Analysis of the human capital contribution indicators to the regional economy efficiency (on the example of the Central Federal District regions)

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Abstract. The paper considers the contribution to the development of human capital through the indicators of the Sustainable Development Goals, indicators of the national projects being implemented in Russia, macroeconomic indicators of economic efficiency of Rosstat. The contribution of human capital to the economy, based on the Sustainable Development Goals, can be considered through indicators of labor productivity, physical and value volume of gross domestic product per capita, the share of the added value of the "Manufacturing" industry in the gross domestic product of Russia, the share of high-tech and knowledge-intensive industries in the gross domestic product. The purpose of the article is to reflect the contribution to the development of human capital in the indicators of the implemented national projects, in macroeconomic indicators of economic efficiency used by Rosstat, in the indicators of the Sustainable Development Goals. To analyze the factors of labor productivity at the mesolevel, the indicators of human capital contribution to the efficiency of economic development of regions. The article characterizes the National Project "Labor productivity and employment support" in the Ivanovo region. The results of regional studies of labor productivity are summarized. On the example of the regions of the Central Federal District the dynamics of gross regional product per capita, the index of the physical volume of gross regional product, the level of labor productivity, the number of issued patents, developed and issued advanced production technologies, the volume of innovative goods, works and services are analyzed.

Keywords: human capital, innovation economy, creativity of regions, digitalization of regions, education, science, scientific potential of the region, national projects, sustainable development goals, labor productivity, gross regional product, science, innovation, patents, inventions, regions of the Central Federal District, Ivanovo region.

JEL codes: J11, J12, J13, R23

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Introduction

In the second half of the 20th – early 21th centuries new theories and concepts of "industrial society" (J. Galbraith), post-industrial society or the theory of three stages (D. Bell, E. Toffler), information society (E. Toffler), knowledge economy as the highest stage of development of post-industrial and innovation economy, nooeconomics (S. Bodrunov, A. Tebekin), etc. became widespread. It was due to the large-scale transformations in the economy associated with scientific and technological progress. There are a lot of studies concerning with circular economy, service economy, shoring economy, innovation economy, creative economy, creative class and precariat one (Berendeeva, 2019).

The domestic publications describe the concept of quality economy as a comprehensive system of methods and tools to ensure the achievement of real economic results, improvement of quality indicators in all spheres of activity and life of people (development of quality assessment methods: life, habitat, products, processes, enterprise; creation of a multilevel quality management system; creation of a multilevel training

system for economics and quality management, etc.) (Okrepilov, 2022)

Nowadays, the concepts of human development are extremely relevant: the theory of human capital is an example. There is a development of Adam Smith's model of the economic man. On its basis appeared the model of the ethical economic man, the sociological man (Berendeeva, 2019), the model of the harmonious man (Trifonov, 2022); questions of human capital formation in the innovation economy (Batrakova, 2021).

Recently, P. Romer's theory of endogenous economic growth gained worldwide recognition. According to this theory, the long-term rate of economic growth depends on political measures. According to P. Romer's theory (1994), subsidies play the important role for research and development, for education, etc. These lead to the economic growth through the implementation of innovations. Along with technological progress, important factors of economic growth in the long term are:

- quality of human capital, which depends on investments in human development (education, health care, etc.);
- creation of the necessary conditions and prerequisites for the protection of intellectual property rights under conditions of imperfect competition;
- state supporting the development of science and technology;
- role of the government in creating a favorable investment climate and borrowing new technologies.

As A. Pilyasov and O. Kolesnikova (2008) note, "significant reserves for awakening the creative activity and innovativeness of the local community are in the regional and municipal tools to support small and medium-sized businesses, form intellectual territories, improve human capital, promote cultural and spiritual diversity and stimulate the creative activity of the local community". Therefore, it is important to have effective institutions and a strong regional authority.

The issue of quantitative and qualitative assessments of the changes taking place is also relevant. Non-financial assets, intellectual property (marketing assets, trademarks, brands, logos, etc.) began to be evaluated when calculating national wealth.

