Structural shifts in the industry of Arctic regions of Russia

S A Berezikov
Luzin Institute for Economic Studies – Subdivision of the Federal Research Centre «Kola Science Centre of the Russian Academy of Sciences», Apatity, Russia
bsa@iep.kolasc.net.ru

Abstract. The concept of modernization of industry adopted as an imperative for development of the Russian economy requires clarification and specification in the process of its implementation with regard to the regional level of the economy. Taking into account the regional economic conditions, the composition and structure of the basic industries and the corresponding main directions of technological development of the industry are of particular importance. The article deals with the problem of determining main directions of technological development of industry in the Arctic regions of Russia. To this end, an analysis of structural shifts in industry in Arctic regions was carried out. The basis of the research methodology was the shift-share analysis and the location quotient. The shift-share analysis was used in its classical interpretation. The studied period is from 2005 to 2016, the base year is 2005. The parameter was gross value added. As a result of the accomplished analysis, branches of specialization were identified and the main factors of structural changes in formation of the gross added value of the industry of the Arctic regions were determined. This made it possible to determine the main content of the regional industrial policy and corresponding main directions of technological development for regions of the Russian Arctic.

1. Introduction
Modernization of structure of economy and industry is a key priority in development of Russian Arctic regions. Realization of this concept will reduce their dependence on raw materials and create high-tech production with high share of value added. According to Agarkov et. al., “in order to choose preferable trends of economic development and to provide efficiency of operations in the Arctic zone, it is crucial to perform research in the areas of industrial efficiency upgrading” [1].

Structural imbalances in economy and industry inherited from the USSR proved to be very resistant to any changes. The structural changes provided by actions of the “invisible hand of the market” do not always lead to the set goals. In addition, in recent years, the problem of formation of rational structural relations among branches of the Arctic industry has become much more acute. Another aspect of structural change policy is the structural diversification of regional industry. However, with regard to Arctic regions, whose economies are largely based on extracting and processing natural resources, it should be noted that diversification should not be an end in itself. It is necessary to determine main directions of technological development of the industry of regions of the Arctic on the basis of an interregional inter-sectoral approach, taking into account the whole set of factors and
limitations, and on this basis to build the processes of modernization and diversification of the structure of regional economy and industry.

2. Methods
One of the many economic, social, political and other factors determining economic dynamics of a regional system is the structure of industrial production. It seems logical to make a comprehensive assessment of contribution of this structure into industrial production, taking into account the totality of all factors. However, in practice, the choice of indicators that quantitatively reflect the degree of influence of these factors on the results of the regional industrial system is associated with difficulties due to the lack of statistical information. This determines the choice of research methods used in the this work.

To assess structural changes in the industry of regions of the Arctic, the location quotient and the shift and share analysis are used.

The first of the methods used in this work is the location quotient, through the analysis of which studies of regional economy very often begin. It estimates the share of economic activities in the spatial unit relative to the respective shares of these activities on a national scale, as baselines depending on the purpose of the study used employment, production, etc. Location quotient is used to determine the branch specialization of spatial units, in our case the region, and is calculated by the formula:

$$LQ_{ir} = \frac{A_{ir}}{A_r} \left( \frac{A_n}{A} \right)^{-1}$$  \hspace{1cm} (1)

where \(A\) is the indicator, \(i\) is the branch of economic activity, \(r\) is the spatial unit (city, region, etc.), \(n\) is the country as a whole. The control value is 1 when \(LQ_{ir} > 1\), the spatial unit \((r)\) specializes in a specific industry \((i)\).

The second of the methods used below is the shift-share analysis (SSA). In the classical or traditional interpretation, the technique of SSA became widespread due to the works [2, 3, 4]. Later, the method was developed in [5, 6, 7]. Currently, SSA is often used, both in the traditional form and in various modifications, in foreign studies of regional economy in order to determine the main driving forces of regional economic changes and predict the future state of regional economic systems [8, 9, 10]. Despite the popularity of the SSA technique in foreign studies, it is not widely used in Russia.

SSA provides an assessment of economic growth of a region, cleared of differences in the sectoral structure, and helps to identify industries in which the regional economy has advantages over the national one. The results of this assessment show how the economic performance of regional producers, ceteris paribus, are systematically higher or lower than the results of economic activity of firms operating in other territories in the same industries.

SSA operates on changes in the economic variable (employment, output, etc.) over time within branches of the regional economy, dividing these changes into constituent elements. It is worth noting that majority of foreign researchers using this methodology as an indicator of economic growth choose indicators of employment growth, explain the lack or incompleteness of data on variables such as gross regional product, regional income or per capita income, as well as ease of access the data on employment at the regional level. At the same time, Russian researchers prefer to use gross value added indicators.

