The selection of the main factors affecting the socio-economic development of the Arctic regions of Russia

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Abstract. This article considers the socio-economic development of the Arctic regions of Russia, using the example of some areas of the North-West Federal District. As part of the study the socio-economic development of the Arkhangelsk Region, the bordering Republic of Komi, and the Murmansk Region was assessed and analyzed. The analysis was carried out by studying the interaction of variables characterizing the social and economic spheres of human activity in the Arctic zone of Russia. In order to do it a system of indicators was formed. The gross regional product was chosen as a dependent indicator. The main indicators of the economic and social sphere were considered as influencing factors. The assessment was carried out by means of studying interrelations of variables and a comparative analysis of factors affecting the Arctic region. The article provides a literature review on the topic. Besides, the given study describes a methodology for conducting a comparative analysis of the socio-economic development of regions. The methodology includes: goal setting, collecting statistical data, analyzing the dynamics of the estimated indicators, primary processing of time series, bringing them to a normalized form, checking for stationarity using two criteria, bringing them to stationary form, the correlation analysis of the studied parameters, the construction of a regression model for the analysis of each region. In order to compare the socio-economic development of the Arctic regions three independent equations were compiled and the coefficients of equations were determined. The article provides general conclusions on the analysis of the identified interrelations. In the future, the model can be expanded in order to obtain more accurate results and to make the most accurate forecast of the socio-economic development of the analyzed regions.

1. Introduction

The Arctic zone of the Russian Federation (AZRF) partly or fully includes the territories of eight constituent entities of the Russian Federation: the Murmansk region, the Arkhangelsk region, the Nenets autonomous region, the Komi Republic, the Yamalo-Nenets autonomous region, the territories of the Krasnoyarsk region, the Sakha Republic (Yakutia), and the Chukotka autonomous region, as well as land and islands located in the Arctic Ocean. The Arkhangelsk region, which is one of the objects of study in this article, includes the Nenets Autonomous District (NAD).

The Arctic zone of the Russian Federation is a peculiar territory with a fragile ecosystem. Its natural features impose certain restrictions on rapid economic development or a high standard of living for the entire population of the Russian Arctic. Nevertheless, the Arctic zone promises great prospects and opportunities that should be the focus of attention of government and business. Prospects and

opportunities will certainly expand with the participation of the state, companies and funds in the context of the current global technological changes.

The peculiarity of the Arctic regions, in particular, the studied territories of the Arkhangelsk, Murmansk regions and the Komi Republic, lies in the high industrial potential. But at the same time, all three regions are characterized by low socio-economic indicators. To improve the socio-economic situation in the regions, it is necessary to apply appropriate measures that can be implemented in the framework of regional development strategies. Strategies, in turn, are devised on the basis of methods of economic and mathematical short-term and long-term forecasting, allowing to predict the development of the regional economy. Thus, in order to devise a strategy for effective development, it is necessary to conduct a thorough analysis of the current situation, analyze the retrospective, and identify regular patterns so that it would be possible to predict the future trends using the obtained results. Despite the similarity of these regions, there are differences in many economic indicators, conditions and trends that can be identified by studying each of the regions separately, which can be done with the help of different methods.

The purpose of this article is to assess and compare the factors affecting the socio-economic development of the Arctic regions of Russia, using the example of the Arkhangelsk Region, the Komi Republic and Karelia, and the Murmansk Region.

2. The indicators estimating the social economic development of Arkhangelsk region and their dynamics

The main indicator of the development of the region is the gross regional product per capita. It is a generalizing indicator of the growth of the regional economy. Due to the fact that the article is devoted to studying socio-economic development of the territories, the assessment was built on the analysis of the impact of socio-economic indicators on the main indicator of growth and development, which is gross regional product per capita (at current prices, roubles). Therefore, in modelling, the gross regional product per capita indicator will be taken as an endogenous variable (in the following analysis: Y_{t1}– for the Murmansk region, Y_{t2}– for the Arkhangelsk region, Y_{t3}– for the Komi Republic).

As exogenous variables, it was decided to use the following: population size, thous. people (X_{t1}^1 – for the Murmansk region, X_{t2}^1 – for the Arkhangelsk region, X_{t3}^1– for the Komi Republic), consumer price index, % (X_{t1}^2 – for the Murmansk region, X_{t2}^2 – for the Arkhangelsk region, X_{t3}^2– for the Komi Republic), the average annual working population, people (X_{t1}^3 – for the Murmansk region, X_{t2}^3 – for the Arkhangelsk region, X_{t3}^3– for the Komi Republic), foreign trade turnover, mln. US dollars (X_{t1}^4 – for the Murmansk region, X_{t2}^4 – for the Arkhangelsk region, X_{t3}^4– for the Komi Republic), incomes of the population, per capita, roubles / month. (X_{t1}^5 – for the Murmansk region, X_{t2}^5 – for the Arkhangelsk region, X_{t3}^5– for the Komi Republic), fixed assets investments, mln. roub. (X_{t1}^6 – for the Murmansk region, X_{t2}^6 – for the Arkhangelsk region, X_{t3}^6– for the Komi Republic).