We calculate the creativity index of the regions. In many studies it is based on the methodology of R. Florida. He considers the summary index of creativity calculated on the basis of three indices: talent, technology and tolerance . A. Pilyasov and O. Kolesnikova modernize the method of R. Florida's methodology in regard to the specifics of our country. The authors demonstrated the top seven regions by the Talent summary index which have good universities and academic schools. They identified 12 leading regions; for example, the leadership of the Nizhny Novgorod and Ulyanovsk regions is associated with a high level of budget spending on science (respectively – 4.91% and 3.11% of GRP) – this is more than in Moscow (2.47% of GRP, the average indicator for Russia is 1.35%). The leadership of Perm Krai and Tomsk region is associated with a large number of issued patents per 1 million residents, the leadership of Rostov, Penza and Vladimir regions – with significant investment in science than the national average (Pilyasov & Kolesnikova, 2008).

The study by I. Groshev and A. Krasnoslobodtsev (2020) provides a regional analysis of the creative space index, which includes three components ("talent", "tolerance", "technology"), and the index of regional digitalization, which contains three indices (digital literacy, ICT development and digital life). The authors proved a strong correlation between the level of creativity in Russian regions and the level of regional digitalization.

The study by V. Novikov (2020) analyzes the conditions and results of innovation activity in the regions of Russia on the example of Moscow, St. Petersburg, the Republic of Tatarstan, Ivanovo, Nizhny Novgorod and Tomsk regions. B. Korobova and Y. Zhigalova (2017) estimate the innovation potential of the Ivanovo region.

The study by N. Shatalova (2022) shows a direct correlation between the level of competitiveness of the Russian economy and 4 indicators characterizing innovation activity in Russia (the level of innovation activity of organizations, the share of organizations that provide technological innovation, the share of innovative goods, works and services in the total volume of shipped goods, the volume of innovative goods, works and services in the entities of the Russian Federation).

The National Research University Higher School of Economics calculates the rating of innovative

development of the entities of the Russian Federation, and provides the indicators of digitization maturity of the regions (Irodova & Sokolov, 2022). Since 2021, the Methodology for Evaluating the Efficiency of Activities of Senior Officials (Heads of Senior Executive Authorities) of Constituent Entities of the Russian Federation and Activities of Executive Authorities of Constituent Entities of the Russian Federation includes the indicator of "digital maturity" of public authorities of constituent entities of the Russian Federation, local authorities and organizations specialized in healthcare, education, municipal services and construction, public transport, which implies use of domestic information and communication technologies in their activities.

Assessments of the efficiency and productivity of economic transformation can often include economic and social indicators. The results of social reforms are usually considered through indicators of the standard of living and quality of life, the welfare of the population. This paper emphasizes the economic goals of the reforms and their implementation.

The increasing importance of the human factor, combined with the development of machinery and technology, has allowed mankind to raise productivity to a new level. Modern research considers the development of human capital as an important factor in increasing labor productivity. Labor productivity in Russia is about 2 times lower than in developed countries (Vertakova, Maltseva & Shulgina, 2019). Gross domestic product (GDP) per employee (at the current exchange rate and to purchasing power parity) and the annual growth rate of labor productivity can be calculated by country. The research on the non-primary industries of the Russian economy has shown that there are significant differences in the level of labor productivity not only between industries, but also between companies of the same industry, with increasing stratification of companies by the level of labor productivity (Simachev, Kuzyk & Fedyunina, 2020).

Russia is implementing the national project "Labor Productivity and Employment Support," which includes the following indicators as targets:

1. Growth of labor productivity at medium and large enterprises of the basic non-primary industries.

2. The number of entities of the Russian Federation involved into the implementation of the national project.

3. The number of medium and large enterprises of primary non-primary industries involved into the implementation of the national project:

3.1 The share of enterprises out of the total number of enterprises involved in the national project, where the increase in labor productivity corresponds to the targets;

3.2. The number of medium and large enterprises of basic non-resource industries that used the measures of support under the national project.

At the beginning of 2023 there were established The Federal Center of Competence and Regional Centers of Competence (RCC) in 60 regions. Their purpose is to help to the companies to implement lean production, improve management, logistics and product sales. There is also a project "Productivity Leaders" to improve the skills of top management of companies. According to the Ministry of Economic Development of Russia, in 2019-2021 more than 2,300 enterprises participating in the National Project have increased labor productivity by 24% – 5% higher than those that were not involved in the National Project. At the same time there was an increase in value added by 383 billion rubles, the output – by 46%, achieved a reduction in production time by 35%, stocks of work in progress – by 36%, Now in the national project is already involved more than 4000 enterprises .

