Analysis of human capital development indicators (case study on the Central Federal District regions)

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Abstract. The paper concerns with the theories and concepts defining the role of a person as a resource, factor, and capital in the modern innovative economy. The authors analyse the indicators of the Sustainable Development Goals, socio-economic development of the Russian Federation necessary for monitoring the achievement of national projects indicators, human development index, and its components in the regions of the Central Federal District in 2018 and 2019. Based on Rosstat data on 2005-2021 for the regions of the Central Federal District, the paper assesses the main indicators of the human capital of the Central Federal District regions: population density, life expectancy, the proportion of people aged 65 and older to the people of the active working age, mortality of the population of the active working age, total fertility rate, infant mortality rate, income and poverty levels of the population, employment rate, the composition of the employed population by age and level of education, for men and women, urban and rural population. The study found that the Central Federal District is ahead of the Russian average in a significant part of the analyzed indicators (except for the average age of the employed population). This refers to the Human Development Index, real monetary income of the population, unemployment rate and a number of other indicators. Within the Central Federal District, Moscow and the Moscow Region are the leaders in terms of the dynamics of human capital development indicator.

Introduction

The transformation of human into a factor of economic growth as a bearer of knowledge, skills, competences, in relation to the increasing role of intellectual resources ("explicit" and "implicit" knowledge), and the importance of a person as an initiator and innovator in the economy has led to the development of various theories related to human capital, a factor of economic growth and socio-economic progress. These are, first of all, the theory of human capital (J. Minser, T. Schultz, G. Becker), the theory of social capital (P. Bourdieu, R. Putnam, J. Jacobs, R. Salisbury, J. Coleman, B. Wellman, S. Wortley). In terms of the resource approach, researchers began to discuss the role of intangible resources, develop the ideas and legislation in the field of intellectual property, and study the national intellectual capital and its components: human, market, technological, and renewable ones (Chub, 2022).

Adam Smith's model of economic man is transformed (in the interpretation of Meckling and K. Brunner is a REMM – Resourceful, Evaluative, Maximizing Man) into a model of an ethical economic man (Berendeeva, 2019), which is complemented by a model of a sociological man (Lindenberg's model is an SRSM – Socialized, Role-playing, Sanctioned Man, which is complemented by an OSAM – Optioned, Sensitive, Acting model).

Nowadays, interdisciplinary studies of human capital are being conducted, for example, the influence

of personality traits on the economic behaviour of individuals (Gimpelson, Zudina & Kapelyushnikov, 2020), the formation of the middle class in Russia (the interface of economics with sociology), etc.

The middle class is considered as a driver of economic growth and ensuring social stability in society. Investments in human capital act as a provider of changes and new standards of consumption (Pishnyak et al., 2020). According to research, in 2018 32% of the population of the Russian Federation could be attributed to the middle class, which is significantly lower than the peak level of 38% at the end of 2015. There is a tendency of reducing the middle class, a change in the "portrait" of the middle class, its economic behaviour (Orlova & Lavrova, 2020).

Russian scientists study various aspects of human capital: the evolution of concepts, the features of human capital of different age categories, for example, pre-retirement age, etc. (Malikova, 2020).

I. Karelin (2022) identifies the following elements of human capital: health capital, competence capital, culture capital, creativity capital, motivation capital, trustworthiness capital, digital competence capital.

By the classification of I. Tomakova, J. Kopteva, and M. Shikyrzh (2022) there are biophysical capital, cultural and educational capital, total labour, and motivational capital, etc.

I. Adova and T. Kaloshina (2022) studies human capital in terms of the sociology of management as a complex and multidimensional category, grouping the factors of human capital into demographic, psychophysiological, competence, socio-cultural, technological, etc. However, many factors influencing the formation of human capital at the meso-level act as indicators of the regional socio-economic development, using both sociological methods and economic assessments.

There is an issue of the capitalization of human resources in modern Russia, determining the reserve of human capital and making long-term forecasts for the development of the country and its territories (Vorontsova et al., 2020).

This research proposes assessment of the human capital of an individual, a commercial enterprise, a region, and a state (Korotovskikh, 2019).

Human capital can be assessed at the macro-, meso-, and micro- levels. There are several approaches to the assessment of human capital: costly, profitable, market ones (Korotovskikh, 2019). At the level of the national and regional economy, the sociological method, the index approach to the assessment of human capital, as well as their combination have recently been developed in domestic publications (Miroshnichenko, 2021), multidimensional statistical methods and correlation analysis (Vorontsova et al., 2020), the index method are used (Podgorskaya & Bakhmatova, 2020).

There are numerous publications on the assessment of the Russian regions human capital. For example, D. Diaghilev and A. Zlokazov (2022) assess the components of the human capital of the Sverdlovsk and Tyumen regions, Perm Krai by 19 indicators, calculate the integral index of the regional human capital based on the assessment of education, healthcare, labour, and socio-cultural capital for each territory.

Indeed, the issues of the role of the human factor in terms of the economic relations transformation are considered by the journal "Theoretical Economics", published by the Yaroslavl State Technical University. For example, E.V. Trifonov dwells on the historical economic laws of human development, finds out their cause-and-effect relationships. According to the system of the historical laws development, he believes in occurring of the harmonious man model after the model of economic man. Also he justifies the consistent appearance of a harmonious, creative, superman, cosmic man, man of higher material and spiritual practices on the arrangement of outer space. The author possesses the high productivity of a harmonious person, higher than the productivity of an economic one, and the development of abilities of each person should become the object of the public primary attention and support; on a large scale it can become "the most powerful factor of development and prosperity of the economy and society" (Trifonov, 2022).

According to O. Brizhak (2021), the intellectual capital or "intellectual power transforms and cognizes modern ecosystems, generates qualitatively new ideas meeting the challenges of the new economic reality and, based on such ideas, creates effective capital combinations." The author actualizes the ides of involving intellectual capital into the national economy development in modern conditions of deep technological transformations, and considers the role of the creative sector and creative industries in it.

