Exploration and production of oil and gas as a factor of economic development of the Arctic resource regions, resource curse

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Abstract. The results of the cluster analysis showed that all the regions classified as the Arctic zone of Russia can be identified as resource regions. Identification was based on such factors as the role of the mining sectors in the region's economy, the share of mineral extraction tax and employment in the extractive industries, especially in oil and gas sector. Econometric analysis built on panel data showed that the production of energy resources in the Arctic regions directly affects the level of socio-economic development of the Arctic regions. At the same time, it is important to take into account that these regions are characterized by a single-industry type of economy, which does not allow for comprehensive innovative development of various sectors of the region's economy. As a result, the “resource curse” of the regions of the Arctic zone of Russia was revealed. This includes significant challenges and threats to the sustainable development of the Arctic regions.

1. Introduction

Traditionally, countries rich in natural resources, such as oil and gas, have been considered to be able to base their development on the use of these resources as a main path to sustainable economic growth. However, since the 1980s, a significant amount of literature has emerged that contradicts the traditional view that natural resources are a benefit to developing countries. Economists and sociologists have identified various cause-and-effect relationships through which the resource curse can function, and various performance variables that affect economic growth. Number of important studies has attempted to summarize and evaluate the literature on the “resource curse” including Frankel [1], Van der Ploeg [2], Ross [3], Deacon [4], Ramez [5].

The aim of the paper is to study the impact of the implementation of projects of exploration and production of hydrocarbons in the Arctic on the socio-economic development of resource regions, as well as their innovative potential.

In recent years, the Arctic regions have become increasingly important for the development of the oil and gas industry of Russia. There is an increase in investment at all stages of the exploration and production of hydrocarbon resources of this territory both onshore and offshore. The development of large-scale oil and gas production, transport and export projects has a significant impact on the socio-economic development of the Arctic regions of Russia. Ultimately, the extraction of hydrocarbon...
resources serves as a catalyst for the socio-economic development of the Arctic regions. However, the regions are significantly lagging behind in the innovation development from other regions of Russia, that, in general, adversely affects to the sustainable development of the resource regions of the Arctic.

2. Methods of research

In the previous works [6-9] in the enclave cluster are located in the Arctic: the Nenets Autonomous district, the Khanty-Mansi Autonomous district, the Yamal-Nenets Autonomous district, the Chukotka Autonomous district and the Magadan region, as well as the Sakhalin region of the Far East. In this regard, it is necessary to determine the mechanisms for sustainable development of resource regions of the Arctic zone.

To determine the impact of resource factors on the socio-economic indicators of the Arctic, a panel analysis was conducted using data from 2011-2016. Models based on panel data are among approaches for building models of the dependence of variables on various factors. The panel data combines both spatial type data and time series data.

In general, the regression model of panel data has the following form [10, 11] as in equation (1):

\[ x_{it} = Z_{it} \alpha_{it} + \varepsilon_{it} \]  

where \( i \) denotes index of economic unit, \( t \) – time period, \( \alpha_{it} \) - the coefficients of the explanatory variables of vector \( Z_{it} \) in the time period \( t \) for the unit \( i \), \( \varepsilon_{it} \) – vector of errors.

This model cannot be estimated, but it is possible to isolate specific factors that are related to a particular economic object at a certain point in time, consequently individual (specific) features can be evaluated as in equation (2):

\[ x_{it} = Z_{it} \alpha_{it} + \gamma_t + f_i + \varepsilon_{it} \]  

with \( Z_{it} \) denoting n-dimensional vector of independent variables without constant, \( f_i \) – individual features that do not depend on time, \( \gamma_t \) – specific features that are not observed in all periods, but for all objects, \( \varepsilon_{it} \) – independent, identically distributed random variables (both for individuals and in time) with zero mathematical expectation and variance \( \sigma^2 \).

Depending on the assumptions about the nature of \( f_i \), models with fixed \( f_i \) are N constant unknown parameters) and random effects \( f_i \) are random and not correlated with errors) are distinguished. To choose between models with fixed-effect, pooled regression, and model with random effects a Wald test, Breusch–Pagan test and Hausman test are performed. Once the relationship model of the dependent variable and factors has been obtained, it is necessary to estimate its accuracy with the help of the determination coefficient, showing how well the regression obtained describes the dependent variable and accounting to be at least 50%.

