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ASSESSMENT OF SUSTAINABLE DEVELOPMENT IN REGIONAL INDUSTRIAL SECTORS UNDER SANCTIONS

AVALIAÇÃO DO DESENVOLVIMENTO SUSTENTÁVEL EM SETORES INDUSTRIAIS REGIONAIS SOB SANÇÕES

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ABSTRACT

Introduction: This study evaluates the adaptation and recovery potential of Russia's industrial sectors, focusing on the Republic of Tatarstan. It emphasizes resilience under sanctions by assessing import dependence and adaptation efficiency as key factors.

Objective: To identify risks and opportunities for sustainable development in regional industrial sectors and inform public policy for adaptation to emerging economic and geopolitical dynamics.

Methodology: The methodology integrates statistical data analysis (2012-2021) with econometric models to measure import dependency and recovery efficiency. A two-dimensional matrix was developed to map sector resilience under sanction pressures.

Results: The analysis identified priority sectors in Tatarstan requiring strategic support to enhance resilience and competitiveness. Vulnerable sectors, such as chemicals, electronics, and vehicles, need diversified sources and modernized supply chains to mitigate import dependence risks.

Conclusion: The proposed methodology effectively assesses and supports vulnerable sectors. Actions such as import reorientation and innovation investments are vital for sustaining regional development amid external pressures.

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Keywords: Import Substitution, Sustainable Economic Growth, Transnational Supply Chains, Recovery Efficiency, Industrial Sectors.

RESUMO

Introdução: Este estudo avalia a capacidade de adaptação e recuperação dos setores industriais da Rússia, com foco na República do Tartaristão. A pesquisa analisa a resiliência desses setores sob pressões de sanções, destacando dependência de importações e eficiência de adaptação como fatores centrais.

Objetivo: Identificar os riscos e oportunidades para o desenvolvimento sustentável de setores industriais regionais e orientar políticas públicas para adaptação a novas realidades econômicas e geopolíticas.

Metodologia: A abordagem metodológica combina análise de dados estatísticos (2012-2021) e modelos econométricos para avaliar a dependência de importações e a eficiência de recuperação de setores industriais. Foram construídas matrizes bidimensionais para mapear a resiliência dos setores sob pressão de sanções.

Resultados: O estudo identificou setores prioritários no Tartaristão que requerem suporte estratégico para fortalecer sua resiliência e competitividade. A análise revelou vulnerabilidades em setores fortemente dependentes de importações, como produtos químicos, eletrônicos e veículos, destacando a necessidade de diversificar fontes e modernizar cadeias de suprimentos.

Conclusão: A metodologia proposta é eficaz para avaliar e planejar o suporte a setores vulneráveis. Medidas como reorientação de importações e investimentos em inovação são essenciais para sustentar o desenvolvimento regional frente às pressões externas.

Palavras-chave: Substituição de Importações, Crescimento Econômico Sustentável, Cadeias de Suprimentos Transnacionais, Eficiência de Recuperação, Setores Industriais.

1 INTRODUCTION

In recent years, growing tensions in the global economy have been driven by several factors. Foremost among these are geopolitical instabilities, prompting shifts in economic policies in major countries like the US and China, and other economically significant nations. The resulting intensification of international competition leads to deglobalization and fragmentation of economic growth centers. This trend encourages the adoption of protectionist policies, expressed through increasing trade restrictions, a greater reliance on measures limiting international trade relations, etc. Among the many emerging trends in the transformation of foreign economic relations, sanctions stand out, heightening the geopolitical and geoeconomic tensions. This issue is particularly urgent for the Russian economy, which faced external pressures in 2014,

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escalating significantly between 2022 and 2024. As a result of the ongoing sanctions from Western countries, processes related to international economic relations had to adjust.

In this environment, identifying mechanisms to mitigate risks to the consistency of trade and economic activities is crucial. While Russia's national economy has stabilizers to absorb market volatility, sector-specific vulnerabilities still arise. These are apparent in the varying resilience of individual sectors and regions to economic shocks. There is a pressing need for systematic monitoring of regional and sectoral adaptation to sanctions and identifying and developing key mechanisms that sustain balanced economic growth on macro and regional-sectoral levels.

This issue is especially pertinent to Russia's industrial sectors, heavily integrated into international supply chains and thus vulnerable to import restrictions on goods for intermediate and final. Studying the shifts within the global economic landscape and their impact on Russia's sustainable economic growth is critical from scientific and practical standpoints. The article aims to assess the adaptation and recovery growth prospects of regional industrial sectors in Russia, with a specific focus on the Republic of Tatarstan.

2 LITERATURE REVIEW

Sanction-based restrictions on foreign trade require new conceptual approaches to the growth of economic systems integrated into sanction-driven conflicts. This issue is particularly relevant at the regional and sectoral levels. This aspect has been less explored in academic literature compared to national economic systems. The significance of evaluating the sustainable development of economic systems at the meso level is determined by the principles of systems analysis, which require examining individual elements of the system to assess the prospects for its integrity and development.

