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METHODOLOGICAL ASPECTS OF THE STUDY OF RESILIENCE OF REGIONAL ECONOMIC SYSTEMS

MARAT SAFIULLIN
Kazan (Volga Region) Federal University – Russia. Center for Advanced Economic Research, Academy of Sciences of the Republic of Tatarstan – Russia. https://orcid.org/0000-0003-3708-8184 E-mail: Marat.Safiullin@tatar.ru

RAFIS BURGANOV
Volga Region State University of Physical Education, Sports, and Tourism – Russia https://orcid.org/0000-0002-8943-0781 E-mail: burganov@mymail.academy

AZAT SHARAPOV
Volga Region State University of Physical Education, Sports, and Tourism – Russia https://orcid.org/0000-0001-8489-183X E-mail: sharapov@mymail.academy

ABSTRACT

Objective: Addressing issues related to the study of resilience and adaptation processes to external factors within industrial sectors and the parameters and prospects for sustainable regional development represent a highly demanded area of contemporary economic research. This article aims to develop a methodological approach to the resilience of regional and industry-specific complexes.

Methods: The authors propose an original methodological approach based on a review, systematization, and critical analysis of approaches to the resilience of regional economic systems.

Results: It is grounded in the necessity of calculating an integrated resilience index for regional systems, derived from the relationship between two sub-indices: performance resilience and preparation resilience.

Conclusion: This approach enables a focused assessment of the relative efficiency in measuring regional economic resilience and a more structured grouping of essential resilience parameters without combining them into a single, undifferentiated measure. Instead, it provides decomposed relative assessments.

Keywords: Resilience; Regional and industry-specific systems; Resilience; Performance resilience; Data decomposition**.**

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INTRODUCTION

The last decade has been marked by a wide range of geopolitical upheavals that have determined the development of the global economy and acute discussions in scientific and expert communities (Alekseev et al., 2022). Among the most prominent manifestations of these systemic transformations are the ongoing conflicts in the Middle East, escalating tensions between China and the US, global crises related to the spread of infectious diseases (Degtev et al., 2022), the potential collapse of the global financial system amid increasing risks of bankruptcy of major banks in the US and Europe, and the growing debt burden in developed countries. These changes include the crisis triggered by the escalation in Ukraine. The resulting sanctions standoff between the Russian Federation and Western countries has reached an unprecedented level, significantly impacting the global economy.

Global sanctions have become increasingly prominent since the 2010s. According to a study by T. Clifton Morgan and A. Navin, the parameters of global sanctions reached their peak in 2022 (Figure 1).

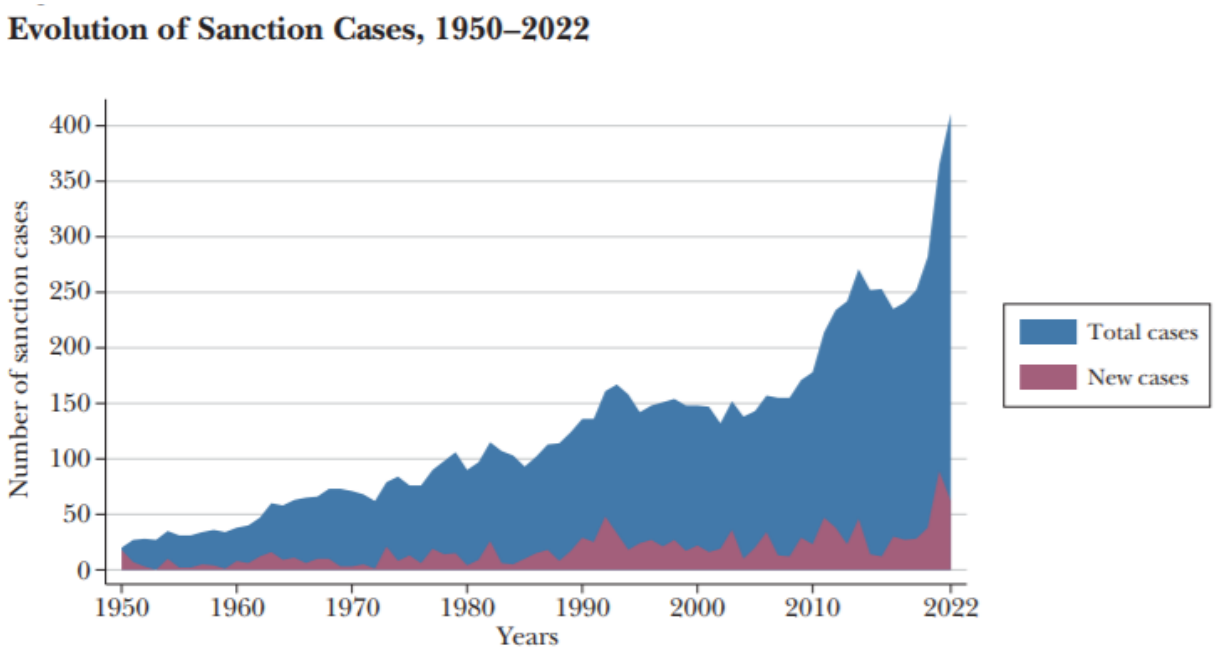

Figure 1. Number of sanctions worldwide from 1950-2022
Source: Morgan et al., 2021