The performance of the three regions is quite similar, but there are some differences. By analyzing the dynamics of these indicators for the period from 1998 to 2017, it was found that the most developed of the studied regions is the Murmansk region.

Gross regional product per capita. During the given period a stable positive trend of this indicator is noticeable. In 2016, in the Murmansk region, it amounted to 560.4 thousand roubles, in the Arkhangelsk region it amounted to 371.5 thousand roubles.

Population size. The data on the region shows negative dynamics of population size. During the analyzed period, the population decreased by an average of 227.7 thousand people.

Consumer price index. For the period from 1998 to 2017 this indicator practically did not change in the regions and fluctuated within the value of 116.02%.

The average annual number of working population. The data on the region shows unfavorable dynamics of the indicator. For the given period the number of economically active population decreased by 59.3 thousand people. This situation is present in many Russian northern regions, which

is, to a greater extent, a consequence of the outflow of the population as a whole to more favourable living areas.

Foreign trade turnover. These regions are more exporters than importers, since export makes more than 60% of trade. The main export item of the Arkhangelsk region is mineral products, more than 50%, besides wood and pulp and paper products, machinery, equipment, vehicles, metals and their derivatives, food products and agricultural raw materials are exported from the region. The main import items are: machinery, equipment, vehicles, chemical products, metals. For the Murmansk region, the main export items are: metals and products made from them, mineral resources, food products, the main import items include: machinery, equipment, vehicles, metals and products made from them. Export structure of the Komi Republic includes: mineral resources, wood and products made from it. Import structure includes: machinery, equipment, vehicles, chemical products. Data shows unstable and fluctuating dynamics of the given indicator, however, since 2013, a gradual decrease in the indicator values by 38.7 thousand USD is noticeable.

Incomes of the population. The indicator of the average per capita incomes of the population shows positive dynamics, there are no jumps and fluctuations. In general, it is sustainable. For the period from 2010 to 2017, this figure increased from 21 972 rubles / month. up to 33,384 rubles per month.

Fixed assets investment. Despite the jumps in the dynamics of this indicator, the trend is positive for the Murmansk and Arkhangelsk regions. From 2010 to 2016 the figure increased from 55,970 million roubles. up to 110 715 million roubles. Such growth should have a positive effect on the development of regions. However, there is a different trend for investments in the Komi Republic. For the same period, the index decreased by 73,211 million roubles.

3. Literature review

A lot of scientists all over the world are preoccupied with the problems of the development of the Arctic zone of our Earth. They seek to find a way to accurately assess the current state of the regions, to describe and analyze the main processes that can affect the development of this region and to develop solutions to achieve success. The problems of ecology and energy are most often touched upon, but also problems of a socio-economic nature are not ignored.

Thus, scientists are analyzing the development in the social and technological spheres of the Arctic in the conditions of modernization [1]. A comparative analysis of the Arctic regions is conducted in terms of poverty and the magnitude of economic and social growth [2]. Some studies analyze the processes of convergence in the economic sphere in the Arctic countries [3].

The problem of regulating relations between industrial companies and indigenous northern peoples as a path to the development of the Arctic is also being studied [4,5].

In addition, reviews of programs and projects on the sustainable development of the Russian Arctic regions are conducted, and measures are proposed to improve the environmental situation [6]. Technological convergence is being studied in countries with Arctic territories [7]. Separately, the problems of innovation and their impact on the social sphere of the region are discussed [8]. The agricultural territories of the Russian Arctic zone are considered, their comparative analysis is carried out [9].

Issues relating to the Northern Sea Route in the context of geopolitical and economic processes in a changing climate [10], [11], [12] are also studied.

4. Analytic methodology for studying factors influencing the global temperature change

This section presents the methodology for modelling and comparative analysis of the socio-economic development of the Arctic regions. In the introduction, the problem was formulated and the goal of the research was set, also, in the relevant section, a review of this problem was conducted. Besides, the class of dependence between the studied indicators was determined and the division into endogenous and exogenous indicators was made on the basis of logical conclusions. All these are the initial, preparatory stages of the methodology. Now it is necessary to present research tools and steps for further analysis.

