, the keyword "import substitution" occurs 233 times in 2019, 147 in 2020, 118 in 2021, 496 in 2022, 624 in 2023, and 411 in 2024. Generally, issues of software and digital technologies import substitution are under study. However, the aspects of regional economic policy development have not yet been sufficiently covered. At the same time, Russia's regions have a rich historical experience of import substitution.

In this regard, the purpose of the study is to compare the economic situation of modern and Soviet industrialisation to determine the factors contributing to import substitution strategy effective implementation in the Russian regions.

Until 2022, experts assessed Russia's import dependence as low one. However, the share of imports was quite significant. For instance, indirect imports for the automotive industry was more than 10% final product value. According to the Central Bank, in 2022, the share of imports from countries announced sanctions against Russia averaged 61% of total imports of raw materials, materials, and manufacturing industries[3]. According to Interfax, the number of sanctions imposed on Russia by foreign states was 18,384 in 21.02.2022 - 23.01.2025[4]. These restrictions should stagnate the Russian economy. However, they stimulate the development and implementation of import substitution strategies in terms of the individual enterprises, regions, industrial territorial complexes and the national economy.

Earlier, Russian technological dependence provided a shortage of important assembly components previously purchased from abroad, and decreased the rate of domestic production. Indeed, the interests of national security required serious changes. The conditions of the industrial sector were similar to the experience of the industrialiation of the Soviet Union in shifting the economy from an agrarian to an industrial development trajectory. Those time, it allowed country to multiply the volume of its industrial production at the shortest possible period. The example of Soviet industrialisation shows the potential of Russia in terms of addressing the complex economical issues.

Indeed, the import substitution strategy is extra-relevant for the economic policy of the Russian regions. It increases in labour productivity, jobs, tax revenues to the budget, and positive impacts on the diversification of regional economies. The regions of Russia are very diverse both in terms of the natural and social resources. Therefore, import substitution strategy concerns with the historical experience and development of local economy.

Main part

In the early 2020s, the sanctions became another large-scale crisis phenomenon after the pandemic. In terms of historical approach to the development of Russia, it is a kind of outstanding economic phenomenon.

Russian industry had a difficult period of deindustrialisation in the 1990s; in this period the industrial production index (IPI) was extremely low (Fig.1).

In the early 2000s, Russia began to restore the industrial potential mainly through the foreign investments. They stimulated Russian economy. However, imported goods prevailed at the market. The development of domestic production was difficult due to the high competition with imports produced in accordance with the latest technologies considering the lowest cost and the best quality. After 2014, the sanctions policy against Russia has sharply raised the issue of the urgency to establish production of its own high-tech products.
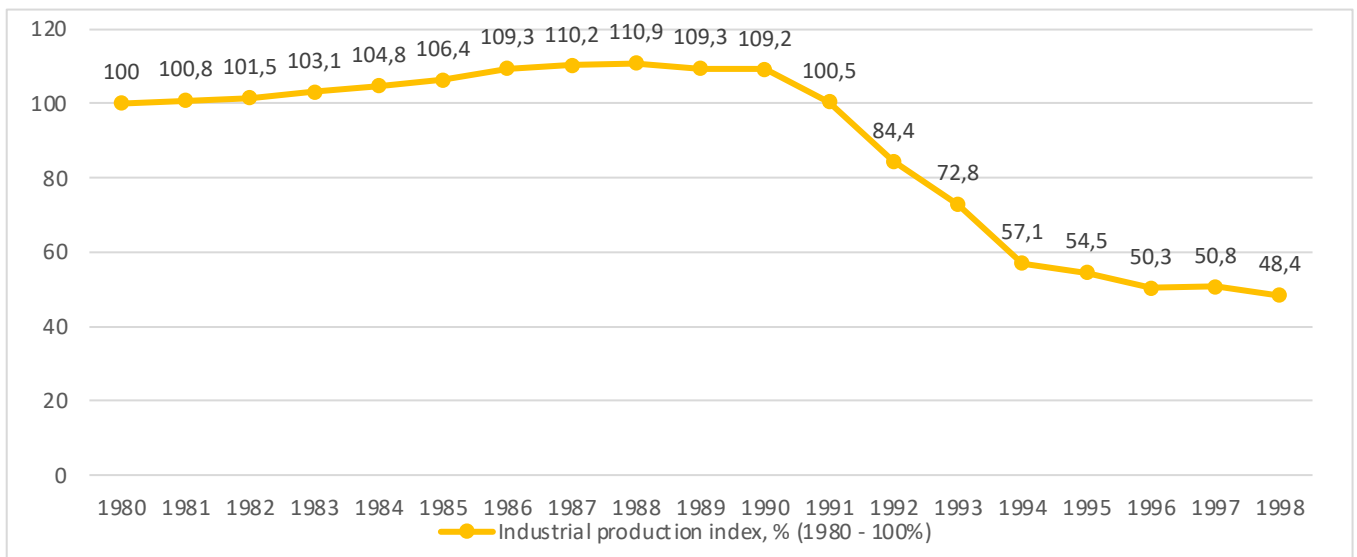
Figure 1. Industrial production index in the USSR-Russian Federation, 1980-1998

