Assessment of resource regions’ readiness for comprehensive exploitation of mineral resources based on shift-share analysis

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Assessment of resource regions’ readiness for comprehensive exploitation of mineral resources based on shift-share analysis

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Abstract. The paper discusses the use of shift-share analysis method for assessing resource regions’ readiness for comprehensive exploitation of mineral resources. The relevance of this study is explained by the fact that the choice of the factors affecting regional processes and the quantitative assessment of their impact are limited by the available statistical information. The lack of necessary statistical data significantly reduces the possibility of using econometric methods. The shift-share analysis method allows assessing the sectors of resource regions’ economy, which serve as keys to identifying their readiness for comprehensive exploitation of mineral resources. The study focuses on the group of 36 resource regions specializing in the extraction of oil, gas and coal.

1. Introduction

Much attention has recently been paid to the development of resource economies and resource regions. This is due to the fact that most countries which have significant reserves of natural resources, including Russia, lag behind the countries that do not have such natural resources in terms of the rate and quality of economic growth, social development, and political and economic institutions. The need to implement the Russian economy’s transition to the innovative development path (scenario) has recently been a key element in the political agenda. The peculiarity is that Russia consists of regions that are extremely different in their social and economic characteristics, which is reflected, for example, in their uneven economic development, the widening of the gap in the most important indicators of regional production, income and poverty, the quality of life of the population. The gap in the level of indicators that evaluate the innovative activity is one of the most significant compared to the other socio-economic indicators. Thus, the gap in the share of internal research and development costs in the gross domestic product has grown to 143-148 times, and in terms of the number of advanced production technologies used the gap has grown to more than a thousand times [1]. At the same time, it is the export-oriented raw materials sector of the Russian economy and resource-type regions that determines the country’s place in the international division of labor, serves as the most important source of income of the budget system, and largely marks the direction of development and growth of the domestic economy. In this paper we understand resource regions (resource-type regions) as the regions whose basic sectors of economy are export-oriented extractive industries, and/or primary processing industries, producing raw materials and/or intermediate products.
The special relevance of this problem is given by the fact that, as the analysis [2] shows, the Russian resource regions are characterized by the development of an enclave dual economy. This development path is associated with the formation of a high-performance export-oriented sector isolated from the rest of the economy and represented by enterprises of extracting and intermediate industries (oil and mining industries, ferrous and non-ferrous metallurgy, etc.). The development of this sector does not provide significant incentives for the modernization of the regional economy, its integration into the all-Russian economic space; it does not create sufficient incentives for the development of the manufacturing industry, the innovation sector and other sectors of the economy. At the same time, export-oriented extractive industries and primary processing industries remain the “locomotives” of the Russian economy and determine its place in the global division of labor.

J. Stiglitz claimed that if the standard economic science focuses on the deformation of initiatives as a result of the issuance of certain privileges and protections, they must have a more harmful aspect since these privileges are usually obtained through corruption and bribery of public officials [3]. The consolidation of privileges for the representatives of wealth enclaves is a source of negative externalities associated with the deformation of incentives for entrepreneurs from other sectors of the economy, which are reoriented from the creation of a new value to rent-oriented behavior associated with participation in the redistribution of value in the high-performance export-oriented sector of the regional economy. The core of the problem is the situation when the “wealth enclaves” remain steady and hinder (or block) the transition to the development path of forming an integrated regional economy, which would provide modernization of manufacturing industries, stimulate innovation activity of small and medium businesses in the region and investment in the sphere of health care and education, research and development. Sustainable preservation and stable “reproduction” of the “wealth enclaves” in the regions rich in mineral resources increase their resource dependence, limit investment flows to a narrow range of sectors producing raw materials and intermediate products, and do not allow breaking short vertical value chains associated with the export of these products to world markets.

