Innovative component of the transformation of resource-based regions

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Abstract. The problem of changing the extensive model of economic development in Russia is directly related to the willingness of resource regions to move to the trajectory of balanced development. Therefore, the question of developing approaches and algorithms for assessing the readiness of resource regions for the development of technologically interconnected industries focused on the production of products with high added value is relevant. The solution to this issue is connected both with the selection of the most informative indicators, on the basis of which an assessment of this readiness can be made, and with a strong differentiation of resource regions. The purpose of the article is to study the possibility of a comprehensive assessment of the readiness of resource regions for the development of technologically interconnected industries focused on the production of products with high added value based on their investment and innovative activity. To solve the problem, the article presents and analyzes statistical information on investment and innovation activity of the studied group of regions for the period 2010-2017. The performed analysis allows us to conclude that the studied group of regions has significant heterogeneity. As an explanation of the causal mechanism, there are two main versions of the resource curse theory. They can be conditionally called “economic” and “political” resource curse. In the first, the so-called crowding-out effect has a negative impact on economic growth (or, in our case, innovation) - a high return on investment in the extractive sector leads to a reduction in investment in other sectors. Within the second framework, resource rent causes a drop in the quality of public administration, which, in turn, negatively affects economic growth. Within the framework of our study, it is difficult to unambiguously draw a conclusion about the causal mechanism that determines a lower indicator of the “innovative activity” component with an increase in the resource dependence of the region, however, the effect of the “crowding out effect” is more likely.

1. Introduction

The new industrial revolution as well as the economic and political sanctions imposed on Russia have clearly demonstrated the vulnerability of the resource orientation of Russian economy. Under current conditions, the country faces the pressing issue of forming a new economic development model based on the rational interaction of the human and environment, the human and technology, and social institutions. It is obvious that science and the manufacturing industry should act as drivers of such changes. The Decree of the Russian President “On national goals and strategic objectives of the development of the Russian Federation for the period up to 2024” of May 7, 2018 (No. 204) explicitly states the need to transform the Russian Federation into one of the largest economies in the world by...
ensuring economic growth rate above the world average, accelerating technological development, prompt introduction of digital technologies, fostering a high-performance export-oriented sector in the basic industries that would be developed on the basis of modern technologies and provided with highly qualified personnel. The solution of these problems is impossible without changing the spatial specialization of resource-based regions.

2. Data and methods
Resource specialization of regions is both a source of welfare growth and the cause of many problems of their development. Basically, gains from the sale of resources provide high revenues to the federal budget and entrench the resource specialization of regions. The effect of the resource dependence development deepens the orientation of the economy towards the extensive exploration of natural resources, leads to a reduction in the share of manufacturing industries, especially, mechanical engineering, and reduces the demand for highly qualified, highly productive workforce and innovations. Negative processes affect not only the resource-based regions in particular, but also the country's economy as a whole.

Increased attention has been paid to the issues of innovative development of Russian resource-based regions against the background of global trends, as well as to the study of their future role in the country's economy.

The first foreign research papers assessing the role of the extractive industries in the country's economy appeared during the formation of the fourth wave of innovation (the Age of Oil). Rapid growth in world oil prices in the 1970s inspired interest in analyzing the role of energy industries in the economy. In the 1970s, many researchers shared the views of A. Smith and D. Ricardo on the positive role of natural resources in the process of economic development (Viner, 1952; Rostow, 1961) [1, 2]. American researchers were first to analyze the impact of changes in the fuel and energy balance on the economic development of countries (Rasche, Sachs, 1977, 1981, 1983) [3-5]. They studied the case of sharp fluctuations in oil prices and its impact on the US economy. Subsequently, a large number of works appeared in which researchers tried to determine the degree of influence of fluctuations in oil prices on the economies of various regions and countries of the world (Burbidge, 1984; Bjornland, 2000; Rautava, 2002; Chuku, 2015) [6-9].