Further, it is necessary to check statistical significance of the obtained regression with the help of F-statistic on 5% significance level. To test the normal distribution of small samples with size from 3 to 50 elements, the Shapiro-Wilk test was developed. The presence of multicollinearity can be verified using the coefficients of pair correlation. If the factor correlation coefficient is large, then there is a connection between these factors. To determine the autocorrelation, the Durbin–Watson statistic is used.

3. Empirical results and discussion

The paper considered 6 factors in two groups: economic (investment per capita, GRP per capita, monetary income per capita) and resource factors (share of employment in the mining industry, the share of mineral extraction taxes in the structure of taxes, the share of mining in GRP). The impact of each resource factors on economic indicators was assessed (3 options). Further, according to the data for 2011-2016 three models were built on the basis of panel analysis for 27 resource regions: the model of pooled regression, the model with fixed effects and the model with random effects.

In general, all the models have approximately the same coefficients and show good quality.
The most adequate model was chosen on the basis of pairwise comparison of the estimated models (Tables 1-3):

- The fixed effects model was compared with the pooled regression (Wald test).
- The random effects model was compared with the pooled regression (Breusch–Pagan test).
- The random effects model was compared with fixed effects model (Hausman test).

**Table 1.** Tests of models (significance level 0.05) for the dependent variable of investment per capita.

| Test          | Chisq | p-value       | Best model |
|---------------|-------|---------------|------------|
| Wald          | 15.10 | p-value < 0.01| Fixed      |
| Breusch-Pagan | 116.52| p-value < 0.01| Random     |
| Hausman       | 22.08 | p-value < 0.01| Fixed      |

The results obtained allow for conclusion that in this case the model with fixed individual effects is suitable. This was expected, since specific regions were chosen for the study, their composition did not change in the analyzed period.

**Table 2.** Tests of models (significance level 0.05) for the dependent variable of GRP per capita.

| Test          | Chisq  | p-value       | Best model |
|---------------|--------|---------------|------------|
| Wald          | 28.03  | p-value < 0.01| Fixed      |
| Breusch-Pagan | 158.01| p-value < 0.01| Random     |
| Hausman       | 25.78  | p-value < 0.01| Fixed      |

**Table 3.** Tests of models (significance level 0.05) for the dependent variable of per capita income.

| Test          | Chisq  | p-value       | Best model |
|---------------|--------|---------------|------------|
| Wald          | 13.89  | p-value < 0.01| Fixed      |
| Breusch-Pagan | 111.91| p-value < 0.01| Random     |
| Hausman       | 23.02  | p-value < 0.01| Fixed      |

As a result, three equations (3), (4), (5) were obtained:

\[
\text{In} = 0.033 \times \ln(\text{ER}) + 0.011 \times \ln(\text{MET}) + 0.396 \times \ln(\text{ME}) + 3.709
\]  

(3)

\[
\text{GRP} = 0.236 \times \ln(\text{ER}) + 0.016 \times \ln(\text{MET}) + 0.134 \times \ln(\text{ME}) + 6.224
\]  

(4)

\[
\text{AI} = 0.152 \times \ln(\text{ER}) + 0.034 \times \ln(\text{MET}) + 0.091 \times \ln(\text{ME}) + 3.469
\]  

(5)

where, \(\text{In}\) - investments per capita, \(\text{GRP}\) - GRP per capita, \(\text{AI}\) - monetary income per capita, \(\text{ER}\) - share of employment in the mining industry, \(\text{MET}\) - share of mineral extraction tax in total taxes, \(\text{ME}\) - share of mining in GRP.

The share of extraction industries in GRP has a great impact on the volume of investments in the region. The coefficient for this factor is 0.396. It was shown that for resource regions the change in the share of mining significantly affects the volume of investment in the region. The level of GRP is significantly affected by the share of extractive industries in the economy and the share of
employment in the extractive industry, with a positive relationship. If the share of employment in the extractive industry changes, GRP will increase by 0.236. The share of employment in the extractive industries and share of extractive industries in the economy also has a significant impact on the average per capita income of the population. Shares of innovative activity in GRP of resource regions of Russia are presented in table 4.