The purpose of the study was to measure the contribution into the development of human capital through the indicators of the national projects being implemented, the macroeconomic indicators of economic efficiency used by Rosstat, and the indicators of the Sustainable Development Goals. Also we can analyze the factors of labor productivity at the mesolevel, indicators of the contribution of human capital in increasing the efficiency of regional economic development.

Metodology

The objects of the study are the regions of the Central Federal District (CFD). The subject of the study is the national project "Labor productivity and employment support", the statistical base of Rosstat, related to

the contribution of human capital in the economy of Russia and the regions of the Russian Federation.

Results

An important issue is to study the impact of the quality of human capital on the labor productivity.

The studying of the labor productivity factors shows that they can be conditionally divided into two groups: "traditional" and "new" ones. "Traditional" factors are the presence of obsolete, worn-out production facilities and infrastructure, backward technologies, including information technology, the shortage of qualified personnel, etc. "New" factors emerged as a result of reforms conducted in Russia since the 1990s. According to Z. Mkrtichan (2020), "additional factors and causes influencing labor productivity in the economy have emerged in the new Russia, aggravating the influence of 'traditional' factors: corruption, non-transparent and excessive regulation of business and production processes by the state, obsolete labor legislation, etc." There are macro- and meso-economic, external and internal, corporate and personal factors. But the intraproductive factors of labor productivity growth (at microlevel) are formidable, because the production activity is carried at microlevel.

We analyzed regional studies of regional indicators and the factors of labor productivity.

E.Yu. Merkulova (2019) classifies the Russian regions according to the level of labor productivity for 2017 (thousand rubles per employee per year), with the following levels identified:

– 343-652 (low level) – 38 entities of the Russian Federation are placed here, including the Central Federal District regions: Bryansk, Vladimir, Ivanovo, Kostroma, Orel, Ryazan, Smolensk, Tambov, and Tver;

– 652-1137 (medium level) – 8 entities of the Russian Federation, including regions of the Central Federal District: Belgorod, Voronezh, Kaluga, Kursk, Lipetsk, Moscow, Tula, and Yaroslavl;

– 1710-2155 – 4 subjects of the Russian Federation, including Moscow as an entity of the Central Federal District;

– 2712-3189 – 2 subjects of the Russian Federation, not in the Central Federal District.

G. Galieva (2019), on the example of the Republic of Bashkortostan, identified the following negative causes inhibiting the growth of labor productivity: the growth of migration of working-age people, as a rule, workers with high qualifications; employers' use of low-paid migrants' labor to reduce business costs; aging of labor resources in many regional labor markets as a result of arrival of working-age population on a smaller scale compared to their departure.

On the example of Krasnoyarsk Krai, S. Samusenko and T. Zimnyakova (2021) showed the predominant contribution to regional productivity growth of export-oriented and mining sectors, the physical rather than human capital. The example of the Kaluga region reveals the influence of the demographic structure and employment of the municipalities on labor productivity. Thus, due to the concentration of population and economic activity in certain municipalities of the region there are imbalances in spatial development. In this regard, there is an issue of applying an active policy of spatial development of the region (Tyutin, 2020).

The study of O. Nagaeva and G. Popadko (2019) showed that a significant influence on the regional level of labor productivity has a sectoral structure of the economy; resource regions are characterized by a higher level of labor productivity than non-resource ones. The authors revealed that within the group of resource regions there is a high differentiation of labor productivity values; the absolute leaders by this indicator are mono-industrial regions, with the dominant oil and gas complex in the economy, and lagging regions with the priority development of the construction and agricultural sectors.

By the 2019 study, 83 entities of the Russian Federation utilizing the modeling method showed that computing of enterprises, an increase in the number of computers connected to Internet networks, and wage levels are the most significant factors influencing the labor productivity (Lubnin & Yuferova, 2022).

