

The assessment of economic security for the “Yenisei Siberia” regions in digitalization

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Abstract. The study suggested integral method of economic security estimation and assessment of the “Yenisei Siberia” regions considering standardization of indicators depends on their threshold values and expert assessment of the significance of groups of indicators. This method allows to estimate the level of regional security from the industrial, scientific, technological, and digital perspectives. The results of the study shows that economic security of the “Yenisei Siberia” regions has different levels depends on the region: Krasnoyarsk region has normal level during the entire period of the study; by the contrast, the negative trend from the “normal” to the “low” levels is presented in Khakassia and Tuva republics. To maintain and increase the levels of economic security in the regions it is required detailed development of each sphere of economic security.

1 Introduction

In Russia the modern economic conditions can be characterized by significant uncertainty of the external and internal environmental factors, emergency of various kinds of challenges and threats (for example, pandemic or decreasing of oil prices) as well as sanctions pressure. From this perspective providing and supporting national security of Russian Federation plays an important role, which is impossible without maintaining economic security of the regions as its integral parts.

“Yenisei Siberia” can be determined as a macro-region which includes Krasnoyarsk region, the Republic of Khakassia and Tuva Republic, due to existing transport, energy and other networks and connections between them. In general, at the present moment the differences in economic development of “Yenisei Siberia” regions according to the main socio- economic indicators have reached the critical levels: for instance, the volume of gross regional product of Krasnoyarsk region in 2019 is 9 times higher than in Khakassia, and 33 times higher than in Tuva; the level of capital investments in Krasnoyarsk region is 12 times higher than Khakassia and 24 times higher than in Tuva; the unemployment rate in Krasnoyarsk region in the 3rd quarter in 2020 is estimated as 7,9%, in Republic of Khakassia – 5, 47%, in Tuva – 21, 5%. This significant gap between socio- economic indicators of regions becomes a threat, namely weakening of the mechanisms of interregional economic interaction and increasing interregional contradictions, which sophisticate the

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implementation of unified macroregional policy of socio- economic transformation. Moreover, the process of digitalization of national economy is accompanied by lack of investments in the implementation of IT -technologies, as well as lack of labor in regions with professional knowledge and skills in digital sphere. These threats and challenges make topical issue of estimating economic security of “Yenisei Siberia” for providing a sustainable development.

2 Methodology of the research

In the modern scientific literature, the most common methods for estimation of economic security of the regions are the following:

1. Methods based on the assessment of the main macroeconomic indicators and their correlation with threshold values (S.Yu. Glazyev) [1];
2. Methodology for ranking regions by threat level (N.V. Dyuzhenkova) [2];
3. Methods of the mathematical apparatus (scientists of the Mordovian State University named after N. P. Ogarev) [3];
4. Assessment of the level of regional security using the scorecard method (S.P. Volkov) [4];
5. Methods based on estimation the rate of growth of the main macroeconomic indicators (I.V. Dolmatov) [5];
6. The method of level of economic security assessment of the region through the threshold levels of indicators (E. A. Utkin, A. F. Denisov, V. Salnikov) [6].
7. An integrated methodology for assessing the economic security of a region (Tretyakov D.V. [7], Onishchenko V. [8])
8. Methodology for estimating the resulting indicators of the economic security of the region (Tsvetkov V.A., Dudin M.N.) [9]

Based on the analysis of already considered methods for estimation and assessing the economic security of regions, it is suggested the author’s integral method of estimation of economic security of “Yenisei Siberia” regions considering the normalization of indicators relative to their threshold values and an expert assessment of the significance of a group of indicators.

The method involves the following stages of application and implementation:

1. Identification of six strategically important areas of the region's activity.
2. Construction the framework of indicators for assessing economic security, considering the peculiarities of the development, and functioning of a given territory and their grouping according to the spheres of activity of the region.
3. Determination of the weight coefficient for a group of indicators by the method of expert assessments.
4. Standardization of indicators and calculation of the coefficient of significance for each indicator and group of indicators.
5. Calculation of the integral indicator considering the weight coefficients of the groups of indicators.
6. Construction of a scale of criterion boundaries and interpretation of the results obtained.

The author’s method is based on the method for calculating the integral indicator of economic security by D. V. Tretyakov. For the further estimation, we have determined and classified the following groups of indicators and their weight coefficients:

1. Industrial safety - 0.15;
2. Scientific and technological safety - 0.15;
3. Investment security - 0.15;
4. Social security - 0.2;
5. Demographic security - 0.2.

6. Digital development - 0.15

The highest coefficients were assigned to the social and demographic sphere of security, which can be explained by the main role of regional authorities lying in providing social protection. The industrial, scientific and technological, investment as well as digital groups of indicators has the same weight. The indicators of digital development were suggested to include in the analysis for the first time which is explained due to special attention to the digitalization process in Program for the Development of the Digital Economy in the Russian Federation until 2035.