In the context of geopolitical turbulence caused by institutional and cyclical shifts in the global economy, it is critical to maintain sustainable socioeconomic development at the level of individual countries and large businesses within their borders (Bagratuni

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et al., 2023; Borodina et al., 2023). Since Russia is at the center of sanction pressure and the transformation of its global economic ties, a key task is to determine its resilience to ongoing changes and explore development prospects (Sergeeva et al., 2024). The emerging institutional environment is defining new mechanisms for economic growth, which are sometimes not aligned with traditional models of economic dynamics. It is appropriate to develop models of economic growth adapted to the accelerating systemic transformations that consider artificial (external) constraints on socioeconomic development. A crucial step in addressing this challenge is the development of tools that identify the resilience of the national economy and its key components (regional and industry-specific complexes) to ongoing shocks. This raises a methodological issue of measuring the resilience of the socioeconomic environment in response to turbulence and the realignment of global economic relations under sanctions against Russia.

LITERATURE REVIEW

The regional and sectoral organization of the economy and the resolution of spatial inequality are the main topics of regional economic theory. According to M.V. Ivanova (Ivanova, 2011), addressing these issues contributes to the sustainable growth of industrial complexes and regional and national economic systems. These concerns gain relevance in the context of turbulence and destructive sanctions, which directly influence macro-, meso-, and sectoral-level economic systems.

The development challenges common to the regional and industry-specific organization of economic systems have gained momentum not only due to the systemic transformations that have intensified over the past decade in Russia. The theory of spatial and sustainable regional economic development dates back to the early 18th century, when scholars began to show interest in the territorial aspects of organizing and stimulating economic growth. This research perspective is present in the works of J.H. von Thünen (1926) who focused on the territorial placement of industrial enterprises and the spatial organization of economic processes to identify and establish sustainable trajectories of regional development.

Some of the most prominent experts in regional economics are W. Christaller (2009) (central place theory), A. Lösch (2007) (the spatial organization of the economy), W. Reilly (1931) (a spatial economic organization model based on the law

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of universal gravitation), and P. Converse (1949).

Regional economic theory became a fully-fledged discipline in the 1950s, with W. Isard (1956) considered its founder. Isard developed the concept of managing territories, industrial complexes, regional infrastructure, population settlement systems, etc.

In the latter half of the 20th century, these topics were further explored by D. Friedman (1973), H. Richardson (1969) (urban agglomeration theory), E. Hoover, F. Giarratani (2020), P. Krugman (1991) (model of interregional labor migration), etc.

The challenges of studying regional economics have been addressed by scholars and practitioners. The primary focus has been on overcoming regional development disparities, developing models and tools for the sustainable growth of regional economic systems, optimizing the allocation of productive resources, and enhancing the economic efficiency of different sectors, especially in the context of systemic transformations and crises.

Despite the extensive research on theoretical and methodological aspects of the nature and mechanism of regional economic growth, it is necessary to acknowledge that regional and industry-specific development under the destructive pressure of external institutional and market factors is insufficiently studied. This issue has become increasingly relevant in the current environment. Turbulence in the global economy, growing risks of macroeconomic instability, uneven resilience potential of regions and industries to crises, and varying institutional environments necessitate the refinement and development of concepts and models for strategic development at the regional level with due regard to the evolving systemic mechanisms that define the dynamics, trajectory, and specifics of economic growth (Kochetkov et al., 2023).

A key area in the theory of regional economic development, particularly in the context of seeking sustainable development for regional and industry-specific complexes amid the destructive impacts of crises, is the theory of resilience. This branch of economic thought gained prominence following the works by K. Foster, E. Hill, R. Martin, B. Fingleton, R. Lagravines, V.V. Klimanov, S.M. Kazakova, A.A. Mikhailova, E.A. Kolomak, N.N. Mikheeva, M.Yu. Malkina, O.V. Kuznetsova, V.E. Seliverstov, V.N. Lazhentsev, V.N. Leksin, and B.N. Porfirev.