The study of existing performance management practices and policies allowed us to divide them into two groups: 1) use of reserves, optimization of existing business processes, production, logistics, etc.; 2) additional investments in the implementation of modern technologies. The latter will be effective only if all the processes in the enterprise are already fixed, and the organizational culture corresponds to the goals and objectives of the company (Vertakova, Maltseva & Shulgina, 2019).

Rosstat highlights the following macroeconomic performance indicators of the economy:

- Index of labor productivity
- Share of high-tech and knowledge-intensive industries in GDP, and in GRP
- Share of investment in fixed capital in GDP, and in GRP
- Indices of changes in capital-labor ratio and yield of capital investment
- Coefficient of fixed assets renewal (in comparable prices)
- End-year degree of depreciation of fixed assets
- High-performance jobs growth
- Number of high-performance jobs growth by type of economic activity by Russian regions
- Level of innovation activity of organizations
- Share of domestic spending on research and development in GDP and GRP
- The coefficient of the inventor activity (the number of domestic patent applications for inventions submitted in Russia, per 10 thousand people of the population) .

In the statistical collection "Russian Statistics"– 2022 in section 5 "Labor" the indicator "the rate of growth (decline) of labor productivity by types of economic activity" is highlighted.

In 2019-2021, the highest rates of growth in labor productivity were observed in the following activities: "Water supply, water removal, organization of waste collection and disposal, and activities to eliminate pollution" (106.6%), "Information and communication" (103.3%), "Wholesale and retail trade, repair of motor vehicles and motorcycles" (103.2%), "Processing industries" (102.8%). The rates of decrease in labor productivity were noted for such kinds of activity as "Transportation and storage" (98.2%), "Real estate activities" (98.6%), "Mining" (99.1%), "Construction" (99.2%) (see Table 1).

Table 1 – Rate of growth (decline) of labor productivity for some types of economic activity in the Russian Federation

Period	2019	2020	2021	Average growth rate for 2019-2021*
Total	**102.4**	**99.6**	**102.8**	**101.6**
Mining	101.3	95.4	100.7	99.1
Processing industries	103.2	104.4	100.7	102.8
Electricity, gas and steam supply, air conditioning	100.1	100.2	105.4	101.9
Water supply, wastewater treatment, organization of waste collection and recycling, activities for the elimination of pollution	106.0	104.6	109.2	106.6
Agriculture, forestry, hunting, fishing and fish farming	106.7	99.9	100.3	102.3
Construction	96.8	101.0	99.8	99.2
Wholesale and retail trade, repair of motor vehicles and motorcycles	101.7	102.3	105.7	103.2
Transport and storage	101.1	90.7	102.7	98.2
Information and communication	105.8	101.4	102.6	103.3
Real estate activities	102.4	96.0	97.5	98.6

**estimate index*
Source: Russian Statistical Annual, 2022

Russia implements the 2030 Sustainable Development Goals (17 goals and 169 objectives). The indices were approved by the UN General Assembly in July 2017 and were updated in 2020-2022. In our opinion, the most significant indices reflecting the contribution of human capital in improving the efficiency of economic

development are the physical volume of GDP per capita, labor productivity, the share of the added value of the "Manufacturing" industry in GDP of Russia, the share of high-tech and knowledge-intensive industries in GDP. For 2017-2021, indices of the physical volume of GDP production per capita and labor productivity in the Russian Federation exceeded 100%. The exception was 2020 – the year of the Covid-19 pandemic. The share of the added value of the "Manufacturing" industry in GDP of the Russian Federation during these years was growing and in 2020 reached 15%. The share of high-tech and knowledge-intensive industries in GDP has grown from 21.8% (2017) to 23.0% (2021) (see Table 2).

