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MODEL OF THE DEVELOPMENT OF THE RUSSIAN ARCTIC MICRO-TERRITORY

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ABSTRACT

The model of human activity in spheres of vital activity is presented. The social, industrial and ecological spheres of human activity in the Arctic micro-territory were chosen. The model in the formalized form is a system of six econometric equations. As the Arctic micro-territory, the Nenets region of the Russian Federation was chosen. Each sphere of human activity is estimated by indicators. The human development potential is assessed by the human development index. The notion of sustainable development in the Arctic micro-territory according to the spheres of human activity is given. With sustainable development, the change in the indices of various spheres of human activity leads to the expansion of the potential of human development.

Each equation of the system of six equations is represented by an ADL- model. The ADL-model shows the dependence of the endogenous indicator of human activity on current and previous values of the influence of the structure of time series.

Keywords: Russian Arctic, socio-economic development, system of econometric equations.

INTRODUCTION

The Nenets Autonomous District is located, mainly, beyond the Arctic Circle, in the northeast of Russia. The length of the region from north to south is 320 km, from west to east - 950 km. The Nenets Autonomous Region borders on the Arkhangelsk Oblast, the Yamalo-Nenets Autonomous District, Usinsk and Vorkuta, which is part of the Komi Republic. The district is washed by the White, Barents and Kara seas of the Arctic Ocean. Most of the area of the region is located beyond the Arctic Circle. The territory is characterized by a subarctic and arctic climate, which do not have a high level of comfort for human life.

According to official data, the Nenets Autonomous District is a fairly young region, and has existed since 1929 [1].

The geographic location of the region and its climatic conditions is one of the most important factors that influences the course of economic and demographic development.

Researchers found that the life of a person in the Arctic region is burdened by natural and climatic factors.

People living and working in the Arctic Circle, work 15-20% less efficiently than representatives of the middle latitudes of Russia.

In the Arctic region, compared to others Russian citizens, residents have lower life expectancy and fertility, higher mortality and susceptibility to diseases of the cardiovascular system.

Specificity of the life of the Arctic region is manifested in its remoteness from large industrial centers. Economic entities of the region depend on food, fuel, energy supplies from neighboring regions of Russia.

The population of the Nenets Autonomous Okrug is very small and has only about 42 thousand inhabitants. In the region, due to specialization in oil and gas production, the shift work method is developed.

The key area of production and economic interest is the extraction and processing of hydrocarbon raw materials. The development of the oil and gas complex of the Nenets Autonomous District began with the creation in 1958 of the Nenets geological exploration expedition to the city of Naryan-Mar. After that, in 1966, the first hydrocarbon deposit discovered on the territory of the Nenets Autonomous District was opened – Shapkinskoye.

1 METHODICAL PROVISIONS FOR SUSTAINABLE DEVELOPMENT OF THE ARCTIC REGION

Sustainable development of the region as a whole is a process of positive and uniform change in the space in which people live and work. The ratio of zones of space should be coordinated with each other. Areas of spaces in which people live and work can be described as spheres of human activity. The main spheres of human activity in the territorial space are the sphere of nature management, the production and economic sphere, the sphere of social infrastructure. The development of all spheres of life and the space of human activity essentially depends on scientific and technological progress. Scientific and technological progress is a driving factor of changes in all spheres of spaces in which people live and work.

This definition of sustainable development is considered in terms of the following components: economic, social and environmental [2]. The economic component of sustainable development is based on the concept of the optimal use of limited resources and the use of environmentally friendly technologies. The social component is aimed at the sustainable development of social infrastructure. From an ecological point of view, sustainable development must ensure the integrity of ecosystems (the ecosystem is a biological system consisting of a community of living organisms and their habitat).

Based on the thoughts mentioned above, a broader definition of sustainable development in the region can be given.

Sustainable development of the region in a broad sense is a process characterized by the following conditions:

A) Uniform change of the natural environment, production of material goods, industrial infrastructure, social infrastructure, ecological systems and social institutions surrounding the population of the region.

B) The change in the sphere of the surrounding space is considered from the point of view of economic, social and ecological criteria.

C) Scientific and technological progress is the main reason for changing areas of space.

The methodological basis for the analysis of sustainable development of the region is the theory of spatial economics and modeling theory. A significant contribution to the scientific categories of spatial economics is made by Weber, I. Tyunen, Nobel Prize winner Paul Krugman [3]. Different models of territories from the perspective of sustainable development factors are presented in [4], [5], [6], [7]. Models based on panel data analysis can be found in [8].

