

The role of human capital and effective innovations for the economic growth of the country

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Abstract. The article discusses issues related to the peculiarities of human capital development at the present stage of development of the federal districts of the Russian Federation. Each indicator contains various indicators that should reflect the specifics of the economic development of each region from the qualitative and quantitative side. The authors have developed an algorithm that allows you to distribute federal districts by rating. Identifying weaknesses in the development of human capital in individual federal districts allows us to develop a set of measures aimed at creating conditions for ensuring a stable improvement in the quality and standard of living based on the advantages of federal districts. Like physical capital, human capital is devalued. For example, people's skills and knowledge may decline with age or become obsolete due to technological progress and innovation. Human capital differs from physical capital in two important aspects. First, human capital is embodied in individuals and cannot be transferred from one person to another. Secondly, human capital is not a liquid asset; in other words, people can sell economic services provided by their human capital. Research in the field of human capital development will deepen understanding of the relationship between the quality of human capital and the pace of economic growth, develop measures to improve the quality of labor resources and reduce unemployment, as well as propose measures to accelerate innovation processes and the introduction of advanced technologies in the regions of the Russian Federation.

1 Introduction

Economic development is an eternal theme of human society and is always at the center of attention of all sectors of society. For a long time, people have been thinking and doing extensive research on economic development. The goal is economic development. But what are the driving factors behind this goal? Some believed that economic development depended on natural resources, which gave rise to a school focused on natural resources. Others believed that science and technology were fundamental to economic development, which led to the emergence of a school focused on science and technology. However, with the constant progress of academic research, people have discovered that focusing on natural

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resources does not explain economic development, and that scientific and technological progress is not a fundamental cause of economic development. In the course of further theoretical and practical research, people have discovered that human resources are the key to economic development. And therefore, the human resource is revered as the "most valuable resource". This point of view can be called human resource-oriented. However, on reflection, we can also find that human resources do not fully explain economic development, which is proven by reality. It is true that human resources are very valuable because they play a crucial role in stimulating economic growth. But this resource can vary greatly, especially in its levels. Only human capital, which is formed through investments, is the core of value creation. Based on this, we conclude that human capital is formed through various forms of investment and that human capital is an essential factor in economic development, the key to identifying the inherent regional economic imbalances and the economic catch-up and overtake. Economic growth is of great importance for the socio-economic development of Russia.

According to the First Deputy Prime Minister of Russia Andrey Belousov, in 2022 the country's GDP will decrease by less than 3%, and in 2023 the decline will be less than 1%. At the same time, the government does not see serious risks for the labor market and notes the recovery of production in a number of sectors, although the situation remains difficult in some industries. In addition, the authorities record a revival of consumer demand and an improvement in business activity in the country, and inflation may drop to 12-13% by the end of the year.

Economic growth changes under the influence of many different factors.

In order to better grasp the tax challenges raised by the digitalisation of the economy and its implications for the PE concept, this chapter proceeds as follows. First, commonly observed key characteristics of digitalised businesses and its implications for the current PE concept are discussed. Second, common business models deployed by enterprises operating in the digitalised economy are classified according to the concept put forward by Hagiu/Wright.

Human capital is the general state of health, skills, knowledge and abilities of the population, the workforce or an individual. "A country's ability to raise living standards over time depends almost entirely on its ability to increase productivity per worker," said Nobel Prize-winning economist Paul Krugman.

Human capital and the infrastructure surrounding it relate to productive expenditures, which means it has the potential for a multiplicative effect and is mainly important for economic growth.

The necessity and importance of research in this area is also determined by the national

Economic growth is considered by representatives of various schools. The basis of the Malthusian position of economic growth was the idea of the difference between the increase in population and the production of means of subsistence. The geometric progression of population growth and only the arithmetic means of subsistence leads to hunger and thereby a decrease in economic growth.

The basis of long-term economic growth in Casianism was considered to be the implementation of macroeconomic policies aimed at avoiding inflation and recessions.