The problem of changing the extensive model of Russia’s economic development is directly related to the assessment of the resource regions’ readiness to move to the comprehensive exploitation of mineral resources, which entails significant positive external effects, i.e. the benefits received by non-privileged actors of the regional economy, located outside the “wealth enclaves”, including entrepreneurs from other sectors of the resource-type economy. Under the influence of positive externalities, it is possible to increase the number of entrepreneurs capable of implementing productive activities, which in turn leads to an increase in the level of education and has a positive effect on the growth of labour productivity [4]. In other words, a productive entrepreneur is a pillar of growth and a source of Schumpeterian innovations in the economy, and the positive externalities associated with their activities are the basis for a broad modernization of the regional economy and the elongation of horizontal value chains.

2. Data and methods

This study presents the group of 36 resource regions specializing in oil, gas and coal production. These regions were selected on the basis of the coefficient calculated by E. Kagan and E. Goosen [5]. The indicator is the ratio of the share of extractive industries in the GRP of the region to the value of the share of extractive industries in GDP of the Russian Federation. To assess the readiness of the studied group of regions for comprehensive exploitation of mineral resources, the data of the official website of the Federal State Statistics Service for 2010 and 2015 [6] were used.

The choice of factors affecting regional processes, including resource regions’ readiness for comprehensive exploitation of mineral resources, and the quantitative assessment of this impact are limited by available statistical information. The absence of the necessary statistical data significantly reduces the possibility of using econometric methods. The shift-share analysis method (SS), which has not yet been widely used in Russian studies, is used in foreign literature for developing typologies of regions and performing economic diagnostics of regional processes. Shift-share analysis is a method...
of analyzing regional growth through quantitative measurement of the contribution of structural factors to the economic dynamics of the region [7, 8, 9, 10, 11, 12]. The main idea of the method is to decompose the growth of the regional indicator into three components: National Share (NS) reflecting the influence of national growth factors; Industry Mix (IM) reflecting the influence of industry growth factors, and Regional Shift (RS) reflecting the influence of regional growth factors on the economic dynamics of the region.

The National Share \(NS'_{ij}\) for sector ‘\(i\)’ of the economy in the region ‘\(j\)’ in the year ‘\(t\)’ is determined as the share of the regional indicator \((y_i)\) growth proportional to the growth of the national indicator \((Y_N)\): \(NS'_{ij} = y_i^{t-1} \cdot \left(\frac{Y_N}{Y_N^{t-1}} - 1\right)\), where \(y_i^{t-1}, Y_N^{t-1}\) stand for the value of the indicators in the sector ‘\(i\)’ and the region ‘\(j\)’ in the year \((t-1)\), and the values of the national indicator in the years \((t-1)\) (basic period) and \(t\) (current period) respectively.

The Industry Mix for sector ‘\(i\)’ of the economy in the region ‘\(j\)’ in the year ‘\(t\)’ reflects the value of the growth of the regional indicator determined by the change in the region’s industry structure. Its value shows how much the growth of the regional indicator would amount if the growth rate of sector ‘\(i\)’ of the regional economy equaled the national rate: \(IM'_{ij} = y_i^{t-1} \cdot \left(\frac{Y_N'}{Y_N^{t-1}} - \frac{Y_N'}{Y_N'}\right)\), where \(Y_N', Y_N''\) are the values of this indicator in the sector ‘\(i\)’ of the national economy in the current and the basic periods. IM is used for assessing the contribution of the regional features of the studied indicator’s structure into its cumulative growth. The positive value of this indicator means that the structure of this industry in the region is more effective compared to the national level, i.e. the share of the fast-growing industry in the region is higher than in the national economy.