A crucial aspect of the theory of economic resilience is the measurement of the resilience of regional and industry-specific complexes. Although the resilience and adaptability of these systems to external factors are often assessed based on

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descriptive analysis of statistical data, capturing the development of the system before and after a crisis, studies address this issue using econometric methods (Klimanov et al., 2019; Kuznetsova, 2023; Martini, 2020). This direction of the theory, which aligns with economic-statistical analysis, is fragmented. Its relevance becomes particularly important when researching and seeking models of regional and industry-specific resilience. This stipulates the need to improve existing approaches in terms of concepts and definitions and measure resilience at the sectoral and regional levels within the methodological framework.

In line with the position of V.V. Klimanov, S.M. Kazakova, and A.A. Mikhailova, the indicators evaluating the resilience of an economy dwell on measuring the stability of its budgetary system during a crisis and its ability to recover afterward (Klimanov et al., 2019). A key feature of their research is the attempt to assess the relationship between the resilience of the budgetary system of the Russian regions and the resilience of socioeconomic trends.

Methodologically, an aggregate resilience index is calculated by summing six indicators (Klimanov et al., 2019):

– Gross regional product (GRP) per capita;

– Unemployment rate;

– Population with incomes below the subsistence level;

– Average monthly nominal wages of employees;

– Average living space per capita;

– Availability of durable goods in households.

According to B.S. Zhikharevich, V.V. Klimanov, and V.G. Marach, it is advisable to assess resilience based on income equality, housing affordability, the prevalence of high-speed Internet, and the business climate characterized by the share of small businesses (Zhikharevich et al., 2020). However, the approach proposed by these researchers is debatable. Supporting the viewpoint of A.A. Pesotskii (2021), these indicators are more aligned with the assessment and analysis of economic security rather than resilience.

Among international studies focused on the empirical assessment of economic resilience, “Resilience: Theory and Applications” by J. Carlson et al. deserves particular attention (Alekseev et al., 2022). The authors identify five key components that collectively evaluate the resilience of economic systems:

– The economic potential of the system expressed through its volumes,

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resources, and inclusive mechanisms of their distribution;

– Social capital measured by the quality of the education system, healthcare provisions, the proportion of low-income population, the development of infrastructure supporting civil society, and other related factors;

– The quality of transportation, logistics, housing, and communal and social infrastructure;

– The degree of integration of the economic system into transnational supply chains and its ability to adapt to disruptions in logistics, including factors such as reserve stocks, diversification of supply geography, etc.;

– The quality of governance reflected in the efficiency of budget management, the effectiveness of emergency services, the level of public trust in authorities, etc.

Among the scientific works measuring the resilience of economic systems, K. Foster's (2007) research deserves special mention. Foster evaluates resilience by assessing two states. The first state is the readiness of the economic system to withstand shock impulses. The second state evaluates its effectiveness in responding to and recovering from macroeconomic shocks. Based on this dichotomous approach, Foster constructs a resilience matrix, which represents the intersection of the two states.

A review of the approaches to the empirical assessment of the resilience of economic systems at the meso- and macro-levels reveals methodological shortcomings. These shortcomings lie in the insufficient formalization of the structural components of resilience, which consequently narrows the scope of structural analysis. While Foster offers a partial solution to this issue, the methodological aspect used to assess parameters such as evaluation and preparation resilience is indirectly addressed. Despite the decomposition of the category into two components (preparation and performance resilience), the division of indicators into group components remains limited. According to Foster's approach, this parameter is evaluated through a broad set of indicators that reveal such characteristics as the structural organization of the economy, infrastructure development, and institutional environment.

Thus, the resilience of regional economic systems should be studied through two key perspectives (in line with decomposition analysis principles). First, it involves assessing the system's ability to recover effectively after being subjected to disruptive shocks. Second, it requires an empirical evaluation of its readiness to withstand

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macroeconomic shocks by identifying vulnerabilities related to potential limitations in access to external markets. This aspect of resilience is best examined through the dualism of import and export dependence, which are critical elements in the context of this research.

The article aims to develop a methodological approach to the resilience of regional and industry-specific complexes to shocks.

According to this position and guided by the research framework proposed by K. Foster (2007), the following section presents our proposed methodological toolkit.

METHODS

The multidimensional state (matrix) of resilience in regional systems is proposed to be studied through a 3D resilience measurement system: import dependence – export dependence – performance resilience. The research focus is driven by the emphasis on sanction shocks which primarily restrict exports and imports and disrupt international supply chains. This affects operational business cycles at the level of regional and industry-specific complexes and the vulnerability of regional economic systems and their readiness to withstand external disturbances.

The performance resilience direction is measured using a modified approach initially proposed by M.Yu. Malkina (2020). The regional assessment indicators from Malkina's model were adapted to regional and industry-specific perspectives, including additional indicators crucial for evaluating regional development efficiency.

Based on the proposed concept for measuring the resilience of regional economic systems, Figure 2 presents a graphical visualization of the approach.