The regional and sectoral level of economic development in the context of increased import dependency and changing foreign economic conditions has been studied by M.N. Uvarova et al. (2022), A.R. Adewale (2017), A. Broocks and J.V. Biesebroeck (2017), A.S. Evtyukhina (2017), G. Alessandria et al. (2021); M. Bershka and R. Lee (2022), C. Grimme et al. (2021), L.-Yu. And G. Huang (2022), D.A. Irwin (2021), and F. Leibovici and M.E. Waugh (2019).

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Particular attention is paid to issues surrounding the sustainable development of economic systems under the pressure of sanctions on export-import operations of economic agents. Sanction-based confrontations, as a tool of state regulation in foreign economic affairs at the national level, gained significant momentum in the 1960s. Since then, this mechanism has rapidly evolved and is now intensively used in the national policies of several countries. Given the relevance of this issue in recent years, numerous studies have been conducted in this area (Animitsa et al., 2015; Alekhina & Zakharkina, 2018; Yevtyukhin, 2017; Tyukavkin & Anisimova, 2023; Hoang & Breugelmans, 2023; Karuppiah & Sankaranarayanan, 2023; Bali & Rapelanoro, 2021; Carfora et al., 2022).

Despite the research dedicated to the sustainable development of economic systems at the meso level, especially under the constraints of foreign trade sanctions, the need to develop theoretical and methodological tools remains. This gap is due to insufficient research on the meso-level examination of the prospects for developing regional industrial complexes in neoclassical and neo-Keynesian economic growth models, especially in the context of the increasingly competitive international environment.

3 METHODS

Based on the principles of comprehensive analysis, one of the key components of the research is descriptive data analysis of common patterns and building economic dynamics models on this basis. These models should rely on the application of economic-mathematical tools. Turning to the second component that determined the methodological foundation for solving the task set in this research, our approach to developing the corresponding tools is presented below. The core of this approach involves assessing the sustainability of industrial sectors in the face of sanction pressure through the lens of two key characteristics:

- Vulnerability of the type of economic activity to changes in the supply of goods for intermediate and final consumption from abroad (import dependence);

- Restoration efficiency expressed in the adaptation to new operating conditions and the return to a new equilibrium growth trajectory.

The relationship between these parameters, which characterize the resilience of industrial sectors in the region under the destructive effects of sanction pressure,

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determines the positioning of the types of economic activity in the geopolitical system of sanction coordinates.

Methodologically, the assessment of the resilience of industrial sectors in the context of the proposed research direction includes four key steps.

Step 1. Collection and systematization of statistical data.

As the foundation for constructing models that assess the relationships between sustainable economic development at the regional and sectoral levels and the resilience parameters of the industrial sectors under analysis, the statistical database from 2012 to 2021 is used. The upper limit of the time series is constrained by the fragmentary nature of statistical data, which characterizes trends in foreign economic activity at the regional and sectoral levels.

Step 2. Assessment of the dependency of regional industrial economic activities on the import supply of intermediate and final consumption goods.

This research stage is methodologically implemented through the following iterative actions:

2.1 Systematization of the commodity nomenclature of imports supplied to regional industrial sectors and subsequent synchronization with OKVED (Russian National Classifier of Economic Activities) codes relating to the industrial complex. This stage forms the basis for identifying industries' dependency on the supply of intermediate and final consumption goods from abroad.

2.2 Building a series of regression models that assess the impact of import supply on the gross value-added of each industrial sector in the region. In model form, this iteration is represented by Formula 1:

$Yi = a + bxi + ei$ (1)

where Yi is the gross value added in the studied industrial sector (i);

xi is the import of intermediate and final consumption goods used in the industrial sector (i);

b is the elasticity coefficient.

2.3 Ranking elasticity coefficients for the exogenous factor (import commodity nomenclature) and constructing standardized values for unification and adjustment to a range between 0 and 1.

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Step 3. Assessment of the recovery efficiency of the industrial sector under external pressure on the national economic system.

The parameter assessing the recovery efficiency of regional-sectoral complexes is proposed to be studied through the lens of indicative analysis of groups of statistical data, aggregated by common characteristics. Agreeing with (Noelle, 2021; Zolotukhina, 2017), the indicators selected for analysis characterize key parameters of the sectors' economic development sustainability (Table 1).

Table 1. Grouping of indicators of industrial sector development efficiency in the region, in the framework of their profiling and related correspondence

Group 1	- Volume of goods shipped - Degree of wear of fixed assets at the end of the year - Coefficient of fixed asset renewal - Industrial production index - Share of unprofitable organizations
Group 2	- Investments in fixed capital - Expenditures on innovations - Volume of innovative products shipped
Group 3	- Product profitability - Net financial result - Liquidity ratio - Equity ratio - Autonomy ratio
Group 4	- Average number of employees in organizations - Average monthly wage - Share of employees working in hazardous industries

Source: Developed by the authors

Methodologically, this research stage is implemented through the following sequence of iterative actions:

1. Calculation of lower and upper threshold values and normalized indices.

2. Calculation of intermediate indices (I1, I2, I3, I4) using the arithmetic mean of the corresponding indicators.

3. Calculation of the normalized integral index of sector recovery according to Formula 2:

$$I\ recovery = \frac{\sum weight_{I_j} * I_j}{\sum weight_{I_j}} \quad (2)$$

where Ij is the intermediate index,

∑weight1 is the weight of this index in the integral recovery index.