Table 2 – Indices of the Sustainable Development Goals, representing the contribution of human capital to the improvement of the economy's efficiency

Period	2017	2018	2019	2020	2021
8.1.1. Index of the physical volume of GDP production per capita, %	101.7	102.8	102.2	97.5	105.2
8.2.1. Index of labor productivity,%	102.1	103.1	102.4	99.6	102.8
9.2.1. Share of the added value of the " Processing industry" in GDP of the Russian Federation, %*	13.7	14.4	14.5	15.0	
per capita, RUB	77 011	90 682	96 858	98 424	
9.b.1. The share of high-tech and knowledge-intensive industries in GDP, %	21.8	21.3	22.2	24.5	23.0
Agriculture, forestry, hunting, fishing and fish farming	106.7	99.9	100.3	102.3	
Construction	96.8	101.0	99.8	99.2	
Wholesale and retail trade, repair of motor vehicles and motorcycles	101.7	102.3	105.7	103.2	

**data presented only up to 2020.*
Source: Russian Statistical Annual, 2022

According to A. Akayev and V. Sadovnichy (2021), since technological progress depends on the level of knowledge, in the information-digital era it should be determined by the dynamics of technological information production in the economy; "the main driving force of the digital economy is the symbiosis "human+intellectual machines", which is effectively operated under human guidance." Meanwhile, information and digital technologies influence traditional sectors of the economy. There is an evolution in the labor market caused by the widespread use of information and communication technology over the past 30 years. There is a technological bias in demand for high-qualified labor, which increases the polarization of labor in the high- and low-skilled segments, reducing medium-skilled jobs and increasing income inequality in society.

Consider the contribution of human capital into the region's economy on the example of the CFD entities: 8 of these regions surround the Moscow agglomeration (Moscow and the Moscow region). But many other regions are located at a distance of 200-300 km to the border of the Moscow region, and all of them form the Moscow macroregion as an economic system. The Moscow agglomeration acts as a key point of national economic growth, possessing enormous resources (financial, labor, material, technological, etc.). The Moscow region has a strategic objective: to maintain and strengthen its leadership position in the competition for human capital and investment. The regions neighboring the Moscow agglomeration improve their competitive advantages through the development of industrial, transport, transit, logistics, infrastructure, and other potentials.

The indices of the human factor contribution to the regional economy are represented in the Rosstat statistical collection "Regions of Russia". They are noted in the following sections: 1. "Main characteristics of the subjects of the Russian Federation", 9. "Gross Regional Product" and 19. "Science and innovation".

The index of GDP (gross value added) takes an important place among the indices of the Sustainable Development Goals. The research of A. Chub (2022) showed that economic development (through the GDP index) correlates with investment into the intellectual and technological capital. A research by S. Shkiotov

(2022) on the example of the economies of the Eurasian Economic Union supported the influence of GDP per capita and the HDI on the level of economic freedom.

Our research reveals that in terms of GRP per capita Moscow is the leader among the CFD regions (more than 1.5 million rubles). In 2020 in 4 regions this index exceeded 500 thousand rubles (Moscow, Belgorod, Kaluga, Lipetsk). In 6 regions this index is in the range of 400-500 thousand rubles (Yaroslavl, Kursk, Tula, Voronezh, Voronezh, Ryazan, Vladimir). And in 6 regions – in the range of 300-400 thousand rubles (Tver, Orel, Smolensk, Tambov, Bryansk, Kostroma). Only the Ivanovo region has less than 300 thousand rubles.

The index of the physical volume of GRP was most favorable (over 100%) in all regions only in 2018. In 2019, there was a decline of this index only in three regions (Lipetsk, Tambov, and Tver). In 2020, there was a decline in 10 regions, which is associated primarily with the Covid-19 pandemic. Only eight CFD regions (Belgorod, Ivanovo, Kursk, Lipetsk, Orel, Ryazan, Tambov, and Tula regions) showed a growth of more than 100% (see Table 3).

Table 3 – Dynamics of GRP per capita and the index of physical volume of GRP in 2018-2020