S. Shkiotov (2022) examines the amount of regional budget expenditures on the information and communication technologies development, and their effectiveness in 85 subjects of the Russian Federation.

However, highlighting aspects of creative work and creative personality, scientists research the negative aspects of the digitalization impact digitalization on a person. As M. Kovalchuk (2022) notes, "a person harmonious live in two planes of worldview (real and virtual); it causes a transformation of his or her consciousness, personality characteristics and his or her social identity". The dangerous consequences of digitalization of life are noted, when for young people the virtual world replaces the real one, and the network environment affects the personality and morality of young people, and one of the human addictions appears – digital, computer and, as a consequence, "digital degradation". The author considers the creation of the competencies which allow us to use digital information without harm to one's health (first of all, mental one), critically evaluate it, etc. (Kovalchuk, 2022).

L. Batrakova (2021) notes the relevance of the scientific research in the field of human capital formation in the innovative economy. Human capital is currently becoming a determining factor in the creation of new modern technologies, production facilities, the development of high-tech products, implementation of the concept of the digital economy as a whole.

A. Akaev and V. Sadovnichy (2021) believe that "in the digital age, the majority of cognitive work will be retained by the human factor, since these works, as a rule, can be fragmented into non-programmable tasks (50-75%) requiring creative human labour to solve them, and routine programmable tasks which can be performed by intelligent machines (IM)".

The purpose of the study is to correlate indicators of the state and development of human capital in indicators of Sustainable Development Goals, indicators of socio-economic development of the Russian Federation necessary for monitoring the achievement of indicators of national projects. Also we analyse the dynamics of the human development index and its components in the regions of the Central Federal District. Moreover, based on Rosstat data, we analyse the main indicators of the human capital of the Central Federal District regions in terms of the demography, employment, and income of the population.

Methods

The object of the study was the regions of the Central Federal District (CFD). The subject of the study includes the indicators related to the formation and development of human capital in the regions of the Central Federal District.

The study period is 2005-2021; according to the human development index – 2018 and 2019.

Research methods are as follows: system and institutional approaches, comparative analysis of Rosstat data in dynamics and by region.

Results

The target public indicators for maintaining and developing the country's human capital are determined, firstly, by the Sustainable Development Goals until 2030, approved by the UN General Assembly in 2017, and adjusted in 2020-2022, and, secondly, by the indicators of socio-economic development of the Russian Federation necessary for monitoring the achievement of the national projects indicators.

Achieving the Sustainable Development Goals provides for the implementation of 17 goals and 169 tasks to poverty elimination, the planet's resources conservation and general well-being ensuring (Russian Statistical Yearbook, 2022).

Goal 1. End poverty in all its forms everywhere (2 indicators).

Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture (4 indicators).

Goal 3. Ensure healthy lives and promote well-being for all at all ages (17 indicators).

Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all (1 indicator).

Goal 5. Achieve gender equality and empower all women and girls (5 indicators).

Goal 6. Ensure availability and sustainable management of water and sanitation for all (2 indicators).

Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all (2 indicators).

Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all (8 indicators).

Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation (5 indicators).

Goal 10. Reduce inequality within and among countries (2 indicators).

Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable (1 indicator).

Goal 12. Ensure sustainable consumption and production patterns (1 indicator).

Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss (1 indicator).

Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels (2 indicators).

Goal 17. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development (2 indicators).

The following indicators, reflecting the development of human capital and its contribution to improving the efficiency of economic development, in our opinion, are (see Table 1).

Table 1 – Indicators of the Sustainable Development Goals reflecting the characteristics of human capital, 2017-2021

Period	2017	2018	2019	2020	2021
4.4.1. Proportion of youth (adults) with information and communications technology skills, %.					
At the age of 15-24 years	94.1	94.2	92.9	92.2	93.3
At the age of 15-74 years	75.5	77.3	75.5	75.4	77.5
8.3.1. Proportion of informal employment in the non-agricultural sector, %*	16.7	16.9	17.4	16.9	17.4
8.5.2. Unemployment rate, %*	5.2	4.8	4.6	5.8	4.8
8.6.1. Proportion of youth (aged 15 to 24) not studying, working or acquiring vocational skills,%*	10.5	10.2	10.6	10.9	10.2
8.7.1. Proportion of children aged 5 to 17 engaged in child labour, %**		0.4		0.4	
8.8.1. Industrial injuries, including deaths, per 100,000 employees	126.3	118.6	116.9	101.7	108.2
Including deaths	5.64	5.39	5.28	4.52	6.03
9.2.2. Employment in the manufacturing sector, % of total employment	14.2	14.1	14.3	14.2	14.2
9.5.1.Expenditure on R&D, % of GDP	1.11	1.0	1.04	1.1	1.0
9.5.2. Researchers (full-time equivalents) per million population	2, 795,6	2, 764,5	2, 730,3	2, 718,7	2, 674,0

*these indicators are presented by sex (men, women) and the unemployment rate by men, women, disabled persons
**formation of the indicator one time every 2 years based on the results of the Comprehensive Observation of Living Conditions of the Population
Source: Russian Statistical Yearbook, 2022

The indicators of socio-economic development of the Russian Federation necessary for monitoring the indicators of national projects achievement include indicators characterizing demography and health care development, living conditions of people (housing and urban environment), the development of small and

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medium-sized businesses, and support for individual entrepreneurial initiative, science and digital economy (see Table 2).

Table 2 – Indicators of socio-economic development of the Russian Federation necessary for monitoring the achievement of indicators of national projects

Name of the national project	Indicators of the national projects
Demographics	Life expectancy of citizens aged 55 years, years. Mortality rate of population above working age (women over 55, men over 60 years), deaths per 100,000 of the corresponding age people.
Healthcare	Mortality of the working–age population (women aged 16-54 years, men aged 16-59 years), deaths per 100,000 people of the corresponding age.
Housing and urban environment	The volume of housing construction, mln m2 of the total area of residential premises. Housing completion in multi-apartment residential buildings, mln m2 of total floor area of residential premises. The average cost of 1 m2 of model housing in the primary market, thousand RUB.
Science	The share of researchers under the age of 39 in the total number of Russian researchers, %. The ratio of the growth rate of domestic R&D costs of all sources to the growth rate of GDP. Internal R&D costs of all sources (at current prices), bn RUB.
Digital Economy of the Russian Federation	The share of households with broadband access to the Internet information and telecommunications network, %. The cost share of domestic software purchased and (or) leased by federal executive authorities, executive authorities of the subjects of the Russian Federation and other state authorities, %. The cost share of domestic software purchased and (or) leased by state corporations, companies with public operation, %.
Small and medium-sized entrepreneurship and support for individual entrepreneurial initiative	The share of small and medium-sized enterprises in the GDP 9 in current prices), %.