The standard shift-share calculation scheme analyses the change in economic performance between two extreme years of the selected time interval. It is assumed that the structure of the object of study does not change over time. This fact is very often the object of criticism for this method. However, our earlier study of structural changes in the industry of regions of the Arctic [11] showed that (in most regions) the structure of the industry has not changed or changed slightly (the Ryabtsev index indicates the identity of structures or characterizes the level of differences as low or very low).

Mathematically, the essence of the technique of SSA in its traditional form, in which the method is used in this work, can be expressed as follows [12]:

$$TC = \sum_{i=1}^{n} (E_{i2} - E_{i1}) = NG + IM + RS$$  \hspace{1cm} (2)
These three components can be expressed as follows:

\[
NG = \sum_{i=1}^{n} r_{oo}(E_i^1)
\]  

\[
IM = \sum_{i=1}^{n} (E_i^1(r_{io} - r_{oo}))
\]  

\[
RS = \sum_{i=1}^{n} (r_{ij} - r_{io})E_i^1 = TC - NG - IM
\]

\(E_i^1\) - the value of the \(i^{th}\) industry in the region in the base period;  
\(E_i^2\) - the value of the \(i^{th}\) industry in the region in the reporting period;  
\(r_{oo}\) - the total growth rate of the indicator for all sectors in the country;  
\(r_{io}\) - growth rate of the \(i^{th}\) industry in the country;  
\(r_{ij}\) - growth rate of the \(i^{th}\) industry in the region;  

\(NG\) is the effect of national growth, it characterizes the part of the indicator changes associated with the overall growth of the national economy. It is equal to the theoretical change in the regional indicator, provided that its growth rate was equal to the national one.

\(IM\) is the effect of the industry structure (proportional shift), it determines the amount of growth of the regional indicator associated with effectiveness of a particular industry. It shows how much the regional indicator would change if it increase with a growth rate equal to the growth rate of the industry at the national level. A positive value of the indicator of proportional shift means that the fast-growing sectors of the national economy are located in the region under consideration.

\(RS\) is the effect of the regional share (differential shift) reflecting the part of changes related to the influence of regional conditions. A positive value of this indicator means the presence of regional competitive advantages in the region under consideration.

\(TC\) is the cumulative change of the regional indicator between the beginning and the end of the analyzed period.

It should be noted that to date, there is no uniform terminology in both domestic and foreign literature within the framework of the shift-share analysis.

In accordance with the considered methodology, the paper analyzes changes in the sectoral structure of industry in regions of the Arctic in the period from 2005 to 2016. Calculations of indicators were made according to Rosstat data on gross value added (GVA) of economic activities related to industry, on gross domestic product, on index-deflator. The data was brought to a comparable form using the deflation method.

3. Results

The sectoral specialization of regions of the Arctic was estimated by calculating the location quotient (LQ) in 2005 and 2016 (beginning and end of the studied period) in order to determine possible changes in the specialization of these regions that occurred in the period under review.

In all regions of the Arctic in the period under review, there was an increase in the coefficient of localization of mining, which indicates an increase in their specialization in this type of economic activity.

The branch of specialization in the Nenets and Yamal-Nenets Autonomous districts remained mining, despite minor changes in the location quotients.

In the Chukotka Autonomous Okrug, the coefficient of localization for electricity, gas and water production also decreased compared to 2005, but specialization in this type of economic activity remained.

In the Murmansk region, specialization in the production and distribution of electricity, gas and water has also increased, with the simultaneous disappearance of manufacturing industries from the region's specialization.
In economically developed countries, the general pattern of structural economic change can be characterized by significant decrease in raw materials sector, simultaneous increase in services and general industrial modernization. Major changes are taking place in less material- and energy intensive sectors [13, 14, 15].

Thus, by the end of the period under review, main branches of specialization of regions of the Arctic were mining as well as production and distribution of electricity, gas and water. It should be noted that the location quotient for each of these activities exceeds 1.25, which, according to the theory of the economic base, indicates that they are the basic industries or the main exporters of regional industrial production. So, we can talk about the presence of the trend opposite to developed countries.

The analysis shows that there were practically no changes in the structure of the industrial GVA of the Nenets Autonomous Okrug in the period from 2005 to 2016. The main branch of industry that ensures the growth of GVA throughout the period under review is the extraction of minerals. Despite the fact that the main driver of the growth of GVA in this industry is the General conditions of industrial activity in Russia (the effect of the national share in the growth of GVA amounted to 107946.78 million rubles), the differential shift is positive and equal to 38931.29 million rubles, which indicates favorable regional conditions for improving competitiveness of this activity.

In the Yamal-Nenets Autonomous district, the distribution of factors of change in the GVA industry is almost identical to the distribution in the Nenets Autonomous district. In both regions, mining-related industries are the industries that determine competitiveness of the region, with superior national opportunities to enhance regional economic growth.