Source: [15]

The historical challenge was close to the experience of the Soviet Union industrialisation. Those time, it allowed country to multiply the volume of its industrial production at the shortest possible period. For instance, in five years, 1931-1936, the number of factories producing machine tools increased from 16 to 48; the volume of production increased by more than 27 times (Fig.2).
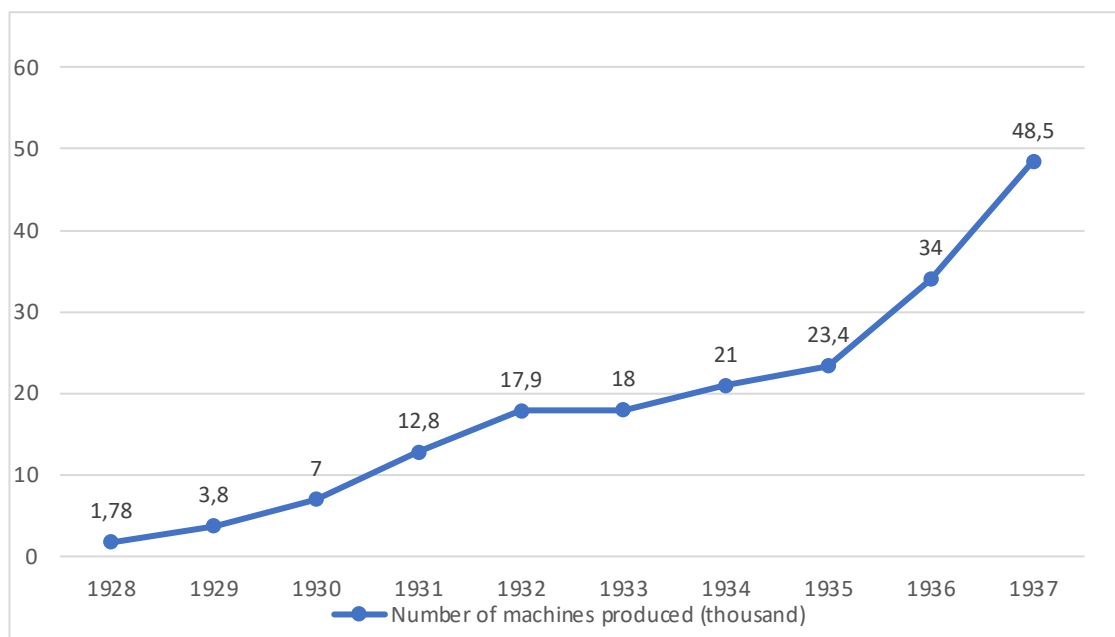

Figure 2. Dynamics of machine tool manufacturing in the USSR

Source: Machine tool industry in the USSR[5]

Indeed, since by 1941 more than 80% of machine tools in the USSR were of domestic production. This example illustrates the extremely high rate of production development, the effectiveness of the import substitution strategy, etc. The second trend of import substitution is the development of domestic production. For instance, synthetic rubber production. During the period of industrialisation in the USSR, several factories for its production were built. The technological process was based on the developments of the Russian scientist S.V. Lebedev. In 1934, the USSR produced 11 thousand tons of synthetic rubber, and by 1936 – 40 thousand tons [9].

