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Differentiation of the Northern Regions of Russia in Terms of Labor Potential

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Abstract. The purpose of the study is to determine significant, sustainable differences between the northern regions of Russia in terms of labor potential of the population. The object of the study is the labor potential of the population of the northern regions of Russia. In order to develop the typology of regions, 22 indicators were selected for the period 2014–2020, characterizing the labor potential of the population and the conditions for its implementation. The correlation analysis has resulted in the formation of a feature space based on eight indicators that determine four blocks of labor potential components: a) demographic, b) health component, c) education, d) economic indicators reflecting interaction in the labor market. The typology has resulted in the identification of six stable types of regions that are characterized by specific inert processes due to cultural-historical and natural-climatic factors. It is revealed that during the COVID-19 pandemic, the gap between regions in terms of labor potential increased, leaving the same ratio of regions. The proposed typology can be used for scientific research in the field of labor potential management the regional level. From a practical point of view, the work may be of interest to state authorities when developing managerial decisions in the field of implementing investment projects, especially within the framework of implementing the state program of socio-economic development of the Arctic zone of the Russian Federation. In addition, the recovery of the economy of certain Russian regions after the severe crisis caused by the pandemic is possible due to the increase in the labor potential of the population. The presented typology makes it possible to identify the priority areas, allows increasing the comprehensive indicator of labor potential, which is most relevant for the northern regions.

Keywords: *labor potential, regional differentiation, typology, northern regions of Russia, Arctic, demographic process, population quality*

Introduction

The Russian space is highly heterogeneous. At the same time, climatic differences between the south and the north of the country determine the economic, social, and cultural development of these territories. These differences are obvious at first glance. The diversity of the North is of particular interest due to a number of factors — climatic differences between East and West, the degree of their development, economic sustainability, natural and mineral resources. In addition,

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the territories differ significantly in terms of population size, density and qualitative characteristics. The totality of qualitative and quantitative characteristics determines the population's ability to work, its labor potential.

Labor potential is of special interest for Northern and Arctic territories, since the tasks set in the Strategy for the Development of the Arctic Zone [1] require significant human resources and high rates of labor potential. As researchers note, the current dynamics of migration processes and general negative demographic trends do not allow reaching the required level of labor potential [1, Fauzer V.V., Smirnov A.V.]. However, these trends differ among northern regions. In addition, differences are observed in the qualitative component of the labor potential. Increased attention not only to the Arctic, but also to the rest of the northern regions, is due to the need to assess the labor potential of regions located in close proximity to the Arctic in order to identify migration reserves in the implementation of large infrastructure projects. In addition to the obvious savings in transport costs, the use of local labor resources is preferable due to easier adaptation to climate change [2, Tatarkin A.I., Zakharchuk E.A., Loginov V.G.].

The reduction of the gap between regions in the qualitative characteristics of the population, the growth of the overall indicator of labor potential is possible due to the identification of common patterns and differences in the formation of the labor potential of the northern regions of Russia. Therefore, the purpose of this study is to develop a typology of the northern regions, identifying differences in social, economic, demographic processes between regions, necessary to determine the reserves for growth of labor potential.

The subject of the study is a set of socio-demographic and economic indicators of the population — people living and working mainly in the northern regions of Russia. The northern regions include the subjects of the Russian Federation, the territories of which are fully or partially referred to the Far North and equated areas [2]. Hereinafter, the region is understood as a subject of the Russian Federation. In this study, the object is the labor potential of the population of the northern regions of Russia. Labor potential is understood as a generalizing characteristic of the measure and quality of the set of abilities for socially useful activities, which determines the capabilities of an individual, groups of people, the entire working population in terms of their participation in labor [3, Maslova I.S.].