The Regional Shift is frequently defined as competition effect. It reflects the difference between the real and the estimated growth in the case the growth rate of the considered sector of the economy equaled the national rate for this sector: \(RS'_{ij} = y_i^{t-1} \cdot \left(\frac{Y_N'}{Y_N'} - \frac{Y_N'}{Y_N'}\right)\). This component characterizes the contribution of all the regional factors except the structural factor into the cumulative growth of this indicator. It serves as the basis for assessing the contribution of the endogenous factors, including human potential, investment climate, institutional conditions and other factors determining the specifics of the region, into its economic growth [13]. The total growth of the RS of the sector ‘\(i\)’ in the region ‘\(j\)’ is calculated as the sum of three components: \(y_i' - y_i'' = NS'_{ij} + IM'_{ij} + RS'_{ij}\).

The shift-share analysis allows identifying the industries that are under the influence of a group of growth factors. Regional economic clusters are based on the industries for which RS values will be positive, which indicates the presence of special conditions in the region, providing these industries with competitive advantages and, as a result, the most successful development path. Based on the IM and RS values components and the ratio between them, 6 types of industries were identified [14] and presented in Table 1.

This typology allows us to assess the sectors of the resource regions’ economy which are key for assessing their readiness to implement comprehensive exploitation of mineral resources. Such sectors are extractive industries, revealing the regions’ resource potential, branches of manufacturing industry, defining the ground for the regions’ transition to the intensive way of development, and infrastructure (transport and communications), showing the extent of the regions’ development and their readiness for comprehensive exploitation of mineral resources.

| Type of industry | Ratio of indicators | Interpretation of indicators |
|------------------|---------------------|-----------------------------|
|                  |                     | Table 1. Typology of industries based on IM and RS ratio. |

3
1. IM>0, RS>0
   Both regional and sectoral development conditions are favourable

2. IM<0, RS>0, |IM|<|RS|
   Favourable regional development conditions outweigh partially
   unfavourable sectoral development conditions

3. IM>0, RS<0, |IM|>|RS|
   Favourable sectoral development conditions outweigh partially
   unfavourable regional development conditions

4. IM<0, RS>0, |IM|>|RS|
   Favourable regional conditions fail to outweigh unfavourable
   sectoral development conditions

5. IM>0, RS<0, |IM|<|RS|
   Favourable sectoral development conditions fail to outweigh
   unfavourable regional development conditions

6. IM<0, RS<0
   Both regional and sectoral development conditions are unfavourable

The most commonly used regional indicators are employment rate, turnover, value added, profit, etc. They should reflect either the scale of activities of enterprises and industries, or their effectiveness. In the first case, the indicator helps select the leading industries in the region, characterized by the fastest and most sustainable growth and high competitiveness, capable of extending the horizontal value chain. In the latter case, the most promising enterprises and industries can be selected [13].

In foreign studies, the employment rate is most often used as the regional indicator. The advantage of this indicator is that it accurately characterizes the general economic dynamics and does not depend on cost indicators. However, some researchers [15] argue that the employment rate does not adequately reflect the changes in the scale of production activities due to the specifics of the Russian labour market and low inter-regional and inter-sectoral mobility of labour resources. The employment rate indicators do not reflect the real economic dynamics, the growth of the output of raw materials and intermediate products is not necessarily accompanied by the growth of employment, and the modernization of mining and processing industries, as a rule, is associated with the Russian resource companies purchasing imported equipment and reducing the number of employees at their enterprises [see: 16]. In this regard, the most appropriate indicator may be the volume of shipped products. Within the framework of this, three sectors of the economy were selected for analysis: extractive and manufacturing sectors of industry and infrastructure, represented by transport and communication. With the aim of assessing the resource regions’ readiness for comprehensive exploitation of mineral resources two regional indicators were chosen: the volume of shipped products and fixed capital investment in different sectors of economic activities. On the one hand, fixed capital investments show resource companies’ readiness to update fixed assets in order to maintain the existing level of development of extractive and manufacturing industries, on the other hand, they reflect the companies’ priorities in terms of the importance of certain industries for them.