2 MODELING OF THE DEVELOPMENT OF THE ARCTIC REGION

2.1 CHARACTERISTIC OF THE MODEL

The autoregressive distributed lags (ADL-model) model is chosen as the theoretical model, in which the current values of the series depend both on the past values of this series, and on the current and past values of other time series. The model is generalized to the case of several exogenous variables. In the general case, we can assume that all exogenous variables are included in the model with the same number of lags, perhaps with some exception.

The ADL - model has the following form:

$$y_t = a_0 + \sum_{i=1}^{n} a_i y_{t-i} + \sum_{j=0}^{q_1} b_j x_{t-j}^1 + \ldots + \sum_{j=0}^{q_k} b_j x_{t-i}^k + E_t \qquad (1)$$

k - number of exogenous variables;
q - number of lags;
n - the depth of the variable delays;
E_t - residues forming white noise process.

This model suggests that if at a certain time t the independent variable x changes, then this change will affect the value of the variable y at the next time period [9].

2.2 DATA

Working with the data consisted of two stages. After we selected endogenous and exogenous variables that correspond to the analyzed processes and reflect the essence of the problem the data was collected. Data was collected for the period from 2004 to 2013 containing the values of endogenous and exogenous variables for the corresponding year. The data was retrieved from the following sources: Federal State Statistics Service [electronic resource] http://www.gks.ru/.

The following endogenous variables have been selected:

y_t^1 – Proportion of the micro-territor's GRP in total GRP of the Russia in year t.

y_t^2 – Proportion of exports of the micro-territory in total exports of the Russia in the year t.

y_t^3 – Wage level in the micro-territory in year t.

y_t^4 – Emissions of air pollutants from stationary sources in the micro-territory in year t.

y_t^5 – Proportion of the micro-territor's volume of products shipped in year t.

y_t^6 – Level of the development of infrastructure industries in the micro-territory in year t.

The following exogenous variables have been selected:

y_{t-j}^3 - Wage level in the region in year $t-j$;

x_{t-i}^1 – Costs of technological innovation import in year $t-i$;

x_{t-i}^2 - Labor productivity in year $t-i$;

x_{t-i}^5 - Growth rate of labor productivity in year $t-i$;

x_{t-i}^6 - Level of the development of manufacturing industries in year $t-i$;

y_t^1 - Proportion of the micro-territor's GRP in total GRP of the Russia in year t;

y_t^5 - Proportion of the micro-territor's volume of products shipped in year t;

x_{t-i}^8 - Energy costs in year $t-i$;

x_{t-i}^9 - Average permanent population in year $t-i$.

2.3 METHODS OF EMPIRICAL TESTING MODEL

The empirical verification of the model consisted of the following steps. Correlation analysis allowed to choose exogenous variables that are closely related to the endogenous variable. The degree of interdependence between pairs of variables was determined on the basis of the values of the correlation coefficients and the level of their significance. Autocorrelation analysis of time series of endogenous variables and time series of exogenous variables was carried out with the aim of identifying the lags that exert the greatest influence on the resulting variable. The correlation matrix of the variables was used to determine the correlation of the analyzed variables. The value was estimated using standard error criteria and the Q-Box-Pearson criterion. For a pair of variables with a correlation coefficient of more than 0.8, one variable was removed from further analysis. The properties of stationarity of time series were tested for the Dickey-Fuller test, that is, the unit root test was used.

The system of equations is created in the form of structural shape model. A structural form model is an econometric model in which the equations are estimated in the form of stochastic correlations between current and lag values of variables in the model. Necessary and sufficient conditions of identifiable equations in the structural form model can be defined as follows. A necessary condition for identifiable equation:

$D + I = N$ - Equation is identified;

$D + I < N$ - Unidentified equation;

$D + I > N$ – Over identified equation,

Where N is the number of endogenous variables in the i-th equation of the system and D is the number of exogenous variables in the system which are not included in the equation of interest.

A sufficient condition for identification of an equation requires that a matrix whose determinant is not zero, and the rank of it is not less than the number of endogenous variables in the system less one can obtained through coefficients of the missing variables (endogenous and exogenous) in one equation but acting as variables in other equations of the system.