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[1] Ukaz Prezidenta Rossiyskoy Federatsii ot 26.10.2020 № 645 «O Strategii razvitiya Arkticheskoy zony Ros-siyskoy Federatsii i obespecheniya natsional'noy bezopasnosti na period do 2035 goda» [Decree of the President of the Russian Federation of October 26, 2020 No. 645 "On the Strategy for the development of the Arctic Zone of the Russian Federation and ensuring national security for the period up to 2035"].

[2] Postanovlenie Pravitel'stva RF ot 16.11.2021 № 1946 «Ob utverzhdenii perechnya rayonov Kraynego Severa i mestnostey, priravnennykh k rayonam Kraynego Severa, v tselyakh predostavleniya gosudarstvennykh garantiy i kompensatsiy dlya lits, rabotayushchikh i prozhivayushchikh v etikh rayonakh i mestnostyakh, priznanii utrativshimi silu nekotorykh aktov Pravitel'stva Rossiyskoy Federatsii o priznanii nedeystvuyushchimi na territorii Rossiyskoy Federatsii nekotorykh aktov Soveta Ministrov SSSR» [Decree of the Government of the Russian Federation of November 16, 2021 No. 1946 "On approval of the list of regions of the Far North and localities equated to regions of the Far North, in order to provide state guarantees and compensations for persons working and living in these regions and localities, invalidating certain acts of the Government of the Russian Federation on the recognition of certain acts of the Council of Ministers of the USSR as invalid on the territory of the Russian Federation"].

Theoretical foundations of regional differentiation

Research on the labor potential of the population has been of interest to scientists for the past 40 years. It is the basis for economic development of the territories and growth of the welfare of society. Its assessment and measurement are still debatable issues due to the qualitative and quantitative nature of the object.

The Institute of Socio-Economic Problems of Population of RAS developed a methodology for assessing the integral indicator of labor potential using the index method under the leadership of N.M. Rimashevskaya [4, Rimashevskaya N.M., Bochkareva V.K., Volkova G.N., Migranova L.A.; 5, Rimashevskaya N.M., Migranova L.A., Toksanbaeva M.S.]. This indicator includes demographic component, indicators of health, education, well-being, educational and qualification level, psychophysical state, social and personal component. In addition, this methodology has been used to analyze the characteristics of labor potential of Russian regions and to compile their ranking.

A group of researchers from the Vologda Scientific Center RAS has developed a similar methodology for calculating the integral indicator of the labor potential of an organization, based on qualitative and quantitative indicators, including physiological, educational, professional, innovative, social and economic potentials [6, Ilyin V.A.].

In recent years, attention to the North and the Arctic has increased, in particular to their labor potential. A team of scientists from the Kola Scientific Center of RAS substantiated the role of labor potential in the development of the Arctic and in the implementation of national interests on its territory [7, Korchak E.A.; 8, Korchak E.A., Skufina T.P.]. In addition, the labor potential of the Northern regions was assessed using the Labor Potential Development Index (LPDI) [9, Popova L.A., Terentyeva M.A.; 10, Popova L.A., Terentyeva M.A.]. The study was conducted on the basis of the All-Russian Population Census data for the period 2002–2010. Five basic indicators were used for the calculation: the share of the able-bodied population, the level of education, vocational training and retraining, qualification and work experience, contributing to increasing the employee's capacity, the level of wages, the armament of labor with means and tools, and the employment rate. It should be noted that the measurement of labor potential and its individual components is usually accompanied by the compilation of ratings, typologies or classifications that reflect regional differentiation.

