
REGIONAL PROBLEMS
Integrated Development of Russia's Arctic Zone

Socioeconomic Modernization of Russia and Its Arctic Regions

G. F. Romashkina^a, N. I. Didenko^{b, *}, and D. F. Skripnuk^b

^a*Tyumen State University, Tyumen, Russia*

^b*Peter the Great St. Petersburg State Polytechnic University, St. Petersburg, Russia*

^{*}*e-mail: didenko.nikolay@mail.ru*

Received February 5, 2016

Abstract—This paper deals with the socioeconomic and technological development of Arctic regions of the Russian Federation in the context of a modernizing world. The methodological basis of the comparative analysis is the concept of primary and secondary modernization or integrated modernization for developing countries.

DOI: 10.1134/S1075700717010105

Many countries, including the United States and Russia, have approved several national programs for developing the Arctic¹ and declared that the Arctic zone is an area of fundamental interest in the scientific, economic, and military-political aspects (see, e.g., [1, 2]). However, the international community envisions the Arctic in extremely contradictory ways. The Arctic is seen as a unique store of natural resources and a zone of territorial claims on the part of the circumpolar countries. Various institutions and organizations have expressed legitimate concern about the impact of large-scale exploitation of polar resources and the effects of global warming, which happens in the Arctic two times faster than in the rest of the world (see [1, 3]). However, despite the ambiguity of the situation, in their plans, countries rely on a number of optimistic forecasts that indicate that the warming in the Arctic will lead to lower costs for exploration and mining of resources, production, and transport, and will contribute to further economic growth in Arctic regions.

In contrast to rapid global population growth, the population of the Arctic in the first decade of the 21st century has decreased slightly. As noted in [4], this was primarily due to the ongoing population decline in the Russian Arctic, which is now home for less than a half the population of the Arctic. Thus, after 2000, the population of Vorkuta and Igarka decreased by more than 20%. In contrast, the younger generation of the Yamalo-Nenets Autonomous Okrug provided a 10% population growth. In Alaska, Iceland, Greenland, and the Arctic regions of Canada, the population grew

even faster than in the world and in these countries. The fastest growing region in the Arctic was Nunavut (Canada), the population of which has increased by almost 20% since 2000.

It has been estimated [4] that, in the first decade of the 21st century, the Arctic economy grew much more rapidly than the world economy, developing more than two times faster than the average growth of the Arctic states. The same paper notes that the Russian Arctic continues to experience the post-Soviet economic decline. In real terms, the GRP of the Arctic zone of the world increased by 42.2% in 2000–2010 due to average annual growth rates of 3.5% [4]. The total volume of GRP of the Arctic zone of the world in 2010 amounted to 442.810 million USD by PPP. Of them, the northern part of the Russian Federation amounted to 71.1%, Alaska 10.8, Northern Canada 1.6, Greenland 0.4, Northern Norway 4.2, Northern Finland 4.5, Iceland 2.5, and Northern Sweden 4.6%.

In the context of growing competition among countries for the Arctic, national security requires the accelerated development of the Russian Arctic [5]. However, despite the formally highest per capita GRP in a number of Arctic regions of Russia, the territorial development lags from the rest of the Arctic countries. In the last 15 years, the Russian Arctic zone has been characterized by negative population growth (up to –7%), the fertility rate has ranged within 1.015–1.35. Let us note that this situation is not typical. For example, in Iceland the fertility rate is one of the highest in Europe and, in 2012, it was 2.04; in Alaska, in the last ten years, the coefficient decreased from 2.6 to 2.3, but still exceeds the level of simple reproduction. The fertility rate in Yamalo-Nenets Autonomous Okrug (YaNAO) is equal to 1.9, which is higher than the national average but below the reproduction level. The migration outflow from the Russian Arctic regions is

¹ In this paper, the Arctic refers to the land and sea areas north of the Arctic Circle (parallel 66°33' N). Five Arctic countries, including Russia, the United States, Canada, Norway, and Denmark, have reached an agreement over the part of the Arctic based on the northern borders of each state.

significantly higher than average both in Russia and in the Global Arctic and, in recent years, the mortality rate has grown. The only Russian Arctic region that is not subject to such fast depopulation is YaNAO. The average life expectancy in this region is higher than the average in Russia, and the quality of life is one of the highest in Russia.

