The global processes influence on the development of the Arctic

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Abstract. In this article, an attempt is made to create a model of global processes influence on the development of the Arctic territories of circumpolar countries. A characteristic of the Arctic territories as a research object is given from the point of view of the territorial, geographical, natural and climatic features, as well as globalization processes such as transnationalisation, scientific and technological progress, market competition. A hypothesis of the global processes influence on the development of the Arctic is formulated. Methodology for creating a model of the global processes influence on the development of the Arctic territories of the circumpolar countries is proposed including the formulation of the research objective, the rationale for the selection of endogenous and exogenous variables, and the creation of a model. The research objective was to create a model of the globalization processes influence on the Arctic development. The indicators reflecting the economic, social, and environmental development of the Arctic territories of the circumpolar countries were selected as endogenous variables. They include the average annual increase in the gross regional product, the share of agricultural products in the gross regional product, the share of industry in the gross regional product, the number of economically active population, the number of unemployed people, and carbon dioxide emissions. The indicators characterizing globalization processes were selected as exogenous variables: the average value of the transnationalization index of the largest transnational corporations (TNCs), world exports of goods and services, royalties and license payments, traditional fuels consumption, electricity consumption per capita, the volume of foreign direct investments. The authors propose a dynamic econometric model consisting of eight econometric equations, each of which is an ADL model that takes into account the time factor. The results of the analysis will be used by the authors in further studies to make forecasts and develop a concept for the development of the Arctic territories of circumpolar countries.

1. Introduction

The Arctic is the northernmost part of the Earth beyond the Polar Circle, with the North Pole in its center. The southern border of the Arctic, according to international law, runs at 66° 33'N. The Arctic includes the continental territories of America, Europe, Asia, a part of the Arctic Ocean with seas and islands, as well as the adjacent parts of the Atlantic and Pacific oceans. The total area of the Arctic is 25 million sq. Km, with 10 million sq. Km of land and 15 million sq. Km of water [1], [2], [3].

Eight Arctic states that are members of the Arctic Council are considered to be circumpolar countries: Denmark (Greenland), Iceland, Canada, Norway, Russia, the USA, Sweden and Finland. Five of the eight Arctic countries (Denmark, Canada, Norway, the USA, Russia) have their territorial waters, and an exclusive economic zone in the Arctic Ocean in accordance with international law [4].
Denmark’s Arctic territories include Greenland and the Faroe Islands (3.0 million sq. Km). The Arctic region of Canada, including the Yukon, the Northwest Territories, Nunavut, Nunavik, occupies 4.3 million sq. Km. Norway has 2.7 million sq. Km of the Arctic territories of Finnmark, Troms, Nurlan, Svabaldard. The U.S. define its Arctic zone as an area that includes the U.S. territories north of the Arctic Circle, the Aleutian Islands chain, an area north and west of the border of the Porcupine, the Yukon, the Kuskoarea rivers, all the adjacent seas, including the Beaufort Sea, the Chukchi and the Bering Seas. The total area of the US Arctic territories is 1.7 million sq. Km. Russia has the largest Arctic territories including the waters of the Arctic Ocean seas (the Barents, the White, the Kara, the Laptev, the East Siberian, the Chukchi Seas) and the Arctic islands according to the "Strategy for the development of the Arctic zone of the Russian Federation and ensuring national security for the period until 2020."

The relief of the Arctic is formed by the Arctic basin and shelf with islands of mainland origin and the adjacent territories of the continents. The Arctic basin is located at 80-90 °N, being on average more than 3000 meters deep. The shelf area includes the seas: the Barents Sea, the Kara Sea, the Laptev Sea, the East Siberian Sea and the Chukchi Sea [5]. In the Arctic, there are long periods of the polar night (from September, 25 to March, 19) and the polar day (from March, 19 to September, 24). At the North Pole, the average annual temperature is around - 19 ° C. The ocean surface temperature is approximately - 1.8 ° C [6], [7]. The Arctic air is dry due to a relatively little rainfall (approximately 150 mm) during the year. In the winter months, the average temperature falls as low as minus 33 ° C. In the summer months, the average temperature in the Arctic basin is about 0 ° C [6], [7].

The climate of the western part of the Arctic basin is milder than that of its eastern part. In the western part of the basin, the winds are mainly south and southwest, in the eastern part they are north and northwest [8, 9].

The development of the Arctic territories is inextricably connected with the processes in the global world. The countries of the world strive to strengthen their positions by increasing the volume of international trade in goods and services, increasing the flows of foreign direct investment and loans, offering new technologies, patents, inventions, know-how. All this determines and strengthens globalization processes of the world economy. The concept of globalization is complex and it has a variety of definitions. Let us consider some of them.