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To determine the weights of the indices, a numerical method for determining the weights of subindices was used Safiullin & Yelshin, 2023). The relative dispersion coefficient for each indicator is calculated using Formula 3:

$$\delta_i = \frac{x_{imax} - x_{imin}}{x_{imax}} \quad (3)$$

where ximax and ximin are the maximum and minimum values of the i indicator.

Based on this, the weight coefficients are assigned the highest value for those criteria whose relative dispersion is the most significant (Formula 4):

$$\omega_i \frac{\delta_i}{\sum_{i=1}^{m} \delta_1} \quad (4)$$

where m is the number of indicators.

For the calculations, 2022 was chosen as the reference period, characterized by high volatility in economic processes due to sanctions pressure.

Step 4. Construction of a two-dimensional matrix reflecting the positioning of industrial sectors based on the analyzed parameters assessing their resilience and development potential under sanctions pressure.

The matrix is constructed based on the design of coordinate axes. The x-axis reflects the values of the parameter characterizing the recovery efficiency of the industrial sector of the region's economy. The y-axis represents the sector's vulnerability to transformational processes in external markets. The distribution area of economic activities based on the axes, which reflect their resilience, is divided into four quadrants according to the principle of median division of the spatial geometric area.

The distribution of economic sectors in this coordinate system based on the four quadrants provides the potential for identifying their strategic positions in the context of their sustainable development under sanctions pressure.

4 RESULTS

The proposed methodological approaches were tested using the example of Tatarstan, a in socioeconomic and industrial development in Russia. The choice of this region is also due to its industry structure which closely resembles the structural organization of Russia's national economy. Thus, our assessments and results apply to the Russian economy.

Tatarstan is one of the most dynamic regions in Russia in terms of economic growth. By the end of 2023, the region ranked fifth among Russian regions by GRP and fifth

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by investment volume. According to the Ministry of Economy of the Republic of Tatarstan, the GRP for 2023 was estimated at 4.104 trillion rubles.

From 1998 to 2023, the region's GRP decreased only three times: in 1998 (91.4%) due to the economic crisis in Russia, in 2009 (96.6%) due to the global economic crisis that started in 2008, and in 2020 (96.9%) due to the recession caused by the COVID-19 pandemic (Figure 1). In 2015, Tatarstan's economy showed stagnation, and the GRP growth index was 100.0%. A similar situation is seen in the dynamics of the physical volume index of GRP in Russia.

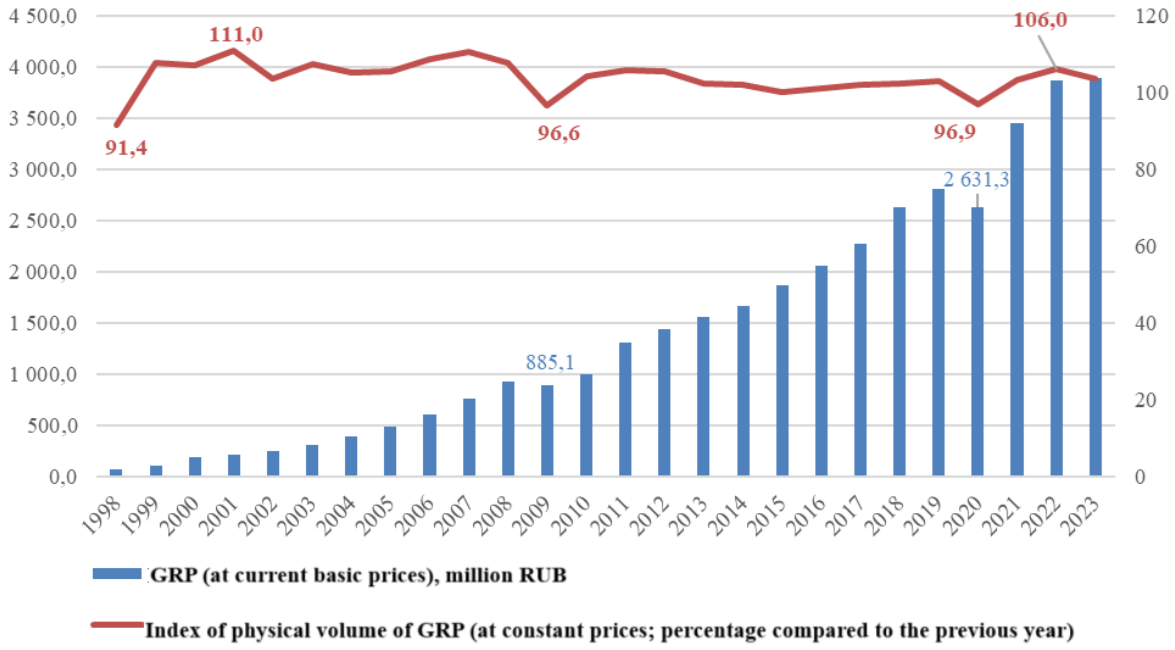

Figure 1. Dynamics of GRP and the physical volume ondex of GRP of Tatarstan, 1998-2023. Source: according to 1998-2022 Rosstat data (Osnovnyye pokazateli sotsialno-ekonomicheskogo razvitiya, 2023)