Economic growth has recently shifted from a traditional to a sustainable perspective that looks at broader aspects of the well-being of development instead of considering purely macroeconomic goals as the only goals [1-5]. Sustainable development focuses on meeting current needs without compromising the resources of future generations, where human capital is a central component. Most of the literature suggests that human capital is a significant driver of economic growth. The need for human capital for economic growth dates back to Adam Smith and other eighteenth-century philosophers and economists who emphasized the role of labor productivity through technological change in creating the

wealth of countries. Effective and efficient technological change, whether innovation or imitation, uses human capital as input [6-9].

Recently, there has been a tendency to consider human capital as a component of a regional or national ecosystem [10-15] argue that "the diverse meaning that human capital management can take in specific local contexts, such as economically developed countries or developing countries, democratic countries, and not oligarchic or even dictatorial regimes, a liberal market economy or a coordinated market economy, etc.," requires additional research. Lin and Edvinsson (2020) point to the need for comparative studies.

Nevertheless, the idea that effective innovations are not autonomous and are amenable to democratic control is becoming increasingly popular. According to some researchers, it is autonomous and social trends in technology development that are the key to understanding the nature of technological development. According to others, the connection between technology and the human factor allows a deeper understanding of the mechanism of interaction between technology and institutions. This understanding allows us to foresee the limits and possibilities of human development and the use of technology.

Effective innovations contribute to technological progress and growth of the real economy. The real sector of the economy is responsible for high rates and sustainable economic growth in long-term development, which determines the theory of innovation as an important component of the theory of economic growth. J. Schumpeter (1934) considered innovation to be the main function of entrepreneurship and the basis of cyclical fluctuations in the economy. He connected Kondratiev's long waves and Juglar cycles with waves of innovation in technology and economics [16-21].

In our work, we will proceed from the fact that economic growth is a system of interaction and reproduction of elements and factors of production of the national economy.

2 Methods

Secondary data from various sources were used for the study. The study also included a number of economic indicators collected from various data sets. These indicators included GDP, an indicator of human capital in the form of school enrolment. The study period is from 2010 to 2021. Calculations of indicators for the human capital development index were carried out for the period 2020-2021.

The system-functional approach is the basis of the research tools within the framework of the topic of the work. Theoretical approaches are based on induction-deduction methods and models, as well as general scientific methods such as analysis, synthesis, generalization, comparison and modeling.

When developing the methodology for assessing the development of human capital, the tools of economic analysis were used: economic and statistical groupings, rating analysis, trend extrapolation, graphical interpretations.

Measuring the stock of human capital has been and remains one of the main tasks of empirical research. However, a more complete measurement of the concept of human capital is a difficult task, since it requires finding suitable empirical analogues of human capital acquired outside the school system, such as non-formal education, on-the-job training or health care.

The United Nations Human Development Index (2000) aims to overcome some of these shortcomings. It measures overall achievements in three key aspects of human development – health, knowledge and standard of living. The European Human Capital Index, developed by the Lisbon Council (2006), is another attempt to measure investments in knowledge and education in different countries. The index is aimed at quantifying how human capital develops during a person's lifetime. It takes into account investments made in various types of human capital development, for example, adult education and parental education,

measuring each of these components either in terms of direct costs or in terms of opportunity costs.

The authors rely on the hypothesis that the country's economic growth depends on the development of human capital and the introduction of effective innovations. The conducted research made it possible for the first time to summarize part of the empirical data on the role of collaboration of human capital and effective innovations on the economic growth of the country.

The Human Capital Index calculates the contribution of healthcare and education to employee productivity. The final index indicator ranges from zero to one and measures labor productivity as a future employee of a child born today, relative to the standard of complete health and complete education.

Based on the data provided by the World Bank, the Global human Capital index for 2020 is characterized by the following results.

The complexity of the device of a new type of economy of the digital age requires the active regulatory participation of the state.

