

# The Analysis of Changes in the Industry Structure of Investment in the Russian Arctic zone

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## ABSTRACT

The purpose of the study was to identify the main trends of structural transformations in the investment sphere of the macro-region that is strategically important for the sustainable development of the Russian economy - the Arctic zone of the Russian Federation. Based on the indicators of the share of economic activities in the total volume of investment in fixed assets, the author provided the analysis of structural shifts and the assessment of the changes in the industrial structure of investment in the Arctic regions for 2017-2019. For the quantitative measurement of structural transformations, the square coefficient of absolute structural shifts of Kazinets, Gatev and Ryabtsev indices, and partial indicators of structural shifts that characterize their mass and speed were used. It was determined that during the period under review, the industry structure of investment in the Arctic zone as a whole did not undergo significant changes, which is explained by the multidirectional dynamics of structural shifts at the regional level. Their analysis proves that investment flows are redistributed towards extractive industries, which gives the possibility to conclude that structural imbalances in the investment sphere of the Russian Arctic are increasing and regional investment is becoming more uneven.

**Keywords:** *Arctic zone, Investment, Structure, Structural shifts.*

## 1. INTRODUCTION

Investment is a crucial condition for ensuring sustainable economic growth and improving the quality of life of the population. Due to investment, the opportunities are expanding not only for the reproduction of fixed capital, but also for the development of fundamentally new industries, the introduction of modern technologies, and the creation of new jobs [1-3].

In Russia, the main consumers of investment are regions, among which the leading role for the development of the national economy is played by the regions of the Arctic zone of the Russian Federation (AZRF) - the country's largest raw material reserve. Thus, according to the estimates, AZRF contains more than 270 billion tons of conventional fuel, including 48.5 billion tons of oil and condensate and over 220 trillion m<sup>3</sup> of natural gas [4], as well as about 10% of the world's proven reserves of Nickel, 19% of platinum group

metals, 10% of titanium, more than 3% of zinc, cobalt, gold, silver, lead, iron and other minerals [5-7].

The strategic importance of AZRF determines the relevance of research on investment processes occurring within this macro-region, the most important characteristic of which is the structure of investment in fixed assets and its dynamics.

## 2. METHODOLOGY

In modern conditions, the study of structural transformations in the regions is of considerable importance, since the structural dynamics of the regional economic system determines its stability to external challenges and threats [8-13].

In Russian practice, the most popular indicator for analyzing the structural changes in regions is the index of differences between two structures (the Ryabtsev index), which can be used both to assess the level of differences

between the structures of two regions and to assess structural differences in one region over two compared periods [14]. For example, in the work of Yu.V. Trifonov and N.V. Veselova [15] Ryabtsev index is used to determine the level of differences in the structure of the gross value added of the Nizhny Novgorod region and the structure of the Volga Federal district. Other authors [16-18] used it for the dynamic analysis of structural changes. Yu.V. Preobrazhensky [19] used the Ryabtsev index both to determine the level of differences in the industrial structure of several regions, and to assess the structural differences in industry in each of these regions over a ten-year period.

Besides, the researchers suggest using other generalizing indicators of structural changes (for example, linear and quadratic coefficients of absolute and relative structural shifts, Gatev index, Salai index [20]), as well as individual (private) indicators of the dynamics of structural shifts [21-23], the calculation of which is necessary to understand why changes occur within the structure.

In this study, both general and specific indicators were used to analyze structural transformations (table 1):

where  $d_{i1}$ ,  $d_{i0}$  are the specific weights of the  $i$ -go element of the structure in the current (1) and base (0) periods;  $n$  is the number of structural elements;  $T$  is the time of the structural shift.

For the interpretation (1), (2), (3) the following conditions were used:

The Kazinz index (1) to 2% reflects a low speed of structural change (small structural shifts); from 2 to 10% - significant structural shifts; more than 10% - strong structural shifts.

The Gatev index (2) ranges from 0 (low intensity of structure change) to 1 (high intensity of structure change).

The Ryabtsev index (3) within 0.000-0.030 indicates identity of structures; 0.031-0.150 - low level of structural differences; 0.151-0.300 - significant level of structural differences; 0.301-0.700 - significant level of structural differences; 0.701 and higher - the opposite type of structures.

The calculations were based on the indicators of the share of economic activities in the structure of investments in the fixed assets of the regions of AZRF for 2017-2019. The analysis for the earlier period was not carried out due to the inability to make comparable calculations due to the transition of the all-Russian classifier of economic activities to the new version (OKVED-2) in 2017. The information base consists of the official data from the territorial bodies of the Federal state statistics service.

All regions whose territories, in accordance with the Russian legislation (Decree of the President of the

**Table 1.** Indicators used to assess structural changes

Indicator	Formula
Quadratic coefficient of absolute structural shifts of L.S. Kazinets (Kazinets index). It allows to estimate the rate of structure change.	$I_K = \sqrt{\frac{\sum_{i=1}^n (d_{i1} - d_{i0})^2}{n}} \quad (1)$
Integral coefficient of structural shifts of K. Gatev (Gatev index). Evaluates the intensity of changes in the structure.	$I_G = \sqrt{\frac{\sum_{i=1}^n (d_{i1} - d_{i0})^2}{\sum_{i=1}^n d_{i1}^2 + \sum_{i=1}^n d_{i0}^2}} \quad (2)$
Index of the difference between the two structures of V. M. Ryabtsev (Ryabtsev index). Determines the level of significance of the difference in structures.	$I_R = \sqrt{\frac{\sum_{i=1}^n (d_{i1} - d_{i0})^2}{\sum_{i=1}^n (d_{i1} + d_{i0})^2}} \quad (3)$
The mass of the structural shift. Shows how many percentage points the specific weight of a structural element has increased (+) or decreased (-) in the current period in relation to the base one.	$M = d_{i1} - d_{i0} \quad (4)$
The speed of the structural shift. Reflects how the mass of the structural shift has changed during its course.	$V = \frac{d_{i1} - d_{i0}}{T} = \frac{M_i}{T} \quad (5)$

Source: calculated by the author.

