



Economic and statistical analysis of industrial production in the North Caucasian Federal District of the Russian Federation

Análisis económico y estadístico de la producción industrial en el Distrito Federal del Cáucaso Septentrional de la Federación Rusa

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ABSTRACT

The article substantiates the need to assess the industrial potential of a region to form an effective regional industrial policy with due regard to economic constraints and ongoing global exogenous changes. To attain this end, the study uses the tools and methods of mathematical statistics and system analysis. The authors of the article analyze the dynamics of industrial production in the North Caucasian Federal District of the Russian Federation, as well as the efficiency of using resources by certain industries and activities. As a result, they determine promising directions for the development of industrial potential in the region.

Keywords: Industry, Branch structure, Region, Analysis, Risk.

RESUMEN

El artículo corrobora la necesidad de evaluar el potencial industrial de una región para formular una política industrial regional eficaz teniendo debidamente en cuenta las limitaciones económicas y los cambios exógenos mundiales en curso. Para lograr este fin, el estudio utiliza las herramientas y métodos de la estadística matemática y el análisis de sistemas. Los autores del artículo analizan la dinámica de la producción industrial en el Distrito Federal del Cáucaso Norte de la Federación Rusa, así como la eficiencia en el uso de los recursos por parte de determinadas industrias y actividades. Como resultado, determinan direcciones prometedoras para el desarrollo del potencial industrial de la región.

Palabras claves: Industria, Estructura sectorial, Región, Análisis, Riesgo.

1. INTRODUCTION

Business conditions in today's Russia are among the most difficult from an economic viewpoint. Numerous sanctions and trade barriers have led to the disruption of integration and cooperative international ties of Russian business structures, a serious transformation of logistics chains, and an outflow of foreign investment and international companies from the country. As a result, serious changes occurred in the economy of regions, and new problems and tasks emerged in various sectors, including industry.

The approved Strategy for the Socio-Economic Development of the North Caucasus Federal District of the Russian Federation until 2030 defines the main ways and directions for achieving the sustainable socio-

economic development of this region, including the use of the existing industrial potential as a general indicator characterizing the development of productive forces.

The industrial production of this region is a determining factor in the current socioeconomic situation. It forms the regional industrial potential which reflects the economic independence of the region and its industrial development. The analysis and assessment of its industrial potential allow us to determine the existing efficiency of industrial production and find promising directions for the development of industries, considering regional competitive advantages.

Based on a high degree of self-sufficiency, the economic independence of regions conditions the need to assess their industrial potential to create and adjust the conditions for the growth and development of the industry with due regard to changing efficiency in the use of resources by industrial enterprises and the ongoing technological and economic shifts.

A set of measures that should contribute to the development of the industrial potential of this region is reflected in the regional industrial policy based on its socio-economic development, infrastructure, and available resources, including human resources. The effectiveness of the implemented regional industrial policy is assessed by four blocks of indicators, which allows for determining the rationality and effectiveness of the measures taken to maintain the current level of the regional industrial potential and identify promising areas of development with due regard to regional specifics.

Thus, the article aims at assessing the industrial potential of the North Caucasian Federal District for the formation of an effective regional industrial policy due to economic restrictions and geopolitical changes.

2. MATERIALS AND METHODS

In the course of the study, we considered scientific works in the field of developing the industrial potential of regions and optimizing their branch structure.

The conceptual foundations of the branch structure of industry in regions are developed based on two key theories: the theory of spatial development and the theory of regional economic development. The theory of spatial development substantiates the diversity of industrial structures by the heterogeneity of their economic environment, whose development is based on the geographical location of industries, sources of raw materials, and the availability of resources (Gainanov et al., 2017; Launhardt, 1869; Tyunen, 1926).

The theory of regional economic development is based on the fact that a region is a unit that generates products (Garnsey, 1956; Richardson, 1969). When regions establish relationships, they tend to relative equilibrium. When dynamic components (cycles, waves, phases, etc.) are included in this theory, levels of regional economic development are differentiated by the changing mobility of the existing production factors, which leads to the emergence of the branch structure of the regional economy (Bashirova, 2020). The concept of branch structure is used in relation to individual branches, in particular, industrial production. The branch structure of the region's industry is characterized by a certain hierarchy, heterogeneity, and certain proportions among industries (Schwarz, 2019; Urasova, Shcheglov, 2023).