An American researcher T. Levit was one of the first to introduce the concept of “globalization” in his article “Globalization of Markets” (T. Levit “Globalization of Markets”). Globalization was considered as a new commercial reality manifesting itself in the emergence of global markets for the standardization of consumer goods [10]. Corporations entering a new reality benefit from savings on the scale of production and distribution of goods and services, marketing and management [11], [12], [13]. By converting this gain to reduced global prices, global companies can selectively destroy competitors [14], [15].

The term “globalization” as a process of forming global firms was proposed by Harvard Business School consultant C. Omé, who noted that the economic nationalism of individual countries becomes meaningless in view of the increasing role of global firms [16].

According to an American researcher T. Friedman, globalization is an indomitable integration of markets, nation-states and technologies, allowing individuals, corporations and nation-states to reach anywhere in the world faster, deeper and cheaper than ever before [17], [18].

The most accurate definition of globalization, in our opinion, was given by the experts of the International Monetary Fund, who believed that globalization is the growing economic interdependence of the countries in view of the increase in the cross-border movement of goods, services and international capital flows, as well as a result of increasing diffusion of technologies. It is this definition of the globalization process that is widely used in modern economic literature.

Scientific and technological progress, competition, economic liberalization as a consequence of the processes of integration and transnationalization of the world economy are considered to be the main prerequisites for globalization.
Scientific and technological progress accelerates globalization processes with the use of new technologies such as information, telecommunications, space and transport technologies.

Information technologies have increased the transparency of market relations (an opportunity to obtain information about any process or product in short time has emerged). The development of transport technologies has significantly reduced the speed of movement of resources (labor and capital resources) between countries. Space technologies (Earth remote sensing, navigation, communications) have made it possible to monitor an object with high resolution. Until the early 2000-es, satellite imagery resolution was about 1 meter, at present it is less than 0.5 meter. The current level of space technology development allows monitoring any objects and controlling their changes at any point on the Earth. Satellite communication provides round-the-clock access to the Internet, which makes it possible to transfer large amounts of data, organize video conferences. It also allows counterparties from different countries to make deals instantly. Satellite navigation systems (GPS, GLONASS) enable an individual to navigate anywhere in the world, to control the movement of an object if it is equipped with a navigation sensor [19].

The process of transnationalization is an increase in the scale of international companies, the formation of large multinational and transnational corporations, the degree of transnationalization of which is determined by the transnationalization index.

Market competition both in the domestic markets and in the global economy takes place between the largest transnational corporations for consumers, product markets, resources (financial, labor) and technologies.

The Arctic is a special region of the world. It is distinguished by special climatic conditions; scarce population; economic, infrastructural, communication underdevelopment. The interest in the Arctic is determined by the world community’s awareness of the limited and exhaustible global hydrocarbon reserves. According to some experts, a quarter of the world's unexplored oil and gas reserves are concentrated on the Arctic shelf. The Climate Warming hypothesis has increased the likelihood of the availability of natural resources in the Arctic. In this regard, it is important to ensure careful development of these territories, taking into account the peculiarities of the influence of globalization processes.

The objective of the article is to create a model of the global processes influence on the development of the Arctic to forecast development indicators for the Arctic territories.

2. Methodology
The influence of global processes on the development of the Arctic will be presented in the form of a dynamic econometric model consisting of eight econometric equations. Each equation is an ADL model that takes into account the time factor [20], [21], [22]. The model will be presented in a general form for eight circumpolar countries. The methodology for creating the model is as follows:

a) to formulate the research objective;

b) to justify the selection of endogenous variables;

c) to justify the selection of exogenous variables;

d) to create a model of the global processes influence on the development of the Arctic territories of a circumpolar country in a general way.

2.1. Formulation of the research objective
The research objective is to create a dynamic econometric model of the global processes influence on the development of the Arctic territories.

The model of the global processes influence on the development of the Arctic territories will take the form of a system which consists of eight econometric equations. Each equation is an ADL model that takes into account the time factor.

2.2. The rationale for selecting endogenous variables
The indicators reflecting the economic, social and environmental development of the Arctic territories of the circumpolar countries were selected as endogenous factors for creating a model of the global processes influence on the development of the Arctic.

Economic development indicators are the following: the average annual increase in the gross regional product per capita, in percent; the share of agriculture in the gross regional product of the territory of a circumpolar country, in percent; the share of industry in the gross regional product of the territory of a circumpolar country, in percent.

