Restructurization of Region's Cooperation Networks in the Conditions of Global Challenges

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Abstract The article considers an approach to assessment of interregional cooperation between large industrialized regions. The approach is based on an iterative scheme for determining the industrial structure of promising interregional cooperation in the region, which makes it possible to structure the sectors of specialization, establish the most rational ones, and ensure risk minimization. The proposed approach was tested on statistical data from a large industrialized region of the Russian Federation—the Republic of Tatarstan. The test determined its rational sector of specialization and the optimal sectoral structure of potential interregional industrial cooperation.

Keywords Interregional networks · Industrial cooperation · Domestic market · Economic integration · Industrialized region · Republic of Tatarstan

1 Introduction

Nowadays the situation in the global economy is changing rapidly. In the context of global challenges, the usual international trade relations and logistics chains are disrupted. However, every situation like this is not just a time of challenges, but also a time of new opportunities. One of these opportunities for the Russian economy is the formation and sustainable development of cooperative ties established between different regions of one country, laying the basis for the national economic space to develop and strengthen. In Russian context, interregional cooperation networks prevent the isolation of the country's regions and promote the economic development of underdeveloped regions by including them in the system of interregional

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595

cooperation networks with stronger regions. In the context of the new reality and global challenges, these connections, as well as the aggregate domestic market, serve as a powerful compensator for fluctuations in the global market.

2   Literature Review

The origins of the theoretical understanding of the essence of cooperation and the basis for the development of its various forms were described in the theories of absolute and relative advantages by A. Smith and D. Ricardo. The works of domestic and international scientists (V.I. Lenin, K. Marx, S.S. Maslov, M.I. Tugan-Baranovsky, A.V. Chayanov, N.G. Chernyshevsky and others) highlight the development of consumer, agricultural, industrial, credit cooperation, the impact of cooperation networks on the state of individual sectors of the national economy [1].

In modern academic literature, research into the economic integration between federal subjects has been growing in recent years. A.G. Granberg [2], S.Yu. Glazyev [3], E.V. Lukin [4], A.A. Tatarkin [5] and others made significant contributions to the research of interregional economic interaction as a factor influencing the competitiveness of the region and the sustainable socio-economic development of the state. At the regional level, various aspects of interregional and international cooperation of Russia's regions, and assessments of comparative interregional cooperative developments in the Republic of Tatarstan are presented in the works of Kazan economic school: T.M. Vakhitova, L.A. Gadelshina, M.Z. Gibadullin, R.V. Kashbraziev, V.V. Khomenko, A.M. Shikhalev [6–12].

A solid branch of literature is devoted directly to the problems of managing the regional economy, interregional trade, cooperation relations and socio-economic systems in general. Important contributors among domestic and international researchers are I. Ansoff, P. F. Drucker, R. L. Daft, M. Porter, V.M. Polterovich, A.A. Thompson, O.E. Williamson, H. Fayol, D. Hussey, A.G. Aganbegyan, L.I. Abalkin. Their works reveal ways and methods of improving the management of the regional economy [13–18].

These studies made significant contribution to the creation of the concept of interregional economic cooperation. At the same time, the methodological basis for assessing the rational specialization of a region, which takes into account and maximize the potential of cooperative networks of a large industrialized region, remains insufficiently studied. By large industrialized regions we understand such regions as the Republic of Tatarstan, the Republic of Bashkortostan, Samara oblast, Nizhny Novgorod oblast, Sverdlovsk oblast, etc.

Based on this, the goal of our research is to restructure the region's cooperation networks based on the optimization of the region's industrial specialization in the face of global challenges.

3 Research Methodology

To fill this gap, we have developed and justified an iterative mechanism for determining the sectoral structure of promising interregional cooperation in a large industrialized region, which allows us to structure specialization sectors, establish rational ones and ensure a reduction in the risk in implementing interregional cooperation. Determination of the sectoral structure consists of three interconnected and sequentially implemented iterations (Fig. 1).

At the first stage, industrial sectors of the regional economy are structured according to the size and dynamics of volumetric indicators. At the second stage, existing and potential industries of specialization are assessed taking into account the level of their efficiency and stability over time, in order to establish the rational ones. At the third stage, the iteration is aimed at additional adjustment of interregional cooperation from the perspective of risk reduction by taking into account the required level of diversification of interregional cooperation networks.

For the sustainable and effective development of interregional cooperation networks, cooperation must grow along the lines of the region's rational sector of specialization. In this regard, at the first stage of the iteration, industries are ranked according to the criterion of their impact on the key socio-economic indicators of the region. For this purpose, we propose a system of indicators, which formes the basis for a comparative analysis and structurization of sectors of the regional economy (Table 1).