Moreover, in the mid 1970’s – early 1980’s, there appeared a number of studies in the problems of economic development of regions in which the oil and gas complex dominated. In their works, J. Sachs and A. Warner (Sachs, Warner, 1995, 1997) [10-12] drew attention to the fact of the slower development of resource-rich countries. At that time, a large number of concepts describing this phenomenon were coined in the literature – "resource curse", “Dutch disease”, “oil curse”, “enclave type of development”, and others (Gylfason, 2001) [13]. Currently, the literature on the “resource curse” is dominated by the direction focusing on the channels through which resource dependence could affect sustainable economic growth (savings, investment, and human capital). V. Polterovich, V. Popov and A. Tonis (2007) [14] confirm the conclusion that the phenomenon of the “resource curse” cannot be explained without taking into account the institutional aspects of the economy. The authors showed that the “resource curse” occurs only in the absence of developed economic and political institutions in the country. A significant contribution to the development of this hypothesis was made by international economists Barro, 1999 [15]; Acemoglu 2001, 2008, 2002; Papyrakis and Gerlagh, 2004 [16-19]; Melhum, 2006; Hodler, 2006 [20-21], and Russian researchers V. Kryukov, S. Guriev, A. Plekhanov and K. Sonin [22-26]. All of the above works reflect the negative impact of the raw materials orientation on the transitional economies of countries rich in natural resources in three areas: technological, macroeconomic, and institutional (Corden and Neary, 1982 [27]; Corden, 1984 [28]; Neary and Wijnbergen, 1986 [29]).

Studies focusing on resource-rich countries that have escaped the "resource curse" are also of interest: Papyrakis and Gerlagh (2007) – on the United States [30]; Pegg (2010) – Botswana [31]; DeGregorio and Labbé (2011) – Chile [32]; Gylfason (2011) – Norway [17]; Loayza (2013) – Peru
In the literature, two basic approaches dominate in assessing the prospects for the development of mono-regions, which include regions specializing in the extraction of mineral resources. The first approach exists within the framework of the reindustrialization concept, the second one is the diversification of region's economy.

The concept of reindustrialization emerged in mid-2013. The term was first used in the “Revival of active industrial policy: current problems and new trends” report of the Organization for Economic Co-operation and Development (OECD). According to the report authors, “new industrialization” based on the transition to a new technological base of production should provide large-scale structural changes in the economies of countries. The study also proposed specific tools for reindustrialization: reshoring, the creation of regional innovation "hubs" based on partnerships between the government, business and research organizations with the leading role of development institutions. Among Russian researchers, reindustrialization of regions is studied by V.B. Korovin and V.V. Akberdina, A.I. Tatarkin, and O.A. Romanova.

While research on industrialization takes into account mainly the end result, papers focused on diversification discuss the choice of directions and methods of regional development. The subject of the analysis is mono-regions with unbalanced structure of its industries. The merit of studies discussing the diversification of regional economy consists in the so-called place-based approach which links the success in changing the region's development trajectory with the focus on specific conditions of this particular region. For example, the studies by Neffke and Rigby note that regions tend to develop such new types of activities which, in one way or another, are connected with the industries already existing on their territory, thus increasing investment activity.

Foray, McCann and Ortega-Argilés associate the change in the development trajectory of lagging regions with the so-called Smart Specialization, whose key elements are innovation, entrepreneurial discovery, partnerships between government, business, science and civil society, cluster development and network structures of interaction. Much attention in the research is paid to microactors able to resist large corporations: individual entrepreneurs, small businesses, regional authorities acting as developers of regional policy and other institutional actors (non-profit and non-governmental organizations, etc.). It is noteworthy that researchers distinguish the so-called related and unrelated diversifications. The authors emphasize that in most cases successful diversification is implemented through reliance on already existing production facilities (related diversification), while unrelated diversification is rather an exception. The strength of the former approach lies in the conclusion that the mechanisms of economic diversification must be associated with the development of relative industries, however, its weakness with regard to resource-based regions is that the enclave model of development of resource industries within highly integrated companies makes such industries underdeveloped and not necessary in resource-based regions. The study of innovation activity could help identify such industries.