Investing in human capital is expensive for individuals and their families. The costs incurred by an individual consist of opportunity costs, which are measured by lost earnings during study, and direct tuition costs (fees and payments to training providers, books and other materials). Investments in human capital are also costly for society, which finances most of the costs of providing educational services.

There are different interpretations and approaches to the assessment of human capital. It is impossible to evaluate human capital by any one economic indicator, it is necessary to use a system of indicators (Table 1), which, having led to an integral indicator, will allow it to be evaluated.

Table 1 Indicators of human capital assessment, compiled by the authors

internalcapital	externalcapital
average annual number of employees (thousand people) (A)	internal expenditures on research and development from all sources (RUB billion) (M)
number of students enrolled in bachelor's, specialist's, master's programs (per 10.000 people) (B)	cost of digital technologies implementation and use (RUB million) (N)
urban population (percentage (%)) (C)	patents issued for inventions and utility models (number) (O)
number of research and development personnel (per 10.000 people) (D)	volume of innovative goods, works, services (percentage of the total volume of goods shipped, works performed, services provided) (P)
number of researchers with postdoctoral degrees (people.) (E)	inventive activity coefficient (the number of domestic patent applications for inventions filed in Russia, per 10.000 people) (R)
population with income below the minimum wage (average percentage of the region's population) (%) (F)	number of advanced manufacturing technologies created (number) (S)
morbidity rate (per 1.000 people) (G)	percentage of high-tech and science-intensive products in the gross regional product (%) (T)
mortality of the population above the working age (per 100.000 of people of the certain age) (H)	percentage of organizations implementing technological innovations in the total number of surveyed organizations(%) (U)
total fertility rate (newborns per woman) (I)	aggregate rate of unemployment and potential labor force(%) (V)
proportion of citizens leading a healthy lifestyle(%) (J)	labor productivity index(%) (W)
percentage of researchers under the age of 39 in the total number of Russian researchers(%) (K)	population income (RUB thousand) (X)
number of theatre- and cinema goers (per 1.000 people) (L)	average pension size (RUB thousand) (Y)

	percentage of households with broadband Internet access (%) (Z)
	the number of personal computers used for educational purposes, in state and municipal organizations carrying out educational activities in educational programs of primary, basic and secondary general education, in training programs for skilled workers, employees, in training programs for mid-level specialists and in higher education programs (per 1,000 students) (AA)
	GRP per capita (RUB million) (AB)

The selection of indicators was carried out taking into account the factor of interdependence, to exclude overlapping numerical values of factor indicators.

In our opinion, it is possible to assess the impact of human capital on the economic growth of a country by indicators reflecting internal capital, which directly depends on the person himself and external capital, which is formed under the influence of any external factors (Table 2)

Table 2. Indicators of human capital development. compiled by the authors based on the data