Russian scientists consider the methodology for assessing regional industries and directions for increasing their industrial potential in various aspects (Khoroshev, Malykh, 2014; Lapaev et al., 2013; Normova, 2022).

To effectively assess regional industries, statistical indicators are used that express quantitative results of the activities of industries in the region (Normova, 2022). Many authors propose to use various methods for assessing the level of industrial development in the region, in particular, a system of indicators for multi-criteria assessment (Lapaev et al., 2013), a model for assessing sectoral priorities in the industry, including

four blocks of indicators (Khoroshev, Malykh, 2014), the use of correlation indicators to assess the branch structure of the region's industry to identify the most promising areas of its development (Moshkov, 2015), etc.

The analysis of studies on the assessment of industrial production in a particular region, as well as conditions and results of the functioning of its industries, allows using several methods and techniques that ensure the objectivity and reasonableness of generalizations, conclusions, and proposals.

The main methodological methods include economic and statistical dependencies based on various production functions, comparative analysis, cost, indirect and point estimates, calculation of indices, and compilation of matrices.

The surveys and reports of the Federal State Statistics Service (Federalnaya sluzhba gosudarstvennoi statistiki, n.d.), as well as open resources by industry sectors, were used as the information basis for the study.

The instrumental and methodological apparatus is based on the systemic approach to the object under study. The basic premise of the study was the methodological relationship between the sustainable development of industrial production and the self-organization of the economic system, which allows identifying problem areas and control parameters within economic efficiency, reflecting the convective transfer of the main external and internal properties with due regard to the optimal use of available resources.

Economic and statistical models aimed at increasing the level of industrial production in accordance with the tasks, levels of research, and classification criteria can take various forms based on the need for the efficient use of available resources, optimal investment activity, the most favorable location of industrial production, and proper current and long-term planning.

The level of efficiency is characterized by indicators of profitability that reflect the ratio of the profit received and the resources spent on production. The use of a separate resource type in the indicator will show the level of efficiency in the use of this resource.

Within the framework of this study, we used indicators of return on sales and return on assets (1, 2):

$$R_p = \frac{P}{C} \quad (1)$$

$$R_a = \frac{P}{A} \quad (2)$$

where R_p is the profitability of sold goods and products (services); R_a is the return on assets; P is the balanced financial result (profit minus loss) received from the sale of goods and products (services); C is the cost of the goods and products (services) sold, including commercial and administrative expenses; A is the value of enterprise assets.

The development of the necessary measures to ensure the effectiveness of economic activity in the modern market predetermines the need to assess the risk of industrial production. For these purposes, it is advisable to use the statistical method of risk assessment based on the calculation of volatility indicators.

Relative volatility indicators common to research are calculated by dividing absolute indicators by the average level for the entire study period. The coefficient of variation is one of the generalizing indicators that measure the amount of risk per unit of the expected result (Vasileva et al., 2007) (3, 4):

$$V = \frac{\sigma}{k} \quad (3)$$

$$S = \sqrt{\frac{\sum_{i=1}^n (x_i - k)^2}{(n-p)}} \quad (4)$$

where V (S) is the coefficient of variation; S is the standard deviation; x_i is the actual value of the result; k is the average expected value of the result; n is the number of levels (the number of enterprises in the commodity market under consideration); p is the number of equation parameters.

The use of a complex indicator that characterizes the dynamics of the level stability coefficient provides for the possibility of calculating the level risk criterion as the ratio of the average annual trend growth, for example, linear $y = ax + b$, i.e. the “a” parameter to the standard deviation (Vasileva et al., 2007):

$$U = \frac{a}{s} \quad (5)$$

where U is the level risk criterion.