Period	Gross regional product per capita, RUB			Index of the physical volume of GRP production in constant prices, as a percentage over the previous year		
	2017	2018	2019	2018	2019	2020
The Russian Federation	614,333.2	647,708.1	640,519.0	102.8	101.6	97.8
Central Federal District	792,780.9	840,986.7	854,978.5	102.8	101.8	99.2
Belgorod region	588,641.5	617,024.6	646,569.0	102.4	102.0	100.1
Bryansk region	304,547.1	333,612.6	347,204.5	103.0	102.3	99.6
Vladimir region	349,856.4	393,135.2	410,443.6	100.5	106.4	99.8
Voronezh region	408,140.7	430,689.9	459,629.5	102.7	101.3	97.4
Ivanovo region	230,325.5	254,801.2	273,821.5	101.5	102.5	101.3
Kaluga region	502,224.2	546,488.9	558,174.6	102.7	102.3	98.7
Kostroma region	299,569.1	320,813.9	323,951.6	100.3	101.5	96.3
Kursk region	405,890.2	448,533.4	487,030.7	102.9	102.7	102.1
Lipetsk region	526,882.4	499,274.3	546,151.3	102.1	98.2	102.8
Moscow region	615,059.9	679,655.1	683,845.1	102.0	106.2	98.9
Orel region	332,418.3	362,066.3	390,170.2	101.1	102.8	100.0
Ryazan region	372,321.8	392,641.3	412,845.1	100.3	101.3	101.1
Smolensk region	354,239.9	372,073.3	386,274.8	102.0	100.0	99.0
Tambov region	343,693.1	349,773.1	378,455.8	103.3	97.7	100.2
Tver region	368,955.6	386,059.1	391,722.2	103.5	98.4	96.6
Tula region	448,896.8	459,650.6	486,544.2	103.2	100.1	103.1
Yaroslavl region	462,207.4	484,799.3	495,102.2	103.2	100.1	99.7
Moscow	1,494,938,0	1,565,396,3	1,567,644,8	103.2	101.1	99.0

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

The index "labor productivity" is one of the main socio-economic indicators.

The following regional projects are implemented in Ivanovo region as a part of the National Project "Labor Productivity and Employment Support" (implementation period 01.10.2018 – 31.12.2024):

- "System measures to increase labor productivity".
- "Targeted support for enterprise productivity improvement" .

The regional project "System Measures to Increase Labor Productivity" provides training under

the programs "Productivity Leaders" (for management) and "Export Growth Accelerator" (for business representatives on drafting an export project). Also, the Industry Development Fund issued concessional loans at a rate of 1% per annum.

The regional project "Targeted support for increasing labor productivity at enterprises" provides methodological and organizational support for increasing labor productivity at enterprises. It establishes the specialized competence centers at the federal and regional level to implement best practices (standard solutions) and improve the labor productivity. In 2019 on the basis of an autonomous non-profit organization "Center for Entrepreneurship Development and Export Support of Ivanovo region" established the Regional Center of Competences in the field of labor productivity.

Our analysis showed that among the CFD regions the highest labor productivity indicator was in 2020 in the Ivanovo, Kursk, and Ryazan regions – 105.7%; 106.2%; 105.9%, respectively; less than 100% it was in the Voronezh, Kostroma, Moscow, and Tver regions – 98.2%; 99.5%; 99.3%; 98.5%, respectively (see Table 4).

Presidential Decree № 231 of April 25, 2022-2031 declared the years 2022-2031 as the Decade of Science and Technology. Consider the indices characterizing the scientific potential of the region.

Scientific studies prove the connection between the socio-economic development of the regions and the level of their scientific potential. They estimate the actual and probabilistic scientific potential of the Russian regions (Shipitsyna & Zhuykova, 2022).

The human contribution to the regional economy is also presented in Section 19. "Science and Innovation".

To assess the scientific potential of the region researchers propose a comprehensive approach. Its components are as follows:

1. Material and technical equipment (resources and methods of inventions development and implementation of projects, due to which scientific activity occurs in the region).

2. The level of education of academic staff, those, who can generate, implement and broadcast the scientific ideas.

3. The volume and structure of scientific research (the set of all available scientific background previously formed in the region, as well as the ability to create their own information and innovation product).

4. The volume of funding (from the federal and regional budgets, extra-budgetary funds, foreign and private investors) as a basis for the formation of scientific activity in the region.

5. Organizational structure of the scientific sphere as a set of all organizations in the region, participating in scientific activity (budgetary and commercial organizations, foundations, competitions, venture business, educational institutions of higher and secondary vocational education) (Shipitsyna & Zhuykova, 2022).

The scientific potential of the regions of Russia is increasing.

– The most of the invention and utility model patents and advanced production technologies are traditionally issued in large Russian regions with a developed scientific and educational infrastructure – Moscow (more than 12 million people) and the Moscow region (more than 7 million people). Voronezh region leads by the number of issued patents for inventions. Bryansk and Voronezh regions are leaders in patents for utility models.