Indicators/ Regions	Central Federal District	Northwestern Federal District	Southern Federal District	North Caucasian Federal District	Volga Federal District	Ural Federal District	Siberian Federal District	Far Eastern Federal District
Population, thousand	39433.600	13982.000	16466.100	5831.000	29282.500	12360.700	17118.300	8169.200
A	21171.200	7065.300	7417.300	3004.100	13434.600	6322.100	7795.200	3954.700
B	322.000	300.000	240.000	210.000	276.000	242.000	278.000	226.000
C	82.300	84.900	82.800	80.300	72.200	81.600	74.300	72.900
D	342.000	91.000	26.000	6.000	105.000	44.000	51.000	13.000
E	52929.000	11901.000	14278.000	2710.000	8827.000	4555.000	10466.000	4246.000
F	11000	12000	15000	20000	14000	12000	19000	15000
G	703.000	20500	711.700	641.600	836.200	839.900	837.500	772.100
H	3583.000	3550.000	3786.900	3139.000	3744.200	3634.600	3879.600	3895.500
I	1.386	1.386	1.483	1.784	1.451	1.623	1.540	1.671
J	7.000	10.700	12.100	14.700	9.500	7.700	6.900	5.600
K	41.600	44.200	43.300	32.900	51.700	50.400	46.800	34.800
L	1460.000	3102.000	950.000	373.000	808.000	693.000	701.000	633.000
M	376.600	165.200	29.200	5.300	186.100	68.600	85.900	17.800
N	171103.700	127356.000	46607.000	13802.300	176901.600	106103.400	81955.800	47045.600
O	1237.000	3385.000	2122.000	519.000	5186.000	1630.000	2769.000	618.000
P	5.000	5.600	2.700	5.300	11.300	3.300	2.600	3.000
R	2.580	3.680	0.800	0.420	1.160	0.820	1.080	0.590
S	553.000	239.000	145.000	37.000	219.000	281.000	120.000	26.000
T	21.200	23.900	16.100	18.700	22.300	11.700	16.600	14.500
U	28.100	22.200	17.800	7.100	22.500	20.900	16.400	15.400
V	4.100	5.000	7.200	14.800	6.100	6.000	8.400	9.200
W	102.400	102.600	103.100	102.300	103.500	101.000	102.700	104.700
X	47538.000	38866.000	30428.000	24317.000	28400.000	36817.000	27659.000	38696.000
Y	15953.000	17521.000	14501.000	13190.000	15213.000	17151.000	15750.000	17491.000
Z	76.500	76.600	72.700	68.100	71.800	73.500	71.100	71.700

AA	638.000	581.000	494.000	422.000	568.000	650.000	587.000	596.000
AB	745.860	644.771	355.210	195.534	425.689	1031.882	486.755	637.041

Calculations for this study were carried out on the basis of open data from the Federal State Statistics Service of the Russian Federation, which meets the signs of reality and reliability of information. The calculations obtained will allow us to compare the development of human capital across the federal districts of the Russian Federation and make recommendations to improve the development of human capital, which in turn directly affects both the economic growth of a particular federal district and the economic growth of the Russian Federation as a whole, which increases its competitiveness in the international arena. In Table 2, we will replace the names of indicators with a letter designation.

The scientific tools for deriving the integral indicator are different. Let's use the distance method, which involves calculating the proximity of the parameter to the best indicator.

The composite index of human capital development is impossible without calculating the intermediate values of the coefficients. Such methods as "sums of points", "sums of ranking places", as well as "the method of relative differences" are widely used. Let's use the latter method, since the first two have errors in the form of subjectivity of expert opinion, which can lead to distortion of the real picture.

We will rank the regions of the Central Federal District from the worst value of the indicator to the best one (Table 3). At the second stage, we will calculate the consolidated index of rural areas development using the geometric mean. The third stage of the rating calculation will be performed using the distance method (formula 4).

Table 3. Interim calculations of the human capital development integral indicator. compiled by the authors

Indicators/Regions	Central Federal District	North Western Federal District	Southern Federal District	North Caucasian Federal District	Volga Federal District	Ural Federal District	Siberian Federal District	Far Eastern Federal District
A	1.000	0.334	0.350	0.184	0.635	0.299	0.368	0.187
B	1.000	0.932	0.764	0.652	0.857	0.752	0.863	0.702
C	0.659	1.000	0.740	0.592	0.850	0.961	0.875	0.859
D	1.000	0.266	0.076	0.018	0.307	0.129	0.149	0.038
E	1.000	0.225	0.081	0.051	0.167	0.086	0.198	0.080
F	1.000	0.917	0.733	0.550	0.786	0.917	0.579	0.733
G	0.913	0.694	0.902	1.000	0.767	0.764	0.766	0.831
H	0.876	0.883	0.829	1.000	0.838	0.864	0.809	0.806
I	0.783	0.777	0.831	1.000	0.813	0.910	0.863	0.937
J	0.517	0.728	0.823	1.000	0.646	0.524	0.469	0.381
K	0.805	0.855	0.838	0.636	1.000	0.975	0.905	0.673
L	0.471	1.000	0.306	0.120	0.260	0.223	0.226	0.204
M	1.000	0.287	0.051	0.009	0.323	0.119	0.149	0.031
N	1.000	0.074	0.027	0.008	0.103	0.062	0.048	0.027
O	1.000	0.277	0.173	0.042	0.424	0.133	0.226	0.051
P	0.442	0.496	0.239	0.469	1.000	0.292	0.230	0.265
R	0.701	1.000	0.310	0.114	0.315	0.223	0.293	0.160
S	1.000	0.432	0.262	0.067	0.396	0.508	0.217	0.047
T	0.887	1.000	0.674	0.782	0.933	0.490	0.695	0.607
U	1.000	0.790	0.633	0.253	0.801	0.744	0.584	0.548