If the U indicator is higher than 1, the levels of time series grow faster than fluctuations, and the ratio of the increase in levels to the standard deviation also increases, which indicates an increase in the stability of production and a decrease in the dynamics of risks. If the level risk criterion is less than 1, the fluctuations increase more than levels, and the risk indicator decrease.

The rationale for selecting economic and statistical methods is based on certain indicators that allow us to identify the constraining factors of industrial development under risk. This toolkit can be adapted to be used in studies on the risk of industrial production at all levels: from individual economic entities to the global economy, which creates conditions for the validity and authenticity of generalizations, conclusions, and statements.

3. RESULTS AND DISCUSSION

The North Caucasian Federal District is one of the federal districts of the Russian Federation. The district includes seven constituent entities of the Russian Federation. In 2022, the district occupies 1% of the country’s area but it concentrates natural and balneological resources and mineral and thermal waters. At the end of 2021, its gross value added amounted to 2,696 billion rubles, which is 2.3% of the country’s gross regional product.

Fig. 1 indicates that in 2021 the largest contribution to the gross value added of the district was made by the Stavropol Krai (38%), whose GRP reached 1,025 billion rubles, and the Republic of Dagestan (30%).

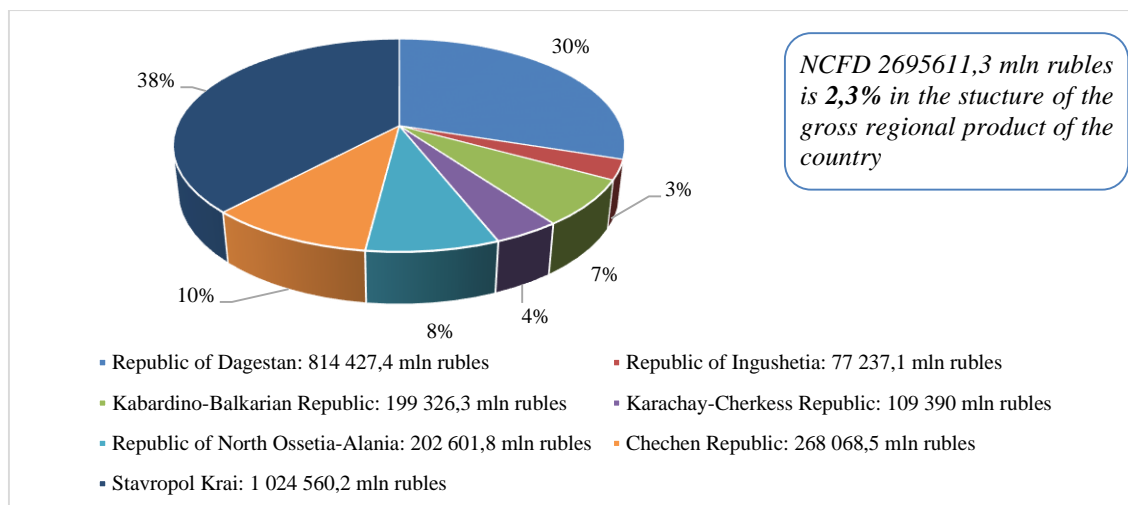


Figure 1. Gross regional product (GRP) of the North Caucasus Federal District in 2021, in million rubles. Source: compiled by the authors based on data from <https://rosstat.gov.ru> (Federalnaya sluzhba gosudarstvennoi statistiki, n.d.).

The industrial production of the North Caucasus Federal District provides more than 30% of the region's gross value added. The predominant share in the branch structure of the industry is occupied by mining and manufacturing industries, which employ the population and tax revenues to the regional budget. In addition, in food, chemical, and metallurgical industries, mechanical engineering and the production of building materials are developed.

Considering the index of industrial production calculated in relation to the corresponding period of the previous year (Fig. 2), the maximum indicators were observed in 2011 (109.8%), and the minimum were recorded in 2018 (95.3%), with a variation range of 14.5%. During 2010-2021, the dynamics of industrial production in the North Caucasus Federal District demonstrated significant volatility.