The next stage is the normalization of time series to prepare for the procedure of checking them for stationarity in order to get more accurate results. The check is carried out by relating each value of the series to the mean of this series. After the normalization has been carried out, a test of the stationarity of the obtained time series takes place. It is necessary to build the most accurate model. Such testing can be conducted in different ways. In this case, the correlogram and the Dickey-Fuller extended criterion were used, the test was performed using the Econometric Views program. In the process of checking, the series were assigned the status of TS (trend stationary) or DS (difference stationary) depending on the values of the statistics tstat and tcrit and the error value (Prob.). The series receives DS status if tstat> tcrit and, if Prob.> 0.05, which means that the hypothesis of the presence of a unit root is confirmed. In case tstat <tcrit, and Prob. <0.05, this suggests that the hypothesis about the presence of a unit root is refuted, and accordingly, the TS status is assigned to the series. If a series is recognized as stationary (TS), we use it in building the model, if the series is not stationary (DS), this series should not be used, since it will lead to a distortion of the results. If the time series does not pass the test for at least one criterion, it is not included in the model.

For the analysis of the interaction of factors, correlation and regression analyses were chosen, as well as the construction of a regression model. Statistical data on the indicators listed in the previous paragraph was selected as the values of the variables for the time series. The data was collected from 1998 to 2016 and began to present time series for further analysis.

At the next stage, the regression model is compiled in the form of three independent equations. At the following stage this model is solved, the coefficients are found, the regression model equations are written with the coefficients found and a significance test is performed. After identifying the interrelations of indicators, a comparative analysis and conclusions are made.

5. The primary data and its analysis

The stage of data collection and processing took place as follows: it was decided which indicators of socio-economic development should be included in the model, these indicators were collected and divided into endogenous and exogenous. An endogenous indicator of the well-being and development of the region was chosen, depending on the factors shaping the state of the socio-economic development of the region. To determine the nature of a change of an indicator over time, trends were built for each of them.

Data was collected for the period from 1998 to 2017. The sample included data up to 2016, due to the absence of values for most of the analyzed indicators for 2017. The source of data was the following sites: 1) the official site of the Federal State Statistics Service of Russia http://www.gks.ru/; 2) the official website of the Office of the Federal State Statistics Service for the Arkhangelsk Region and the Nenets Autonomous District http://arhangelskstat.gks.ru/; 3) the official website of the Territorial Body of the Federal Statistics for the Murmansk region http://murmanskstat.gks.ru/; 4) the official website of the Territorial Body of the Federal State Statistics Service in the Komi Republic http://komi.gks.ru/.

6. Empirical testing of the model

According to the results of checking the stationarity of all series using the Dicky-Fuller criterion and analyzing the correlogram, consumer price index for each of the regions did not pass the stationarity tests. Individual roots were found in these series, respectively, the series were excluded from further analysis. The remaining time series passed the stationarity check as a result of differentiation of the first and second order, thus all other indicators, except for the GRP indicators for the Murmansk region and the Komi Republic (the initial series successfully passed the tests), were brought to a stationary form.

The dependence of the variables can be described as follows:

$$Y_{t1} = f(X_{t1}^1, X_{t1}^2, X_{t1}^3, X_{t1}^4, X_{t1}^5, X_{t1}^6) \quad (1)$$

$$Y_{t2} = f(X_{t2}^1, X_{t2}^2, X_{t2}^3, X_{t2}^4, X_{t2}^5, X_{t2}^6) \quad (2)$$

$$Y_{t3} = f(X_{t3}^1, X_{t3}^2, X_{t3}^3, X_{t3}^4, X_{t3}^5, X_{t3}^6) \quad (3)$$

Correlation coefficients for the Murmansk region are presented in table1.

Table 1. Correlation matrix for the Murmansk region

	Y_{t1}	X_{t1}^1	X_{t1}^2	X_{t1}^3	X_{t1}^4	X_{t1}^5	X_{t1}^6
Y_{t1}	1						
X_{t1}^1	-0.9528	1					
X_{t3}^2	0.9944	-0.9586	1				
X_{t1}^3	0.9820	-0.9319	0.9819	1			
X_{t1}^4	-0.5475	0.7307	-0.5563	-0.5165	1		
X_{t1}^5	0.8441	-0.8263	0.8227	0.8446	-0.5288	1	
X_{t1}^6	-0.6703	0.4908	-0.6649	-0.7031	0.0866	-0.3565	1

The correlation coefficients for the Arkhangelsk region are presented in table 2:

Table 2. Correlation matrix for the Arkhangelsk region

	Y_{t2}	X_{t2}^1	X_{t2}^2	X_{t2}^3	X_{t2}^4	X_{t2}^5	X_{t2}^6
Y_{t2}	1						
X_{t2}^1	-0.9550	1					
X_{t2}^2	0.9929	-0.9492	1				
X_{t2}^3	0.9150	-0.9318	0.9019	1			
X_{t2}^4	-0.5429	0.7087	-0.5092	-0.5529	1		
X_{t2}^5	0.5578	-0.6464	0.5852	0.5827	-0.4614	1	
X_{t2}^6	-0.1971	-0,0573	-0.1987	-0.0459	-0,3868	0,2363	1

Correlation coefficients for the Republic of Komi are presented in Table 3.