The next step is to choose a method for normalizing the indicators. In our opinion, the standardization according to the Tretyakov's method is rather simplified, that is why we have been using the system of regulation by E. S. Mityakov. [10]

According to this method, if the actual value of the indicator should not be less than its threshold, then the following function is applied:

$$y = \begin{cases} \frac{(1-\frac{a}{x})}{2^{\ln\frac{10}{3}}}, & \text{if } \frac{x}{a} > 1 \\ 2^{-\log\frac{10}{3}\frac{a}{x}}, & \text{if } \frac{x}{a} \leq 1 \end{cases}, \quad (1)$$

where x is the actual value of the indicator a ;

a is the threshold value of the indicator a ;

y is the normalized value of the indicator a .

If the actual value of the indicator a should be no more than the threshold, then the following function is applied:

$$y = \begin{cases} \frac{(1-\frac{x}{a})}{2^{\ln\frac{10}{3}}}, & \text{if } \frac{x}{a} < 1 \\ 2^{-\log\frac{10}{3}\frac{a}{x}}, & \text{if } \frac{x}{a} \geq 1 \end{cases} \quad (2)$$

Further, to combine the results of normalized indicators in resulting indicator group, it is necessary to use a simple arithmetic mean formula, which is justified by the interchangeability of the selected private indicators that are not in functional dependence and, as a result, have the same weight.

The formula for calculating the arithmetic mean for each group of indicators is as follows:

$$K_r = \frac{\sum K_i}{n}, \quad (3)$$

where n is the total number of indicators in the selected assessing group of the economic security of the region.

To build an integral assessment of the level of economic security, it is necessary to consider the weighting factor of each of the groups:

$$ESR = K_1 \times X_1 + K_2 \times X_2 + \dots + K_n \times X_n, \quad (4)$$

where K_n is the average value for each group of indicators;

X_n is the weighted value of the indicator as part of the economic security of the region;

n is the number of indicators' groups.

Thus, the formula for calculating the level of economic security of a region:

$$ESR = 0,15xindust + 0,15xsciencetech + 0,15xinvest + 0,2xsoc + 0,2xdemog + 0,15xdigit \quad (5)$$

For interpretation the level of economic security of the region the authors have developed the following scale (Table 1):

Table 1. The levels of assessment of regional economic security.

ESR evaluation	Criteria- based lines	Comments
High	1,00 and higher	Lack of problematic socio- economic zones
Normal	0,90-1,00	Insignificant problems in the studied social and economic processes in the region
Low (pre-crisis)	0,70-0,89	Problems in different parts of regional economic security; government regulation and control are required
Crisis	0,5-0,69	Significant problems and high level of threats influence on regional economic security; the urgent regional authority's regulation and control are required
Emergency	0,49 and lower	Significant threats influence on regional and national economic security

3 Results

The method suggested above was applied to estimate the economic security of “Yenisei Siberia” regions. In the table 2 it is shown the values of indicators of industrial security of the regions from 2017 to 2019.

Table 2. Indicators of industrial security of the region in 2017-2019.

Regions		Krasnoyarsk region	Republic of Khakassia	Republic of Tuva	Threshold
Indicators per year					
Growth of GRP compared with the previous year in %	2017	105	115	112	No less than 105
	2018	109	106	113	
	2019	120	113	115	
Industrial index in % compared with the previous year	2017	108	87	87	No less than 105
	2018	100	108	88	
	2019	94	101	101	
Agricultural production index compared with the previous year,%	2017	102,4	100,7	100,3	No less than 105
	2018	97,4	93,6	93,4	
	2019	104,5	99,5	99,5	
Retail trade turnover, compared with GRP, in %	2017	29	38	40	No less than 40
	2018	27	38	37	
	2019	24	35	34	

The growth of GRP in Krasnoyarsk region and Republic of Tuva have positive dynamic, while the dynamic of GRP in Khakassia has no clear tendency, but all three regions show the values of indicator higher than threshold. The industrial index in Krasnoyarsk region and Khakassia is decreasing, in Tuva it shows a insignificant growth, but in 2019 the indicators of three regions were below the threshold, which indicates the insufficient development of Yenisei Siberia in the industrial sphere. Situation in agricultural sector of Khakassia and Tuva can be characterized as negative by the agricultural production index, while in Krasnoyarsk region this index has grown in 2019 and almost reached the threshold value. The volume of retail trade turnover is falling from year to year in three regions and is significantly below the threshold value.

The next element of the economic security of the region is scientific and technological security (Table 3).

Table 3. Indicators of scientific and technical safety in 2017-2019.