3. Results and discussion
The purpose of the article is to study the possibility of a comprehensive assessment of resource regions’ readiness for the development of technologically interconnected industries focused on manufacturing of high-value-added products based on their investment and innovative activity.

In this paper, the resource-based regions (or “resource type” regions) are understood as regions that, due to their geographical location and the presence of significant natural resource potential, specialize in mining and processing products of the mineral resource complex, and that host on their territory the largest mineral export-oriented vertically integrated companies (VICs) that determine the direction and nature of the regional economy development.

Based on previous studies, 36 resource-based regions were identified. This group includes regions in which the share of extractive industries in the region’s GRP reached 5% at least once during
the study period (2005–2014). Monoregions (those with maximum resource dependence) include: Nenets Autonomous Okrug, Khanty-Mansi Autonomous Okrug – Yugra, Sakhalin Region, Tyumen Region, Yamalo-Nenets Autonomous Okrug, Republic of Sakha (Yakutia), Chukotka Autonomous Okrug, Orenburg Region, Komi Republic. Highly dependent regions include Tomsk region, Udmurt Republic, Kemerovo Region – Kuzbass, Astrakhan Region. Regions with middle degree of dependence include Irkutsk Region, Republic of Tatarstan, Magadan Region, Krasnoyarsk Territory, Perm Territory, Samara Region, Belgorod Region, Murmansk Region, Republic of Karelia, Amur Region, and Republic of Khakassia. Finally, the group of regions with low dependence includes Kursk Region, Trans-Baikal Territory, and Republic of Tyva. Non-resource-based regions are Volgograd Region, Khabarovsk Territory, Kaliningrad Region, Republic of Buryatia, Republic of Bashkortostan, Republic of Ingushetia, Chechen Republic, Republic of Kalmykia.

To assess the investment activity of the region, three criteria were chosen: the share of investments in mining, the share of investments in manufacturing, and the share of investments in transport and communications. Table 1 presents the values of these indicators for the Russian Federation for 2010–2016 as well as descriptive statistics of these criteria calculated for all regions of the Russian Federation on the whole and for the group of resource-based regions taken separately.

For a comprehensive assessment of the region’s innovative activity, three criteria were also selected: the proportion of organizations making marketing, organizational and technological innovations (%). Table 2 summarized the values of these indicators throughout the Russian Federation for the period 2010–2017. Table 3 presents descriptive statistics of these criteria calculated for all regions of the Russian Federation as a whole and for the group of resource-based regions taken separately.

Table 1. Assessment of the region’s investment activity.

| Russian Federation | 2010      | 2011      | 2012      | 2013      | 2014      | 2015      | 2016      |
|--------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| The share of investments in mining (%) |           |           |           |           |           |           |           |
| 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
| min | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| mean | 14.28 | 13.90 | 15.27 | 16.02 | 16.48 | 17.20 | 17.16 |
| med | 2.31 | 2.22 | 3.47 | 3.54 | 2.92 | 2.97 | 3.09 |
| max | 86.81 | 91.77 | 91.62 | 93.19 | 95.84 | 96.89 | 92.93 |

For all regions of the Russian Federation

| min | 0.05 | 0.31 | 0.26 | 0.07 | 0.00 | 0.00 | 0.00 |
| mean | 25.04 | 24.58 | 27.25 | 27.47 | 27.46 | 29.11 | 28.92 |
| med | 20.50 | 16.16 | 19.69 | 19.09 | 18.16 | 19.05 | 17.30 |
| max | 86.81 | 91.77 | 91.62 | 93.19 | 95.84 | 96.89 | 92.93 |