Researchers pay special attention to the differentiation of regions due to the specifics of the Russian space [11, Mareeva S.V., Voron O.V., pp. 44–50]. A country with such a huge area a priori cannot be homogeneous, and understanding the peculiarities of development of each individual territory is a crucial task for implementing national projects and achieving global goals. In this paper, typology as a method of scientific knowledge is used for the differentiation of regions, which is a process of dividing a set of objects into homogeneous groups for ordering and further description of the properties of objects belonging to a particular type. In social sciences, typologies are used to differentiate a variety of objects, analyze situations, and apply managerial decisions to different types and groups of objects. Typology refers to the formation of time-stable groups of

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regions with similar socio-economic and demographic processes that determine the formation and development of the characteristics of the labor potential. It is of great scientific and applied importance [12, Glavatskaya N.]. The development of a typology of Russian regions in general, and of the northern regions in particular, was previously carried out for various reasons [13, Ivashkova T.K., Morozova N.V.; 14, Starikova T.V.; 15, Makarova T.V.; 16, Ignatev V.G., Nurtdinov I.I., Zhilina N.N.; 17, Fedorov G., Korneevets V.]. Foreign studies also resort to the development of the typology of regions. Particular attention is paid to socio-demographic processes as the basis for the development of territories [18, Kladivo P., Ptáček P., Roubinek P., Ziener K.; 19, Topaloglou L., Kallioras D., Manetos P., Petrakos G.; 20, Woods M.]. A team of researchers from the Institute of Socio-Economic Problems of Population and the Higher School of Economics developed a typology of Russian regions based on indicators characterizing human potential [21, Lokosov V.V., Ryumina E.V., Ulyanov V.V.].

The present study develops a typology of the northern regions of Russia according to certain indicators that characterize the labor potential of the region's population and the efficiency of its use.

Analysis of works in the field of labor potential measurement at the regional level has allowed to define theoretical ideas about the structure of labor potential and to formulate a hypothesis about the existence of time-stable types of northern regions with similar trends in qualitative and quantitative characteristics of labor potential of the population.

Methods

A variety of mathematical methods and tools can be used to develop a typology. In the process of typology, the problem of choosing the initial indicators that form the feature space acquires a special role. Relative indicators are used for comparability of objects. Compliance with the condition of the necessity and sufficiency of the number of features in the formation of a feature space is ensured by the selection of indicators that correspond to the task. Moreover, the correlation analysis eliminates one of two indicators that have high level of interrelation between them. The correlation analysis conducted by the author assumed the exclusion of one of the pair of indicators with high correlation values (more than 0.7 modulo).

The sources of information at the stage of collecting indicators corresponding to theoretical ideas about the labor potential of the population of the northern regions were the statistical collections and reference books of Rosstat, as well as the results of the annual survey of the labor force, statistical data from various departments. The selection of indicators was carried out on the basis of the purpose of the study by analyzing the data of statistical reference books and literature on the measurement and differentiation of labor potential. As a result, 22 indicators determining the sign space for four groups of indicators, representing a characteristic of the main components of labor potential, were identified:

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- Demographic component of the labor potential shows the main quantitative characteristics of the labor potential: a) natural population growth, per 1000 people; b) total fertility rate, per 1000 people; c) total fertility rate; d) mortality from external causes, per 1000 people; e) crude mortality rate, per 10000 people; f) coefficient of migration growth, per 10000 people; g) share of the urban population in the total population, %; h) share of the population of working age, %;

- Physical health component includes four indicators: a) life expectancy, years; b) healthy life expectancy, years; c) mortality at working age, per 10000 people; d) morbidity, per 10000 people;

- Educational component: a) number of students enrolled in bachelor's, specialist's, and master's programs, per 10000 people; b) number of students enrolled in mid-level specialists training programs, per 10000 people; c) share of labor force with higher education, %;

- Indicators characterizing the labor market: a) unemployment rate, %; b) GRP per capita, rub.; c) median per capita income, rub.; d) average monthly nominal wages of employees of organizations, rub.; e) average age of employees, years; f) share of economically active population, %; g) share of gross value added of mining in GRP, %.

The following is the reasoning behind the selection of indicators.