Source: Russian Statistical Yearbook, 2022

Many of the above-mentioned indicators of the Sustainable Development Goals and socio-economic Development of the Russian Federation necessary for monitoring the national projects indicators achievement relate to the living standards indicators.

Nowadays, researches of the living standards indicators are still relevant (Berendeeva & Ledyakina, 2021), and reflect the characteristics of human capital.

For instance, V. Stepanov, V. Bobkov, E. Shamaeva, and E. Odintsova (2022) propose an integral indicator of the living standards (derived on the basis of the socio-economic indicators), which is considered as an important criterion indicator of the effectiveness of regional socio-economic policy. They consider a model linking the indicator of the living standards with a set of indicators of socio-economic policy in the regions of Russia. They also identify a set of indicators related to the implementation of regional socio-economic policy (indices of human potential, innovation, infrastructure, information society, etc.).

Decree of the President of the Russian Federation No. 68 of February 4, 2021 identifies 20 indicators for assessing the effectiveness of the activities of senior officials (prominent public officials) and the activities

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of executive authorities of the subjects of the Russian Federation. However, most of them are indicators characterizing the living standards, the quality of human capital:

– trust in the authorities (which is determined by assessing public opinion regarding the achievement of the national development goals of the Russian Federation in the subjects of the Russian Federation);

– population of the subject of the Russian Federation;

– life expectancy at birth;

– the number of people employed in the small and medium-sized businesses, including individual entrepreneurs and self-employed;

– growth rate (growth index) of real average monthly wages;

– the growth rate (growth index) of the real per capita money incomes;

– poverty level;

– housing quantity;

– number of families improved the housing conditions;

– the proportion of citizens who are systematically engaged in physical training and sports;

– effectiveness of the system of identification, advancement and support of talented children and youth;

– conditions for the training of a socially responsible and balanced personality;

– number of cultural events attended;

– the proportion of citizens engaged in voluntary (volunteer) activities;

– education level;

– quality of the urban environment;

– environmental quality;

– others.

The Human Development Index (HDI) acts as an integral indicator of human capital development in both world and Russian practice. At the end of 2019, the HDI in Russia was 0.824; the country ranked 52nd in the world in terms of the living standards. According to the data of the Analytical Center under the Government of the Russian Federation for 2019, Moscow city occupies a leading position in the HDI rating by regions; at the same time, a high gap remains in our country between the subjects of the Russian Federation with the highest and least level of human development – in 2019 the difference was 19.4% . 1st place among the federal districts in Russia occupies the Ural, 2nd – Central, 3rd – Northwestern, 4th – Volga, 5th – Siberian, 6th – Southern, 7th – Far Eastern, 8th – North Caucasian one.

The regions of the Central Federal District are divided into types: highly developed – financial and economic centers (Moscow city and the Moscow region), developed – based on manufacturing (Lipetsk and Yaroslavl regions) or mining industry (Belgorod region), medium-developed – industrial and agricultural (Vladimir, Ivanovo, Kaluga, Kostroma, Ryazan, Smolensk, Tver, and Tula regions), and agricultural and industrial (Bryansk, Voronezh, Kursk, Oryol, Tambov regions). There are no less developed (according to the classification of the Analytical Center under the Government of the Russian Federation) in the Central Federal District.

Our analysis according to the data for 2019 showed the highest HDI are in Moscow city (0.94), Belgorod region (0.882), Moscow region (0.866), respectively; the lowest ones are in Ivanovo (0.812), Tver (0.833), Bryansk and Kostroma regions (0.83), respectively. The analysis of the HDI components showed the following:

– Moscow city is the leader by all HDI components;

– the income index is the highest one (more than 0.8) in the Belgorod, Voronezh, Kaluga, Kursk, Lipetsk, Moscow, Tula, Yaroslavl regions, and in Moscow city;

– the longevity index is the highest one (more than 0.8) in the Belgorod, Voronezh, Lipetsk, Moscow, Ryazan, Tambov regions, and in Moscow city;

– The education index in the regions is quite high – about 0.94 and higher; the maximum values are in Moscow city (0.997), Oryol region (0.979), more than 0.96 – in Belgorod, Voronezh, Kaluga, Kursk, Ryazan, and Yaroslavl regions (see Table 3).