In the Murmansk region, the distribution of factors of change in the GVA industry is characterized by the most significant negative differential shift ($RS$) in manufacturing among all analyzed regions. The absence of the necessary regional conditions for improving competitiveness of manufacturing, along with the presence of slow-growing industries in the structure of this sector (negative proportional shift) provided a significant drop in its share in the structure of the region's GVA industry in the period under review.

The Chukotka Autonomous Okrug is the only region in which the effect of the regional share ($RS$) is the main factor in the growth of GVA in mining and industrial production in general.

4. Discussion

The results show that all regions of the Arctic industry are featured with slowly growing industries (for all types of industrial activities, the proportional shift is negative: $IM < 0$). At the same time, a positive value of differential shift ($RS > 0$) is observed in mining industries in all the regions under consideration. The combination of these factors ($IM < 0$ and $RS > 0$) indicates that these industries have unique regional conditions that allow them to develop faster than the Russian economy as a whole.

The analysis of structural changes in manufacturing shows that only in the Nenets and Yamal-Nenets Autonomous districts regional conditions contribute to the growth of their competitiveness. In other regions of the Arctic, the effect of the regional share takes negative values ($RS < 0$), while it is worth noting the fact that for the Murmansk region and the Chukotka Autonomous Okrug $|RS| < |IM|$, i.e. the decline in production in these regions is faster than in the manufacturing industries at the country level as a whole.

Structural changes in production and distribution of electricity, gas and water are characterized by favorable regional conditions in the Nenets, Yamal-Nenets and Chukotka Autonomous districts. In the Murmansk region production in these industries is declining ($RS < 0$).

Since, when determining directions of technological development of industry of the Arctic regions, one should take into account that differences in technological level between the branches are so great that there is no sense in talking about a single technical policy for all spheres of management. Perhaps, the most appropriate approach in this case will be to determine main directions of technological development of the industry, depending on dominant industries in a region. This will allow: first, to
concentrate efforts on development of leading industries, taking into account regional characteristics; second, to ensure their harmonious development with preservation of basic competencies, since dominance of a sector in the structure of industry inevitably affects the Genesis of technologies in the region, its level of technology and prospects for economic growth.

It was previously determined that the basic type of economic activity related to industry, in most regions of the Arctic is currently mining ($LQ > 1.25; RS > 0$), with a tendency to increase specialization in this type of activity. Then, according to the proposed approach, main directions of technological development of the industry of the Northern and Arctic regions should be determined in this area. That is, the strategy of industrial modernization should be based on the "principle of increasing and concentrating scientific knowledge and production potential in the resource sectors of the economy of these territories, taking into account the current trends in technological development of the economy" [16].

References
[1] Agarkov S A et al 2018 Journal of Mining Institute 230 209-216
[2] Fuchs V R 1959 Changes in the Location of U.S. Manufacturing Since 1929 J. of Reg. Sci. 1 1-18
[3] Dunn E J 1960 A statistical and analytical technique for regional analysis Papers in Reg. Sci. 6 97-112
[4] Ashby L D 1964 Survey of current business 44 13-20
[5] Esteban-Marquillas J M 1972 A Reinterpretation of Shift-Share Analysis Regional and Urban Economics 2 249-261
[6] Berzeg K 1978 The Empirical Content of Shift-Share Analysis J. of Reg. Sci. 18 463-469
[7] Barff R A and Knight P L 1988 Dynamic Shift-Share Analysis Growth and change 19 1-10
[8] Goschin Z 2014 Regional growth in Romania after its accession to EU: a shift-share analysis approach Procedia Economics and Finance 15 169-175
[9] Chao L 2016 The Fishery Industrial Structure in China Based on the Application of Shift-Share Analysis Asian Agricultural Research 8 8-20
[10] Gardiner B et al 2012 Spatially Unbalanced Growth in the British Economy Working Paper CGER 1 17-29
[11] Berezikov S A 2017 North and the market: the formation of the economic order 54 165-178
[12] Floyd C F 1976 Projections of employment growth in Georgia: A shift and share analysis. Studies in applied reg. sci. 1 142.
[13] Teslya A et al 2016 The Concept of Economic Growth of the Construction Industry in St. Petersburg MATEC Web of Conferences 53 01005
[14] Cherepovitsyn A E et al 2016 Analysis of production and consumption of rare-earth metals in the EU and the BRICS Tsvetnye Metally 5 5-10
[15] Didenko N et al 2018 A country competitiveness analysis. Adl-model involved International Multidisciplinary SGEM 18 3-10
[16] Berezikov S A 2016 North and the market: the formation of the economic order 50 86 (in Russian)