The GRP is only above the national average in two of the seven considered regions of the Arctic zone of the Russian Federation (Krasnoyarsk krai, Yamalo-Nenets Autonomous Okrug); in two other regions, the per capita GRP is almost identical to the national average (Sakha-Yakutia, Arkhangelsk oblast).² Three regions, Murmansk oblast, Nenets Autonomous Okrug, and Chukotka Autonomous Okrug, lag significantly behind the national average performance under conditions of increasing divergence. The high per capita GRP in the 2000s was due to unprecedentedly high oil and gas prices. The decline in energy prices may lead to the economic degradation of the regions, posing a threat to the Russian national security. One can argue about how economically viable it is to expand the settlement of polar areas, urban growth, and the concentration of industries in the area of high environmental vulnerability [3, 4], but without providing proper economic development, Russia risks losing these territories [5].

To analyze the trends and patterns of development of Russian Arctic regions, we applied a methodology that ensures the comparability of the level of performance of regions in a global context, which brings them to the comparative evaluation of the modernization level [6].

GENERAL CHARACTERISTICS OF THE METHODOLOGY

We consider the modernization to be a process of the society's transformation from a traditional agrarian state into a modern industrial and post-industrial state. The modernization of the economy is associated with the need for innovative development and the creation of the system of indicators for evaluating the innovative development of countries and classifying countries and regions in terms of innovation and technological development.

Chinese Professor He Chuanqi's concept [6], which we have adopted for further analysis, consists of considering world modernization to be a long historical process that can be divided into two main periods, i.e., first and second modernization. The first modernization (FM) is the transition from agricultural civilization to industrial civilization, while second modernization (SM) is the transition from industrial civilization to a civilization based on knowledge, information economy, and information society from

material culture to the so-called post-material society. In terms of global competition, developing (catching up) countries are trying to combine periods of the first (industrial) and second (informational) modernization. Modernization coordinated as a result of the transition process is called integral modernization (IM) [7].

To analyze the modernization processes, we used the following [8, 9]³:

Components of the first modernization index (FMI)

Economic indicators include the GRP per capita (USD), the proportion of individuals employed in agriculture in total employment*, the proportion of value added in agriculture in relation to GRP*, and the proportion of value added in services in relation to GRP.

Social indicators include the proportion of the urban population, the number of doctors per 1000 people, the infant mortality rate*, and life expectancy.

Education indicators include the level of adult literacy, the proportion of students receiving higher education between the ages of 18 to 22 years.

Components of the secondary modernization index (SMI)

Innovation in education includes the proportion of R&D expenses in GRP, the number of scientists and engineers engaged in R&D per 10 000 people, and the number of people in the country who filed patent applications per 1 million people.

Knowledge translation includes the proportion of students in secondary schools aged 12–17, the proportion of students aged 18–22, the number of television sets per 100 households, and the number of personal computers per 100 households.

Quality of life includes the proportion of the urban population, the number of physicians per 1000 people, the infant mortality rate*, life expectancy, and energy consumption per capita.

Quality of economy includes GRP per capita, GRP per capita by purchasing power parity (PPP), the proportion of value added of the material sector in GRP*, and the proportion of individuals employed in the material sector in total employment*.

Components of the integrated modernization index (IMI)

Economic indicators include GRP per capita, GRP per capita by PPP (USD), the proportion of the value

³ Indices and subindices show the current value of the indicator with respect to the standard of developed countries (for example, when the current value of the indicator is 65 and the standard is 78, the corresponding subindex is taken equal to 83.3%). The exceptions are the indicators marked with (*), which show the proportion of the standard against the current value of the indicator so that growth in the index corresponds to a reduction in the current level of the indicator.

² For the purpose of comparability, Moscow is not included in the review.

added of services in GRP, and the proportion of employment in the service sector.

Social indicators include the proportion of the urban population in the total population, the number of physicians per 1000 people, and life expectancy. *Eco efficiency* includes the ratio of GRP per capita to energy costs per capita.

Education indicators include the proportion of expenditure on research and development in GRP, the number of individuals applying for patents per 1 million people, the proportion of university students aged 18–22, and the number of Internet users per 100 people.

DYNAMICS OF MODERNIZATION PROCESSES IN RUSSIA AND ITS ARCTIC REGIONS

According to the monitoring results of the Center for Studies of Modernization, Chinese Academy of Sciences (CSM CAS) [7], by 2006, 35 countries (the survey included 131) carried out primary industrial modernization by 100% or more, exceeding the level of development that 18 industrialized countries of the West reached by the beginning of the 1960s. By 2006, Russia implemented this modernization stage by 97%, ranking 41st; eight of the ten indicators had indices of 100% (in full compliance with standard values), while two indicators were less than 100%, i.e., per capita GDP (78% of the average of developed countries in 1960) and the index of life expectancy were 94% of the similar average for the period taken as a standard (70 years). Due to the rapid growth of oil and gas revenues by 2008, the Russian per capita GDP exceeded the desired value, and life expectancy increased to 97%. In general, the primary modernization index in Russia increased to 99.7%. The global financial and economic crisis that began in 2008 reduced the pace of development of most countries, including Russia [8].