The demographic component included 8 indicators, among which the indicators with high value of Pearson's pair correlation stand out. For this reason, the following indicators were excluded from the analysis and the final matrix of the feature space: total fertility rate, summary fertility rate, mortality from external causes, total mortality rate, and the share of the population of working age. In addition, the indicator of migration growth was excluded from the analysis, since it was not possible to identify a stable dynamics of this indicator in the regional context: in different years it varied both positively and negatively. The excluded indicators in the correlated pair made a smaller contribution to the intergroup variance. This became decisive in the choice of indicators included in the analysis. As a result, after the preliminary analysis, two indicators from the demographic component used for further analysis were left — natural population growth and share of the urban population in the total number.

The physical health component included 4 indicators, two of which — life expectancy at birth, mortality at working age — have high correlation values. The indicator of life expectancy at birth was excluded from the analysis due to a strong correlation, as well as healthy life expectancy due to the lack of data for the entire study period.

Three indicators were selected for the educational component, two of which have a high level of correlation: number of students enrolled in bachelor's, specialist's, and master's programs and number of students enrolled in mid-level specialist training programs. The indicator of the number of students enrolled in mid-level specialist training programs was excluded from the analysis.

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At the stage of labor potential distribution and its further development, the labor market and its structure, which determines the demand on labor potential, plays an important role. The key characteristic, reflecting the efficiency of the labor market, is the unemployment rate. In addition, a number of cost indicators — GRP per capita, median average per capita income, average monthly salary — indirectly reflect living standards of the population, region's attractiveness and production structure. Of the 7 indicators, characterizing the labor market, two are involved in further analysis — the unemployment rate and the average monthly nominal wage of employees of organizations.

The choice of mathematical tools is determined on the basis of the problem statement, the scale of measurement and the amount of data. The regions were grouped through the use of multidimensional statistical classification methods, the main of which was the hierarchical clustering method. Cluster hierarchical analysis as a method of multidimensional classification meets all the requirements and tasks.

Within the framework of cluster analysis, the Ward's method [22, Ward J.H.] was used — a method for measuring distances using the square of the Euclidean distance. The stability of the typology was verified by repeating the clustering procedure for data collected over 7 years, from 2014 to 2020.

Results and conclusions

According to the results of the cluster analysis, 22 out of 24 regions showed stable dynamics in the studied time period. The Primorskiy and Zabaikalskiy krais are excluded from the typology, since they belonged to different clusters from year to year. The results of the final typology are given in Table 1.

Table 1

Distribution of regions by types

I type "Educational"	Republic of Buryatia, Republic of Sakha (Yakutia), Tomsk Oblast, Tyumen Oblast without autonomies
II type "Underexamined"	Kamchatka Krai, Magadan Oblast, Murmansk Oblast, Sakhalin Oblast, Khabarovsk Krai
III type "Rapidly aging"	Amur Oblast, Arkhangelsk Oblast without Autonomous Okrug, Irkutsk Oblast, Krasnoyarsk Krai, Perm Krai, Republic of Karelia, Republic of Komi
IV type "Urbanized"	Khanty-Mansi Autonomous Okrug, Yamalo-Nenets Autonomous Okrug
V type "Profitable"	Nenets Autonomous Okrug, Chukotka Autonomous Okrug
VI type "Poor"	Republic of Tyva, Republic of Altai

In characterizing each type of region, it is important to compare data for 2020 with data for previous years, before the COVID-19 pandemic. It is worth noting that in 2020, the main socio-demographic trends inherent to each type of region remained, although the differences became more pronounced, revealing the strengths and weaknesses in the accumulation and use of various components of labor potential. In 2020, compared to 2019, the year before the pandemic, the total mortality and mortality of the population of working age increased in all the studied regions,

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which was reflected in the vital rate of the population; the unemployment rate also increased. In addition, the morbidity rate has decreased, apparently due to the reduction in routine medical examinations of the population.

More detailed description of each type of region is presented below.