In the structure of Tatarstan's GRP (Figure 2), industrial activities dominate in 2023, accounting for 47.1%. Of them, the share of mining activities is 25.2%, manufacturing industries 24.6%, electricity, gas, steam, and air conditioning supply 1.8%, and water supply, sewage, waste collection, and waste management activities 0.5%. Agriculture accounts for 4.1%, construction 8.2%, wholesale and retail trade 10.7%, and transportation and storage 5.3%.

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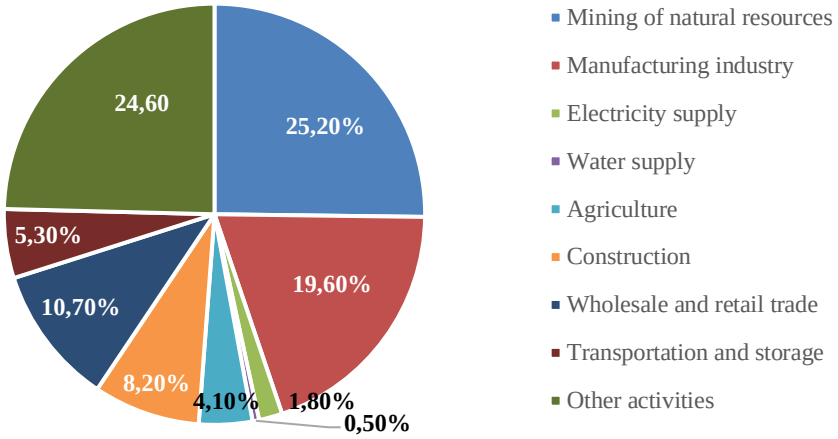

Figure 2. Structure of the GRP of Tatarstan in 2023.
Source: Rosstat (Osnovnyye pokazateli sotsialno-ekonomicheskogo razvitiya, 2023)

In the industry structure (Figure 3), the share of mining of natural resources was 23.7%, manufacturing industries 71.2%, electricity, gas, steam supply, and air conditioning 3.8%, and water supply, waste disposal, and pollution cleanup activities 1.3%.

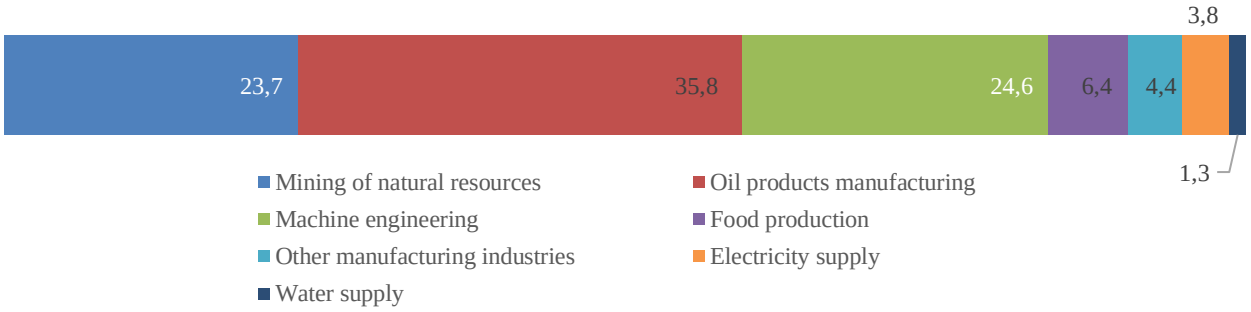

Figure 3. Industry structure of Tatarstan in 2023
Source: Rosstat (Osnovnyye pokazateli sotsialno-ekonomicheskogo razvitiya, 2023)

An essential parameter characterizing regional development is its integration into the international division of labor. This aspect becomes particularly relevant under external pressure on the Russian national economy, which largely predetermines the prospects for regional development in the framework of external restrictions on export-import operations. An analysis of the structural features of the region's foreign economic activity determines the prospects for the stability of key macroeconomic indicators and competitive position at the national level. Some of the current statistical data showing the main parameters of foreign trade operations at the regional level are unavailable in the general databases of Rosstat and other government bodies.

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Therefore, the analysis of these aspects will be presented for the "acute" post-sanction period as of 2022.

The foreign trade turnover of Tatarstan increased by 40.8% in 2021, reaching 17,546,399.2 thousand USD (Osnovnyye pokazateli sotsialno-ekonomicheskogo razvitiya, 2023). This growth was driven by a 50.4% increase in imports (1,833,106.6 thousand USD in value), while exports rose by 36.8% (3,247,857.1 thousand USD). The volume of imports from foreign countries grew faster than exports: +52.8% (1,773,384.4 thousand USD in value) compared to export growth of +45.7% (3,230,729.8 thousand USD).