For the group of resource-based regions

| The share of investments in manufacturing (%) | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
| min | 0.02 | 0.04 | 0.06 | 0.02 | 0.01 | 0.00 | 0.00 |
| mean | 20.17 | 21.10 | 19.50 | 19.11 | 19.22 | 19.97 | 19.72 |
| med | 12.92 | 14.10 | 16.32 | 15.58 | 15.29 | 16.63 | 16.16 |
| max | 53.09 | 53.96 | 59.44 | 60.84 | 60.00 | 54.41 | 58.48 |

For all regions of the Russian Federation

| min | 0.02 | 0.04 | 0.06 | 0.02 | 0.01 | 0.00 | 0.00 |
| mean | 9.89 | 10.86 | 11.73 | 12.29 | 13.21 | 14.62 | 14.28 |
| med | 8.71 | 6.98 | 6.59 | 8.81 | 8.14 | 10.57 | 11.50 |
| max | 35.15 | 30.61 | 33.74 | 44.18 | 49.18 | 50.21 | 47.42 |

For the group of resource-based regions

| The share of investments in transport and communications (%) | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
| min | 0.02 | 0.04 | 0.06 | 0.02 | 0.01 | 0.00 | 0.00 |
| mean | 9.89 | 10.86 | 11.73 | 12.29 | 13.21 | 14.62 | 14.28 |
| med | 8.71 | 6.98 | 6.59 | 8.81 | 8.14 | 10.57 | 11.50 |
| max | 35.15 | 30.61 | 33.74 | 44.18 | 49.18 | 50.21 | 47.42 |
The analysis of the results presented in Table 2 shows that the values of the indicators changed during the study period. Since 2012, there has been a decrease in the proportion of organizations making marketing and organizational innovations in the total number of enterprises. The largest proportion of organizations making technological innovations falls on 2012, the least value was recorded for 2016.

Table 2. Assessment of the region's innovative activity.

|                         | 010 | 011 | 012 | 013 | 014 | 015 | 016 | 017 |
|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| Proportion of organizations making marketing innovations, % | 2.2 | 2.3 | 1.9 | 1.9 | 1.7 | 1.8 | 1.4 | 1.4 |
| Proportion of organizations making organizational innovations, % | 3.2 | 3.3 | 3.0 | 2.9 | 2.8 | 2.7 | 2.4 | 2.3 |
| Proportion of organizations making technological innovations, % | 7.9 | 8.9 | 9.1 | 8.9 | 8.8 | 8.3 | 7.3 | 7.5 |

Table 3. Statistics of criteria for assessing the innovative activity of the region.

| Proportion of organizations making marketing innovations, % | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| For all regions of the Russian Federation                | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| mean                                                   | 2.17 | 2.07 | 1.87 | 1.81 | 1.57 | 1.67 | 1.33 | 1.29 |
| med                                                    | 2    | 1.8  | 1.6  | 1.6  | 1.4  | 1.5  | 1.1  | 1.1  |
| max                                                    | 7    | 5.9  | 7.1  | 7.1  | 5.7  | 7.7  | 4.8  | 6.0  |
| For the group of resource-based regions                 | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| mean                                                   | 1.98 | 1.99 | 1.68 | 1.62 | 1.38 | 1.37 | 1.22 | 1.03 |
| med                                                    | 1.8  | 1.7  | 1.45 | 1.4  | 1.2  | 1.2  | 1.0  | 0.9  |
| max                                                    | 5.9  | 5.9  | 7.1  | 7.1  | 4.6  | 4.6  | 4.0  | 4.0  |

| Proportion of organizations making organizational innovations, % | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|-----------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| For all regions of the Russian Federation                        | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| mean                                                            | 3.1  | 3.1  | 2.7  | 2.6  | 2.5  | 2.5  | 2.2  | 1.9  |
| med                                                             | 2.6  | 2.7  | 2.4  | 2.5  | 2.3  | 2.3  | 2.1  | 1.6  |
| max                                                             | 18.6 | 15.5 | 9.4  | 8.0  | 10.0 | 6.7  | 6.0  | 7.0  |
| For the group of resource-based regions                          | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| mean                                                            | 3.3  | 3.4  | 2.7  | 2.5  | 2.6  | 2.4  | 2.1  | 1.7  |
| med                                                             | 2.8  | 2.8  | 2.3  | 2.4  | 2.4  | 2.4  | 2.1  | 1.4  |
| max                                                             | 18.6 | 15.5 | 9.4  | 8.0  | 10.0 | 6.7  | 4.6  | 5.0  |