Table 3 – HDI rating of the regions of the Central Federal District in 2019

	GDP per capita, (in purchasing-power adjusted dollars)	Income index	Life expectancy, years	Longevity Index	Education Index	HDI (2019)	Rank in Russia (2019)	HDI (2018)	Rank in Russia (2018)
The Russian Federation	29,189	0.857	73.3	0.806	0.952	0.870			
Central Federal District	32,727	0.875	74.5	0.826	0.965	0.887	2	0.883	2
Belgorod region	31,759	0.870	74.2	0.820	0.960	0.882	10	0.877	10
Bryansk region	16,178	0.768	72.3	0.789	0.943	0.830	66	0.822	68
Vladimir region	18,192	0.786	71.9	0.781	0.947	0.835	58	0.825	64
Voronezh region	20,793	0.806	73.6	0.811	0.969	0.859	23	0.853	24
Ivanovo region	11,930	0.722	71.8	0.781	0.948	0.812	77	0.805	78
Kaluga region	24,755	0.833	72.4	0.789	0.960	0.858	25	0.851	27
Kostroma region	16,407	0.77	72.4	0.789	0.939	0.830	65	0.826	63
Kursk region	22,966	0.821	72.3	0.788	0.968	0.856	26	0.851	28
Lipetsk region	26,236	0.841	73.3	0.806	0.946	0.862	19	0.861	17
Moscow region	27,585	0.849	73.9	0.814	0.941	0.866	15	0.860	18
Oryol region	18,873	0.792	72.6	0.793	0.979	0.850	35	0.841	43
Ryazan region	18,945	0.792	73.2	0.803	0.960	0.849	39	0.844	37
Smolensk region	17,739	0.782	71.9	0.782	0.949	0.834	59	0.826	62
Tambov region	18,129	0.786	73.6	0.809	0.954	0.846	42	0.842	41
Tver region	18,383	0.788	71.2	0.771	0.951	0.833	60	0.827	60
Tula region	21,704	0.813	72.2	0.787	0.959	0.849	37	0.845	36
Yaroslavl region	22,820	0.820	72.9	0.799	0.964	0.858	24	0.852	26
Moscow	49,043	0.936	78.4	0.889	0.997	0.940	1	0.936	1

Source: Human Development Index in Russia: Regional differences (December 2021)

Researchers assess the quality of human capital in accordance with the following: education, health, and the external environment. Human health and education, including advanced training, obtaining new knowledge, developing new skills and competencies play an important role in the formation of human capital. It is especially important for the formation of human capital in the conditions of digital economy. The researchers use a different number of indicators for assessing human capital. For instance, among them are: 45 statistical indicators (demographic, labour, research, and socio-cultural) (Gurban & Myzin, 2012); 146 indicators of statistical and sociological assessment[1]; integral indicators (Vorontsova et al., 2020); an integral assessment of the level of human capital development by structural elements (Novikova, Oleksiuk & Novikov,

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[1] *Index of human capital development in the Far East // Agency for the Development of Human Capital in the Far East of Russia [Electronic resource]. Available at: https://index.hcfe. ru/about/ (accessed 10.01/2023)*

2020). The use of these methods allows us to identify regions with high, medium, and low efficiency of human capital, and propose measures to reduce this type of regional differentiation (Karelin, 2022).

The average productivity of human capital is calculated as the ratio of the GDP per employee to the indicator of human capital and regional differentiation of the human capital efficiency (Karelin, 2022).

The most popular are: a) the methodology by N. Shepeleva and A. Akulov (2016), which was supplemented by I. Karelin (2022) who introduced the capital component of population digital competencies; b) the methodology proposed by O. Zabelina, T. Kozlova and A. Romanyuk (2013) (see Table 4).

Table 4 – Indicators for assessing the human capital of the territory (according to the Russian researchers)

Name of the national project	Indicators of the national projects
I.N. Karelin (2022)	Elements of human capital: 1) health capital (indicators: life expectancy at birth, years); 2) competence capital (average duration of education of the economically active population, years); 3) capital of culture (the number of theater spectators and the number of museum visits per 1,000 people, people); 4) capital of creativity (the number of personnel engaged in R&D, per 100 thousand people, people.); 5) motivation capital (employment rate, %); 6) reliability capital (the number of registered crimes per 100 thousand people, units); 7) digital competence capital (digital quality index of the population).
I.A. Tomakova, J.Yu. Kopteva, M. Shikyrzh (2022)	Elements of human capital: 1) biophysical capital (birth rate, population structure by working age, share of investments in healthcare, etc.); 2) cultural and educational capital (the total area of residential premises per inhabitant on average, the share of managers and specialists with specialized higher education, provision of preschool educational organizations, the number of students of colleges and universities per 1000 people, the share of investments in education, the number of employees engaged in scientific research, etc.); 3) total labour and motivational capital (the level of average monthly wages, the unemployment rate, investments in fixed assets, the region's need for personnel, the share of the organizations' payroll in total costs, in revenue, etc.).
O. Zabelina, T. Kozlova and A. Romanyuk (2013)	Indicators: – the number of students of higher educational institutions per 10 thousand people; – the number of personnel engaged in scientific research and development, per 10 thousand people employed in the economy; – the share of expenditures of the consolidated budget of the region on education, physical training, health care, social policy to GRP; – investments in education, healthcare, social services, and other social and personal services to the total volume of investments in fixed assets; – the level of population economic activity; – the population unemployment rate; – employment with higher education to population ratio;

Name of the national project	Indicators of the national projects
	– the share of innovative goods (works, services) in the total volume of shipped goods (works, services); – life expectancy at birth; – morbidity rate per 1000 people population; – the number of theater spectators per 1000 people population; – the number of visits to museums per 1000 people population – the number of registered crimes per 100 thousand people population; – percentage of persons (households) with Internet access; – sale of alcoholic beverages in total per capita.
L.A. Novikova, N.V. Oleksiuk, N.A. Novikov (2020)	Indicators (indexes): – index of life expectancy of the population (the ratio of average life expectancy to the maximum achieved); – education index (the ratio of the number of students to the total number of young people from 15 to 30 years old); – income index (the ratio of the number of population groups receiving benefits to the number of population groups receiving average incomes); – health index (the ratio of the amount of health care costs of 10 % of the inactive part of the population to the amount of costs of 10% of the richest).
T.A. Miroshnichenko (2021)	Indicators: employment, salary, children with preschool education; available social area per person; share of the working age population; life expectancy; share of private enterprises in the total number of operating enterprises.

Source: composed by authors

However, researchers assessing the indicators of the formation and development of human capital propose to improve the methodological base: for example, to conduct panel surveys of households, representative annual surveys to study various aspects of the well-being of the population, to use objective and subjective indicators, etc. (Vorontsova et al., 2020).

We consider the main indicators of the Central Federal District regions human capital by units: demography, employment, personal income.

In 2005-2021, with a small increase in the population of the Central Federal District (by 1 mln people), a noticeable increase in the population was observed in Moscow city (by 1.7 mln people, 15.7%) and in the Moscow region (by about 1 mln people, 14.5%).

Recently, there was a depopulation in the Central Federal District as a whole, and in all regions with excluding only the Moscow region (see Table 5).