The commodity structure of imports consistently maintains a high dependence on supplies of goods such as machinery, equipment, and vehicles (69.04%), chemical industry products (16.3%), and, to a lesser extent, metals and metal products (6.17%) (Figure 4).

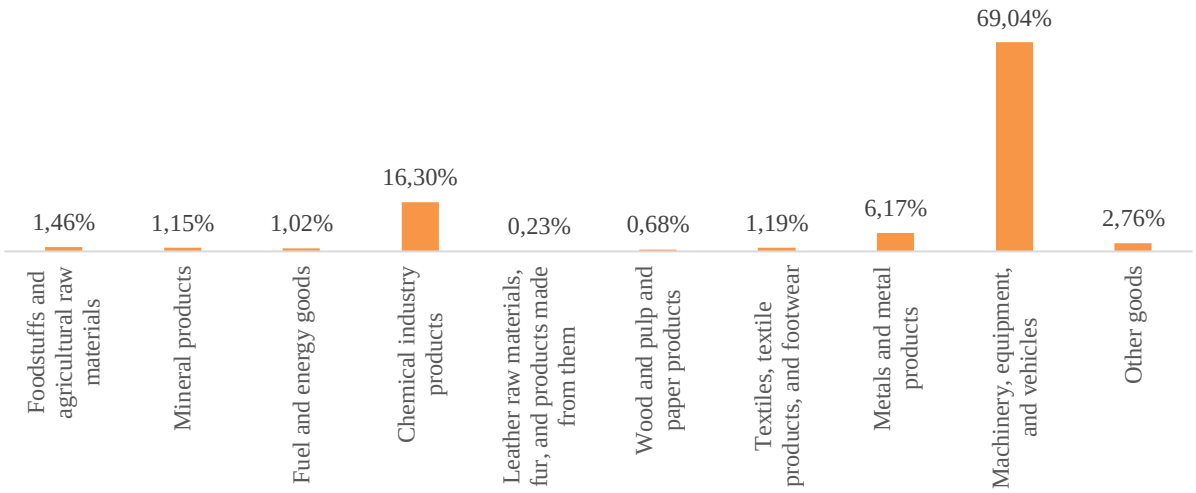

Figure 4. Shares of commodity groups in Tatarstan's imports in 2021

Source: Compiled by the authors based on data from the Federal Customs Service of Russia (Privolzhskoye tamozhennoye upravleniye, n.d.)

The analysis of the main economic development parameters in Tatarstan demonstrates high indicators of macroeconomic dynamics. However, according to the data presented on the region's import dependency, there are indications of its vulnerability to sanctions limiting the supply of goods from abroad. These risks were mitigated and neutralized in 2022-2023 by redirecting supply geographies, establishing parallel import schemes, and advancing technological solutions in the Fintech sector to ensure relatively uninterrupted transnational supplies and associated international payments. The increased sanction pressure in 2024 (for instance, disconnecting the

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Moscow Interbank Currency Exchange (MICEX) from transnational US dollar and euro trading) underscores the need for heightened attention to sustainable development in regional industrial complexes against growing risks to the rhythm of export-import operations.

Considering these threats and the risks to maintaining the development dynamics of regional industrial complexes and relying on the proposed methodological tools, the following section provides an application example based on an industrial sector of Tatarstan's economy, OKVED 29 "Manufacture of motor vehicles, trailers, and semi-trailers".

In the first phase, iterations were conducted to identify import commodity groups essential for the economic activities of the sector under study. Based on data from the Federal Customs Service of Russia, a statistical database of the imported commodities' nomenclature and corresponding time series was compiled for 2012-2021.

In the second phase, a regression model was constructed to assess the sector's vulnerability to changes in import supplies. Gross value added was selected as the endogenous factor, while the exogenous factor was the import of goods for this economic activity (Table 2).

Table 2. Source data for the regression model for OKVED 29 – "Manufacture of motor vehicles, trailers, and semi-trailers"

	X (import, thousand rubles)	**Y (gross value added, thousand rubles)**
2021	121,196,519	78,757,473
2020	66,792,577	59,177,230
2019	54,419,730	45,986,730
2018	57,912,026	42,658,826
2017	54,730,471	44,299,530
2016	44,924,574	20,329,081
2015	26,935,749	15,371,268
2014	31,484,914	26,839,288
2013	42,389,441	33,431,961
2012	36,361,249	30,990,767

Source: Rosstat (Kratkiy statisticheskiy sbornik, n.d.)

As a result of econometric modeling, the following outcomes of the regression analysis were obtained (Table 3).