| Proportion of organizations making technological innovations, % | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|----------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| For all regions of the Russian Federation                       | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| mean                                                            | 3.3  | 3.4  | 2.7  | 2.5  | 2.6  | 2.4  | 2.1  | 1.7  |
| med                                                             | 2.8  | 2.8  | 2.3  | 2.4  | 2.4  | 2.4  | 2.1  | 1.4  |
| max                                                             | 18.6 | 15.5 | 9.4  | 8.0  | 10.0 | 6.7  | 4.6  | 5.0  |
The analysis of the results presented in Table 2 shows that the values of the indicators changed during the study period. Since 2012, there has been a decrease in the proportion of organizations making marketing and organizational innovations in the total number of enterprises. The largest proportion of organizations making technological innovations falls on 2012, the least value was recorded for 2016.

In view of the above, it was proposed that the assessment of the region’s innovative activity should be based not on the values of the indicators proper but on the calculated values (coefficients) representing the ratio of the value of the studied indicator in a particular region to the value of the indicator for the Russian Federation as a whole.

Table 4 presents descriptive statistics of the coefficients characterizing the innovative activity of resource-based regions.

Table 4. Coefficients of innovation activity resource regions.

|                          | 2010 min | 2010 mean | 2010 med | 2010 max | 2011 min | 2011 mean | 2011 med | 2011 max | 2012 min | 2012 mean | 2012 med | 2012 max | 2013 min | 2013 mean | 2013 med | 2013 max | 2014 min | 2014 mean | 2014 med | 2014 max | 2015 min | 2015 mean | 2015 med | 2015 max | 2016 min | 2016 mean | 2016 med | 2016 max | 2017 min | 2017 mean | 2017 med | 2017 max |
|--------------------------|----------|-----------|----------|----------|----------|-----------|----------|----------|----------|-----------|----------|----------|----------|-----------|----------|----------|----------|-----------|----------|----------|----------|-----------|----------|----------|----------|-----------|----------|----------|----------|
| Proportion of organizations making marketing innovations, % |          |           |          |          |          |           |          |          |          |           |          |          |          |           |          |          |          |           |          |          |          |           |          |          |          |           |          |          |          |
| min                      | 0.00     | 0.00      | 0.00     | 0.00     | 0.00     | 0.00      | 0.00     | 0.00     | 0.00     | 0.00      | 0.00     | 0.00     | 0.00     | 0.00      | 0.00     | 0.00     | 0.00     | 0.00      | 0.00     | 0.00     | 0.00     | 0.00      | 0.00     | 0.00     | 0.00     | 0.00      | 0.00     | 0.00     |
| mean                     | 0.90     | 0.86      | 0.86     | 0.85     | 0.81     | 0.76      | 0.87     | 0.73     |          |           |          |          |          |           |          |          |          |          |           |          |          |          |           |          |          |          |           |          |          |          |
| med top quartile         | 0.82     | 0.74      | 0.74     | 0.74     | 0.71     | 0.67      | 0.71     | 0.64     |          |           |          |          |          |           |          |          |          |          |           |          |          |          |           |          |          |          |           |          |          |          |
| max                      | 1.03     | 1.08      | 1.17     | 1.05     | 1.18     | 1.00      | 1.07     | 1.00     |          |           |          |          |          |           |          |          |          |          |           |          |          |          |           |          |          |          |           |          |          |          |
| Proportion of organizations making organizational innovations, % |          |           |          |          |          |           |          |          |          |           |          |          |          |           |          |          |          |          |           |          |          |          |           |          |          |          |           |          |          |          |
| min                      | 0.00     | 0.00      | 0.00     | 0.00     | 0.00     | 0.00      | 0.00     | 0.00     | 0.00     | 0.00      | 0.00     | 0.00     | 0.00     | 0.00      | 0.00     | 0.00     | 0.00     | 0.00      | 0.00     | 0.00     | 0.00     | 0.00      | 0.00     | 0.00     | 0.00     | 0.00      | 0.00     | 0.00     |