The following concerns have been considered by selecting the method for estimating the parameters of the structural model. If the model is identifiable we used the method of indirect ordinary least squares (OLS). If the model was over identified we used the method of two-step OLS. For over identified equation the theoretical values of the endogenous variables have been estimated. After substituting them for the actual values conventional OLS has been used on the improved structural form of over identified equations.

Calculation of the coefficients in the structural form and the transition from a structural form model to the reduced form model is characterized by the following factors. The number of equations in reduced form is the number of endogenous variables in the model. In each equation of the reduced form the endogenous variable is expressed through all predefined variables in the model. Assessment of the adequacy of equations in the reduced form model was performed based on Fisher's F-test and the coefficients of the reduced form have been estimated using OLS.

3 EMPIRICAL TESTING MODEL

Choosing exogenous and endogenous variables allowed us to construct a system of equations in the following structural form model:

$$\begin{aligned}
y_t^1 &= a_0 + a_1 y_{t-1}^1 + .. + a_j y_{t-j}^1 + a_{j+k} x_{t-j}^1 + a_{j+k+l} x_{t-j}^2 \\
y_t^2 &= b_0 + b_1 y_{t-1}^2 + .. + b_j y_{t-j}^2 + b_{j+k} x_{t-j}^5 + b_{j+k+l} x_{t-j}^6 \\
y_t^3 &= c_0 + c_1 y_{t-1}^3 + .. + c_j y_{t-j}^3 + c_{j+k} x_{t-j}^5 + c_{j+k+l} y_{t-1}^1 \qquad (2) \\
y_t^4 &= d_0 + d_1 y_{t-1}^4 + .. + d_j y_{t-j}^4 + d_{j+k} x_{t-j}^8 + d_{j+k+l} x_{t-j}^9 + d_{t-1} y_{t-1}^5 \\
y_t^5 &= e_0 + e_1 y_{t-1}^5 + .. + e_j y_{t-j}^5 + e_{j+k} y_{t-1}^3 \\
y_t^6 &= f_0 + f_1 y_{t-1}^6 + .. + f_j y_{t-j}^6 + f_{j+k} x_{t-j}^6 + f_{j+k+l} y_{t-1}^1
\end{aligned}$$

For each equation of the structural form, the reliability of the regression equation has been evaluated based on the F-Fisher criterion. The coefficients have been calculated using OLS, and the reliability of coefficient was verified using the standard t-test.

For y_t^1:

Critical-$F = 9.01 < F = 32.274$. Thus, the regression equation is statistically significant at the level $\alpha = 0.05$ and has the form: $y_t^1 = -0.299 + 0.00649 x_{t-1}^1 - 0.00194 x_{t-1}^2$.

For y_t^2:

Critical-$F = 6.39 < F = 7.689$. Thus, the regression equation is statistically significant at the level $\alpha = 0.05$ and has the form: $y_t^2 = 0.80 + 0.777x_{t-1}^5 - 0.805x_{t-1}^6$.

For y_t^3:

Critical-$F = 9.01 < F = 134$. Thus, the regression equation is statistically significant at the level $\alpha = 0.05$ and has the form: $y_t^3 = 645.007 + 1204.669y_{t-1}^1 - 557.569x_{t-1}^5$

For y_t^4:

Critical-$F = 5.59 < F = 6.335$. Thus, the regression equation is statistically significant at the level $\alpha = 0.05$ and has the form: $y_t^4 = 0.347 + 521.722y_{t-1}^3 - 3.405x_{t-1}^8 + 0.191x_{t-1}^9$.

For y_t^5:

Critical-$F = 5.41 < F = 11.882$. Thus, the regression equation is statistically significant at the level $\alpha = 0.05$ and has the form: $y_t^5 = -2.690 + 22.49y_{t-1}^5 + 0.088y_{t-1}^3$.

For y_t^6:

Critical-$F = 9.01 < F = 35.274$. Thus, the regression equation is statistically significant at the level $\alpha = 0.05$ and has the form: $y_t^6 = 0.877 + 5.03x_{t-1}^6 + 0.31y_{t-1}^1$.

A necessary condition for the identification of the model was considered for each equation of the improved structural model. All six equations were over identified. In addition to that the sufficient condition for identification was also verified for all equations in the system. Because among the equations of the system all equations were over identified the model as a whole was also over identified and, therefore, to determine the parameters of the equations two-step OLS was used.