Then, by 2010, the first modernization index (FMI) in Russia rose again, but it did not reach 100% because of the gap in life expectancy (98% of the norm). However, if we consider the ranking of developing (modernizing) countries, Russia's position was displaced (from 40th to 43rd) by Kuwait, Brazil, and Turkey. During this period (2010), the average FMI of 131 countries amounted to 96 points, and was characterized by a huge gap between the countries of 32–100 points [6].

Regions of the Russian Federation circumpolar area are significantly behind the pace of the first modernization of the average national rates. Murmansk oblast nearly repeats the average national trend, and Arkhangelsk oblast, Yakutia, and Krasnoyarsk krai are slightly behind. The rapid development of the modernization processes in the first five years of the 2000s gave way to unstable growth and, in some regions, a decrease in the level of socioeconomic development.

Nenets Autonomous Okrug lags significantly behind the average level of modernization of the Russian Arctic regions; its FMI decreased from 92.2% in 2000 to 90.7% in 2012. The uneven development of Chukotka Autonomous Okrug, Krasnoyarsk krai, and Yakutia is due to the fact that these regions were hit the hardest by the 2008–2009 crisis. By 2012, Chukotka still could not return to 2005 levels. These regions cannot be described as lagging in terms of GRP, but the main thing that prevents us talking about the end of the first modernization is the underdevelopment of the service sector and the archaic structure of employment. In general, during the first decade of the 21st century, All Russian Arctic regions exceeded the 92% level of development that 18 industrialized countries of the West reached in the early 1960s.

General trends for all of Russia are shown in Fig. 1⁴; the pace of modernization slows down when moving from the center to the north and east. The presence of resource wealth in the absence of mechanisms to convert resource advantages into economic and social categories does not define the leadership of regions. For example, note the differences between the rates of the first modernization of the Yamalo-Nenets and Nenets autonomous okrugs.

The lag of Russian Arctic regions is even more significant when including the indicators of the second modernization in the analysis. The second modernization should result in the formation of the knowledge-based economy, informatization, development of services, networking, dissemination of digital technology, commitment to innovation, lifelong learning, etc.

In 2010, Russia entered the phase of the second, i.e., information, modernization with the level of SMI in Moscow reaching 104.5 points, but other regions are lagging behind the leader sometimes an order of magnitude. By 2012, the number of countries covered by monitoring of CSM CAS increased to 135. The second, information stage of modernization is characteristic of about 40 countries; more than 90 countries were at the stage of the first, i.e., industrial, modernization, while four countries were completely agrarian [6]. Differences between countries for the level of SMI ranged from 18 to 108 points. Among the informationally developed countries, the United States occupied only the first place (108 points), Russia remained a moderately developed country (74.4 points, 28th place), and China was qualified as a preliminary developed country (54 points, 51st place).

In 2006–2012, the integrated modernization index (IMI) in Russia increased from 59th to 67th place, but because of competition with more successful countries in the ranking of the implementation of integrated modernization, Russia only rose by two places (from 37th to 35th place). Of the 12 components of the inte-

⁴ Figures 1–3 were constructed according to author's calculations based on the data from <http://mod.vsec.ac.ru>.

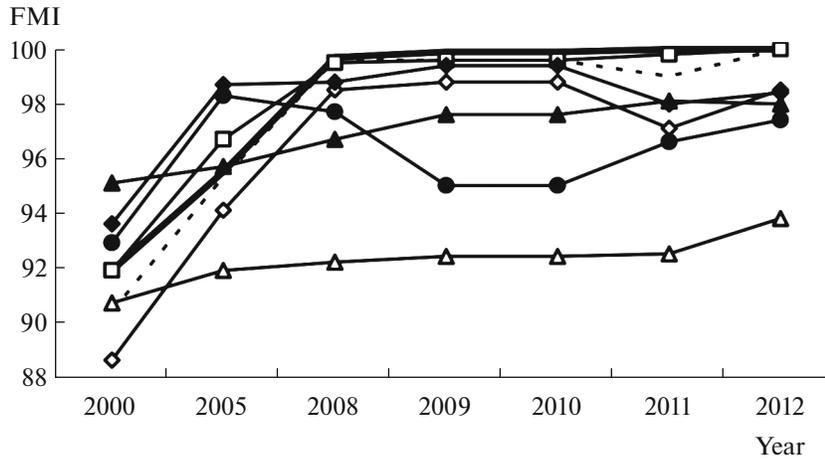


Fig. 1. Dynamics of first modernization indexes (FMI) of the regions of the Russian Arctic, 2000–2012. — Russia; —□— Murmansk oblast; --- Arkhangelsk oblast; —◆— Republic of Sakha (Yakutia); —◇— Krasnoyarsk krai; —▲— Yamalo-Nenets AO; —●— Chukotka AO; —△— Nenets AO.