Table 3. Correlation matrix for the Komi Republic

	Y_{t3}	X_{t3}^1	X_{t3}^2	X_{t3}^3	X_{t3}^4	X_{t3}^5	X_{t3}^6
Y_{t3}	1						
X_{t3}^1	-0.9613	1					
X_{t3}^2	0.9796	-0.9877	1				
X_{t3}^3	0.8530	-0.9167	0.9146	1			
X_{t3}^4	-0.5356	0.6717	-0.5871	-0.5323	1		
X_{t3}^5	0.5679	-0.6461	0.6621	0.7071	-0.3761	1	
X_{t3}^6	-0.9407	0.9309	-0.9378	-0.7873	0.6353	-0,5289	1

Regression equations, taking into consideration the excluded variables, are as follows:

$$Y_{t1} = \alpha_0 + a_1 X_{t1}^1 + \alpha_2 X_{t1}^2 + a_3 X_{t1}^3 + \alpha_4 X_{t1}^5 \quad (4)$$

$$Y_{t2} = b_0 + b_1 X_{t2}^1 + b_2 X_{t2}^2 + b_3 X_{t2}^3 \quad (5)$$

$$Y_{t3} = c_0 + c_1 X_{t3}^1 + c_2 X_{t3}^2 + c_3 X_{t3}^3 + c_4 X_{t3}^6 \quad (6)$$

The equations with the coefficients found are shown in (7), (8), (9):

$$Y_{t1} = -0{,}4578 + 0{,}3285 X_{t1}^1 + 0{,}9391 X_{t1}^2 + 0{,}0642 X_{t1}^3 + 0{,}1261 X_{t1}^5 \quad (7)$$

$$Y_{t2} = 0{,}2727 + 24{,}2786 X_{t2}^1 + 6{,}9568 X_{t2}^2 + 0{,}4117 X_{t2}^3 \quad (8)$$

$$Y_{t3} = 0{,}1163 + 5{,}4765 X_{t3}^1 + 0{,}2075 X_{t3}^2 + 0{,}026\, X_{t3}^3 + 0{,}0045 X_{t3}^6 \quad (9)$$

7. Results and Discussion

Analyzing all the above, we can draw some conclusions. Since each of the studied Arctic regions had its own model, the conclusions will be drawn up accordingly, with a final comparison at the end. As a result of assessing the socio-economic development of the Murmansk region, the Arkhangelsk region

and the Komi Republic, through correlation and regression analysis, it was found that the following indicators have the closest link with GRP per capita: average per capita incomes of the population, investments and population size (which, of course, is not surprising, given that this indicator is used in calculating GRP per capita). The income of the population is closely related with GRP, because the dynamic increase in income of the population leads to the growth of GRP, these indicators, as a rule, both change the same way. The amount of fixed assets investment also showed a strong effect on the GRP. Indeed, qualitative improvements in the economic and social sphere of a region or country depend on long-term investments. At the same time, investments have a cumulative effect, i.e. investment made in the past period, extends its influence for long periods of time, which allows to develop many spheres of life and strengthen economic processes.

Regarding the assessment of the socio-economic development of the Arkhangelsk region, the influence of other indicators, except for those listed above, was not found.

However, the Murmansk region was also influenced by the values of foreign trade turnover. The strong connection is explained by the fact that the Murmansk region is distinguished by large volumes of metallurgical production facilities operating on its territory, which affects the openness of state formations of the Murmansk region, thanks to which the region is integrated with neighboring states. Such foreign economic activity has a great positive effect on the standard of living of the population.

The GRP of the Republic of Komi is closely related to indicators of population size, the level of per capita income, investment, and the number of economically active population. GRP is influenced by economically active population, because it directly participates in economic activities. But since the coefficient is reverse connection, it can be assumed that in this region a high level of GRP stimulates jobs. However, if we return to the description of the dynamics and its ratio for both indicators, we can see that the level of employment of the population remains static, while the GRP indicator is steadily growing. Perhaps this is due to the lack of response, insensitivity of the population to changes in the state of the economy.

Considering all of the above, regions that are geographically close to each other, belong to the same district (in this case, the North-West Federal District) and belong to the same peculiar space may have a number of differences due to the characteristics of the economy, which have different impact on socio-economic development. These factors must be taken into account for the further development of territories and spheres of life. The regression model used for the analysis can be further extended to include new variables, deviations, various test criteria for greater accuracy, to investigate the effects of previous periods, the effects of various spheres of human activity, and also to be used for prediction.

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