Using the improved structural form of the model for all over identified equations, theoretical values of the endogenous variables were calculated and substituted in the resulting system of equations of the initial values of exogenous variables. Furthermore theoretical values of the endogenous variables were substituted into the structural from model. The reliability of the regression equation was tested based on the F-Fisher criterion. The coefficients were calculated using OLS and tested with the standard t-test.

The final system of simultaneous econometric equations is as follows:

$$y_t^1 = -0.299 + 0.00649x_{t-1}^1 - 0.00194x_{t-1}^2$$

$$y_t^2 = 0.80 + 0.777x_{t-1}^5 - 0.805x_{t-1}^6$$

$$y_t^3 = 645.007 + 1204.669y_{t-1}^1 - 557.569x_{t-1}^5$$

$$y_t^4 = 0.347 + 521.722y_{t-1}^3 - 3.405x_{t-1}^8 + 0.191x_{t-1}^9$$

$$y_t^5 = -2.690 + 22.49y_{t-1}^5 + 0.088y_{t-1}^3$$

$$y_t^6 = 0.877 + 5.03x_{t-1}^6 + 0.31y_{t-1}^1.$$

CONCLUSION

The territory of the Russian Arctic is extremely rich in numerous types of natural resources. Due to the aggravation of the geopolitical struggle for the use of resources, interest in the Arctic and in the Arctic region as such increases. A unique feature of the Arctic regions of the Russian Federation is the indigenous peoples living there and leading traditional economic activities. In the Nenets Autonomous District, according to the 2010 census, 18% of the total population are indigenous people, mostly Nenets. Over 1.5 thousand Nenets are nomadic and engaged in reindeer herding, fishing, hunting, traditional and artistic crafts. Small production volumes, low competitiveness, transport difficulties, lack of modern equipment and equipment are all reflected in the low fitness of indigenous peoples and the results of their economic activities to the modern economic structure, which brings certain adjustments to the development of the region.

The article shows a model of the Arctic micro-region based on the concept of spatial economy. The Nenets Autonomous Okrug is analyzed in the spheres of human life. Each sphere of human activity is estimated by indicators from the position of sustainable development of the region. The indicators are either endogenous or exogenous variables in the model. The model has its own exogenous indicators for each endogenous parameter. The structural form of the model in the form of a system of equations shows the choice of exogenous and endogenous variables of the model. The article presents solutions for the improved structural form of the model.

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REFERENCES

[1] Regional portal of the Nenets Autonomous Area [An electronic resource] http://www .info83.ru/transport/paromnaryan-mar.

[2] Didenko N., Skripnuk D., Krasulina O., Modelling the Spatial Development of the Russian Barents-Arctic Region, SGEM 2016, BK 2: Political Sciences, Law, Finance, Economics and Tourism Conference Proceedings, Albena, Bulgaria, vol. V. pp. 471-478, 2016.

[3] Kant S., et. al., New Frontiers of Forest Economics: Forest economics beyond the perfectly competitive commodity markets, Forest Policy and Economics, Netherlands, vol. 72, pp. 1-6, 2016.

[4] Rakison D. H., Gary Lupyan G., The development of modeling or the modeling of development?, Behavioral and Brain Sciences, UK, vol. 31/issue 6, p.726, 2008.

[5] Pickering M. J., Garrod S., The interactive-alignment model: Developments and refinements, Behavioral and Brain Sciences, UK, vol. 27/issue 2, pp. 212-225, 2004.

[6] Jones R. W., Modelling of growth and development of cereal crops for resource management, The Memoirs of the Entomological Society of Canada, Canada, vol. 120/issue S143, pp. 39-45, 1988.

[7] Glinskiy V., Serga L., Khvan M., Assessment of Environmental Parameters Impact on the Level of Sustainable Development of Territories, Procedia CIRP, Netherlands, vol. 40, pp. 625-630, 2016.

[8] Shively W. P., The Development of Party Identification among Adults: Exploration of a Functional Model, American Political Science Review, USA, vol. 73/issue 4, pp. 1039-1054, 1979.

[9] Didenko N.I., Samylovskaya E.A., Kulik S.V., Skripnuk D.F., Krepkaia T.N., Analysis of convergence-divergence in the development of economic processes in circumpolar countries, SGEM 2017 Political Sciences, Law, Finance, International Relations, Vienna, Austria, pp.537-545, 2017.