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Table 3. Parameters of statistical significance for the equation estimating the impact of import dependency on the volume of value added in OKVED 29, "Manufacture of motor vehicles, trailers, and semi-trailers"

Regression Statistics	
Multiple R	0.929619257
R-squared	0.864191963
Adjusted R-squared	0.847215958
Standard error	7,395,569.026

Analysis of variance					
	df	***SS***	***MS***	***F***	***Significance F***
Regression	1	2.78431E+15	2.78431E+15	50.90667567	9.85448E-05
Residual	8	4.37556E+14	5.46944E+13		
Total	9	3.22187E+15			
	Coefficients	*Standard error*		*t-statistics*	*P-value*
Y-intercept	4,525,087.198	5,467,240.885		0.827672915	0.431850825
Variable X1	0.656414571	0.092000639		7.134891427	9.85448E-05

The regression model, based on its validation using the Fisher F-test (F_table = 5.13 < F_calculated), is generally adequate. With a 95% probability, the model aligns with the original data and can be used to assess the impact of imports on the volume of added value produced. Additionally, since the calculated t-value is greater than the critical value (critical t = 2.306), the observed differences are statistically significant (significance level $p < 0.05$).

The most notable feature of the constructed model is the elasticity coefficient obtained for variable X1, which, in the next iteration step, will be ranked alongside similar coefficients obtained for other examined industrial sectors.

The results of the ranking of the estimates, which characterize the degree of import dependency of the industrial sectors in Tatarstan, are presented in Table 4.

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Table 4. Indicators characterizing the level of import dependency of industrial sectors in Tatarstan's economy.

No. OKVED	**Elasticity coefficient (b) in the equation** $Yi = a + bxi + ei$
5 – Coal mining	0.404337093
6 – Extraction of oil and natural gas	0.00
7 – Extraction of metal ores	0.00
8 – Extraction of other mineral resources	3.33571466
10 – Food production	11.70989201
11 – Beverage production	14.64714879
12 – Tobacco products manufacturing	-2.367702326
13 – Textile manufacturing	0.458334314
14 – Clothing manufacturing	-2.275077541
15 – Leather and leather products manufacturing	0.863386505
16 – Wood processing and production of wood and cork products, except furniture, production of basketry and wickerwork materials	7.379097033
17 – Paper and paper products manufacturing	6.182344308
18 – Printing and reproduction of recorded media	-176.2590722
19 – Coke and refined petroleum production	7.413512215
20 – Chemical substances and products manufacturing	1.972189459
21 – Manufacture of pharmaceutical products and materials for medical and veterinary purposes	2.988130732
22 – Manufacture of rubber and plastic products	1.951956228
23 – Manufacture of other non-metallic mineral products	2.648172412
24 – Metallurgical production	1.581994844
25 – Manufacture of fabricated metal products, except machinery and equipment	-1.090490672
26 – Manufacture of computers, electronic and optical products	3.225552944
27 – Manufacture of electrical equipment	0.536782504
28 – Manufacture of machinery and rquipment not elsewhere classified	0.102013896
29 – Manufacture of motor vehicles, trailers, and semi-trailers	0.656414571
30 – Manufacture of other transport equipment	1.236134227
31 – Furniture manufacturing	2.140165749
32.1 – Manufacture of jewelry, costume jewelry, and similar articles	-7.819511572
32.5 – Manufacture of medical instruments and equipment	2654.747001

Source: Calculated by the authors

According to the proposed methodological framework, a key component determining the sustainability of regional industrial complexes under sanction pressure is the empirical assessment of their recovery efficiency in the emerging turbulent environment of external markets. The solution to this problem was implemented by constructing an integral recovery index, consisting of several intermediate sub-indices.

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An example of an intermediate index (I3), which determines the final value of the aggregated recovery efficiency index, is shown in Table 5 with the calculation chronology and evaluation results. According to the proposed methodological solutions, lower and upper threshold values were calculated, followed by the calculation of the normalized value of index I3. The final assessments are presented in Table 4 (column 7).

Table 5. Original data for constructing the I3 index and the results of the construction.

Year	Net financial result of organizations, million RUB.	Product profitability, %	Liquidity ratio, %	Ratio of own working capital coverage, %	Autonomy ratio, %	I_3	$I_{recov.}$
1	2	3	4	5	6	7	8
2021	5,669,917.00	3	77.9	-29.4	28.9	0.5154	0.3718
2020	5,582,720.00	1.5	79.4	-40.5	27.9	0.5034	0.3441
2019	-16,862,940	-5.2	86	-41	29.8	0.4917	0.3450
2018	-7,459,603	-5.4	73.7	-63	6.2	0.4656	0.3411
2017	9,169,480	2.6	92.6	-23.6	28.2	0.5109	0.3340
2016	4,330,989	1.6	101.9	-26	28.7	0.5081	0.3250
2015	-3,704,975	-2	85	-35.7	32	0.5035	0.3280
2014	-3,441,274	-1.5	73.5	-24.4	35.1	0.5097	0.3413
2013	4,782,236	1.6	68.8	-23.8	42.1	0.5224	0.3206
2012	9,385,757	2.6	84.8	-15.7	48.3	0.5345	0.3278
Average value							**0.3379**

Values for other subindices involved in determining the aggregate value of the recovery effectiveness index were determined (Table 6).