| mean                     | 1.02     | 1.03      | 0.90     | 0.86     | 0.93     | 0.91      | 0.88     | 0.72     |          |           |          |          |          |           |          |          |          |          |           |          |          |          |           |          |          |          |           |          |          |          |
| med top quartile         | 0.88     | 0.85      | 0.77     | 0.83     | 0.86     | 0.89      | 0.88     | 0.61     |          |           |          |          |          |           |          |          |          |          |           |          |          |          |           |          |          |          |           |          |          |          |
| max                      | 1.31     | 1.41      | 1.12     | 1.14     | 1.18     | 1.26      | 1.17     | 1.00     |          |           |          |          |          |           |          |          |          |          |           |          |          |          |           |          |          |          |           |          |          |          |
| Proportion of organizations making technological innovations, % |          |           |          |          |          |           |          |          |          |           |          |          |          |           |          |          |          |          |           |          |          |          |           |          |          |          |           |          |          |          |
| min                      | 0.00     | 0.00      | 0.00     | 0.00     | 0.06     | 0.19      | 0.00     | 0.03     |          |           |          |          |          |           |          |          |          |          |           |          |          |          |           |          |          |          |           |          |          |          |
| mean                     | 1.01     | 0.92      | 0.84     | 0.86     | 0.93     | 0.84      | 0.77     | 0.78     |          |           |          |          |          |           |          |          |          |          |           |          |          |          |           |          |          |          |           |          |          |          |
| med top quartile         | 0.85     | 0.84      | 0.75     | 0.80     | 0.83     | 0.71      | 0.74     | 0.69     |          |           |          |          |          |           |          |          |          |          |           |          |          |          |           |          |          |          |           |          |          |          |
| max                      | 1.33     | 1.29      | 1.10     | 1.10     | 1.13     | 1.08      | 0.93     | 0.88     |          |           |          |          |          |           |          |          |          |          |           |          |          |          |           |          |          |          |           |          |          |          |
| Analysis of the median values of the criteria makes it possible to conclude that half of the regions from the study group have a level of innovative activity below the national average (the median value is less than 1). The analysis of the top quartile values of the criteria shows that while in 25% of resource oriented regions the percentage of marketing and organizational innovations is higher than the national average (the top quartile is equal to or higher than 1), the percentage of applying...
technological innovations in 2016 and 2017 is observed in less than 25% resource regions (top quartile value is less than 1).

Analysis of the median values of the criteria makes it possible to conclude that half of the regions from the study group have a level of innovative activity below the national average (the median value is less than 1). 25% of resource-based regions show a percentage of making marketing and organizational innovations above the national average (the top quartile is equal to or higher than 1). Less than 25% of resource-type regions have a low percentage of applying technological innovations in 2016 and 2017 (the top quartile is less than 1). Moreover, by 2017, there had been a steady decline for all three types of innovation.

4. Conclusions

From the point of view of the causal mechanism, there are two main versions of the “resource curse” theory. They can be tentatively termed “economic” and “political” resource curse. In the first case, the so-called crowding out effect has a negative impact on economic growth (or, in our study — innovations): a high return on investment in the mining sector leads to a reduction in investment in other sectors. Within the second version, rent-seeking behaviour causes a drop in the quality of public administration, which, in turn, negatively affects economic growth. In our study, it is difficult to draw an unambiguous conclusion about the causal mechanism that determines a lower indicator of the “innovation activity” component at an increase in the region’s resource orientation, however, an impact of the “crowding out effect” is more likely.

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