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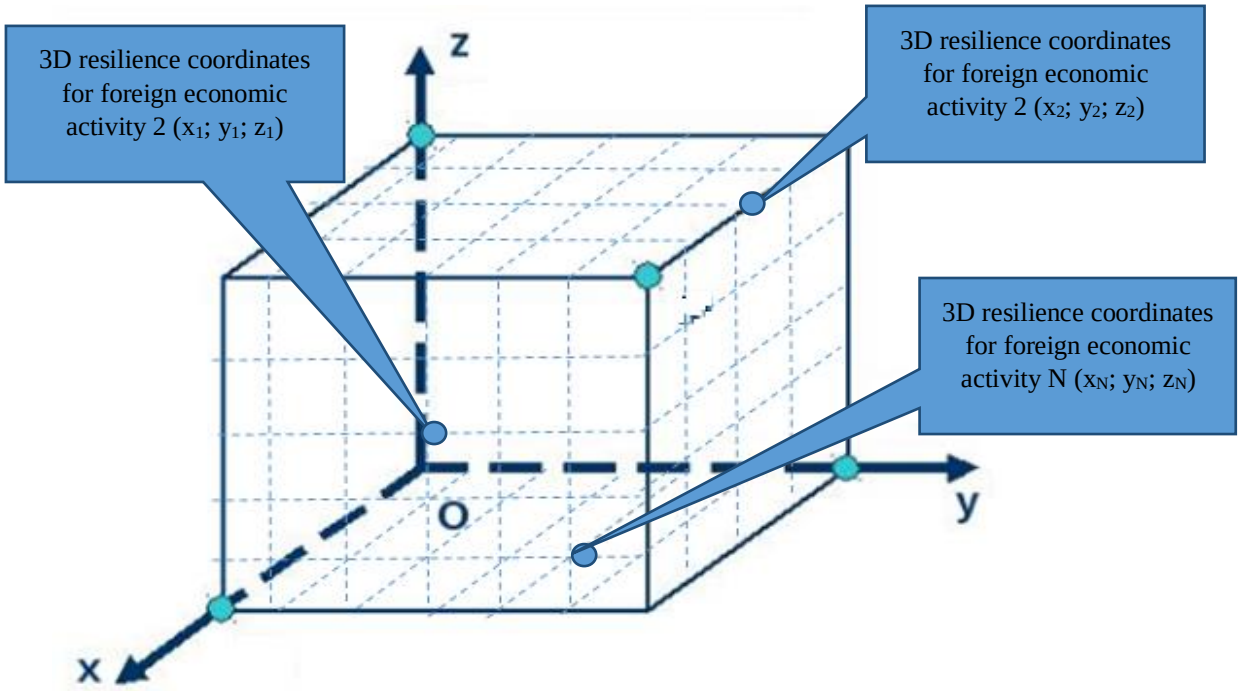

x is the scale characterizing regional resilience to shocks in import dependence
y is the scale characterizing regional resilience to shocks in export dependence
z is the scale characterizing regional resilience to shocks in performance resilience

Figure 2. 3D analysis of regional resilience based on the construction of a matrix in the coordinate system import dependence – export dependence – performance resilience (3D resilience)
Source: developed by the authors

A 3D resilience matrix for regional economic systems is proposed to be constructed at the intersection of the following axes: import dependence (Res_{imp}), export dependence (Res_{exp}), and performance resilience (Res_{per}).

The integrated resilience indicator is calculated as the ratio of the aggregated assessment of the efficiency and recovery potential of the regional complex to the integrated value of its vulnerability (based on a formalized analysis of the industry's integration into the system of transnational cooperative links). This approach is driven by the need for a relative assessment of resilience which increases the objectivity of the results and their subsequent interpretation. This method helps understand whether development institutions that provide the recovery potential of the regional economic system under external pressure can offset regional vulnerability arising from localized external cooperative ties.

Based on the presented logic, it is appropriate not to calculate the integral value of the resilience index as the synthesis and aggregation of the studied sub-indices and instead compare such components of resilience as performance resilience and

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vulnerability.

Formally, the integral indicator of regional resilience is proposed to be calculated using formula 1:

$$\text{Res} = \frac{\text{Res\_per}}{\text{Res\_vul}} \quad (1)$$

where

Res is the integral assessment of the regional level of resilience;

Res_per is the integral indicator characterizing the efficiency of regional recovery;

Res_vul is the integral indicator characterizing the readiness of the regional economic system for crisis shocks (preparation resilience).

To specify the proposed conceptual approach, we need to disclose the iterative sequence of calculations of individual components within the aggregated index of regional resilience (Res_{exp}, Res_{imp}, Res_{per}).