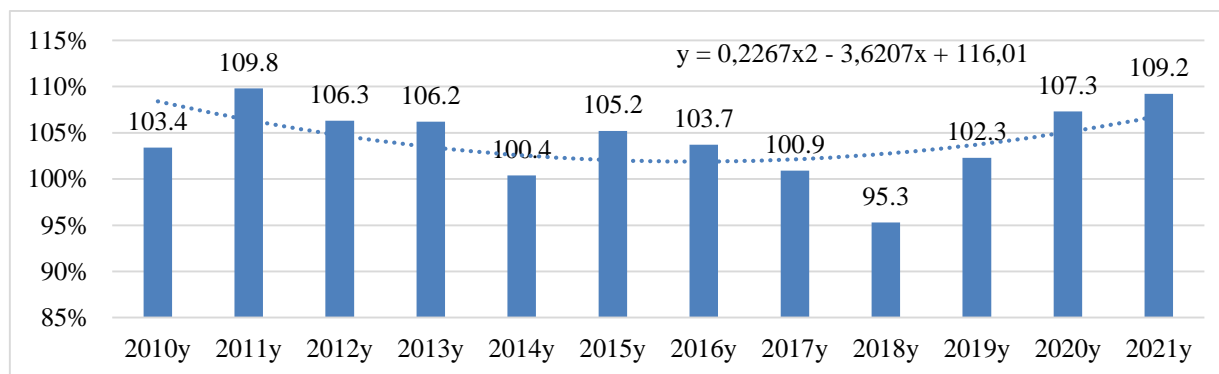


Figure 2. Industrial production index in the North Caucasus Federal District in 2010-2021, as % of the previous year. Source: compiled by the authors based on data from <https://rosstat.gov.ru> (Federalnaya sluzhba gosudarstvennoi statistiki, n.d.).

In 2022, significant changes in the functioning of economic activities also affected the results of industrial production in the North Caucasus Federal District. Compared to 2021, the industrial production of the North Caucasus Federal District increased by 2.7% in 2022. During 2022, industrial production increased in Dagestan (+8.5%), North Ossetia (+6%), Ingushetia (+10.8%), Karachay-Cherkessia (+5.6%), Chechnya (+5.6%), and Kabardino-Balkaria (+2.1%).

In 2022, the index of industrial production in the field of mining in the North Caucasus Federal District amounted to 98.1%. The highest growth was recorded in the Chechen Republic (+16.8%), and the largest

decrease occurred in Dagestan (-14.8%). Compared to 2021, manufacturing in the North Caucasus Federal District increased by 3.1% in 2022. A significant increase in output was noted in Dagestan and Ingushetia (+12.6%). The production of electricity, gas, and steam in the North Caucasus increased by 0.8%. The largest increase was noted in Karachay-Cherkessia and Kabardino-Balkaria (by 12.1 and 12%, respectively). Production in the field of water supply and sanitation, waste collection and disposal, as well as activities to eliminate pollution, increased by 6.3% in the North Caucasus Federal District in 2022. The highest growth was registered in Ingushetia (by a factor of 1.6).

The current structure of the manufacturing industry in the North Caucasus Federal District is dominated by the production of food and beverages (35%), as well as the production of chemicals and chemical products and the production of medicines and materials used for medical purposes (29%). In terms of mining, 68% is attributed to oil and natural gas, 16.5% is the provision of services in the field of mining, 9.4% is the extraction of other minerals, and 5.9% is the extraction of metal ores. The leader in all sectors of industrial production is the Stavropol Krai, as evidenced by Fig. 3.