Source: Here and in the following figures (2, 3) and tables (1, 2), the authors' calculations are based on the data from <http://mod.vsc.ac.ru>.

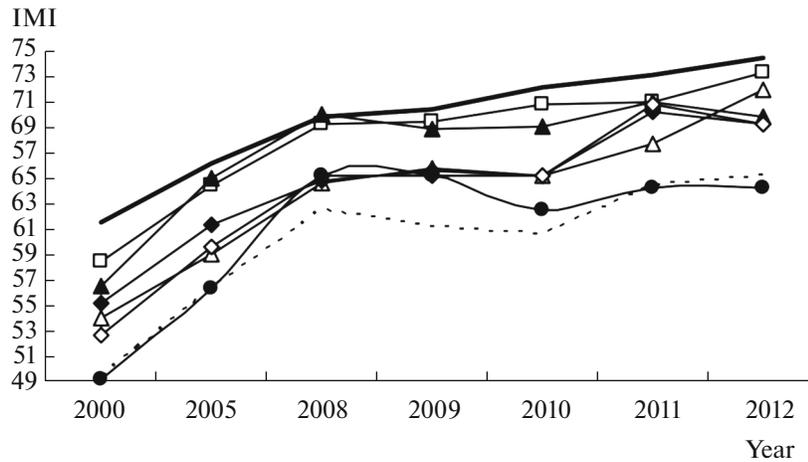


Fig. 2. Dynamics of second modernization indexes of the regions of the Arctic zone of Russia, 2000–2012. — Russia; —□— Murmansk oblast; --- Arkhangelsk oblast; —◆— Republic of Sakha (Yakutia); —◇— Krasnoyarsk krai; —▲— Yamalo-Nenets AO; —●— Chukotka AO; —△— Nenets AO.

Source: Authors' calculations are based on the data from <http://mod.vsc.ac.ru>.

grated modernization index (IMI) for the whole of Russia, only the number of physicians per 1000 population has reached 100%. In terms of other indicators, Russia showed a positive trend, but the whole world was also developing, so the level of integrated modernization from 51.1% in 2000 only rose to 67% in 2012.

The greatest lag occurred in the field of innovation in knowledge (294 individuals who filed patent applications per 1 million people, accounting for 44.5% of the level of developed countries; the proportion of R&D expenditure reached 1.1% of GDP, or 45.8% of the level of developed countries), environmental performance (GDP per capita in energy costs per capita) was 20.9% of the level of developed countries, Table 1.

Let us see how regions of the Arctic zone of Russia fit into the global context (Fig. 2).

All regions of the Russian Arctic are lagging behind the national average rates of the second modernization. Thus, in 2012, the levels of SMI for Arkhangelsk oblast (65.1) and Chukotka Autonomous Okrug (64.3) were more than ten points below the national average; Krasnoyarsk krai (69.2), Yakutia (69.3), and YaNAO (69.8 in 2012) lag behind by about five points. Only Murmansk oblast roughly matches the average national pace of development, but still lags behind by 2012 at the 73% level of the second modernization.

The quality of life index and the associated index of knowledge translation in the regions under consider-