Table 4. Share of innovative goods, works and services in GRP of resource regions of Russia in 2011-2015, %.

| The name of the region                  | Ranking in the innovative development | Ranking in the resource specialization | 2011  | 2012  | 2013  | 2014  | 2015  |
|----------------------------------------|---------------------------------------|----------------------------------------|-------|-------|-------|-------|-------|
| Republic of Tatarstan                  | 2                                     | 8                                      | 15.4  | 19.0  | 20.8  | 20.2  | 20.4  |
| Samara region                          | 3                                     | 12                                     | 22.3  | 25.8  | 23.0  | 21.3  | 18.8  |
| Sakhalin region                        | 8                                     | 18                                     | 45.3  | 49.7  | 47.8  | 53.7  | 11.2  |
| Republic of Bashkortostan              | 10                                    | 7                                      | 6.1   | 5.4   | 5.9   | 9.0   | 10.6  |
| Perm region                            | 13                                    | 10                                     | 9.6   | 9.3   | 20.9  | 11.3  | 9.2   |
| Kemerovo region                        | 34                                    | 3                                      | 0.6   | 0.3   | 0.5   | 2.9   | 3.8   |
| Tomsk region                           | 35                                    | 16                                     | 3.3   | 1.8   | 2.7   | 2.6   | 3.8   |
| Krasnoyarsk region                     | 39                                    | 14                                     | 1.0   | 3.0   | 4.3   | 3.5   | 3.6   |
| Tyumen region                          | 40                                    | 13                                     | 0.1   | 0.8   | 0.8   | 2.6   | 3.6   |
| Republic of Komi                       | 43                                    | 5                                      | 6.6   | 5.0   | 4.6   | 4.8   | 3.2   |
| Irkutsk region                         | 51                                    | 15                                     | 0.8   | 1.0   | 0.6   | 1.2   | 2.3   |
| Amur region                            | 54                                    | 24                                     | 1.7   | 2.2   | 2.5   | 2.2   | 2.0   |
| Orenburg region                        | 55                                    | 11                                     | 2.6   | 1.5   | 1.3   | 0.9   | 1.9   |
| The Republic Of Sakha (Yakutia)        | 65                                    | 17                                     | 0.3   | 0.2   | 1.6   | 0.9   | 0.4   |
| Murmansk region                        | 59                                    | 23                                     | 0.1   | 0.1   | 0.6   | 2.6   | 1.1   |
| Khanty-Mansiysk AD                     | 67                                    | 1                                      | 2.4   | 0.4   | 0.3   | 0.3   | 0.3   |
| Chukotka AD                            | 70                                    | 20                                     | 0.0   | 1.0   | 1.3   | 0.1   | 0.2   |
| Yamalo-Nenets AD                       | 71                                    | 2                                      | 1.0   | 1.0   | 0.0   | 0.0   | 0.1   |
| Republic of karelia                    | 74                                    | 22                                     | 0.2   | 0.2   | 0.1   | 0.1   | 0.1   |
| Nenets AD                              | 84                                    | 4                                      | 0.0   | 0.0   | 0.0   | 0.0   | 0.0   |

As can be seen from table 4, the resource regions of the Arctic zone, as well as less developed regions with severe natural and climatic conditions, are the leaders in the production of oil and gas, as well as a number of other minerals in Russia. At the same time, the share of innovative production in the GRP structure of such regions is absent, or has a close value to zero. All resource regions of the Arctic are at the end of the rating of innovative regions of Russia.
4. Conclusion

In recent decades, economists note that the economy of resource-rich regions and countries (especially in Africa, Latin America, the Middle East, the former Soviet Union) tends to grow more slowly than countries. In recent years, some resource-rich countries have seen the opposite situation - positive and rapid economic growth. As a result, it is not the availability of natural resources that affects the growth of production, but the efficiency of the use of revenues from the production and export of natural resources. In the end, at present, the researchers focus more and more on the impact of resource countries on such indicators as labor productivity, development of the financial sector, human capital, and growth of innovation in the economy.

Based on the use of panel data, the article showed that for the resource regions of Russia, first of all, with fewer natural resources. The special term "resource curse" was introduced. "Resource curse" refers to the inverse relationship between the dependence on natural resources and economic growth.

Arctic zone, there is a direct relationship between the resource factors and socio-economic indicators. Meanwhile, the resource regions, especially the Arctic zone, are significantly lagging behind in terms of innovative development, which determine the sustainability of the region's development.

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