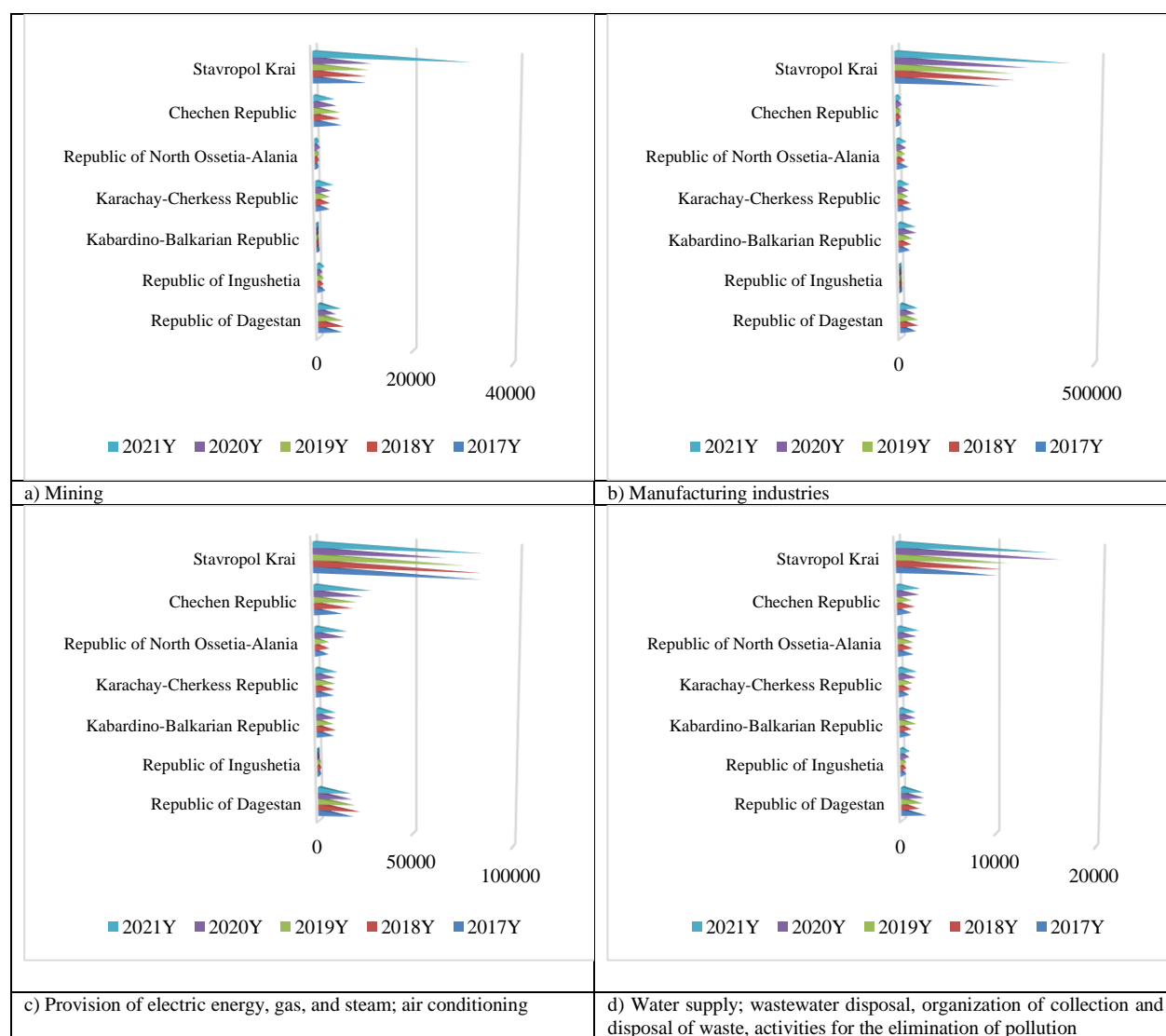


Figure 3. Dynamics of the volume of shipped goods of own production, works, and services performed by regions of the North Caucasus Federal District by type of economic activity, in actual prices (million rubles). Source: compiled by the authors based on data from <https://rosstat.gov.ru> (Federal'naya sluzhba gosudarstvennoi statistiki, n.d.).

Our analysis proves that the industrial development of the North Caucasus Federal District is highly uneven. This is primarily due to the existing natural competitive advantages of each region, provided by natural, industrial, labor, and intellectual potentials. These aspects significantly affect the formation of the branch structure of the industry in the North Caucasus Federal District.

Based on the conducted research, it can be concluded that the sustainable socio-economic development of this region is determined by the stable functioning of the main industries, which reflect the competitive advantages of a particular regional system. The sustainable development of industrial production should entail the technological and technical development of the regional economy even under exogenous changes.