The result of structurization is the integrated coefficient of the specialization sector, calculated by formula (1).
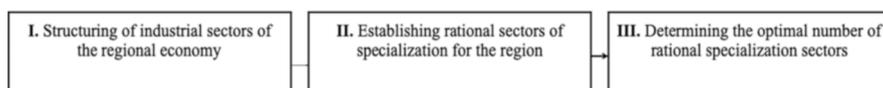
$$K_{OC_i} = \sum_{n=1}^{6} x_n, \tag{1}$$

Fig. 1 Scheme for determining the sectoral structure of the region

Table 1 System of indicators for industrial sectors of specialization

№	Indicator's name
1	The share of industries in the structure of the gross regional product
2	Production volume of regional industries in all-Russian economic indicators, %
3	Share of industries in the commodity structure of export interregional trade turnover, %
4	Share of industries in the commodity structure of exports international trade turnover, %
5	Average monthly salary of employees, rub
6	Average number of employees, people

where

K_{OC_i}—the total value of the integrated coefficient of the sector of specialization for the i-th industry;

x_n—industry's score in each indicator;

n—number of indicators included in the analysis, $n = \overline{1, 6}$;

i—number of industries compared, $i = \overline{1, 10}$, because in this research we consider only industrial branches of region's economy.

The essence of structuring industries of specialization is to rank manufacturing industries in descending order of their share in the relevant indicators. The ratings were compiled by assigning points (from 0 to 1). The integrated coefficient K_{OC_i} varies in the range from 0 to 6. Depending on the value of the coefficient, three cases arise, which characterize the level of economic potential of the industry.

1. $3 \prec K_{OC_i} \leq 6$. The value of the coefficient closer to the upper limit indicates a high level of economic potential of the industry, an increase in production volumes and, as a consequence, the deepening specialization of the region in this industry.
2. $1 \prec K_{OC_i} \leq 3$. Industries that score a value greater than 1, but are not very far from it, can be assessed as potentially attractive for inclusion in the interregional cooperation. In this case, one was chosen as the threshold value because if an industry has the maximum share in at least one indicator, then it can be considered that it has potential and needs to be increased.
3. $0 \leq K_{OC_i} \leq 1$. When the coefficient value is less than 1, this indicates that this industry has low economic potential, since it has a small share in the indicated indicators, and is not of interest for further study.

We should note that in this study we analyze industrial cooperation networks, because such form of cooperation allows us to develop and strengthen other forms of interregional cooperation.

However, not all industries of the region's industrial specialization identified during the first iteration equally contribute to the sustainable development of interregional cooperative networks, so there is a need to identify more efficient and stable industries of the region's specialization, i.e. rational sectors of specialization. To do this, at the second stage, existing and potential industries of industrial specialization are assessed taking into account the level of their efficiency and stability over time, in order to establish the rational ones. Consequently, specialization is considered rational from the point of view of two indicators—efficiency (the profitability of the industry) and stability (the level of fluctuation in profitability). In this regard, we have introduced a relative variation indicator h, which reflects the correlation between the level of profitability and the degree of its fluctuation. The level of variability is calculated using formula (2) and has a threshold value equal to or less than 30% (33%).

$$h = \frac{\sigma}{PI_{\text{cp}}} \leq 30\% \, (33\%) \,, \tag{2}$$

where

h—relative measure of variation;

$\sigma = \sqrt{D}$—standard deviation;

$PI_{cp} = \frac{PV}{I} * 100\%$—the average profitability of the specialization industry including the discount, which was defined as the ratio of discounted cash income of the return flow to the original investment, taking into account the discount rate of 15% and the payback period of 3 years [11, p. 26].

The concentration of interregional cooperation networks on only one or two rational sectors of specialization creates excessive dependence on market trends and narrows the possibilities for expanding cooperation ties. At the same time, there is an objective need to determine the maximum number of sectors of rational specialization in the region. Exceeding the limit can lead to increased costs, reduced production efficiency and investment. In such a situation, at the third stage, the iteration is aimed at additional adjustment of interregional cooperation from the point of view of reducing its risk by additionally taking into account the required level of sectoral diversification of interregional cooperation networks. It allows to compensate for the risks arising from crisis phenomena when the number of effective industries of specialization limited, to diversify interregional cooperation networks, and to strengthen its position in the interregional market.

An integral indicator that demonstrates the degree of sectoral diversification of interregional cooperation networks, taking into account the number of industries and their contribution to the formation of the commodity structure of exports from the studied region to the other regions of the Russian Federation, is calculated using formula (3).

$$K_d = \sum_{i=1}^{n} d_i^2, \qquad (3)$$

where

K_d—integral coefficient of sectoral diversification of interregional cooperation networks, in shares;

d—share of the i-th industry in the commodity structure of export of interregional trade turnover, %;

i—number of industries.

Depending on the value of the integral coefficient K_d we can distinguish between high, medium and low levels of interregional cooperation networks diversification (Table 2).

A successful degree of industrial diversification is considered to be an interval from 1000 to 2000, which characterizes the optimal volume of rational industries of specialization in the region, and usually corresponds to an average of five to six industries of regional specialization. When managing interregional cooperation networks, this coefficient value is desirable. If $K_d < 1000$, then interregional

Table 2 Classification of types of cooperation

Cooperation type	K_d
Low diversification	$2000 < K_d \leq 10{,}000$
Medium diversification	$1000 < K_d \leq 2000$
High diversification	$K_d \leq 1000$

cooperation is considered highly diversified, which corresponds to more than ten sectors of the regional economy. If $2000 < K_d \leq 10{,}000$, then the concentration of interregional cooperative networks is greater than diversification. The maximum value $= 10{,}000$ characterizes the situation when the volume of exports is limited to only one regional industry [19, p. 10].