V	1.000	0.820	0.569	0.277	0.672	0.683	0.488	0.446
W	0.978	0.980	0.985	0.977	0.989	0.965	0.981	1.000
X	1.000	0.818	0.640	0.512	0.597	0.774	0.582	0.814
Y	0.911	1.000	0.828	0.753	0.868	0.979	0.899	0.998
Z	0.999	1.000	0.949	0.889	0.937	0.960	0.928	0.936
AA	0.982	0.894	0.760	0.649	0.874	1.000	0.903	0.917
AB	0.723	0.625	0.344	0.189	0.413	1.000	0.472	0.617

Standardized indicators were calculated by us when determining the rating according to the geometric mean, so then we will determine the rating for each enterprise by the formula:

$$R_j = \sqrt{\sum (1 - x_{ij})^2} \quad (4)$$

3 Results and Discussion

The results presented in the study give an idea of how various factors potentially interact with each other, influencing economic growth through innovation in the regional context of the Russian Federation. With regard to income inequality, the long-term negative relationship is consistent with the notion that excessive imbalances can hinder capacity development. However, the conclusion about interaction with innovation forces us to reconsider assumptions about the disproportionate impact on the commercialization of new technologies, as some studies have shown that innovation can help reduce inequality. Indicators such as government spending and investment are consistent with theories that position government assistance and private capital accumulation as significant factors of long-term productivity, which raises questions about the specific experiences of subjects that deserve further study. Nevertheless, it is worth noting that both gross domestic savings and human capital have a positive and significant impact on overall economic growth. Thus, savings and human capital also seem to support interpretations of capacity building that deserve deeper consideration. In the short term, adaptive demand management appears to benefit from the positive impact of government spending, as well as changes in spending and investment. However, the context-dependent effects of inequality highlight the individualization of stabilization strategies. Focusing solely on high-tech exports when measuring innovation or using static tools risks losing sight of the complexity that requires a balanced perspective. Identifying these dynamics can serve as a guideline for conducting well-adapted comprehensive policy studies aimed at supporting private efforts and government coordination to promote sustainable, inclusive growth in the regions. In addition, continuous research on the diversity of the region, relevant to policy issues, remains crucial.

Let's evaluate the integral indicator of human capital development in the regions of the Central Federal District. The maximum value of the integral indicator indicates the last place in the rating among the studied regions according to the selected indicators (Table 4).

Table 4. Calculation of the rating using the distance method

Federal District	Integral indicator	Rating
Central Federal District	1.059	1
Northwest Federal District	2.139	2
Southern FO	2.851	6
North Caucasian Federal District	3.312	8
Volga Federal District	2.304	3

Ural Federal District	2.703	4
Siberian Federal	2.814	5
District Far Eastern Federal District	3.099	7

The highest value of the integral indicator signifies the lowest rating among the analyzed regions according to the selected parameters (figure 1).