ASSESSMENT OF IMPORT AND EXPORT DEPENDENCE OF THE REGIONAL ECONOMIC SYSTEM (RES_{EXP})

Disruptions in foreign trade relations, particularly those reflected in restrictions on exporting to established foreign markets, will undoubtedly influence the vulnerability of regional development and the parameters of resilience. In this context, a crucial aspect of researching regional resilience is identifying the sensitivity of these processes to the localization of goods supplied abroad. A key methodological aspect of assessing and analyzing resilience is evaluating regional export dependence (Res_{exp}).

The methodological basis for assessing regional export dependence (*I*exp_reg) involves analyzing the share of products imported from unfriendly countries in the total GRP (2).

$$I\text{exp}_{\text{reg}} = \frac{\text{Volume of exports from unfriendly countries}}{\text{GRP}} \quad (2)$$

The import dependence of regional economic systems is assessed in a similar manner (3).

$$I\text{imp}_{\text{per}} = \frac{\text{Volume of imports from unfriendly countries}}{\text{GRP}} \quad (3)$$

To unify the values assessing the export dependence of regional economic

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systems (Res_{exp}) and compare the values obtained with each other for the subsequent integration of data into the 3D resilience model, all the estimates (indices) are standardized.

If the studied indicators belong to the category of stimulants, i.e., their higher values indicate an increase in the efficiency of the studied object, formula 4 is used:

$$Z_i = \frac{X_i - \overline{X_i}}{\sigma_i} \quad (4)$$

where

X_i is the actual value of the i indicator;

$\overline{X_i}$ is the average value of the i indicator;

σ_i is the standard deviation.

If the analyzed indicator belongs to the category of a disincentive (its growth means a decrease in efficiency), it is advisable to use formula 5.

$$Z_i = \frac{\overline{X_i - X_i}}{\sigma_i} \quad (5)$$

To bring the indicators to a single scale (from 0 to 1) and calculate the integral index, the obtained normalized values of the indicators are transformed into a function of the standard normal integral distribution (6).

$$Z_i^{norm} = \frac{1}{\sqrt{2\pi}} e^{\frac{-z_i^2}{2}} \quad (6)$$

where

Z_i is the normalized value of the indicator.

EVALUATION OF RECOVERY EFFICIENCY

The methodological basis for measuring such a state of regional resilience as performance resilience is a tool based on the ratio of the predicted value of the analyzed parameter to its actual value. This approach is implemented in the following sequence.

Step 1. Evaluation of the deviation of the predicted value of the studied parameter from its actual value.

This approach is implemented through a series of autoregressive functions applicable to each analyzed parameter:

Real accrued wages;

Population size;

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Poverty level;

Employment of the population;

Surplus/deficit of the consolidated budget of the constituent entity of Russia.

The first four indicators are designed to assess the ongoing changes in the quality of life of a region's population. The last parameter assesses the budgetary sustainability of the regional economic system.

This methodological approach is mostly based on the research by M.Yu. Malkina (2020).

In algorithmic form, the sequence of steps is presented in Figure 3.

Step 1. Development of an autoregressive equation for each parameter being analyzed: $\hat{y} = \alpha + \beta t + e$
where
$\hat{y}$ is the predicted value;
t is the time factor

Step 2. Forecasting the analyzed parameters ($\hat{y}$) for a time period characterized by increased turbulence within the impact of macroeconomic shocks on the economic system. In relation to sanctions shocks for the Russian economy, these are 2014 and 2022

Step 3. Comparison of the predictive values of the parameters with their actual values. This step lays the basis for assessing the deviation index using the formula:
$Ri = \frac{\hat{y}}{y}$-1
Ri is the value of the i indicator participating in the construction of the aggregate value of the integral resilience index;
$\hat{y}$ is the predicted value of the index during the crisis;
y is the actual value of the index during the crisis

Figure 3. Sequence of the empirical assessment of the deviation of the predicted value of the studied resilience parameter from its actual value (in the direction of performance resilience)
Source: developed by the authors

Step 2. For each analyzed indicator, the values are normalized (standardized) according to the previously presented approach (formula).

Step 3. Determination of the integral value (Res_{per}) of the regional resilience index assessing recovery efficiency based on the geometric mean of the partial values of the normalized analyzed indicators ($\sqrt[i]{Rinorm}$).

INTEGRAL ASSESSMENT OF REGIONAL/INDUSTRY RESILIENCE

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According to the approach, the integral assessment of the resilience of regional economic systems is measured based on a comparison of the value of the performance resilience parameter to the value of the aggregated indicator characterizing the dependence of the research object on the transformation of foreign economic relations (7).

$$\text{Res} = \frac{\text{Res\_per}}{\text{Res\_vul}} \quad (7)$$

In this case, the value of the Res_{per} indicator is estimated using the formula ($\sqrt[i]{Ri\text{norm}}$), where $Ri\text{norm}$ is the normalized values of the indicators used to assess recovery efficiency.