Table 5 – Population dynamics of the Central Federal District regions

	Population (year-end estimate; thousand people)				Population change (annual growth; as a percentage)	
	2005	2010	2020	2021	2020	2021
Central Federal District	38,109	38,445	39,251	39,104	-0.5	-0.4
Belgorod region	1,512	1,532	1,541	1,532	-0.5	-0.6

	Population (year-end estimate; thousand people)				Population change (annual growth; as a percentage)	
	2005	2010	2020	2021	2020	2021
Bryansk region	1,327	1,275	1,183	1,169	-0.8	-1.2
Vladimir region	1,486	1,441	1,342	1,324	-1.2	-1.4
Voronezh region	2,361	2,335	2,306	2,287	-0.8	-0.8
Ivanovo region	1,102	1,060	987	977	-1.0	-1.0
Kaluga region	1,023	1,009	1,001	1,013	-0.2	1.2
Kostroma region	700	666	628	621	-0.8	-1.2
Kursk region	1,178	1,126	1,097	1,083	-0.7	-1.2
Lipetsk region	1,194	1,172	1,128	1,114	-1.0	-1.3
Moscow region	6,784	7,106	7,708	7,769	0.2	0.8
Oryol region	822	786	725	714	-1.2	-1.5
Ryazan region	1,189	1,152	1,098	1,085	-1.0	-1.2
Smolensk region	1,025	983	921	910	-1.5	-1.2
Tambov region	1,139	1,090	995	981	-1.2	-1.4
Tver region	1,415	1,350	1,246	1,230	-1.2	-1.3
Tula region	1,615	1,550	1,449	1,433	-1.2	-1.2
Yaroslavl region	1,313	1,271	1,241	1,227	-1.0	-1.1
Moscow	10,924	11,541	12,655	12,635	-0.2	-0.2

Source: Regions of Russia. Socio-economic indicators, 2022

The analysis of life expectancy of the population in 2021 in the subjects of the CFD demonstrated significant regional differences by this indicator. In most regions it is 68-69 years. In other subjects it is 70 years and higher: Moscow city (74.55), Belgorod (70.67), and Moscow regions (70.35) (Regions of Russia. Socio-economic indicators, 2022). The indicator of life expectancy is influenced by the population age structure. In the regions of the Central Federal District, the proportion of people over the working age is 26.1% (2021). The difference by this indicator is 6.7%. For instance, in the Moscow region it is 22.7%, in the Tambov region – 29.4%, in Ryazan region it is 28.4%, and Tula region it is 28.8%. In most regions of the Central Federal District this indicator is in the range of 26.2-27.9% (Regions of Russia. Socio-economic indicators, 2022).

According to Rosstat data on 2005-2015, the mortality rate of the working-age population in the regions of the Central Federal District decreased by 1.6 times. In 2015-2021 it increased by 1.2 times which is a negative trend. In 2005-2021, the infant mortality rate in the Central Federal District regions decreased by 2.5 times, and the total fertility rate increased by 1.23 times which is a positive trend.

The analysis of the indicators of population fertility and mortality by subjects of the Central Federal District in 2021 showed the following:

– the total fertility rate in most subjects of the Central Federal District fluctuates in the range of 1.2-1.4 (the maximum value is in Moscow city – 1.597 and in the Moscow region it is 1.460, the minimum value is in the Smolensk region – 1.130), which indicates a narrowed replacement of these regions population (the limit of population replacement is 2.1);

– the greatest differences in the mortality rate of the working-age population (by 1.9 times): from 423.2 – in Moscow city to 807.5 – in the Tver region. By this indicator, the excess of the average value for the Central Federal District (586.9) is in the Bryansk, Vladimir, Ivanovo, Kostroma, Kursk, Lipetsk, Ryazan, Smolensk, Tula, Yaroslavl regions (more than 700). Below the average value for the Central Federal District are those in the Belgorod (556.3), and Moscow (579.4) regions;

– significant differences in the infant mortality rate (2.2 times): the minimum value is in the Bryansk

region (3.0), the maximum is in the Vladimir and Orel regions (6.7) (see Table 6).

Table 6 – Indicators of the population fertility and mortality of the subjects of the Central Federal District in 2021

	Total fertility rate*	Mortality of the working-age population**	Infant mortality rates ***	
			Infant mortality rates	Rank in the Russian Federation 2021
Central Federal District	1.422	586.9	4.0	
Belgorod region	1.267	556.3	4.4	42
Bryansk region	1.280	747.6	3.0	4
Vladimir region	1.277	758.7	6.7	81
Voronezh region	1.287	657.4	4.5	43
Ivanovo region	1.261	706.4	3.2	6
Kaluga region	1.440	698.1	3.5	9
Kostroma region	1.383	720.9	3.8	23
Kursk region	1.341	708.0	3.7	19
Lipetsk region	1.340	735.7	3.7	16
Moscow region	1.460	579.4	3.7	21
Oryol region	1.221	688.0	6.7	80
Ryazan region	1.236	714.6	5.6	71
Smolensk region	1.130	763.2	6.3	78
Tambov region	1.284	666.2	3.4	8
Tver region	1.311	807.5	4.7	48
Tula region	1.224	723.9	5.8	73
Yaroslavl region	1.356	701.9	3.7	15
Moscow	1.597	423.2	3.6	12

*number of children per 1 woman
**the number of deaths per 100,000 people of the appropriate age
***the number of children died under the age of 1 year, per 1,000 live births
Source: Regions of Russia. Socio-economic indicators, 2022

The analysis of population employment by the subjects of the Central Federal District in 2021 revealed the following:

– the employment rate in the regions for 2019-2021 has changed insignificantly: more than 1 % increased only in Ivanovo (+1.6 %), Kaluga (+1.3 %), Yaroslavl (+1.2 %) regions. The highest employment rate is in Moscow city – 67.2% (2019) and 66.2% (2021). The lowest employment rate in 2021 among the regions of the Central Federal District was in the Ryazan region (53.1%), Oryol (53.8%), 60% or more – in Belgorod (61%), Kaluga (62%), Lipetsk (62%), Moscow (62.8%), Tula (60.7%) regions;