I. Regions with a high proportion of students, "educational" - Republic of Buryatia, Republic of Sakha (Yakutia), Tomsk Oblast, Tyumen Oblast without autonomies. Regions of this type are characterized by high rates of the number of university students — in 2020, the average value for the cluster was 327.8 people per 10000 population. The mortality rate of the population of working age in these regions is one of the lowest. One of the negative trends is that while the educational level of the population is high, unemployment is relatively high and the share of unemployed with higher education is the highest among other regions, which suggests that the regions are experiencing an acute problem of "over-education". Among the regions belonging to the first type, a special place is occupied by the Tomsk Oblast, where the number of students is maximum in relation to the total population among the northern regions. Being a "talent foundry", the region provides qualified workforce to nearby regions, including the Arctic ones, where there is a shortage of qualified labor.

II. Regions with insufficient coverage of the population with medical diagnostics, "underexamined" — Kamchatka Krai, Magadan Oblast, Murmansk Oblast, Sakhalin Oblast, Khabarovsk Krai. A feature of this type of regions is the low morbidity rate combined with high mortality rates, which may indicate a problem in the field of public health. However, this fact cannot unambiguously reflect the quality of work of medical organizations in these regions. Russian and foreign scientists in their studies note the regional features of the self-preservation behavior of the population [23, Korolenko A.V.; 24, Petrovic D., de Mestral C., Bochud M.], which can also be considered as a qualitative characteristic of labor potential and affect morbidity and mortality rates. A feature of the territorial location of regions of this type is their border position with access to the northern seas.

III. "Rapidly aging" type includes Amur Oblast, Arkhangelsk Oblast without Autonomous Okrug, Irkutsk Oblast, Krasnoyarsk Krai, Perm Krai, Republic of Karelia, Republic of Komi. In these regions, throughout the entire study period, the total mortality rate remained the highest among all types of regions, and in 2020, it increased by 15 p.p. compared to 2019. In addition, regions belonging to this type have the lowest birth rates. Thus, the regions are rapidly losing population due to natural movement. The age structure of the population imposes its limitations and makes adjustments to the structure of the labor potential and features of its management.

IV. "Urbanized" — Khanty-Mansi Autonomous Okrug, Yamalo-Nenets Autonomous Okrug. The economy of these regions is based on the extraction and processing of oil and gas. Rich deposits provide a high level of income for the population and the availability of medical services. These regions are characterized by the lowest mortality rates combined with high morbidity rates. Due to low mortality rates and a fairly high birth rate in these regions, a large natural population

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growth is observed. In addition, the population of these regions is the most urbanized and the average unemployment rate is at a record low (2.7% in 2020). With a small number of university students, these regions have the highest proportion of employees with higher education. In some years, the natural population growth in these regions was the highest among the studied regions. Despite the high indicators of qualitative and quantitative characteristics of the labor potential, the regions are constantly experiencing its shortage due to the migration movement of the population.

V. *"Profitable"* — *Nenets Autonomous Okrug, Chukotka Autonomous Okrug* — are distinguished by high rates of morbidity, mortality in working age and mortality from external causes. Natural population growth is predominantly positive. In these regions, the share of mining in the structure of GRP is high, the unemployment rate is higher than the average for Russia. The maximum migration outflow of population was observed in these territories during the period under study, with the highest per capita median income and GRP per capita indicators. A high proportion of the workforce with higher education is provided through temporary migration — workers on a rotational basis.

Type VI *"poor"* includes mountainous border regions — *the Republics of Tyva and Altai.* The poverty of these regions determines the whole range of qualitative characteristics of the labor potential of the population living in these territories. Unlike other regions of the Far North and equivalent areas, these regions are located in more southern latitudes, but due to the mountainous terrain, the climate corresponds to the indicators of the northern regions. Industry specialization and natural resource potential of these regions determine the overall well-being of the population. Among the specific features of these regions, it is worth noting the structure of the population — the age-sex pyramid of a progressive type — with a high birth rate, the predominance of children and youth, the rural population; there is a high level of poverty and unemployment. Improving the qualitative characteristics of the labor potential in these regions requires significant financial investments. The combination of factors of poverty, unemployment, unavailability of medical services and other negative processes contributes to the outflow of active youth to other more prosperous regions, where there is an opportunity to develop and realize labor potential.