– In terms of advanced production technologies used, Vladimir region leads after the capital region, followed by Tula, Kaluga, Yaroslavl, Tver, Lipetsk, and Voronezh regions. Outsiders are the Ivanovo and Orel regions. Relatively low figures are in the Bryansk, Kostroma, Kursk, and Ryazan regions (see Table 4).

Conclusions

We can consider the contribution of human capital to the economy, based on the Sustainable Development Goals. It can be also correlate with the indices of labor productivity, the physical and value volume of GDP per capita, the share of added value of the "Manufacturing" industry, and the share of products of high-tech and knowledge-intensive industries in GDP of Russia. In 2020, Moscow was a leader by the index of "GRP per capita" among the regions of the CFD. Only in four regions this index exceeded 500 thousand rubles (Moscow, Belgorod, Kaluga, Lipetsk regions). According to the analysis of labor productivity among the CFD regions, in 2020 this indicator was highest in the Ivanovo, Kursk, and Ryazan regions (over 105 %); less than 100 % it

was in the Voronezh, Kostroma, Moscow, and Tver regions.

Table 4 – Indices of human capital contribution to science and innovation on the example of the regions of the Central Federal District

Period	Labor productivity in 2020 as a percentage of the previous year	Patents issued, 2021		Developed advanced production technologies, 2021	Advanced production technologies in use, 2021	Volume of innovative goods, works and services	
		inventions	utility models			million, RUB	As a percentage of the total volume of shipped goods, work and services
Belgorod region	101.1	**147**	82	34	**3 349**	**190,335.9**	**11.6**
Bryansk region	104.2	29	97	9	1 779	35,265.2	7.9
Vladimir region	104.8	112	28	10	6 604	27,132.8	3.8
Voronezh region	98.2	336	90	24	3 072	38,083.6	4.0
Ivanovo region	105.7	52	20	10	900	12,964	5.7
Kaluga region	100.3	140	33	... 1)	3 514	35,790.5	3.3
Kostroma region	99.5	47	10	... 1)	1 760	1 836.8	0.8
Kursk region	106.2	114	31	–	1 794	17,028.5	2.6
Lipetsk region	103.5	38	23	... 1)	3 105	46,904.1	3.6
Moscow region	99.3	984	405	201	16,190	502,758.0	7.6
Orel region	101.7	47	11	... 1)	1 378	5 315.3	2.1
Ryazan region	105.9	120	65	13	1 881	30,078.4	5.5
Smolensk region	101.6	33	21	... 1)	2 256	8 819.3	2.2
Tambov region	100.9	78	22	-	2 010	20,395.6	6.0
Tver region	98.5	79	48	... 1)	3 158	48,113.1	9.4
Tula region	103.8	98	56	... 1)	4 440	134,432.4	10.3
Yaroslavl region	103.4	89	67	4	3 511	30,375.2	5.0
Moscow	102.5	4 280	1 614	421	13, 077	795,297.0	3.2

1) Data are not published in order to ensure the confidentiality of primary statistical data received from organizations in accordance with Federal Law № 282-FZ of November 29, 2007 "On official statistics and the state statistical system in the Russian Federation" (paragraph 5 of Art. 4, Part 1 of Art. 9).
Source: Regions of Russia. Regions of Russia. Socio-economic indicators, 2022

The scientific potential of the regions of Russia is increasing. The most of the invention and utility model patents and advanced production technologies are traditionally issued in large Russian regions with a developed scientific and educational infrastructure – Moscow and the Moscow region. Voronezh region leads by the number of issued patents for inventions. Bryansk and Voronezh regions are leaders in patents for utility models. In terms of advanced production technologies used, Vladimir region leads after the capital region, followed by Tula, Kaluga, Yaroslavl, Tver, Lipetsk, and Voronezh regions. Outsiders are the Ivanovo and Orel regions. Relatively low figures are in the Bryansk, Kostroma, Kursk, and Ryazan regions.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHORS' CONTRIBUTION

Alla B. Berendeeva – conceptualization, project administration, funding acquisition, writing – original draft.

Olga O. Korobova – data curation, formal analysis, validation, writing – review & editing.

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