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[5] *Kalabekov, I.G. The USSR and the countries of the world in numbers. Source: https://su90.ru/machinetools.html#g5 (accessed on 30.01.2025)*

One of the components of the Soviet economic policy towards industrialisation was to support the formation of foreign concessions (investments) for the transfer of authority to manage domestic companies, without losing the ownership. The purchase of imported technologies and the joint ventures contributed to the Soviet economy formation. However, it was later decided to abandon the concessions, since the influence of foreign states and the promotion of their own interests within the country adversely affected both the development of their own independent production and the sovereignty of the USSR as a whole. Therefore, the country's leadership decided to practice of concluding paid foreign contracts for the implementation of technological assistance. Indeed, from 1923 to 1933, about 170 contracts were concluded with foreign companies and specialists [3]. One of the most striking examples of successful experience is the projects of the Magnitogorsk Iron and Steel Works (Arthur G. McKee and Co, Freyn Engineering Co, etc.), Nizhny Novgorod Automobile Plant (Ford and Austin Motor Company), Dneproges (Hugh Cooper, General Electric and Newport News Shipbuilding), the American company Albert Kahn Inc. contributed to the construction of more than 500 industrial enterprises in the USSR, i.e., the Stalingrad Tractor Plant.

There are also attracting foreign investments into the Russian economy in the 1990s. The Soviet Union faced organizing modern high-tech production in a short time. Developing our own technologies required resources. Therefore, it was decided to conclude contracts with foreign companies and purchase the missing drawings and designs. For instance, the production of tractors at the Krasny Putilovets plant in Leningrad since 1924 has been organised according to drawings purchased from the American company Ford. The foreign countries and companies cooperate was determined by the crisis of the economies of developed countries during this period (the "Great Depression)," and required huge financial costs from the USSR.

The fundamental difference between the historical stage of the import substitution policy of the USSR and the current situation, concerns with Russian industrial economy. The industrial recovery after the collapse of the 1990s is a brief period of reindustrialisation, i.e. the return of the usual industrial production methods. Nowadays, society is already living in the conditions of the fourth industrial revolution, described in book by K. Schwab. Emphasising the importance of the current period of technological development, he notes: "In terms of scale, scope, and complexity, the fourth industrial revolution has no analogues in all previous human experience. We will observe the technological breakthroughs in a wide range of fields, including artificial intelligence, robotics, robotic cars, three-dimensional printing, nanotechnology, biotechnology, etc." [14].

Indeed, the industrial growth as "a natural process of development of all productive forces based on digitalisation (automation, computerisation, networkingisation) in all sectors of the national economy, in terms of the requirements of social development, quality of life, and environmental conservation" [13] in economics is called neoindustrialisation. The theoretical content of neoindustrialisation continues to be actively debated. However, the research devoted to it allows us to define it a new paradigm of economic development [16]. Moreover, the processes of digitalisation and digital transformation increas scientific interest to the neoindustrialisation [6].

Moreover, there is a significant difference between the import substitution strategy of the two historical periods. The industrial growth of the USSR during the period of industrialisation was mainly extensive – the level of production increased due to the raise in quantitative characteristics. Nevertheless, it is ineffective for the Russian Federation, since the modern Russian economy is already at an industrial stage of development and it requires intensive technological growth increasing labour productivity. Moreover, there is a shortage of qualified personnel in the Russian Federation today. Therefore, the quantitative growth of production is associated with a significant risk of labour shortages. The current import substitution strategy, accompanied by a number of additional incentive mechanisms, allows the Russian economy to regain its lost under the influence of sanctions positions in conditions of personnel shortage. Analysing the current indicators, there are some positive trends. According to the Russian Ministry of Economic Development in 2024, the manufacturing industry is showing growth of +17.9%. The machine-building complex accounts for about 40% of the total growth in manufacturing output; the overall growth in the complex is +55.5%. Meanwhile, output growth accelerated significantly to +32.7% in the production of transport vehicles and equipment[6].