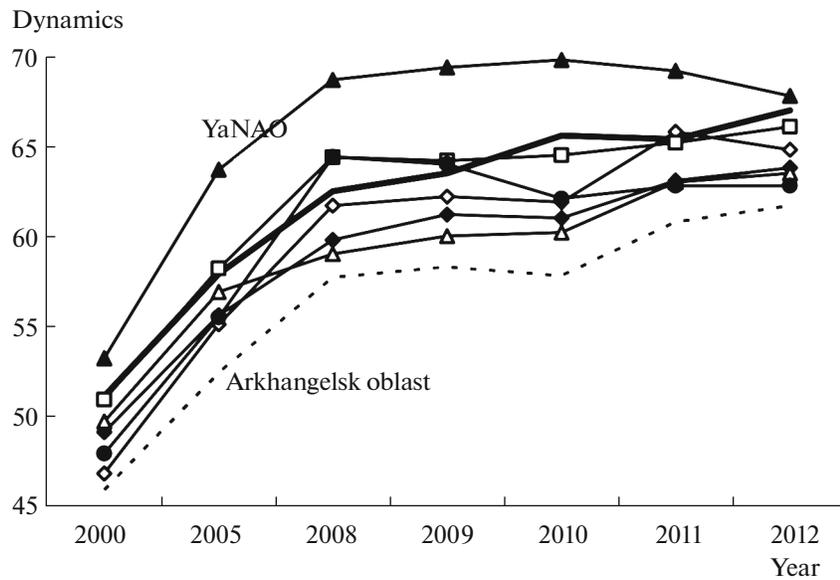


Fig. 3. Dynamics of integrated modernization indexes in the regions of the Russian Arctic, 2000–2012. — Russia; —□— Murmansk oblast; --- Arkhangelsk oblast; —◆— Republic of Sakha (Yakutia); —◇— Krasnoyarsk krai; —▲— Yamalo-Nenets AO; —●— Chukotka AO; —△— Nenets AO.

ation, as well as in Russia as a whole, have good momentum. This is primarily due to the development of extractive industries.

The economy quality index in some northern regions of Russia (Yamalo-Nenets AO) is even higher than the national average, which is also associated with high GRP per capita due to the extractive industries. However, in Arkhangelsk oblast and Krasnoyarsk krai, this figure is lower, i.e., 50.2% and 51.3% in 2012 (Table 2).

Let us take a more detailed look at the leading (YaNAO and Murmansk oblast) and lagging (in terms of the pace of modernization) regions of the Russian Arctic, i.e., Arkhangelsk oblast and Chukotka AO, which are pronouncedly characterized by almost all of the most serious problems of the economy and social sphere.

Yamalo-nenets Autonomous Okrug. The entire territory of YaNAO refers to the Far North area (more than half of the territory is located beyond the Arctic Circle) and covers 769 300 km². The climate of YaNAO is characterized by severe long winters (on average 182 days), the frequent passage of cold waves and cyclones, which are accompanied by severe storms and blizzards. According to the data of January 1, 2015, this territory is home to 540 000 individuals, the number of inhabitants per 1 km² is 0.7 individuals, per capita cash income (per month) amounted to 60.7 thousand rubles (the second place in the Russian Federation). Almost 84% of YaNAO residents live in the cities, but only the capital of the okrug, Salekhard, can be considered a medium-sized city, with a population of about 50 thousand people. In Soviet times, the terri-

tory also had developing local trades and fish farming, which were supported by grants from the center. Later the Yamal economy became almost single-industry.

It should be noted that the implementation of the program of construction of objects of the seaport on the Yamal Peninsula [10] will not be successful without linking the network of maritime, rail, road and pipeline types of transport. The modern support framework of the transport system of YaNAO was formed as a result of the large-scale investment program of development of the oil and gas industry in 1970–1990. In connection with the focal development the terrestrial transport network of the okrug is fragmented, having two transport regions, i.e., western and eastern. The basis of the entire transport network is Salekhard, the Labytnangsky industrial and transportation hub, where large volumes of goods are handled from water transport to rail and vice versa. In 2010, construction of the Obskaya–Bovanenkovo–Karskaya railway was completed, which is used to deliver cargo destined for the development of deposits of the Yamal Peninsula. The key problems of main gas and oil and gas condensate transport are the lack of a unified system for transporting gas condensate in the district, the wear of the main oil and gas transport equipment, and the lack of development of main oil transportation.

Reserves of hydrocarbons, gas, oil, and condensate are the basis of industrial production in YaNAO. Mining operations account for over 88% of industrial production. Volumes of annual extraction of natural gas within the boundaries of the region account for over 80% of Russian gas production, or one-fifth of world

Table 1. Components of the integrated modernization index (IMI) for Russia in 2000 and 2012

| Russia | 2000 | | | 2012 | | |
|---|-------|------------|----------|-------|------------|----------|
| | fact* | standard** | index, % | fact* | standard** | index, % |
| Combined gross regional product (GRP) per capita, USD | 1660 | 27680 | 6 | 12740 | 43176 | 29.5 |
| Proportion of value added in services against GDP, % | 54 | 68 | 79.4 | 56.2 | 74.9 | 75 |
| Combined gross regional product (GRP) per capita in PPP, USD | 8010 | 27770 | 28.8 | 22710 | 40612 | 55.9 |
| Proportion of employed in services in total employment, % | 59 | 70 | 84.3 | 62.5 | 74.2 | 84.2 |
| Integrated economic index | | | 49.6 | | | 61.1 |
| Proportion of urban population in total population, % | 73 | 79 | 92.4 | 74 | 80.3 | 92.2 |
| Number of doctors per 1000 people | 4.2 | 3 | 100 | 4.91 | 2.9 | 100 |
| Life expectancy, years | 65 | 78 | 83.3 | 70.24 | 80.7 | 87 |
| Eco efficiency: GDP per capita against energy expenditure per capita (USD/USD), % | 0.4 | 4.9 | 8.2 | 1.9 | 9.1 | 20.9 |
| Integrated social index | | | 71 | | | 75 |
| Proportion of students aged 18–22 years, enrolled in higher education, % | 41 | 62 | 66.1 | 76.1 | 77.9 | 97.7 |
| Proportion of R&D expenditures in GDP, % | 1.1 | 2.6 | 42.3 | 1.1 | 2.4 | 45.8 |
| Number of residents who filed patent applications per 1 million people | 138 | 926 | 14.9 | 294 | 660 | 44.5 |
| Number of personal computers per 100 households | 6 | 85 | 7.1 | 86 | 120 | 71.7 |
| Integrated knowledge level index | | | 32.6 | | | 64.9 |
| Integrated modernization index (IMI) | | | 51.1 | | | 67 |