4 Results

The proposed approach towards the determination of the sectoral structure of promising interregional cooperation was tested with statistical data from a large industrially developed region of the Russian Federation—the Republic of Tatarstan [20].

Based on the above methodology, according to calculations Eq. (1), structural changes in the production sectors of the Republic of Tatarstan were determined at the aggregate level. Analysis of the obtained values showed a steady increase in the coefficient of the petrochemical and engineering industries of Tatarstan over the entire period of the study. This indicates a high level of economic potential of these industries, increasing production volumes and specialization of the region in these sectors.

Based on the obtained indicator values, the agricultural sector has an average level of economic potential. Its indicator according to formula (1) has a stable position greater than one over the entire study period. Therefore, it is assessed as a potential sector of specialization for expanding areas of interregional cooperation. Finally, the lowest value of the obtained indicators corresponds to the remaining manufacturing sectors, which indicates a low level of their economic potential in comparison with other sectors.

The generalized results of the research carried out using petrochemical and mechanical engineering industries of the Republic of Tatarstan showed the following. Firstly, both sectors of Tatarstan's economy are profitable. The average level of profitability in petrochemicals remains at 5.08%, in mechanical engineering—9.58%. A smoothing procedure based on the moving average method was additionally applied to some studied data on the profitability.

The dynamics of profitability of the petrochemical industry are more stable compared to the dynamics of the mechanical engineering industry, which has a deep amplitude of fluctuations, which characterizes the instability of the development of the mechanical engineering industry. Secondly, calculations according to Eq. (2) showed that when smoothing the initial data, the variability of the indicator for the

petrochemical industry is within the normal range, namely $h = 31\%$.

$$PI_{cp} = \frac{1}{9} \sum PI_i = 5.08\%; \quad D_{H\backslash x} = \frac{1}{n-1} \sum_{i=1}^{n} \left(PI_i - PI_{cp}\right)^2 = 2.50;$$

$$\sigma_{H\backslash x} = \sqrt{2.50} = 1.58\%; h_{H\backslash x} = \frac{1.58}{5.08} = 0.3112 = 31.12\% \approx 31\%.$$

Consequently, the petrochemical industry is a rational sector of regional specialization, contributing to the sustainable and effective development of interregional cooperation networks of the Republic of Tatarstan. We cannot say this about the mechanical engineering industry. For it, the variation indicator $h = 86\% \geq 30\%$ (или 33%) is higher than the threshold indicators and can be characterized as clearly immoderate (unstable).

$$PI_{cp} = \frac{1}{9} \sum PI_i = 9.58\%; \quad D_M = \frac{1}{n-1} \sum_{i=1}^{n} \left(PI_i - PI_{cp}\right)^2 = 67.15;$$

$$\sigma_M = \sqrt{67.15} = 8.19\%; h_M = \frac{8.19}{9.58} = 0.8554 = 85.54 \approx 86\%.$$

In this case, calculations showed the insufficient efficiency of the mechanical engineering industry from the point of view of the sustainability of the development of interregional cooperation.

The results of calculations according to Eq. (3) based on the structure of export of interregional trade turnover of the Republic of Tatarstan showed that the value of the coefficient of sectoral diversification of interregional cooperation networks was $K_d = 3292$ and belongs to the interval $2000 < K_d \leq 10{,}000$, which characterizes low-diversified cooperation between regions. This result confirms the concentration of the region's economy on only two industries—petrochemical and mechaninal engineering. However, at the first stage of the iteration, we identified a potential sector of specialization for expanding the zones of interregional cooperative cooperation in Tatarstan—the agricultural sector. Our assessment showed that the profitability index is 1.29%, and the level of variability is 38%. Despite the relatively low, but relatively stable profitability, the agricultural industry can be considered as a potential sector of specialization of the economy of Tatarstan for its inclusion in the process of interregional cooperation networks.

5 Discussion

An assessment of interregional cooperation networks in the Republic of Tatarstan showed that the republic has low-diversified interregional cooperation. Its specialization sectors are petrochemical and mechanical engineering. Moreover, today

only the petrochemical industry acts as a rational one. The engineering industry needs additional adjustments from governing bodies, the development of strategic development plans, etc. A potential sector of specialization of the Republic of Tatarstan for expanding zones of interregional cooperation is the agricultural sector. Consequently, it is necessary to expand the sectoral structure of the region and increase the efficiency of manufacturing industries of specialization.

6   Conclusion

Thus, for the sustainable and effective development of interregional cooperation networks, cooperation must grow along the lines of rational specialization based on the efficiency, stability and competitiveness of the regional industry. It has been determined that a balance is required between rational specialization of the region and sectoral diversification of interregional cooperation networks, which allows compensating for the risks arising from unforeseen crisis events in a limited number of profitable industries.

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