Social development indicators are the following: the number of economically active population of the territory of a circumpolar country, as a number of people; a proportion of the population with secondary education, as a percentage; a proportion of the population with higher education, as a percentage; the number of unemployed people are all social development indicators.

An environmental development indicator is the following: carbon dioxide emissions per capita, in metric tons.

Endogenous factors are shown in Table 1.

**Table 1.** Endogenous factors for creating a model of the global processes influence on the development of the Arctic territories of a circumpolar country

| Endogenous variables | Measurement unit | Endogenous factor |
|----------------------|------------------|------------------|
| $Y_t^1$              | %                | The average annual increase in the gross regional product per capita in year $t$ |
| $Y_t^2$              | %                | The share of agriculture in the gross regional product in year $t$ |
| $Y_t^3$              | %                | The share of industry in the gross regional product in year $t$ |
| $Y_t^4$              | number of people | The number of economically active population in year $t$ |
| $Y_t^5$              | %                | Percentage of population with secondary education in year $t$ |
| $Y_t^6$              | %                | Percentage of population with higher education in year $t$ |
| $Y_t^7$              | number of people | The number of unemployed people in year $t$ |
| $Y_t^8$              | metric tons      | Carbon dioxide emissions per capita in year $t$ |

Source: compiled by the authors

2.3. The rationale for selecting exogenous variables

The indicators reflecting globalization processes such as transnationalization, scientific and technological progress, market competition were selected as exogenous factors.

The transnationalization process is reflected by the following indicators: the average value of the transnationalization index of the 100 largest TNCs in the world, in percent; the average value of the transnationalization index of the largest energy TNCs, in percent; world exports of goods, million USD; world exports of services, million USD.

Scientific and technological progress is assessed with the following indicators: royalties and payments for licenses in the world, million USD; world exports of high-tech goods, million USD.

The largest companies compete in the global markets for resources and markets. The indicators reflecting competition are the following: traditional fuel consumption in the world, as a percentage of all energy resources; electricity consumption per capita in the world, kWh/person; global foreign direct investment, million USD.
Exogenous factors for creating a model of the global processes influence on the development of the Arctic territories of circumpolar countries are presented in Table 2.

**Table 2. Exogenous factors for creating a model of the global processes influence on the development of the Arctic territories of a circumpolar country**

| Exogenous variables | Measurement unit | Exogenous factor |
|---------------------|------------------|------------------|
| $X^1_t$            | %                | The average transnationalization index of the 100 largest transnational corporations in the world in the year $t$ |
| $X^2_t$            | %                | The average value of the transnationalization index of the largest energy TNCs in the year $t$ |
| $X^3_t$            | million USD      | World exports of goods in year $t$ |
| $X^4_t$            | million USD      | World exports of services in year $t$ |
| $X^5_t$            | million USD      | Royalty and license fees in the world in year $t$ |
| $X^6_t$            | % of world exports of goods | World high-tech exports in year $t$ |
| $X^7_t$            | % of all energy resources | World traditional fuel consumption in year $t$ |
| $X^8_t$            | kW h/person      | Electricity consumption per capita in the world in year $t$ |
| $X^9_t$            | million USD      | Global foreign direct investment in year $t$ |
| $X^1_{t-i}$        | %                | The average transnationalization index of the 100 largest TNCs in the world in the year $t-i$ |
| $X^2_{t-i}$        | %                | The average value of the transnationalization index of the largest energy TNCs in the year $t-i$ |
| $X^3_{t-i}$        | million USD      | World exports of goods in year $t-i$ |
| $X^4_{t-i}$        | million USD      | World service exports in year $t-i$ |
| $X^5_{t-i}$        | million USD      | Royalty and license fees in the world in the year $t-i$ |
| $X^6_{t-i}$        | % of world exports of goods | World exports of high-tech goods in year $t-i$ |
| $X^7_{t-i}$        | % of all energy resources | World traditional fuel consumption in year $t-i$ |
| $X^8_{t-i}$        | kW h/person      | Electricity consumption per capita in the world in year $t-i$ |
| $X^9_{t-i}$        | million USD      | Global foreign direct investment in year $t-i$ |
| $Y^1_{t-i}$        | %                | Average annual increase in the GRP per capita in the year $t-i$ |
| $Y^2_{t-i}$        | %                | Share of agriculture in the GRP in year $t-i$ |
| $Y^3_{t-i}$        | %                | Share of industry in the GRP in year $t-i$ |
| $Y^4_{t-i}$        | number of people | Number of economically active population in year $t-i$ |
| $Y^5_{t-i}$        | %                | Percentage of population with secondary education in year $t-i$ |
| $Y^6_{t-i}$        | %                | Percentage of university graduates in year $t-i$ |
| $Y^7_{t-i}$        | number of people | The number of unemployed people in year $t-i$ |
| $Y^8_{t-i}$        | metric tons      | Carbon dioxide emissions per capita in year $t-i$ |

Source: compiled by the authors
Table 3 is a summary table of the relationship between exogenous and endogenous variables of the model of the global processes influence on the development of the Arctic territories of a circumpolar country.