Table 2

Average cluster indicators in 2020

	I	II	III	IV	V	VI
Morbidity per 1000 people	723.1	694.8	896.3	1 047.6	1 180.6	763.4
Mortality at working age (per 100 000 people of working age)	520.0	643.6	656.6	416.3	718.2	630.0
Number of students enrolled in bachelor's, specialist's, and master's programs per 10000 population;	327.8	148.4	202.0	67.0	14.0	138.5
Share of labor force with higher education	35.0	35.5	29.5	38.7	34.5	33.8

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Natural population growth, per 1000 people	-0.1	-3.5	-5.5	5.8	1.9	6.4
Share of urban population in total population, %	66.3	86.3	76.8	88.3	72.7	41.8
Unemployment rate, %	7.8	5.3	7.0	2.7	6.6	16.0
Median per capita income, rub.	33 322.0	55 106.4	32 904.9	72 359.0	86 859.5	20 329.0

Table 3

Average cluster indicators in 2019

	I	II	III	IV	V	VI
Morbidity per 1000 people	756.7	729.5	961.3	1096.3	1267.7	744.9
Mortality at working age (per 100 000 people of working age)	489.2	608.9	607.6	363.5	689.8	592.9
Number of students enrolled in bachelor's, specialist's, and master's programs per 10000 population;	332.5	176.4	204.3	72.5	13.5	136.0
Share of labor force with higher education	32.3	34.6	27.6	41.9	35.3	29.9
Natural population growth, per 1000 people	1.6	-1.7	-3.2	7.2	3.1	6.9
Share of urban population in total population, %	66.3	86.2	76.7	88.3	72.7	41.8
Unemployment rate, %	6.4	4.6	6.0	2.2	5.9	11.7
Median per capita income, rub.	32651	52555.6	31745.9	68883.0	82213.0	18437.0

According to the results of the study, various types of regions with special characteristics and stable trends in the accumulation, distribution and use of labor potential were identified. This typology will make it possible to take into account the regional characteristics of the labor potential for the development of management decisions at various levels.

Conclusion

Summarizing the results of the cluster analysis, it should be noted that the hypothesis of significant sustainable differences among the northern regions of Russia in the accumulation and use of labor potential has been confirmed. In addition, regions with similar socio-economic and demographic trends that form stable types over time were identified. Most of the studied regions (22 out of 24) have a stable ratio of the considered indicators for 7 years.

Analysis of the situation for the period 2014–2020 showed how inert the processes of formation and use of labor potential are. The most significant role in the formation of labor potential is played by those factors that Paul Krugman called "factors of the first nature" [25, Krugman P.] — geographical location, climate, availability of minerals and natural resources. These are the resources that make it possible to create socially significant facilities, ultimately forming quality labor potential. However, not all regions with such advantages use them to improve living standards and quality of life of the local population, which is particularly evident in times of crisis.

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In the pandemic crisis year of 2020, there was divergence between the different types of regions: the processes previously observed accelerated. This was especially reflected in demographic processes: in regions with unfavorable situation in the field of public health protection — a key indicator of labor potential — during the crisis period, the mortality rate of the population increased significantly compared to other, more prosperous regions. Changes in other indicators of labor potential also depended on regional characteristics and reserves that were in the regions by the beginning of the pandemic. In addition, in 2020, the heads of the regions were forced to make decisions regarding measures to control the spread of the virus, and the "margin of safety" of the regional economy played an important role in making certain decisions.

Economic recovery of the northern regions will depend on the qualitative and quantitative characteristics of the labor potential of the population. It is especially important to learn the lessons of the pandemic and, taking into account the existing socio-demographic trends for each type of region, make decisions to improve individual indicators of labor potential and its use.

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