The sustainability of industrial production is based on general and special principles, interrelations, and interdependencies of the region's economy and its self-organization with due regard to the dialectical unity of factors and conditions of economic activity in an aggressive market environment. The instability of environmental factors conditions the possibility of risks and assessing their impact on the development of industries in a particular region (Ter-Grigoryants, Deryzemlya, 2021; Ter-Grigoryants et al., 2022).

For the sustainable development of industry in the region, it is necessary to ensure a rigid relationship between the volume of output and the number of production factors used, which will determine the effectiveness of the ongoing regional industrial policy.

A generally accepted indicator of production efficiency is a criterion that expresses the relationship between the result and the functioning resource. Depending on the ratio, two indicators can be calculated: forward and backward. The former represents the ratio of the result obtained to the resources and characterizes the output per unit of the resource. The larger the value, the higher the resource efficiency. The latter reflects the ratio of invested resources to results and characterizes the capacity of the resource per unit of output. The larger the value, the lower the resource use. There will be as many forward and backward indicators as there are elements of the resource potential, each of them characterizes the use of a particular resource (Vasileva et al., 2007).

Fig. 4 indicates that the highest level of production profitability was typical of manufacturing enterprises during 2010-2021.

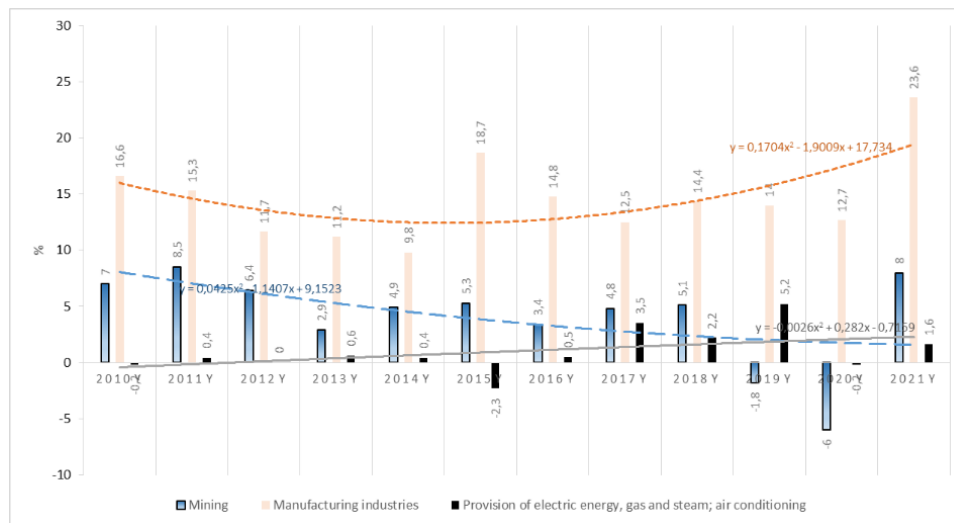


Figure 4. Dynamics of profitability of the goods, products, and services sold by enterprises of the North Caucasus Federal District for mining, manufacturing, production, and distribution of electricity, gas, and water in 2010-2021 (actual values and polynomial trends), %.

Source: compiled by the authors based on data from <https://rosstat.gov.ru> (Federal'naya sluzhba gosudarstvennoi statistiki, n.d.).

Thus, the profitability of production in 2021 amounted to 23%, which is 7% more than in 2010. During the study period, mining was characterized by insufficient performance indicators. In 2010–2018, production was profitable. In 2019 and 2020, there was a decrease in economic activity (-6% in 2020). However, the profitability of mining was 8% in 2021. In terms of electricity, gas, and steam supply, as well as air conditioning activities, these industries show the lowest cost recovery rates. There is a 25% probability of unprofitable production among such enterprises.

Considering the efficiency of using all the assets of enterprises (Fig. 5), it should be noted that the fluctuation of this indicator is high in all sectors of industrial production in the North Caucasus Federal District.