Russian Federation No. 296 of 02.05.2014), are somehow part of the Russian Arctic: Murmansk and Arkhangelsk regions, Yamalo-Nenets, Nenets and Chukotka Autonomous districts, Krasnoyarsk territory, the Komi Republic, Karelia and Sakha (Yakutia)) were considered.

### 3. RESULTS AND DISCUSSION

The structure of investment in the fixed assets of the Russian Arctic is largely determined by the current structure of the economy of the regions that make up it. Since in most of them it has a pronounced raw material orientation, the largest volume of investment falls on the extraction of minerals (60.5%). This trend is mainly typical for the Nenets and Yamalo-Nenets Autonomous districts, in which the leading place belongs to the investment-attractive gas and oil industries: the share of production in the investment structure of these regions in 2019 was 91.1% and 85%.2%, respectively.

The significant amounts of capital investment in AZRF are also directed to transportation and storage (13.9%), as well as manufacturing (8.0%). The largest share of investment in transport characteristic of the Republic of Karelia (25.1%), Murmansk (25.6%) and Arkhangelsk (21.8%) regions, which have sufficiently

well-developed transport infrastructure [24], and the transport sector is among the leading sectors of the economy and of the Republic of Sakha (23.2%), where, due to the implementation of major investment projects, in particular projects for the construction of the pipeline system "Eastern Siberia – Pacific Ocean" and pipeline "Power of Siberia", formed a rather long system of pipelines [25]. A high share of capital investment in manufacturing is typical for the Arkhangelsk (29.2%) and Murmansk regions (24.7%).

The calculation of differences in branch structure of investments into fixed capital of AZRF, indicates its insignificant change over the period 2017-2019 with relative preservation of proportions of types of economic activity: Kazinetz index (1) showed the deviation of the weights of economic activities on average 0.657%, which is interpreted as "small structural changes"; Gatev index (2) showed a value that characterizes the "low intensity" changes of structures (IG=0.021); Ryabtsev index (3) the structure of the 2017 and 2019 are "identical" (IR=0.015).

At the same time, the analysis of the structural changes for each type of economic activity shows that there were multidirectional changes within the

**Table 2.** Changes in the structure of investments in the fixed assets of AZRF for 2017-2019

OKVED-2 section: type of economic activity	Shift mass	Shift rate
Section A: Agriculture, hunting and forestry	0.302	0.151
Section B: Mining and quarrying	1.205	0.602
Section C: Manufacturing	-0.353	0.176
Section D: Provision of electricity, gas and steam; air conditioning	1.133	0.567
Section E: Water supply, sanitation, waste collection and disposal, pollution elimination	-0.488	0.244
Section F: Construction	-0.032	0.016
Section G: Wholesale and retail trade; repair of motor vehicles and motorcycles	-0.366	0.183
Section H: Transportation and storage	0.159	0.080
Section I: Hotels and catering establishments	-0.019	0.009
Section J: Information and communication activities	0.119	0.060
Section K: Financial and insurance activities	0.290	0.145
Section L: Real estate transactions	-0.053	0.026
Section M: Scientific, professional and technical activities	-2.041	1.020
Section N: Administrative activities and related additional services	0.204	0.102
Section O: Public administration and military security; social security	-0.500	0.250
Section P: Education	0.251	0.126
Section Q: Health and social services	0.415	0.208
Section R: Culture, sports, leisure and entertainment	-0.250	0.125
Section S: Other services	0.016	0.008

Source: calculated by the author.

investment structure of AZRF during the period under analysis (table 2).

The largest positive structural changes occurred in the types of economic activities "Mining" and "Provision of electricity, gas and steam; air conditioning". In the first case, the positive dynamics was achieved mainly due to an increase in the share of mineral extraction in the investment structure of the Yamalo-Nenets Autonomous region (shift mass +5.68% at a rate of 2.8%) and Yakutia (shift mass +11.99% at a rate of 5.9%). In the second - by increasing the share of electric power in the investment structure of all Arctic regions. The shares of agriculture, transport, education, healthcare, information technology, administrative and financial activities increased less significantly (shifts in the range of 0.01-0.41%) in the structure of investments in AZRF.

The largest negative structural shifts occurred in the scientific and technical sphere of AZRF, and only due to the decrease in the share of investments in the Yamalo-Nenets Autonomous region (shift mass -4.2% at a rate of 2.09%), Krasnoyarsk territory (shift mass -3.7% at a rate of 1.84%) and the Murmansk region (shift mass -0.5% at a rate of 0.26%). In other regions of the Russian Federation, this type of economic activity shows positive dynamics.

#### 4. CONCLUSION

The analysis showed that the redistribution of investment flows associated with an increase in the share of some types of economic activity and a reduction in the share of others demonstrates an increase in the investment attractiveness of extractive industries in the Russian Arctic, primarily in regions that export hydrocarbons. This not only increases their dependence on market fluctuations in global raw materials markets, but also indicates an increase in structural imbalances in the investment sphere of the Russian Arctic and an increase in the unevenness of regional investment in the Arctic, when the main volumes of investment are concentrated in export-oriented regions with raw materials specialization. Such deformations lead to a significant gap in the levels of regional socio-economic development, which contradicts the objectives of Russia's spatial development.

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