The Res_{vul} indicator is determined similarly based on the geometric mean of the parameters characterizing the import and export dependence of the research object in aggregated and standardized form (8).

$$Res \text{ vulnerability} = \sqrt[2]{\text{Resimp} * \text{Resexp}} \quad (8)$$

Based on the methodological approach, the algorithmic concept for implementing a sequence of actions for empirical assessment of regional resilience is presented in Figure 4.

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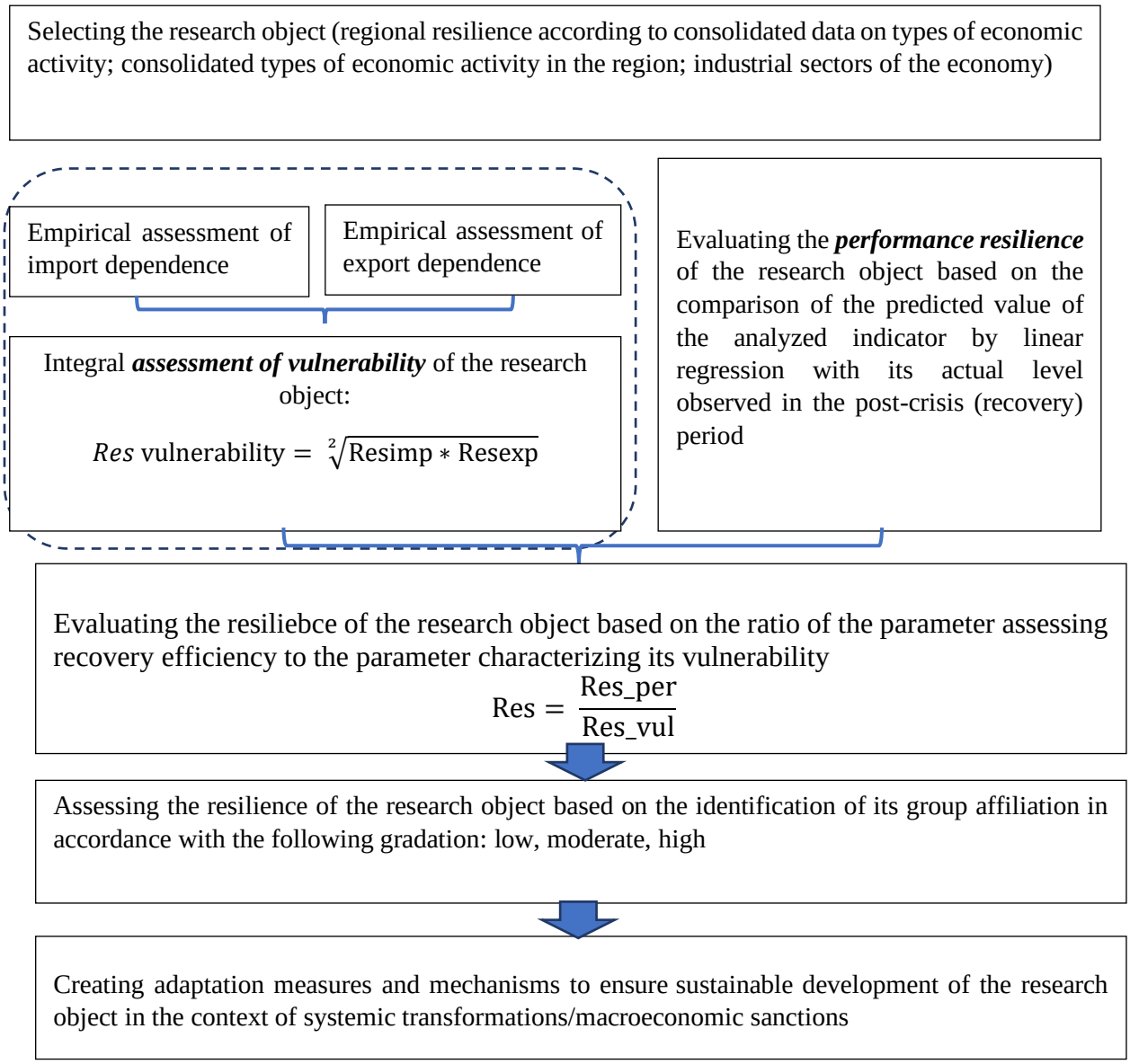

Figure 4. Algorithm for the empirical assessment of resilience of regional economic sectors according to the concept of 3D resilience modeling
Source: developed by the authors

Depending on the inclusion of a region in a range of resilience values, mechanisms of state support are determined in the sphere of ensuring its most effective adaptation to macroeconomic shocks (sanctions against the national economy).

In concentrated form, the possible values of the relative resilience index of a region/industry according to the assessment paradigm are presented in Table 1.