* Fact is the current value of the indicator.

** Standard is the standard or target value of the indicator. Index (percent) shows the proportion of the standard value of the indicator against its actual value at the current time.

The authors' calculations are based on data from <http://mod.vsc.ac.ru>. Tables on the site were prepared by the Institute of Social and Economic Development of Territories (ISERT), Russian Academy of Sciences (Vologda) using the Information Analytical System for Monitoring the Modernization Parameters of Russian Regions (IS Modernization patent no. 2012661285, 2012) in accordance with the methodological developments of the Center for Studies of Social and Cultural Changes, Institute of Philosophy, Russian Academy of Sciences. The tables contain detailed data, including those obtained from the Center for Studies of Modernization, Chinese Academy of Sciences.

production. Volumes of oil and gas condensate mining in YaNAO make about 8% of total Russian production. Systemic problems of the fuel and energy complex of YaNAO consist of insufficient volumes of geological exploration, the decline in oil production, the low efficiency of utilizing associated petroleum and natural gas in condensate production, and the problem of using low-pressure gas.

High levels of income and the fact that the area is sparsely populated have largely determined the style and quality of life in the region. The first modernization in YaNAO is almost completed; only a fraction of the value added in the services sector in relation to GRP amounted in 2012 to 36.1% or 80% of the norm. In terms of the quality of life (except high infant mor-

tality, 52.2% of the norm) and indices of knowledge translation, YaNAO is ahead of all its neighbors (Table 3), but the index of innovation in knowledge is the lowest among the regions in question (4.2%). YaNAO has 0.85 scientists and engineers per 10000 people (2.2%), and the patent activity is 11.2% of that in developed countries. The economy quality index is low due to the lag in the service sector (83.2%). The index of integrated modernization in Yamalo-Nenets Okrug, which depends on the average level of the 20 most developed countries, is the highest of all regions of the Russian Arctic, but after 2008, it decreased (to 67.8% in 2012) and only three of its twelve components (GRP, the proportion of the urban population, and the number of doctors) reached 100%, while the pro-

Table 2. Second modernization indices (SMI) and their components for Russia and its Arctic regions in 2000/2012

| Region | Innovation in knowledge | Knowledge translation | Quality of life | Economy quality | Second modernization |
|-----------------------------|-------------------------|-----------------------|-----------------|-----------------|----------------------|
| Russia | 55.7/55.7 | 59/93.6 | 82.3/94.9 | 49.5/53.5 | 61.6/74.4 |
| Murmansk oblast | 30.8/32 | 65/103.7 | 88.6/103.3 | 49.5/54.2 | 58.5/73.3 |
| Nenets AO | 6.8/5.5 | 60.6/95.4 | 74.9/104.6 | 74.1/82.2 | 54.1/71.9 |
| Yamalo-Nenets AO | 3.5/4.2 | 71.4/96.4 | 85.9/95.1 | 65.2/83.2 | 56.5/69.8 |
| Republic of Sakha (Yakutia) | 28.6/26.2 | 64.6/102.2 | 78.6/90.7 | 48.6/58.2 | 55.1/69.3 |
| Krasnoyarsk krai | 26.1/36.9 | 62.3/95 | 79.5/93.6 | 42.7/51.3 | 52.7/69.2 |
| Arkhangelsk oblast | 12.2/13.2 | 59.9/99.1 | 82.7/98.1 | 42.3/50.2 | 49.3/65.1 |
| Chukotka AO | 11.2/3.1 | 60.2/97.2 | 76.3/83.1 | 48.5/73.9 | 49.1/64.3 |

portion of R&D expenses is 0.01% of GRP or 0.4% of the norm of developed countries, environmental efficiency is 20.9% of the norm of developed countries.