Table 3: Interdependence of endogenous and exogenous parameters of the model of the global processes influence on the development of the Arctic territories of a circumpolar country

| Endogenous variables | Lag endogenous variables | Exogenous variables |
|----------------------|-------------------------|---------------------|
| \( Y^1_t \)          | \( Y^1_{t-j} \)         | \( Y^2_t \) \( Y^3_t \) \( Y^4_t \) \( Y^5_{t-1} \) \( Y^6_{t-1} \) \( Y^7_t \) \( X^2_{t-1} \) \( X^6_{t-1} \) \( X^7_t \) |
| \( Y^2_t \)          | \( Y^2_{t-j} \)         | \( Y^3_t \) \( Y^4_{t-1} \) \( Y^5_{t-1} \) \( Y^6_{t-1} \) \( Y^7_t \) \( X^2_{t-1} \) \( X^6_{t-1} \) \( X^7_t \) |
| \( Y^3_t \)          | \( Y^3_{t-j} \)         | \( Y^4_t \) \( Y^5_{t-1} \) \( Y^6_{t-1} \) \( Y^7_t \) \( X^2_{t-1} \) \( X^5_{t-1} \) \( X^7_t \) |
| \( Y^4_t \)          | \( Y^4_{t-j} \)         | \( Y^5_{t-1} \) \( Y^6_{t-1} \) \( Y^7_t \) \( X^8_t \) \( X^7_t \) |
| \( Y^5_t \)          | \( Y^5_{t-j} \)         | \( Y^6_{t-1} \) \( Y^7_t \) \( X^8_t \) |
| \( Y^6_t \)          | \( Y^6_{t-j} \)         | \( Y^7_t \) \( X^8_t \) |
| \( Y^7_t \)          | \( Y^7_{t-j} \)         | \( Y^8_t \) \( X^8_t \) |
| \( Y^8_t \)          | \( Y^8_{t-j} \)         | \( Y^9_t \) \( Y^3_t \) \( Y^4_t \) \( Y^7_t \) \( X^3_t \) \( X^4_t \) \( X^7_t \) |

Source: compiled by the authors

2.4 Creating a model of the global processes influence on the development of the Arctic territories of a circumpolar country in the general form

The general form of the equations system is as follows:

\[
\begin{align*}
Y^1_t &= f(Y^2_{t-j}; Y^3_t; Y^4_t; Y^5_{t-1}; Y^6_{t-1}; Y^7_t; X^2_{t-1}; X^6_{t-1}; X^7_t)
Y^2_t &= f(Y^2_{t-j}; Y^3_t; Y^4_{t-1}; Y^5_{t-1}; Y^6_{t-1}; Y^7_t; X^2_t; X^6_t; X^7_t)
Y^3_t &= f(Y^3_{t-j}; Y^4_{t-1}; Y^5_{t-1}; Y^6_{t-1}; Y^7_{t-1}; X^2_{t-1}; X^7_t)
Y^4_t &= f(Y^4_{t-j}; Y^5_{t-1}; Y^6_{t-1}; Y^7_{t-1}; X^2_{t-1}; X^7_t)
Y^5_t &= f(Y^5_{t-j}; Y^1_{t-1})
Y^6_t &= f(Y^6_{t-j}; Y^1_{t-1}; Y^5_t)
Y^7_t &= f(Y^7_{t-j}; Y^1_{t-1}; Y^4_t; Y^6_{t-1}; Y^8_{t-1}; X^2_{t-1}; X^7_{t-1})
Y^8_t &= f(Y^8_{t-j}; Y^1_{t-1}; Y^2_t; Y^3_t; X^3_t; X^4_t; X^7_t)
\end{align*}
\]

3. Conclusion

As a result of the research conducted, the authors proposed a model of the globalization processes influence on the development of the Arctic territories of circumpolar countries as a system of econometric equations in a general form. The results obtained will be used in further studies related to making forecasts and working out a concept for the development of the Arctic territories of the circumpolar countries.

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