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Table 1. Grouping of regions/industries by their relative degree of resilience

No.	Resilience level	Range of Res index values
1	High	1.5 < Res < 2
2	Moderate	1 < Res ≤ 1.5
3	Low	0 ≤ Res ≤ 1

Source: developed by the authors

In conformity with the border values of the relative resilience index of the region/industry, Table 2 groups the research objects according to the degree of resilience to external shocks (sanctions against the national economic system).

Table 2. Classification of research objects through aggregated parameters of their resilience

Characteristics of resilience as applied to the research object	Border value of the parameter import dependence (x) (max)	Border value of the parameter export dependence (y) (max)	Border value of the parameter performance resilience (z) (max)	Border value of the integral indicator of resilience (max)*
Regions/industries with a ***low*** level of foreign trade cooperation and a ***low*** level of recovery efficiency	0.5	0.5	0.5	Res ≤ 1.00
Regions/industries with a ***low*** level of foreign trade cooperation and a ***high*** level of recovery efficiency	0.5	0.5	1	Res ≤ 2.00
Regions/industries with ***high*** import dependence, ***low*** export dependence, and ***low*** recovery efficiency	1	0.5	0.5	Res ≤ 0.71
Regions/industries with ***high*** import dependence, ***low*** export dependence, and ***high*** recovery efficiency	1	0.5	1	Res ≤ 1.41
Regions/industries with ***low*** import dependence, ***high*** export dependence, and ***low*** recovery efficiency	0.5	1	0.5	Res ≤ 0.71
Regions/industries with ***low*** import dependence, ***high*** export dependence, and ***high*** recovery efficiency	0.5	1	1	Res ≤ 1.41

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Regions/industries with ***high*** import dependence, ***high*** export dependence, and ***low*** recovery efficiency	1	1	0.5	Res ≤ 0.50

Note: a methodological feature of the developed toolkit for assessing the relative resilience index ranges from 0 to 2. This is due to the boundary values of the sub-indices limited by the area of the cube sectors (3D model, Figure 3).
*According to the proposed methodological approach, the boundary value of the integral resilience indicator is calculated as the ratio of the performance resilience (z) parameter to the geometric mean of the parameters assessing export and import dependence.
Source: developed by the authors

As an alternative grouping of regional and industry-specific complexes by resilience level, Figure 4 presents a graphic visualization of the identification process.

Based on the synthesized evaluations that characterize the relative efficiency of economic system resilience, the studied subjects are divided into three major groups. The first group comprises regional and industry-specific systems with low recovery efficiency, regardless of export and import dependence. According to the developed methodology, the maximum integral resilience level for these subjects cannot exceed one.

The second group includes subjects characterized by a moderate level of resilience. Regional and industry-specific systems in this cluster have a high level of performance resilience, while also showing signs of high import and export dependence.

Finally, regional and industry-specific systems with the best parameters (low import dependence and moderate export dependence, combined with high recovery efficiency) form the third group, characterized by a high level of resilience (Table 3).

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Table 3. Graphical interpretation of the 3D resilience of regional types of economic activity

Characteristics of resilience as applied to the research object	Resilience of foreign economic activity by direction			Aggregated level of resilience of foreign economic activity	
	Level of import dependence (the lower, the better)	Level of export dependence (the lower, the better)	Performance resilience (the higher, the better)		
Foreign economic activity 1	Low	Low	Low	**Low** (0 ≤ Res < 1)	**Group 1 "Foreign trade activities that are weakly resilient"**
…	High	Low	Low		
Foreign economic activity N	Low	High	Low		
	High	High	Low		
Foreign economic activity 1	High	Low	High	**Moderate** (1 ≤ Res < 1.5)	**Group 2. "Foreign trade activities that are moderately resilient"**
Foreign economic activity N	Low	High	High		
	High	High	High		
Foreign economic activity 1…N	Low	Low	High	**High** (1.5 ≤ Res < 2)	**Resilient foreign trade activities**

Source: developed by the authors

Depending on the classification of a regional economic activity within a certain range of resilience values, mechanisms for state support and management of regional industrial systems are determined. These mechanisms ensure the most effective adaptation to macroeconomic shocks, particularly those manifested as sanctions against the national economy.

CONCLUSIONS

According to the proposed methodology for assessing resilience and based on the calculated parameters, industries with low values for the performance resilience indicator (Group 1) have relatively low overall resilience scores. This is true even if they have a weak dependence on external economic factors.

Economic activities that show high recovery efficiency but are dependent on imports and exports fall into the category of moderately resilient to external shocks. According to the methodological approach, recovery efficiency offsets the negative

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externalities associated with the potential localization of exports and/or imports. However, the high vulnerability of these industries to disruptions in transnational cooperative links creates an increased risk for sustainable development in turbulent conditions.