Table 6. Final assessments of subindices and the aggregated value of the index evaluating the recovery effectiveness of regional industrial sectors in Tatarstan.

I_1	I_2	I_3	I_4	$I_{recovery}$
0.2546	0.2473	0.5154	0.5239	0.3718
0.3100	0.1062	0.5034	0.4934	0.3441
0.3125	0.1173	0.4917	0.4949	0.3450
0.3158	0.1214	0.4656	0.4981	0.3411
0.3068	0.0635	0.5109	0.4918	0.3340
0.3053	0.0447	0.5081	0.4759	0.3250
0.3494	0.0831	0.5035	0.3827	0.3280

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0.3259	0.1242	0.5097	0.4252	0.3413
0.3053	0.0803	0.5224	0.3917	0.3206
0.2995	0.0301	0.5345	0.4840	0.3278

Source: Calculated by the authors

The integral assessments of the index evaluating the economic development sustainability of the studied sector in the region underwent a normalization procedure. This allowed us to obtain the final standardized values for the studied period. The average values of the indices for the economic sectors in Tatarstan were ranked, and the recovery index for the foreign economic activity 29 received a rank of 0.1. The calculations were performed for industrial economic sectors, included in the consolidated groups B, C, D, and E.

The final ranks, based on which the matrix was constructed, are presented in Table 7. The results of the calculations are shown in Figure 5. The matrix is based on the arithmetic averages of the obtained standardized rows.

Table 7. Standardized values of assessments characterizing the import dependence of industrial sectors and their recovery efficiency.

OKVED	Recovery	Vulnerability	OKVED	Recovery	Vulnerability	OKVED	Recovery	Vulnerability	OKVED	Recovery	Vulnerability
5	0 .93	0.92	**13**	0.86	0.79	**20**	0.04	0.50	**27**	0.46	0.71
6	0.00	0.83	**14**	0.68	0.29	**21**	0.71	0.38	**28**	0.32	0.83
7	1.00	0.83	**15**	0.82	0.88	**22**	0.18	0.46	**29**	0.07	0.75
8	0.57	0.25	**16**	0.75	0.04	**23**	0.43	0.33	**30**	0.21	0.96
10	0.14	0.13	**17**	0.29	0.21	**24**	0.50	0.67	**31**	0.79	0l54
11	0.39	0.08	**18**	0.61	0.00	**25**	0.36	0.58	**32.1**	0.89	0.83
12	0.96	0.42	**19**	0.11	0.17	**26**	0.25	0.63	**32.5**	0.64	1.00

Source: Calculated by the authors

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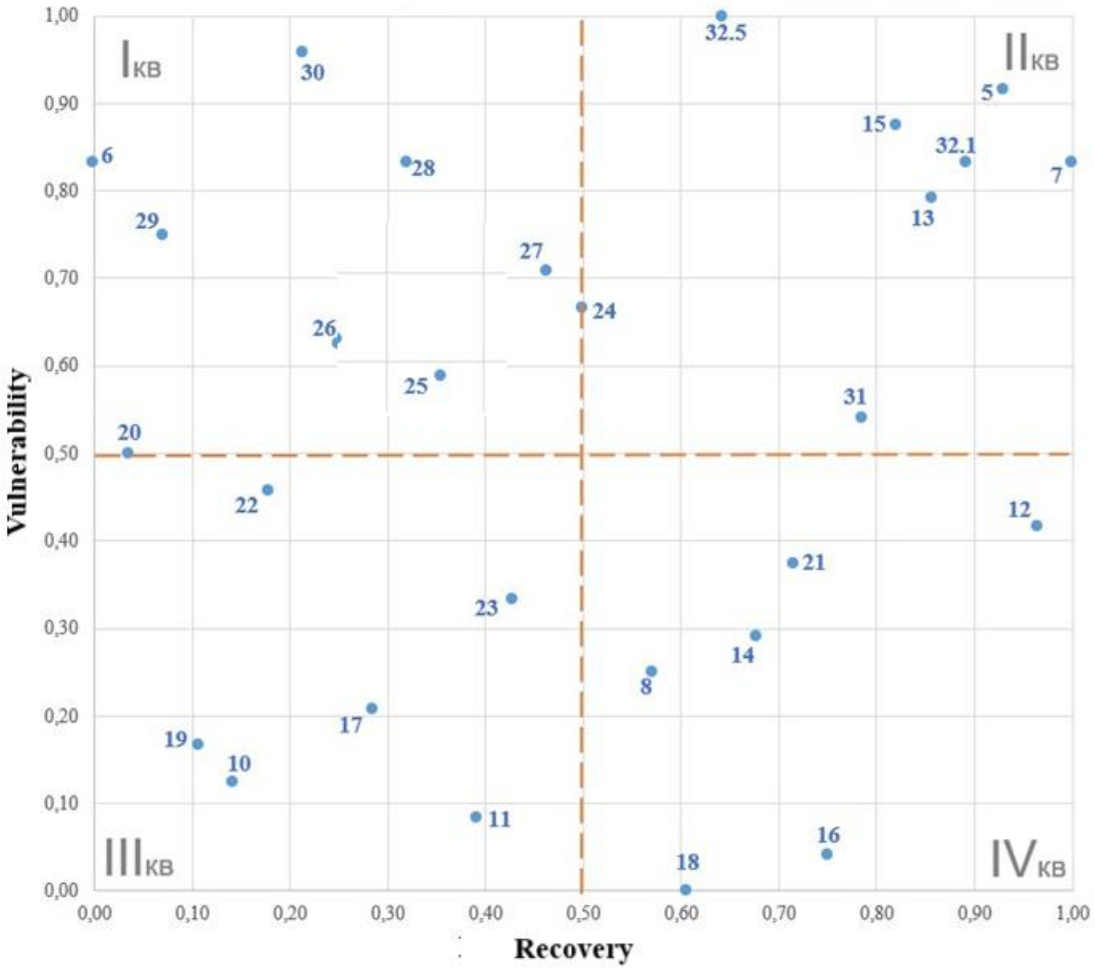