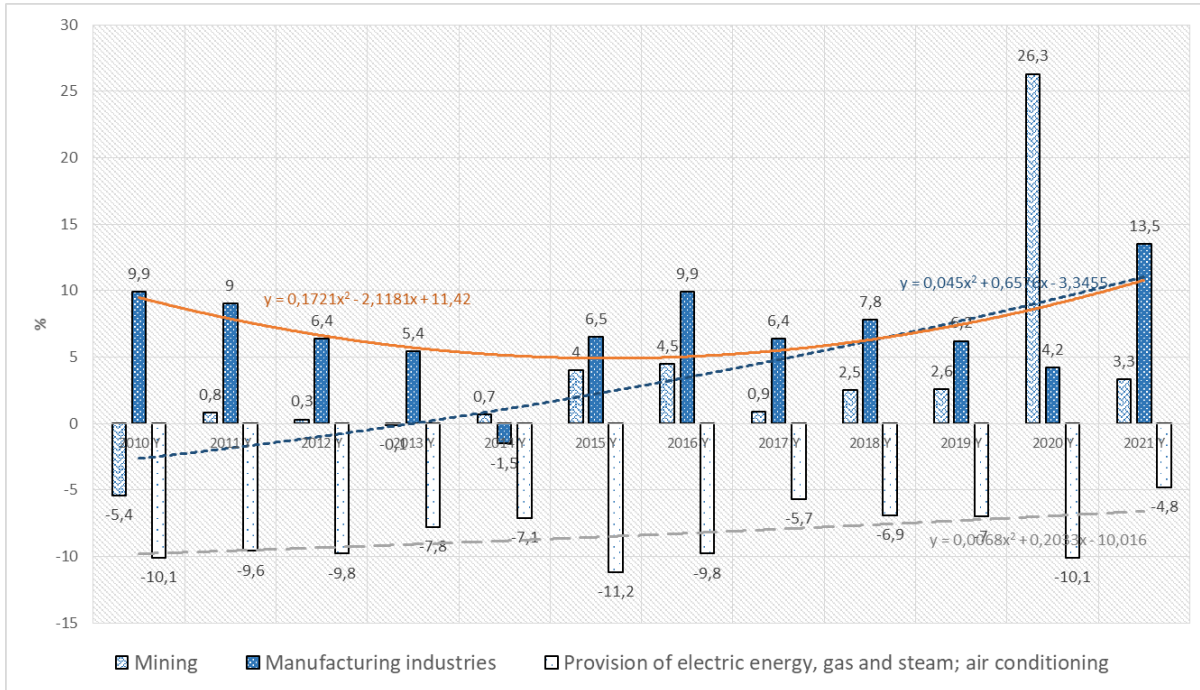


Figure 5. Dynamic return on assets of enterprises in the North Caucasus Federal District for mining, manufacturing, production, and distribution of electricity, gas, and water in 2010-2021 (actual values and polynomial trends), %.

Source: compiled by the authors based on data from <https://rosstat.gov.ru> (Federalnaya sluzhba gosudarstvennoi statistiki, n.d.).

In 2010-2021, businesses in the electricity, gas, and steam industries failed to make efficient use of their assets. In general, the return on assets of industrial enterprises of the North Caucasus Federal District indicates the insufficient performance of their activities.

The above-mentioned relative indicators of volatility are interpreted in the following manner: the higher the indicator value, the higher the risk and the lower the sustainability of production; the weaker the volatility, the lower the risk of production. An increase in absolute volatility should not always be interpreted as a negative factor. If there is an increase in volatility and an increase in actual production volumes, the risk of economic activity might decrease. This phenomenon reflects the growth of guaranteed minimums typical of crisis periods. A low level of volatility, which means high stability of the levels of time series, does not indicate progress. As a result, it is important to analyze the risk of a trend calculated as a criterion measuring the dynamics of the levels of the phenomenon under study.

The calculations of fluctuation indicators of industrial production in the North Caucasus Federal District are shown in Table 1.

Table 1. Estimated fluctuations in the industrial production of the North Caucasus Federal District of the Russian Federation in 2010-2021.