– The average age of the employed population in the Central Federal District is 42.7 years which is higher than for Russia as a whole – 41.8 years. The maximum indicator is in Moscow city (43.2 years). Among the other regions of the Central Federal District, fluctuations in this indicator are insignificant: from 41.5 (Smolensk region) to 42.9 (Tambov, Tula regions);

– more than 85% of the employed population in the Central Federal District has higher (40.6%) and secondary specialized education (44.5%). The highest proportion of employees with higher education is in Moscow city (51.8%), the Moscow region (42.5%). In other regions, the share of employed with higher education is in the range of 27-30% – in Bryansk, Vladimir, Ivanovo, Kostroma, Tambov, Tver, Yaroslavl

regions (minimum – 27.2%); in the range of 30-35% – in Belgorod, Voronezh, Kaluga, Kursk, Lipetsk, Oryol, Ryazan, Smolensk, Tula regions (maximum – 35.2%);

– the highest proportion of employed with secondary specialized education is in the Kostroma region (54.3%); in the Kursk, Lipetsk, Ryazan, Tambov, Tver, Yaroslavl regions this indicator is higher than 50%. The lowest values are in Voronezh (38.4%), Moscow Region (41.1%), and Moscow city (41%);

– high employment with secondary general education (more than 20%) in Bryansk, Voronezh (the maximum value is 23.5%), Ivanovo regions; the minimum value is in Moscow city (5.6%);

– employed with basic general education (grades 9 of school) is 1.5% (Moscow city); 5.6% (Ryazan region) (see Table 7);

– the employment rate of the urban population in 2021 is 63.2%. The highest employment rates of the urban population are in Moscow city (66.2%) and the Moscow region (64%). Among other regions of the Central Federal District, the highest employment of the urban population is in Kaluga (63.4%), Belgorod (63.2%), and Lipetsk (62%) regions. The employment of the urban population is minimal, in the range of 55-59% is in the Bryansk, Kostroma, Oryol, Ryazan (the minimum value is 55.5%), Smolensk, Tambov regions, in other regions – in the range of 60-65%;

– The employment rate of the rural population is 54.5% and varies by region from 47.1% (Ryazan region) to 57.6% (Kaluga region). Among other regions of the Central Federal District, the highest employment of rural population is in the Moscow region (57.5%), medium (56-57%) is in Belgorod, Vladimir, Ivanovo, Lipetsk, Smolensk, Tula regions; low (about 50%) is in Voronezh, Kostroma, Oryol regions;

– the unemployment rate (according to sample surveys of the population) in the regions of the Central Federal District is 3.5%, which is lower than the average for Russia – 4.8%; the minimum unemployment is in Moscow city (2.6%), in other regions of the Central Federal District it ranges from 3.4% (Bryansk, Moscow regions) to 5.9% (Yaroslavl region). The unemployed are 79.2% urban and 20.8 % rural, 48.9% male and 51.1% female. The highest unemployment is in the age group of 30-39 years, followed by the age of 20-29, and 50-59. The total number of the unemployed is dominated by persons with secondary specialized (41.6%), and higher education (28.5%). The registered unemployment rate (0.6%) is almost 6 times lower than the general one (3.5%) (Regions of Russia. Socio-economic indicators, 2022).

The characteristics of employment of the region's population are primarily influenced by the sectoral structure of the economy:

– a high proportion of people employed in manufacturing industries (over 20% of the total number of people employed) – in Vladimir (the maximum value is 24.3%), Ivanovo (21.3%), Kaluga (23.3%), Kostroma (21.3%), Tula (22.3%), Yaroslavl (20.6%) regions. The minimum values are in Moscow city (9%), Kursk (13.4%), and Voronezh (13.7%) regions;

– a high proportion of people employed in agriculture, forestry, hunting, fishing and fish farming in the Tambov region (21.1% of the total number of employed), 10-12.5% – in the Belgorod, Voronezh, Kursk, Lipetsk regions, less than 5% – in the Vladimir, Ivanovo, Kaluga, Moscow, Smolensk regions;

– a high proportion in the employment of wholesale and retail trade; repair of motor vehicles and motorcycles (over 20% of the total number of employed) is in the Voronezh, Ivanovo, Moscow regions and Moscow city (Regions of Russia. Socio-economic indicators, 2022).

Employment of the population is closely related to migration of the population (primarily intraregional and interregional) Our study showed that residents of Moscow, Moscow, Vladimir, Kaluga, Tver, Tula regions are much more actively involved in interregional migration than in intraregional ones. The regions located around the Moscow agglomeration compete for attracting investments, skilled labour, and talented youth; there is a migration outflow of the most qualified personnel to the Moscow agglomeration. At the same time, there is a reverse trend associated with an increase in the pace of withdrawal of production and office functions from Moscow to neighbouring regions, with the arrival of investors, with the strengthening of interregional ties for the supply of food and light industry products, with the migration of Muscovites and residents of the Moscow region to country houses, cottages, etc. (Berendeeva & Berendeeva, 2022).