Figure 5. Positioning matrix of industrial sectors in Tatarstan's economy across strategic directions for analyzing prospects of their sustainable development in the "Vulnerability" "Recovery Efficiency" coordinate system.
Source: Compiled by the authors

5 DISCUSSION

The results show the positioning of industrial sectors in Tatarstan's economy and the analyzed coordinate system and provide insight into potential government measures to adapt regional-industry complexes to the new geo-economic agenda.

Sectors in Quadrants 1 and 2 are of particular interest due to their elevated import dependency. Sectors in Quadrant 1 exhibit below-average recovery efficiency, identifying them as the most vulnerable industries in the regional economy. This group includes:

6 – Extraction of crude petroleum and natural gas

20 – Manufacture of chemicals and chemical products

25 – Manufacture of fabricated metal products, excluding machinery and equipment

26 – Manufacture of computers, electronic and optical products

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27 – Manufacture of electrical equipment

28 – Manufacture of machinery and equipment not elsewhere classified

29 – Manufacture of motor vehicles, trailers, and semi-trailers

30 – Manufacture of other transport equipment

Quadrant 2 includes sectors that, while vulnerable to import changes, demonstrate a higher recovery potential:

5 – Coal mining

7 – Mining of metal ores

13 – Manufacture of textiles

15 – Manufacture of leather and leather products

31 – Manufacture of furniture

32.1 – Manufacture of jewelry, costume jewelry, and similar items

32.5 – Manufacture of medical instruments and equipment

24 – Metallurgical production (on the edge of Quadrant 1)

Quadrants 3 and 4 are less vulnerable to import changes. However, Quadrant 4 includes sectors with stronger recovery potential:

8 – Extraction of other minerals

12 – Manufacture of tobacco products

14 – Manufacture of clothing

6 – Processing of wood and production of wood and cork products (excluding furniture), manufacture of straw and plaiting materials

18 – Printing and reproduction of recorded media

21 – Manufacture of pharmaceuticals and materials used in medical and veterinary applications

The less vulnerable sectors with relatively low recovery potential (Quadrant 3) include:

10 – Manufacture of food products

11 – Manufacture of beverages

17 – Manufacture of paper and paper products

19 – Manufacture of coke and petroleum products

22 – Manufacture of rubber and plastic products

23 – Manufacture of other non-metallic mineral products

These empirical findings align with other studies on the prospects for sustainable development of regional-industry complexes under external sanction pressures on the

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national economy. In (Safiullin et al., 2023), the authors identify three groups of imports: non-critical and critical with or without the possibility of source diversification. Both critical import groups include chemical products, optical items, electrical machinery and equipment, and plastics. In this study, these categories, except plastics, fall into Quadrant 1, the most vulnerable (plastics fall into Quadrant 4).

Our findings can be compared with the Russian government resolution of March 10, 2022, which lists the industries most dependent on imports (Postanovleniye Pravitelstva RF, 2022). If we cross-reference the OKVED codes from Quadrants 1 and 2 of this study with those identified as import-dependent in the Resolution, all OKVED codes in Quadrant 1 except for crude oil and natural gas extraction match. In Quadrant 2, the sectors include textile production and leather goods manufacturing.

6 CONCLUSIONS

The findings demonstrate that the regional economy is vulnerable due to shifts in foreign economic relations. Should imports in sectors highly reliant on foreign components and intermediate goods decrease, significant macroeconomic repercussions are likely. Government authorities must focus on supporting these economic sectors, which are vital for sustainable development under the new economic conditions. A critical measure to mitigate risks of slowing economic growth is to reorient imports of raw materials, technologies, and goods toward other countries. In this context, the proposed methodological toolkit enables the identification of Tatarstan's most essential economic activities that require support mechanisms. The presented methodology allows identifying suitable and effective strategies for coordinating support mechanisms for the region’s most vulnerable economic sectors. This approach enhances the likelihood of overcoming the crisis and lays the foundation for maintaining the region's competitive advantages and ensuring sustainable development in the future.

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