Branch	Average value, %		Variation coefficient		Level risk criterion	
	2010-2015	2016-2021	2010-2015	2016-2021	2010-2015	2016-2021
1	2	3	4	5	6	7
Profitability of the goods, products, and services sold						
Mining	5.83	2.25	0.33	2.30	-0.34	-0.09
Manufacturing industries	13.88	15.33	0.25	0.27	-0.05	0.30
Provision of electricity, gas, and steam; air conditioning	-0.18	2.13	-5.88	0.93	-0.26	-0.04
Return on assets						
Mining	0.05	6.68	60.91	1.45	0.43	0.21
Manufacturing industries	5.95	8.00	0.68	0.41	-0.35	0.09
Provision of electricity, gas, and steam; air conditioning	-9.27	-7.38	-0.16	-0.29	0.07	0.16

Source: calculated by the authors based on data from <https://rosstat.gov.ru> (Federalnaya sluzhba gosudarstvennoi statistiki, n.d.).

The study allows us to conclude that the riskiest type of activity in the North Caucasus Federal District is mining, and the least risky is manufacturing. Despite low-performance indicators in the field of providing electricity, gas, and steam, as well as air conditioning, there is a planned decrease in management risks in these industries.

Based on the analysis of efficiency indicators and industrial production fluctuations, we assessed the industrial potential of each region in the North Caucasus Federal District by industry and type of activity (Table 2).

Table 2. The assessment of the industrial potential of the North Caucasus Federal District by industry and type of activity.

Branches and activities	Potential*		
	Not developed enough	Medium level of development	Most developed / promising
Manufacturing industries: food production, including beverages and tobacco			RD, RI, KBR, KCR, NOA, CR, SK
Textile and clothing production; leather, leather goods, and footwear manufacturing	RI, NOA, CR	KBR	RD, KCR, SK
Wood processing and wood production	RD, RI, KBR, KCR, NOA, CR, SK		
Pulp and paper production	RD, RI, KBR, KCR, NOA, CR	SK	
Coke and oil, rubber and plastic production	KBR, NOA, CR	RI, KCR	RD, SK
Chemical production and production of pharmaceuticals	RI, KCR, CR, NOA	KBR, RD	SK
Other non-metallic mineral production	NOA	RI, KBR, KCR, CR	RDSK
Metallurgical production and production of finished metal products	NOA, CR	RD, KBR, KCR	RI, SK
Production of machinery and equipment, including vehicles	RI, KBR, KCR, NOA	CR	RD, SK

Manufacturing of computers, electronic and optical products, electrical equipment	RI, CR, NOA	RD, KBR, KCR	SK
Production and distribution of electricity, gas, and water	RI	RD, SK	KBR, KCR, NOA, CR
Mining	RI, KBR	KCR, CR, SK	RD, NOA

*Republic of Dagestan – RD
 Republic of Ingushetia – RI
 Kabardino-Balkarian Republic – KBR
 Karachay-Cherkess Republic – KCR
 Republic of North Ossetia-Alania – NOA
 Chechen Republic – CR
 Stavropol Krai – SK

Source: compiled by the authors.

Thus, the Stavropol Krai has the maximum competitive advantages for the development of industrial potential among all the regions of the North Caucasus Federal District. Two large power plants and a good level of gasification in these territories can become a significant advantage in the development of new production. When developing the industrial potential of the North Caucasus Federal District, it is necessary to pay attention to a variety of industrial and agro-industrial clusters which allow receiving state support.

4. CONCLUSION

In the context of political and economic challenges faced by the Russian economy today, new opportunities and incentives are emerging for increasing the competitiveness of industrial enterprises, creating new industries, and developing priority sectors of the national economy. The North Caucasian Federal District is a promising macro-region in terms of industrial development both to meet their own needs and to substitute imports at the national level.

Important prerequisites for ensuring the sustainable dynamics and efficient functioning of regional industries are a balanced economic policy in terms of creating special economic zones and industrial clusters, elaborating and implementing investment projects for the development of industries, and delimiting the powers of the federal and regional levels in the field of improving management mechanisms and stimulating mutually beneficial economic relations between business entities for the production and sale of high-quality industrial products.

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