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[6] *On the dynamics of industrial production. The Ministry of Economic Development of Russia. Source: https://www.economy.gov.ru/*

In modern conditions, high-tech technologies and innovative products are becoming a priority in import substitution [10]. The relevance of innovations in industrial production in the Russian Federation was studied by experts of the ISSEK of the Higher School of Economics. According to their research, the level of innovation activity in the Russian industry increased by +1.3% in 2023, compared with 2022. The largest increase in innovation activity occurred in the manufacturing industry due to both government industry support and increased consumer demand for domestic products. The total cost of innovation in industry has also increased to +9% compared to the level of 2022. The largest increase in innovation costs is in furniture, clothing, food, beverages, and tobacco production. However, the increase in the cost of innovation in high-tech industries, for example, in the manufacture of computers and electronics in 2023 amounted to +55.8%; the production of aircraft increases to +10.5% compared with 2022. The increase in the total volume of innovative high-tech products in 2023 was +19% compared to last year[7]. These shows the growing demand and production of high-tech goods. Domestic manufacturers of the high-tech industry were able to establish innovative production and introduce it into the market.

In 2022-2023, Russian production has become more innovative. The overall increase in innovation activity may shows a steady increase of economic policy effectiveness. The innovations became demanded by domestic companies largely due to the withdrawal of many foreign manufacturers from the Russian market. This increased the demand for domestic products. The government support for import substitution has increased the Russian economic development. The domestic manufacturer increases the production.

Currently, Artificial Intelligence (AI) is one of the most important components of industrial automation. The introduction of AI in the production provide the prospects for its development: reduction of production costs, greening of production, improvement of labour safety, etc. Meanwhile, according to the Skolkovo Research Centre's 2023 reports, the use of AI in industry is not widespread; only 20% of Russian companies use generative AI in production. Presumably, as a result of the national project 'Data Economy', by 2030, the contribution of AI to the GDP of the Russian Federation may amount to more than 11 trln RUB[8]. AI is currently used by Gazprom (to optimize gas production), Sber (optimization of logistics and production management), Rosatom (product quality control and forecasting of equipment technical condition), etc. The range of AI applications is extremely extensive. In general, the prospects for AI are difficult to overestimate. For example, according to PwC forecasts, by 2030, the growth of the global AI-based global economy will amount to $15.7 trln USD[9]. Therefore, artificial intelligence technology is an important component of the import substitution and neoindustrialisation strategy.

With sanctions being imposed against Russia, it is especially important to ensure stable regional socio-economic development. Therefore, to replace imports is a part of an independent economic policy.

According to the HSE, Russian regions have varying degrees of dependence on foreign technologies. The regions of the Russian Federation with a high share of the manufacturing industry in the domestic regional product, a high level of innovative development, and a multisectoral specialisation model are in the zone of maximum risk. In 2023, the Yaroslavl Region ranked 8th in terms of import dependence and contribution to the regional economy with a value of 4.7% (Table 1)

Indeed, the economic policy related to import substitution has been implemented in Yaroslavl region for a long time. On January 26, 2015, the Government of the Yaroslavl Region adopted Resolution No. 55-p "On approval of the consolidated import substitution plan in the Yaroslavl Region until 2020".[10]

Table 1 – Rating of the Russian Federation regions, level of import dependence, specialisation

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Rank	Region	The level of import dependence and specialisation, the contribution to the regional economy, %
1.	Kaluga region	5.8
2.	Ulyanovsk region	5.5
3.	Samara region	5.4
4.	The Republic of Tatarstan	5.0
5.	Vladimir region	5.0
6.	Nizhny Novgorod region	5.0
7.	Republic of Mari El	4.8
8.	Yaroslavl region	4.7
9.	Kurgan region	4.7
10.	Tula region	4.6