3. Results and discussion
Table 2 presents the typology of resource regions based on the analysis of the dynamics of the amount of shipped products.

| Sectors of the economy and classes | Transport and communications |
|-----------------------------------|-----------------------------|
| Extractive                        |                             |
| Khanty-Mansiysk Autonomous Okrug  | (5,5)                       |
| Yugra                             | (5,5,4)                     |
| Krasnoyarsk Kray                  | (5,5,6)                     |
| Manufacturing                     |                             |
| Kursk Region                      | Krasnoyarsk Kray            |
| Republic of Karelia               | Komi Republic               |
| Republic of Kalmykia              | Volgograd Region            |
| Kemerovo Region                   |                             |
Two classes were identified in the extractive and manufacturing sectors of the economy: Type 1 (both regional and sectoral development conditions are favourable) and Type 5 (favourable sectoral development conditions fail to outweigh unfavourable regional development conditions). In the sector defining transport and communications Type 4 (favourable regional conditions fail to outweigh unfavourable sectoral development conditions) and Type 6 (both regional and sectoral development conditions are unfavourable) were identified. The Republic of Ingushetia was excluded from this classification as its amount of shipped products in the manufacturing sector of industry equals zero.

The analysis showed that the most effective structural shifts occurred in the Republic of Udmurtia, which is characterized by favourable regional and sectoral development conditions in the extractive and processing sectors of the economy. Yet, in its sector of transport and communications favourable regional conditions fail to outweigh unfavourable sectoral development conditions. The major mineral resource in Udmurtia is oil, while significant peat reserves were found there as well, and both brown and black coal were extracted. At the same time, the Republic has advanced manufacturing industries and diversified agriculture. The major branches of industry are machine building, metal industry, ferrous metallurgy and wood processing industry.

The group of regions that are characterized by favourable regional and sectoral conditions in the extractive and manufacturing sectors and unfavourable regional and sectoral conditions for transport and communications presents certain interest as well. This group includes Yamalo-Nenets Autonomous Okrug, the Republic of Buryatia, the Republic of Tyva, and the Republic of Khakassia. For instance, Yamalo-Nenets Autonomous Okrug ranks among the leading Russian regions in terms of hydrocarbons, especially natural gas and oil. So, its economy is based on oil and gas extraction.

The mentioned national republics are referred to the regions of “new resource exploitation”, which implies active development of both extractive (for example, coal mining) and manufacturing industries. At the same time, these subjects of the Russian Federation are characterized by generally weak development of internal communication infrastructure. In the Republic of Buryatia and the Republic of Tuva there is no railway connection, which weakens their competitive position, and levels favorable regional and sectoral conditions of development in the extractive and manufacturing sectors of the economy.

To identify the priorities of resource regions’ development in terms of the renewal of fixed assets in the extractive and manufacturing sectors of the economy, and in the transport and

| Type | Region                      | Region                      |
|------|-----------------------------|-----------------------------|
| 5,1,4| Nenets Autonomous Okrug    | Belgorod Region             |
|      | Bashkortostan Republic      | Arkhangelsk Region          |
|      |                             | Kaliningrad Region          |
|      |                             | Chechen Republic            |
|      |                             | Trans-Baikal Kray           |
| 1,5,4| Murmansk Region             | Astrakhan Region            |
|      | Tatarstan Republic          | Orenburg Region             |
|      | Perm Kray                   | Republic of Sakha (Yakutia) |
| 1,5,6| Samara Region               | Khabarovsk Kray             |
|      | Tyumen Region               | Amur Region                 |
| 5,   | Irkutsk Region              | Magadan Region              |
|      | Tomsk Region                | Chukotka Autonomous Okrug   |
|      | Sakhalin Region             |                             |
| 1,1,4| Republic of Udmurtia        | Republic of Buryatia        |
|      |                             | Republic of Tyva            |
|      |                             | Republic of Khakassia       |
| 1,1,6| Yamalo-Nenets Autonomous Okrug |                             |

| Type | Region                      | Region                      |
|------|-----------------------------|-----------------------------|
communications sector, we present the results of the analysis of the dynamics of fixed capital investments in these sectors (table 3).