Regional economic sectors with a high potential for recovery efficiency, combined with low dependence on external economic factors, form the third group of economic activities with the highest resilience values. According to the proposed methodological solutions, the sectors included in this cluster are characterized by a conservative external economic policy marked by weak integration into global economic systems. The high level of resilience in these sectors is likely due to this factor, along with the implemented state regulatory measures that ensure their high efficiency. These sectors are predominantly non-tradable, focusing exclusively on domestic consumers, such as education, healthcare, financial services, utilities, social services, construction, and public catering.

The ability to eliminate vulnerability from the localization of import and/or export processes through effective tools that ensure their recovery reveals the resilience potential of these regional and industry-specific complexes. The programming and scenario analysis of the 3D resilience model determines the ability of these systems to adapt and recover under the impulse pressure of macroeconomic shocks.

The approach based on identifying the relative resilience indicator of regional economic sectors reveals the effect where vulnerability processes are mitigated by the process characterized by recovery efficiency (Figure 5). This means assessing how effectively the internal mechanisms of the constituent entity under consideration can neutralize or offset the risks associated with export and import dependence.

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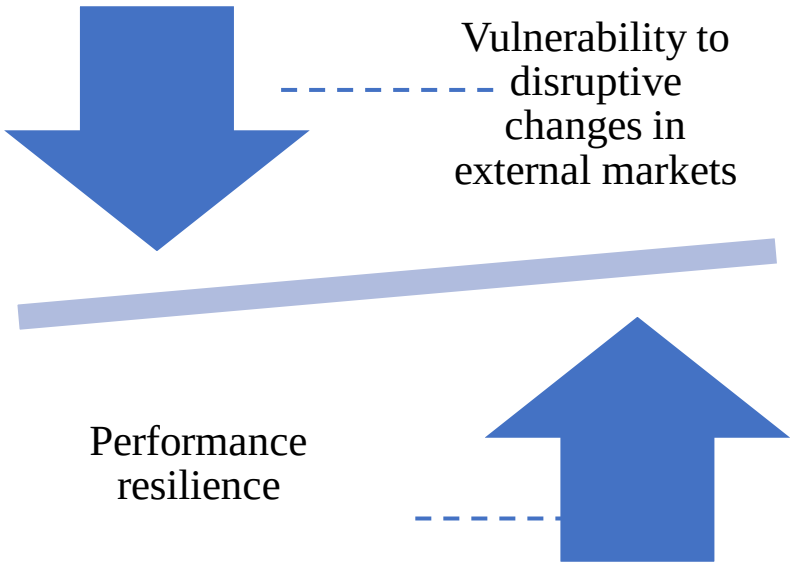

Figure 5. The effect of decreasing the vulnerability of regional economic sectors to turbulence in external markets within the framework of key parameters of recovery efficiency
Source: developed by the authors

If a region/industry demonstrates a high level of vulnerability as a result of deep integration into transnational supply chains and has low scores for performance resilience, the integral resilience index calculated as the ratio of these parameters tends to zero and does not exceed the maximum value equal to one. This indicates that the region/industry has a low potential for mitigating risks associated with limited foreign trade relations. The internal development mechanisms of the object under study can offset the negative externalities caused by macroeconomic shocks and further localization of foreign economic activity.

On the contrary, if regional sectors of the economy have a high level of the Res_{vul} indicator and also a high level of the resilience indicator assessing Performance Resilience (Res_{per}), the integral assessment of resilience will have an average level and range from 1 to 1.5. Finally, if the research object has a high level of the Res_{per} indicator and a low value of the Res_{vul} indicator, its resilience potential will be characterized by a maximum level and tends to the value of 2.

The proposed methodological approach to the resilience of regional and industry-specific complexes is based on a synthesis of Russian and international. The key distinctive features of this approach include:

1. The decomposition of the category under study according to the proposed 3D framework, enabling the potential to assess resilience parameters through factor analysis.

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2. The evaluation of the aggregated vulnerability indicator. By assessing the vulnerability of the research object based on parameters of import and export dependence, the approach offers a more adaptive examination of resilience potential, particularly from the perspective of analyzing sanction-related shocks, whose most critical manifestation is the localization of access to external markets.

3. The methodological feature justifying the necessity of calculating an integral resilience index based on the ratio of its two sub-indices (performance resilience and preparation resilience) focuses on the relative effectiveness of measuring resilience. Being in line with traditional economic research principles, this approach provides a higher level of objectivity in analytical assessments. It allows the structuring of essential resilience parameters into more clearly defined relative assessments without completely synthesizing them.

The proposed methodological approach can be supplemented and further developed in terms of the instrumental foundation and the indicative base used for assessing the relevant manifestations of regional resilience. Based on the 3D paradigm used for studying the resilience of regional systems, the approach is fully capable of forming the core and an updated methodological foundation for the research subject, potentially giving a new impulse for economic systems at the macro- and meso-levels in the theory of resilience studies.

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