Source: Rating of Russian regions by import dependence of their specialisations[11]

On December 28, 2022, the Order of the Department of Investment, Industry and Foreign Economic Affairs of the Yaroslavl Region No. 418-OD "On the products necessary to ensure import substitution" was issued[12]. The Yaroslavl Chamber of Commerce and Industry has been actively cooperated with manufacturers. For instance, the Direct Contact service was established to share information about the goods and services produced by the local enterprises; the guidebook 'Subcontractors of the Yaroslavl Region' with information about the opportunities of regional industrial enterprises was published. As a result, the regional enterprises actively interact with each other. It promotes the development of new logistics chains and co-operation links. Moreover, the Chamber organises subcontract exchanges on the portal subcontractrf.ru.[13]

In December 2024, a new technological platform for import substitution had been introduced in Yaroslavl. An experimental metalworking plant has been established at Yaroslavl State Technical University (YSTU). The new site has more than 15 pieces of equipment. The new technology platform was created with a grant from the Ministry of Industry and Trade of Russia in the amount of 300 mln RUB. The latest modern equipment has been purchased for it. Moreover, the Yaroslavl group of companies Paritet uses domestic components and raw materials for the production of its key products. Instead of foreign engines, it uses engines from the Yaroslavl Motor Plant YaMZ-536.

Nevertheless, the systematic and comprehensive approach requires planning and implementation of effective import substitution strategy in the region in terms of the existing industrial potential [11], and the institutional environment [12]. Indeed, the regulatory and scientific foundations of this strategy should be provided at the federal level. According to the experience of countries overcoming sanctions for years, the most effective policy is a policy of "aggressive" market cooperation [7].

Conclusion

Based on the USSR experience, the import substitution strategy contains the following aspects in terms of the regions:

1. Development of competitive products demanded both in the domestic and global markets and produced by innovative technologies.

2. R&D to implement domestic and international experience in marketing, industrial cooperation, intersectoral and interregional integration, modern methods of increasing competitiveness, business

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[11] *On approval of the consolidated import substitution plan in the Yaroslavl Region until 2020. Source: https://docs.cntd.ru/docume nt/424026795?ysclid=m6jtm58y4q2365597 (accessed on 30.01.2025)*

[12] *On approval of the consolidated import substitution plan in the Yaroslavl Region until 2020. Source: https://docs.cntd.ru/docume nt/424026795?ysclid=m6jtm58y4q2365597 (accessed on 30.01.2025))*

[13] *From import substitution to import dependence. Kommersant. Source: https://www.kommersant.ru/doc/5607069?ysclid=m6jts10 bi7936539277 (accessed on 30.01.2025)*

ecosystems, etc.

3. Improving the quality of management in forecasting, planning and decision-making, monitoring the effects of sanctions in various areas, and responding quickly to emerging problems.

In the future, import substitution through neoindustrialisation allows the Russian economy to achieve a new level of its development. The active public participation in supporting innovation and industrial cooperation will contribute to the sustainable growth of small and medium-sized businesses. The development of the high-tech sector of GDP will allow Russia to achieve technological sovereignty and increase the resilience of the economy to global crises. Therefore, the economic policy related to the implementation of the import substitution strategy contains significant development potential.

The modern import substitution strategy implemented in the Russian Federation has deep historical roots. At the same time, the conducted research revealed significant differences due to new economic and political realities. They require a careful approach to the application of historical experience. The territorial differentiation of Russian regions and the degree of their economies dependence on imports determine the development individualised regional import substitution strategy. The successful implementation of the import substitution policy in Russia requires a flexible and adaptive approach combining government support, stimulating innovation, and the latest technologies. However, a key success factor is the transition from extensive to intensive development requires investments in technology and human capital.

CONFLICT OF INTEREST
The authors declare no conflict of interest.

AUTHORS' CONTRIBUTION
Konstantin A. Kruglov – writing.
Fedor A. Belyaev – writing.
Anna V. Rajkhlina – conceptualisation, project administration.

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