Table 7 – Composition of the employed population by level of education

| | Employed - total | Including have an education | | | | | | |
| | | higher | secondary specialized – total | from it | | average general | basic general | do not have a basic general |
				on the programs of training middle-ranking specialists	on the training programs for qualified workers and employees 1)			
Central Federal District	100	40.6	44.5	27.5	17.0	12.2	2.5	0.1
Belgorod region	100	33.7	49.8	24.6	25.2	14.7	1.6	0.2
Bryansk region	100	28.7	49.2	28.0	21.2	20.0	2.0	0.1
Vladimir region	100	28.6	48.1	24.8	23.3	19.4	3.8	0.2
Voronezh region	100	35.2	38.4	26.9	11.5	23.5	2.9	0.1
Ivanovo region	100	28.0	46.8	22.7	24.1	21.0	4.0	0.2
Kaluga region	100	30.6	47.3	27.7	19.6	19.3	2.7	0.1
Kostroma region	100	27.6	54.3	36.5	17.8	12.1	5.5	0.4
Kursk region	100	34.7	52.0	26.4	25.6	10.4	2.8	0.2
Lipetsk region	100	30.3	52.8	31.6	21.1	14.9	1.8	0.2
Moscow region	100	42.5	41.1	27.5	13.6	14.3	2.0	0.0
Oryol region	100	34.8	46.4	23.2	23.2	14.8	4.0	…
Ryazan region	100	34.0	50.4	30.0	20.5	9.5	5.6	0.5
Smolensk region	100	30.7	49.4	29.3	20.1	14.1	5.4	0.3
Tambov region	100	29.1	53.0	31.7	21.3	13.8	3.5	0.6
Tver region	100	27.2	53.7	30.1	23.6	13.7	5.1	0.3

| | Employed - total | Including have an education | | | | | | |
| | | | | from it | | | | |
		higher	secondary specialized – total	on the programs of training middle-ranking specialists	on the training programs for qualified workers and employees 1)	average general	basic general	do not have a basic general
Tula region	100	32.9	48.1	29.8	18.3	16.3	2.6	0.2
Yaroslavl region	100	29.8	51.5	22.8	28.7	13.8	4.6	0.2
Moscow	100	51.8	41.0	27.5	13.5	5.6	1.5	0.1

1) Including initial professional education
Source: Regions of Russia. Socio-economic indicators, 2022

The factors correlating with the coefficient of migration growth in the studied regions are as follows: the proportion of the population of working age, the unemployment rate according to sample surveys of the population, the average monthly nominal accrued wages of employees of organizations, consolidated budget expenditures per capita, gross regional product per capita, production index (by manufacturing industries), etc. (Kareev & Berendeeva, 2022).

The analysis of income indicators of the population by subjects of the Central Federal District in 2019-2021 showed the following:

– the situation with real monetary incomes in the Central Federal District regions is better than in Russia as a whole. But in the last 3 years, real incomes of the population have been declining, especially in 2020, when there was an epidemic of Covid-19. In 2019 the decline in real incomes of the population was typical for 6 regions (Ivanovo, Orel, Ryazan, Tambov, Tula, Yaroslavl regions), in 2020 – for all regions (except Moscow), in 2021 – only for the Lipetsk and Tambov regions. The largest increase in the indicator in 2021. It was observed in Moscow city (107.6%) and the Moscow region (106.4%) (see Table 8);

– the real accrued wages of employees of organizations in 2019-2021 in all regions of the Central Federal District grew: in general, in the Central Federal District – 106,2% (2019), 104,2% (2020), 105,6% (2021). Moscow city always has the maximum indices for the growth of real incomes and wages in the Central Federal District. In 2021, the growth of real wages in Moscow city amounted to 106.8%, while in the regions of the Central Federal District the indicator was 102% or less in 3 regions (Lipetsk, Tula, Yaroslavl), more than 102 to 103.8% – in 7 regions (Voronezh, Ivanovo, Kaluga, Moscow, Ryazan, Smolensk, Tambov), 104% and higher – in 7 regions (Belgorod, Bryansk, Vladimir, Kostroma, Kursk, Orel, Tver) and Moscow city;

– the ratio of the average monthly accrued wages of employees of organizations with the subsistence minimum (as a percentage) in 2021 in Russia as a whole was 236%. The maximum values in the Central Federal District in 2021 were in Moscow city (547.7%) and the Moscow region (427.3%), the minimum (less than 300%) – in the Ivanovo (277%), Kostroma (293.3%) and Bryansk (294.4%) regions;

– the share of the population with monetary incomes below the subsistence minimum/poverty line in Russia in these years decreased from 12.3% (2019) to 11.0% (2021). In 2021, the minimum values of the indicator were in Moscow city (5.5%) and the Moscow region (6%), the maximum – in the regions: Smolensk (14.3%), Bryansk (13.0%), Ivanovo (12.9%). Relatively low values of the indicator were in: Belgorod (7.0%), Voronezh (7.9%), Kaluga (8.9%), Kursk (9.1%), Lipetsk (8.1%), Tula (9.7%), Yaroslavl (8.9%) regions (Regions of Russia. Socio-economic indicators, 2022).

Table 8 – Dynamics of income and the level of poverty of the subjects of the Central Federal District in 2019-2021

	Real monetary incomes of the population (as a percentage of the previous year)			The number of people with monetary incomes below the subsistence minimum/ poverty line (as a percentage of the total population of the subject)			The ratio of the average monthly accrued wages of employees of organizations with the value of the subsistence minimum, percent
	2019	2020	2021	2019	2020	2021	2021
The Russian Federation	101.9	98.6	103.8	12.3	12.1	11.0	236
Central Federal District	103.0	98.7	105.2				
Belgorod region	100.7	98.1	100.7	7.8	7.2	7.0	392.8
Bryansk region	100.4	96.2	102.1	13.8	13.6	13.0	294.4
Vladimir region	102.0	98.0	101.1	12.6	12.5	11.8	327.3
Voronezh region	101.1	95.5	100.2	8.9	8.5	7.9	386.8
Ivanovo region	99.5	97.2	100.1	14.2	13.7	12.9	277.0
Kaluga region	102.7	99.5	100.5	10.2	9.7	8.9	391.1
Kostroma region	101.0	97.2	102.2	12.6	12.5	11.8	293.3
Kursk region	100.9	97.8	101.0	9.9	9.9	9.1	359.6
Lipetsk region	102.6	95.7	98.9	8.6	8.4	8.1	374.1
Moscow region	102.7	97.7	106.4	7.3	6.8	6.0	427.3
Oryol region	99.6	98.6	101.6	13.6	12.9	12.1	311.4
Ryazan region	99.9	97.2	102.6	12.7	12.8	12.4	349.0
Smolensk region	100.4	98.3	100.5	16.3	15.6	14.3	303.4
Tambov region	98.1	94.3	99.1	10.7	10.8	10.5	313.0
Tver region	103.2	97.4	101.6	11.7	11.4	10.8	331.7
Tula region	99.9	98.2	100.6	10.3	10.1	9.7	375.2
Yaroslavl region	99.5	98.3	103.9	10.3	9.9	8.9	350.7
Moscow	104.6	100.2	107.6	6.4	6.0	5.5	547.7

Source: Regions of Russia. Socio-economic indicators, 2022

Further analysis of the human capital characteristics by the subjects of the Russian Federation implies a comparison of indicators on financing education, healthcare, other social sectors, indicators of the development of science and innovation, etc.