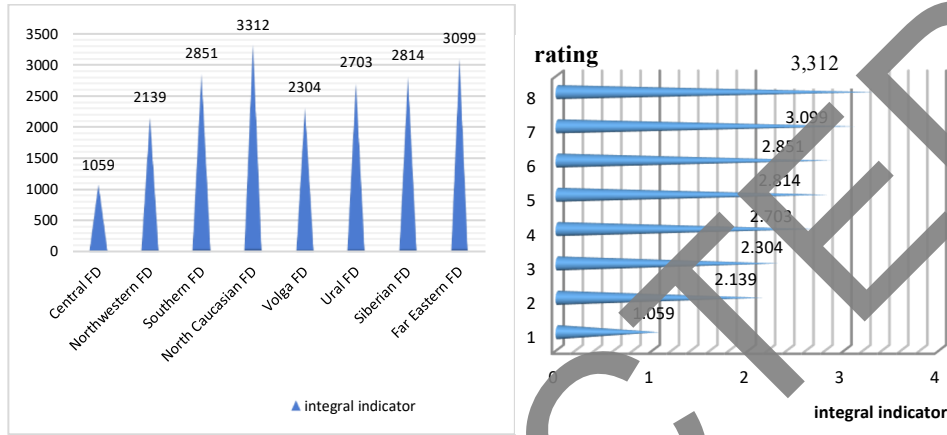


Fig.1. Human capital development integral indicator and Federal Districts rate in 2021, compiled by the authors based on the calculations

As for effective innovations, the main problems faced by stakeholders in the formation and implementation of effective innovations were identified:

- access to innovation financing varies between federal districts and sectors of the economy within the Federal District;
- reliable innovation ecosystems should balance startups, scaling up and mature firms;
- the key point is to find a balance between insufficient/excessive investments in the search for directions for innovation;
- a combination of policy measures is essential to improve the innovation financing landscape.

The development of the territory in which it is accumulated directly depends on the development of human capital. A high level of human capital contributes to the formation of innovations in all spheres of existence. The process of implementing effective innovations is taking place at a faster pace, since the quality and standard of living are higher in these territories, which means that the population is more ready to use them.

The scientific results created by research scientists ensure not only the growth of scientific results, but also, ultimately, the growth of the economy [6, 9, 19-20]. Therefore, the growth of spending on science is the factor that causes a chain of growth in the number of researchers, then the number of scientific results, and therefore scientific technologies, which determines their use to achieve economic growth and development of the state. Expectations of economic growth are likely to be very long for our country due to the reduction in spending on science, the low proportion of R&D expenditures in GDP, and the weak involvement of business in innovation and investment processes. Practically the only thing that the state has done in the current 2022 to support R&D is to expand the list of expenses for which an investment deduction for income tax can be claimed: by the law of the subject of the Russian Federation, it is possible to establish a specific deduction in the amount of expenses for research and development work, and up to 90% of such expenses

can be attributed to reduce the income tax paid to the regional budget and 10% of the tax paid to the federal budget.

The study of the business climate in Russian science (Doing Science), during which a survey of the heads of three hundred and sixty universities and scientific organizations was conducted, made it possible, based on the opinions received[21-36].

4 Conclusion

As a result of the conducted research, the following results were obtained. The analysis of the formation and problems of the introduction of effective innovations in the Federal Districts of the Russian Federation is also carried out.

Two key factors play a decisive role in the economic growth of any country - human capital and effective innovation. The competitive advantage of the federal districts stems from the development of its human capital and innovative activity, leading to the current rating and technological situation in the Russian Federation, which determine the quality and living conditions of the population and their financial well-being. At the same time, to provide added value, it is necessary to pay great attention to the protection of one's intellectual property. These two factors will allow federal districts to be competitive and have an advantage over others in the form of high market potential.

This study has many limitations. Further research is needed to better understand the complex relationships between human capital, economic growth and related factors. In particular, future research may examine the impact of additional channel variables, such as access to health care and social capital, on economic growth and income inequality. In addition, future research may use more advanced econometric methods, such as panel data analysis, to better capture the dynamic relationships between these variables over time.

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