Regions		Krasnoyarsk region	Republic of Khakassia	Republic of Tuva	Threshold
Indicators per year					
Share of released innovative products in released industrial commodities, %	2017	4,1	0,1	0,3	No less than 15
	2018	3,3	0,5	0,1	
	2019	2,5	0,1	0,7	
Innovative activity of organizations, %	2017	7,1	2,1	2,4	No less than 5
	2018	7,1	4,0	1,8	
	2019	7,4	4,5	1,8	
Number of employees in R&D in % to employed	2017	0,5	0,09	0,3	No less than 1
	2018	0,5	0,1	0,3	
	2019	0,6	0,04	0,3	
Internal costs for R&D in % to GRP	2017	0,97	0,04	0,50	No less than 2
	2018	0,85	0,04	0,42	
	2019	0,99	0,05	0,44	

Dynamics of released innovative products and number of employed in R&D in three regions are significantly lower than threshold. Innovative activity is rising in Krasnoyarsk region and Khakassia, while in Tuva this indicator is falling. The share of internal costs for R&D can be characterized as rather stable, but it is lower than threshold of 2%.

The indicators of investment security of the regions are presented in Table 4.

Table 4. Indicators of the investment security in 2017-2019.

Regions		Krasnoyarsk region	Republic of Khakassia	Republic of Tuva	Threshold
Indicators per year					
Capital investments in % to GRP	2017	24	12	19	No less than 25
	2018	22	17	22	
	2019	19	15	25	
Index of factual volume of capital investments, compared with the previous year, %	2017	102	170	138	No less than 105
	2018	94	103	110	
	2019	106	138	118	
Consumption of fixed capital, %	2017	46,1	39,2	43,1	No less than 40
	2018	46,4	40,8	42,1	
	2019	46,3	41,2	41,1	
Rate of replacing of fixed assets, %	2017	9,4	4,9	9,2	No less than 15
	2018	9,3	5,1	12,2	
	2019	8,7	6,5	8,4	
Rate of disposal of capital assets, %	2017	0,9	0,3	1,2	No less than 5
	2018	1,1	0,5	2,4	
	2019	0,6	0,9	0,9	
Share of foreign investments in overall volume of capital investments, %	2017	11,5	1,7	27,3	No less than 15
	2018	12,4	4,6	25,2	
	2019	6,6	6,7	30,8	

Capital investments in % to GRP and rates of replacing and disposal of capital assets in three regions are lower than threshold. At the same time, index of factual volume of capital investments is no less than 105% - that means positive dynamics. Share of foreign investments in overall volume of capital investments are decreasing in Krasnoyarsk region from 11,5 to 6,6%, meanwhile this indicator is rising in Khakassia and Tuva from 1,7% to 27,3% and 6,7% to 30,8% relatively.

Indicators of social security of regions are presented in table 5.

Table 5. Indicators of social security in 2017-2019.

Regions		Krasnoyarsk region	Republic of Khakassia	Republic of Tuva	Threshold
Indicators per year					
Rate of unemployment based on ILO methodology, %	2017	5,7	4,8	18,0	No less than 5
	2018	4,8	5,1	14,8	
	2019	4,5	5,3	12,7	
Housing, m2 per person	2017	23,9	22,7	13,5	No less than 22
	2018	24,3	23	13,8	
	2019	24,6	23,4	13,9	
Population with the incomes less than subsistence level, in % to overall population	2017	35,8	18,8	17,6	No less than 10
	2018	34,4	18,5	17,1	
	2019	34,7	18,9	17,5	
Assets ratio, number of times	2017	14,2	10,9	10,9	No less than 8
	2018	13,3	10,9	10,9	
	2019	12,9	10,4	10,4	
The number of crimes per 1,000 people of the population, units	2017	17,8	21,4	36,3	No less than 24
	2018	14,9	20,4	28,5	
	2019	3,7	3,6	5,5	

The indicators of unemployment rate, people's access to housing and number of crimes in Krasnoyarsk region and Khakassia shows rather stable situation in these regions. While in Tuva the employment rate is higher than normal in 2 times, index of housing is low. Population with incomes less than subsistence level in three regions are higher than normal: in Krasnoyarsk region is more than in 3 times, in Khakassia and Tuva - almost more than in 2 times. Number of crimes in the macroregion is less than normal and decreasing every year.

Demographic security indicators are presented in Table 6.

Table 6. Indicators of demographic security in 2017-2019.