The *Murmansk oblast* occupies 144.9 km² and is home to 771100 people [11]; it is the most western region of the Russian Arctic, bordering Finland. The area is bordered by the Barents and White seas and includes the Kola Peninsula. The geographical position determined the specialization of the region as a frontier outpost of Russia; transport, mining, marine fisheries, and defense industry traditionally lead the economy. The structure of the economy is more diversified than in other northern regions, including the major regions, i.e., 18.6% of the GRP is mining, 15% is processing industry, 9.6% is trade, 9.4% is public administration, and 7.6% is fisheries and aquaculture [11]. The largest proportion of funds within state programs for developing the Arctic zone of the Russian Federation were invested into this region.⁵ However, according to the data of 2014, enterprises of the *Murmansk oblast* are characterized by a large proportion of obsolete fixed assets and a high proportion of unemployment, while investments in fixed assets in 2014 decreased by 12% compared to the same previous period. The 2008 crisis had significant pressure on the modernization indicators in 2008–2010 and, in 2011, the economy growth in the region resumed. In terms of the first and second modernizations, this is one of the most consistently developing regions. In terms of the pace of modernization, the *Murmansk oblast* is

⁵ Following the adoption of the Arctic zone of Russia's Development Strategy, substantial financial resources were directed into the region. In 2014 and 2015, the proportion of budget resources (budgets of all levels) in total investment in fixed assets of the *Murmansk oblast* was 26.6 and 41.8% with an average value for the Arctic zone of the Russian Federation 5.5 and 7.6%, while the average for Russia is 17 and 16.5%, respectively (according to the data of Rosstatmonitoring, http://www.gks.ru/free_doc/new_site/region_stat/calendar1.htm. Cited September 20, 2016).

second only to *YaNAO*, but the level of balancing (calculated as the dispersion of sub-indexes) is higher. According to the data of 2012, the first modernization in the region is fully implemented and the second modernization is completed by 73.3%. Among the components of the second modernization, the index of innovation in knowledge lags behind (32% of the norm) due to low (by international standards) patent activity (103.8 people per 1 million residents or 15.7% of the norm), the proportion of R&D costs is 0.85% of GRP, or 35.4% of the norm for developed countries, and the number of scientists and engineers is 17.5 per 10000 people or 44.9% of the norm. These indicators are lagging behind the national average level (see Table 1), which is partially compensated by higher incomes of the population (32900 rubles/month in 2014; 35700 rubles/month in 2015), which is determined mainly by the northern salary allowances⁶. The integrated economic index in the region is low (see Table 2) due to the low per capita GRP (26.6% of the norm) and low environmental efficiency (20.9% of the norm).

Thus, despite its frontier status, in terms of almost all indicators, the *Murmansk oblast* is developing at the national average level (see Figs. 1–3, Table 2).

Arkhangelsk oblast is among the regions where the first modernization by 2008 was almost 100% implemented. The rapid growth in the beginning of the 2000s under the pressure of the 2008 crisis was replaced by a decrease in a number of indicators (see Figs. 1–3). By 2012, GRP amounted to 12483 USD per capita or 28.9% of the level for developed countries; the regional services sector is developing quite rapidly (the proportion of employed in the services

⁶ GRP per capita in the *Murmansk oblast* is slightly above the national average, but the proportion of social transfers in the actual consumption of households in 2012 was 28.8% compared to the national average of 18.2%.

sector was 63.5% at the norm of 74.2%). The Arkhangelsk oblast (without NAO) is home to 1.15 million people on the territory of 413000 km², the level of income of the population (24800 rubles per month in 2014) almost coincides with the national average [11]. One of the major constraints of development is a low level of innovation in knowledge. Thus, the proportion of R&D expenses amounts to 0.24% of GRP, the number of scientists and engineers is 7.1 per 10000 people, and the number of people who filed patent applications is 75.7 per 1 million people. The region is characterized by a high level of urbanization (76.6% of the population live in urban areas), the rate of knowledge translation reached 99.1% of the level of developed countries, the quality of life is 98.1% of the norm, but this did not lead to an adequate increase in the economy quality index.⁷ Thus, the proportion of employment in the material sector in total employment was 36.4% at the norm of 26%; the index of the proportion of value added in the material sector (agriculture and industry) in GRP amounted to 48.1% of the norm. In terms of the integrated modernization index, Arkhangelsk oblast also lags significantly behind the national average rates (see Fig. 3).