Conclusions

Our analysis showed that according to the data for 2019, the highest human development index (HDI) is in Moscow and Belgorod regions and in Moscow city; the lowest one is in the Ivanovo, Tver, Bryansk, and Kostroma regions. The analysis of the components of HDI showed the following:

– Moscow city is the leader by all HDI components;

– the income index is the highest (more than 0.8) in the Belgorod, Voronezh, Kaluga, Kursk, Lipetsk, Moscow, Tula, Yaroslavl regions and in Moscow city;

– the longevity index is the highest (more than 0.8) in the Belgorod, Voronezh, Lipetsk, Moscow, Ryazan, Tambov regions, and in Moscow city;

– the education index in the regions is quite high – about 0.94 and higher; the maximum values are in Moscow city, Oryol; more than 0.96 – in Belgorod, Voronezh, Kaluga, Kursk, Ryazan and Yaroslavl regions.

The total fertility rate for 2005-2021 increased in the regions of the Central Federal District by 1.23 times, while in most subjects of the Central Federal District it fluctuates in the range of 1.2-1.4 (the maximum values are in Moscow city and the Moscow region, the minimum value is in the Smolensk region), which generally indicates a narrowed reproduction of these regions population.

In 2005-2015, the mortality rate of the working-age population in the regions of the Central Federal District decreased by 1.6 times (a positive trend), and in 2015-2021 it increased by 1.2 times (a negative trend). According to the mortality rate of the working–age population, the differences by region are 1.9 times: the minimum value is in Moscow city, the maximum is in the Tver region.

In 2005-2021, the infant mortality rate in the Central Federal District regions decreased by 2.5 times. There are significant differences (2.2 times) in this indicator: the minimum value is in the Bryansk region, the maximum value is in the Vladimir and Orel regions.

The situation with real monetary incomes in the Central Federal District regions is better than in Russia as a whole. In 2019 the decline in real incomes of the population was typical for 6 regions (Ivanovo, Orel, Ryazan, Tambov, Tula, Yaroslavl regions), in 2020 – for all regions (except Moscow city), in 2021 – only for the Lipetsk and Tambov regions. The largest increase by the indicator was in 2021 in Moscow city and the Moscow region. Moscow always has the maximum indices for the growth of real incomes and wages, the minimum indicator of poverty of the population in the Central Federal District.

The real accrued wages of employees of organizations in 2019-2021 in all regions of the Central Federal District decrease: according to the ratio of the average monthly accrued wages of employees with the subsistence minimum in 2021, the maximum values in the Central Federal District in 2021 were in Moscow city and the Moscow region, the minimum (less than 300%) – in the Ivanovo, Kostroma, and Bryansk regions.

The proportion of the population with monetary incomes below the subsistence minimum/poverty line in Russia has been declining in these years. In 2021, the minimum values of the indicator were in Moscow city and the Moscow region, the maximum – in the Smolensk, Bryansk, Ivanovo regions. Relatively low values of the indicator were in Belgorod, Voronezh, Kaluga, Kursk, Lipetsk, Tula, Yaroslavl regions.

The employment rate in the regions in 2019-2021 has changed insignificantly: more than 1% has increased only in the Ivanovo, Kaluga, and Yaroslavl regions. The highest employment rate is in Moscow city, the lowest employment rate in 2021 among the regions of the Central Federal District is in the Ryazan and Orel regions. The average age of the employed population in the Central Federal District is 42.7 years on average, which is higher than the average for Russia as a whole.

More than 85% of the employed in the Central Federal District has higher and secondary specialized education. The highest proportion of employees with higher education is in Moscow city (51.8%), and the Moscow region (42.5%). In seven regions, the proportion of employees with higher education is in the range of 27-30%, in nine regions – in the range of 30-35%. In seven regions, a high proportion of employees with secondary specialized education – 50-54%.

The employment rate of the urban population exceeds the employment rate of the rural population by 8.7%. High employment of the urban population (more than 62%) is in Moscow city, Moscow, Kaluga, Belgorod, and Lipetsk regions. The minimum employment of the urban population in the range of 55-59%

is in the Bryansk, Kostroma, Oryol, Ryazan, Smolensk, Tambov regions. The highest employment of rural population (56-58%) is in Kaluga, Moscow, Belgorod, Vladimir, Ivanovo, Lipetsk, Smolensk, Tula regions; low (about 50%) – in Voronezh, Kostroma, Oryol regions; the lowest employment (50% and below) – in Voronezh, Kostroma, Oryol, Ryazan regions.

The unemployment rate in the Central Federal District regions is lower than the average for Russia; the minimum unemployment is in Moscow city (2.6%), in other regions of the Central Federal District it ranges from 3.4% to 5.9%. The unemployed are 79.2% urban and 20.8% rural, 48.9% male and 51.1% female. The highest unemployment is in the group of 30-39 years, followed by the age of 20-29, and 50-59. The total number of the unemployed is dominated by persons with secondary specialized (41.6%) and higher education (28.5%). The registered unemployment rate (0.6%) is almost 6 times lower than the general one (according to sample surveys of the population).

The characteristics of regional employment are primarily influenced by the sectoral structure of the economy, as well as by population migration. In many regions interregional migration prevails over intraregional one.

CONFLICT OF INTEREST
The authors declare no conflict of interest.

AUTHORS' CONTRIBUTION
Alla B. Berendeeva – conceptualization, project administration, writing – original draft.
Dmitry V. Kareev – data curation, formal analysis, validation, writing – review & editing.

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