Table 3. Typology of resource regions based on the analysis of the dynamics of the amount of fixed capital investments in three sectors of the economy.

| Sectors of the economy and classes | Transport and communications |
|-----------------------------------|-----------------------------|
|                                   | 2                           | 4                           | 6                           |
| Extractive                        | (5,5,2) Republic of Kalmykia | (5,5,4) Krasnoyarsk Kray     | (5,5,6) Republic of Karelia Khabarovsk Kray |
|                                   | (5,1,2) Murmansk Region Kemerovo Region | (5,1,4) Kursk Region | (5,1,6) Trans-Baikal Kray Republic of Sakha (Yakutia) Amur Region Magadan Region |
|                                   | (3,1,2) Volgograd Region | (3,1,4) Khanty-Mansiysk Autonomous Okrug - Yugra | (3,1,6) Tatarstan Republic Tyumen Region |
| Manufacturing                     | (1,5,2) Astrakhan Region Sakhalin Region | (1,5,4) Kaliningrad Region | (1,5,6) Belgorod Region Komi Republic Chechen Republic Orenburg Region Yamalo-Nenets Autonomous Okrug Republic of Khakassia Chukotka Autonomous Okrug |
|                                   | (1,1,2) Bashkortostan Republic Republic of Udmurtia Perm Kray Samara Region Republic of Buryatia Republic of Tyva Irkutsk Region Tomsk Region | | (1,1,6) Arkhangelsk Region Nenets Autonomous Okrug Republic of Ingushetia |

In the extractive sector of the economy three classes (Type 1, Type 3, and Type 5) were identified. In the manufacturing sector of the economy two classes were identified: Type 1 and Type 5. In the transport and communications sector three classes (Type 2, Type 4, and Type 6) were allocated. Let us consider the resource regions whose economy saw structural changes which allowed them to become leaders in terms of investment in fixed assets in the mentioned sectors of the economy.

The group of the leading regions in the analysis of the dynamics of fixed capital investments is characterized by favorable regional and sectoral conditions of development in the extractive and manufacturing sectors of the economy, and favorable regional conditions for development which outweigh partially unfavorable sectoral conditions for development in the transport and communications sector. For this group of resource regions, this is due to a number of different reasons. For example, the Samara Region is one of the leaders among the subjects of the Russian Federation in the development of public-private partnership projects, which determines the need to invest resources, both from the private and public sectors of the economy in the renewal of fixed capital. Tomsk Region
is leader in innovations not only within the Siberian Federal District, but also in Russia as a whole, which means a diversified economy of the region. The Republic of Tyva and the Republic of Buryatia are the regions of “new resource exploitation”, which predetermines the necessity of investing resources in the extractive and manufacturing sectors and transport infrastructure. Another group of regions (Arkhangelsk Region, Nenets Autonomous Okrug, and the Republic of Ingushetia) are characterized by “failure” in terms of the volume of investments in the infrastructure sector of the economy, with unfavorable regional and sectoral development conditions.

4. Conclusion
The shift-share analysis of the resource regions in terms of the volume of shipped products showed that they fall into classes that are characterized either by favorable regional and sectoral conditions for development, or favorable sectoral development conditions which fail to outweigh the unfavorable regional conditions for the development of the extractive and manufacturing sectors of the economy, while transport and communication are characterized by Types 4 and 6. On the other hand, the typology of resource regions obtained on the basis of the analysis of the dynamics of fixed capital investments showed that a significant amount of these regions belong to Type 1 (favorable regional and sectoral development conditions) concerning the investment in the extractive and manufacturing sectors. In this sense, resource regions have a significant potential for the transition to the intensive development path in the context of their readiness for comprehensive exploitation of mineral resources.

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