Regions		Krasnoyarsk region	Republic of Khakassia	Republic of Tuva	Threshold
Indicators per year					
Annual population growth rate, %	2017	100	0,98	101	No less than 100
	2018	0,99	0,99	100	
	2019	0,99	0,99	100	
Ratio of depopulation (ratio of the number of deaths and births)	2017	1,03	1,03	0,39	No less than 1
	2018	1,17	1,3	0,42	
	2019	1,16	1,2	0,44	
Total fertility rate, children per 1 woman	2017	1,77	1,82	3,44	No less than 2,15
	2018	1,66	1,54	3,18	
	2019	1,58	1,52	3,12	
Life expectancy at birth, ages	2017	70,0	69,3	64,21	No less than 70
	2018	70,6	70,2	66,29	
	2019	70,7	71,2	66,47	
Growth of migration for 10.000 of population	2017	1,7	0,4	-4,2	No less than 0,1
	2018	0,3	-0,1	-3,3	
	2019	0,1	-1,7	-3,0	

The annual population rate in three regions is almost equal to threshold, but the total fertility rate and the ration of depopulation is close to the threshold values only in the Republic of Tuva. Life expectancy at birth in Krasnoyarsk region and Khakassia is close to the threshold, while in Tuva this indicator is less than threshold (66,47 ages). Migration index is higher than threshold only in Krasnoyarsk region, which can be explained by the size and the level of development of the region.

Indicators of digital development of regions are presented in Table 7.

Table 7. Indicators of digital development of regions in 2017-2019.

Regions		Krasnoyarsk region	Republic of Khakassia	Republic of Tuva	Threshold
Indicators per year					
Proportion of households having broadband Internet access to overall households, %	2017	63.9	58.3	81.7	No less than 73
	2018	66.8	54.5	87.4	
	2019	66.4	53.5	78.4	
Proportion of population using Internet for getting governmental and municipal services in digital form to overall population at the age of 17 – 72, %	2017	80.4	64.0	78.8	No less than 77
	2018	77.5	80.0	86.4	
	2019	83.1	73.9	90.4	
Proportion of organizations using Internet in % to overall number of organizations	2017	89,7	85,8	83,5	No less than 90
	2018	90,0	87,6	82,2	
	2019	91,7	89,8	79,7	
Proportion of organization using servers in % to overall number of organizations	2017	47,7	48,1	35,1	No less than 53
	2018	51,5	50,3	35,1	
	2019	52,3	50,5	33,6	
Proportion of organization using cloud services in % to overall number of organizations	2017	22,0	23,2	16,6	No less than 26
	2018	24,1	20,9	20,9	
	2019	26,4	24,5	20,0	

Thus, the proportion of households with broadband Internet access is below the threshold in the Krasnoyarsk region and Khakassia, while in Tuva this indicator has been higher than the threshold for three years. The use of the Internet by the population for receiving state and municipal services in digital form is at a high level in the Krasnoyarsk region and Tuva, and insignificantly lower than threshold in Khakassia. Organizations actively use the Internet, servers and cloud services in the Krasnoyarsk region and Khakassia, while in Tuva the use of these digital devices and technologies is limited.

The standardization of all the indicators of the six elements of economic security using the Mityakov's method has allowed to obtain the following integral assessments of the level of economic security for each regions.

Table 8. Assessments of the integral indicator of the level of economic security of the regions in the "Yenisei Siberia" project.

Regions		Krasnoyarsk region	Republic of Khakassia	Republic of Tuva
Indicators per years				
Value of integral indicator	2017	0,90	0,92	0,90
	2018	0,93	0,85	0,87
	2019	0,94	0,89	0,89
Level of economic security of region	2017	Normal	Normal	Normal
	2018	Normal	Low	Low
	2019	Normal	Low	Low

4 Discussion

The results of the study shows that economic security of the “Yenisei Siberia” regions has different levels depends on the region: Krasnoyarsk region has normal level during the entire period of the study from 2017 to 2019; by the contrast, the negative trend from the “normal” to the “low” levels is presented in Khakassia and Tuva republics. To maintain and increase the levels of economic security in the regions it is required detailed development of each sphere of economic security. The lowest level according to the assessment results was obtained by the industrial sector, mainly due to the indicator of retail trade turnover. To improve the situation, it is necessary provide financial support for small and medium-sized businesses. Furthermore, it is worth noting that all regions in the Yenisei Siberia project have a high potential in developing the agricultural sector, but this potential is not implemented, as it can be seen from the index of agricultural production. In this case, the strategic goal of regional policy should be the development of rural areas and support for agricultural production.

5 Conclusions

The authors have suggested the integral method of economic security estimation of the “Yenisei Siberia” regions considering standardization of indicators depends on their threshold values and expert assessment of the significance of groups of indicators. This method allows to estimate the level of regional security from the industrial, scientific, technological, and digital perspectives. The results of the study shows that economic security of the “Yenisei Siberia” regions has different levels depends on the region: Krasnoyarsk region has normal level during the entire period of the study; by the contrast, the negative trend from the “normal” to the “low” levels is presented in Khakassia and Tuva republics. To strengthen the level of economic security in these regions, it is necessary provide financial support for small and medium-sized businesses, as well as to develop rural areas and agricultural production.

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