Administratively, the *Nenets Autonomous Okrug (NAO)* is part of the Arkhangelsk oblast, through being taken into account separately in the Russian statistics. According to the 2015 data, the population of NAO is 43000 people on the territory of 176800 km². In the economy of NAO of GRP 74% in 2012 and 76% in 2013 were represented by mining, so the wage level is relatively high [11], which indirectly leads to an increase in the indices of quality of life (104.6%) and knowledge translation (95.4%). Note that, in NAO, the proportion of social transfers in the actual consumption of households was 63.2% (in 2012), while the proportion of the budget (budgets of all levels) in total investment in fixed assets within 2011–2014 did not exceed 2% per year. At the same time, the knowledge economy in the NAO almost does not develop. According to the data of 2012, the proportion of R&D expenses amounted to 0.03% of GRP and the number of scientists and engineers was per 10000 people; there were no patent applications and the index of innovation in knowledge amounted to 5.5% in 2012. These data are all the more revealing given that the region almost caught up with the developed countries in terms of the proportion of students (101.5%), the proportion of students in secondary schools (95%), the number of television sets (101.5%), and the number of personal computers (73.3% of the level of developed countries).

⁷ The region has a relatively high proportion of social transfers in the actual consumption of households (22.5% in 2012, without NAO).

* * *

The analysis shows that, over the past decade, the global Arctic has grown twice as fast as the whole world, but the development of the Russian Arctic regions lags behind the national average rates and is concentrated in a small number of regions that had economic benefits due to all-time high energy prices. Due to this, there was an increase in the social component, but there was almost no technological or institutional modernization. Developing most successfully in socioeconomic and sociocultural dimensions, the Arctic regions of Russia are not like that in terms of modernization.

The Russian Arctic regions entered the 2000s with a number of problems caused by both the collapse of the single economic complex and the low quality of territorial administration. Recently, several government documents were accepted that assumed the accelerated development of these regions; however, as shown by the results of our analysis, this is not sufficient.

Let us note that, even in the region with the greatest support from the federal budget, Murmansk oblast, the main indicators that determine progress in a modern economy based on knowledge has not yet reached half the level of developed countries. Other regions are still in line with a mining and resource economy, while the high first modernization index calculated according to the technique of CMS CAS is defined only by the high level of the per capita gross regional product (YaNAO, Nenets AO, Chukotka AO). As is known, the per capita gross regional product for sparsely populated Arctic regions, which have price levels, social transfers, and other forms of income redistribution that are significantly higher than the national average, does not reflect the real situation (see, e.g., [4]).

Thus, the currently implemented state programs for developing the Russian Arctic has impacted the dynamics of development, but no qualitative transition to a different development trajectory has happened yet.

ACKNOWLEDGMENTS

This article was prepared based on the results of a study carried out with the financial support of the grant of the Russian Scientific Fund (project no. 14-38-00009), Peter the Great St. Petersburg State Polytechnic University.

REFERENCES

1. O'Rourke, R., *Changes in the Arctic: Background and Issues for Congress* (2016). <https://www.fas.org/sgp/crs/misc/R41153.pdf>.
2. State Program Social and Economic Development of the Russian Arctic for the Period till 2020 approved by the Decree of the Government of the Russian Federation on April 21, 2014.

3. Year eBook 2014. Update Rapid Change in the Arctic, 2014 United Nations Environment Programme. <http://www.un.org/Depts/Cartographic/english/htmain.htm>.
4. Arctic Human Development Report: Regional Processes and Global Linkages (Nordic Council of Ministers, 2014). <http://www.norden.org/en/publications>.
5. B. N. Porfir'ev, D. O. Eliseev, F. D. Larichkin, A. I. Tatarkin, A. I. Shishkin, P. A. Minakir, V. M. Kattsov, V. V. Kuleshov, V. A. Tsvetkov, E. A. Zakharchuk, V. N. Lazhentsev, D. A. Gainanov, and S. V. Kuznetsov, *Russian Arctic: Current Development Paradigm*, Ed. by A. I. Tatarkin (Nestor-Istoriya, St. Petersburg, 2014) [in Russian].
6. He Chuanqi, *Modernization Science. The Principles and Methods of National Advancement* (Springer, 2012).
7. *China Modernization. Report Outlook (2001–2010)*, Ed. by He Chuanqi (Peking University Press, Beijing, 2010).
8. N. I. Lapin, “Recent theoretical and methodological aspects of research of Russian modernization,” *Sots. Issled.*, No. 1 (369), 5–10 (2015).
9. G. F. Romashkina, “Modernization processes in the regions of the Urals Federal District,” *Sots. Issled.*, No. 1 (369), 19–26 (2015).
10. The Decree of the President of the Russian Federation of May 2, 2014 No. 296 On the Land Territories of the Arctic Zone of the Russian Federation.
11. *Regions of Russia. Socio-Economic Indicators. 2014. Statistical Yearbook* (Rosstat, Moscow, 2014) [in Russian].

Translated by K. Lazarev