

# The Impact of Human Capital on Innovation Activity in the Region

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**Abstract.** One of the most important factors for increasing innovation activity in the region is human capital, which contributes to the formation and realization of the innovation potential of business structures and the economy as a whole. The need to improve human capital is realized at the upper levels of government in Russia and measures are being taken that contribute to creating conditions and providing a favorable environment for its development. The hypothesis of this study was the thesis that innovative activity in the region depends on the human capital that this region possesses. The article analyzed the level of influence of various factors characterizing human capital on the results of regional innovation activities using the method of correlation and regression analysis. As an information base for the study, data from the Federal State Statistics Service for 2017 in 86 regions of the Russian Federation on indicators of innovation activity and human capital indicators were taken. As a result of the analysis, it was concluded that the indicators of innovation activity in the region depend on the quality of human capital, the average employment rate has the most significant effect, and the creation of new jobs will positively affect the innovation activity.

## 1. Introduction

Currently, innovation is a powerful engine of economic growth. Countries with high rates of innovative activity are becoming leaders in terms of economic development. For progressive innovative development, it is necessary to create appropriate conditions [1], in which the "human" or social factor occupies an important place, since the welfare of the organization is largely determined by the attitude of consumers and the loyalty of employees [2]. Lack of attention to human capital on the part of management, for example, the lack of demand for its hidden assets, leads to idleness and, as a result, to losses in the form of lost profits, reduced competitiveness and investment attractiveness of economic systems [3]. In modern post-industrial society, it is the quality of personnel and labor resources that has a decisive influence on increasing the competitiveness of the economy of an enterprise, region and country. The researchers note that the objects that dominate the model of the knowledge economy as the basis for managing the innovative development of enterprises in the region [4] are the most successful in development. Innovation and human capital form a complex of knowledge necessary to create new or transform old products. The combination of innovation and human capital is one of the main factors of innovation development. Some researchers put forward a clause according to which the productivity of an enterprise directly depends on the qualitative composition of the human capital of an enterprise, while other scientists point out that human capital and its reserves create a systemic basis for creating innovations [5]. Human capital is a key factor of economic growth in a crisis due to the formation and implementation of the innovative potential of business structures and the economy

as a whole [6]. The need for human capital development is realized at the upper levels of government in Russia. The plan of measures for the transformation of the business climate, adopted by Decree of the Government of the Russian Federation No. 20-p dated January 17, 2019, provides for the implementation of measures contributing to the creation of conditions and providing a favorable environment for the development of human capital through improving the effectiveness of normative legal regulation and the effectiveness of national and federal projects at all stages of their planning and implementation [7].

## **2. Literature review**

The article Claude Diebolt & Ralph Hippe (2019) conducted a study of the human capital of European regions in a historical perspective in the period 1850-2010. and its impact on innovation and economic development (number of patents per million inhabitants and GDP per capita). Human capital data includes agricultural employment, population density, infant mortality, fertility, marital status, fertility, and literacy. In particular, literacy has a significant impact on current patent applications per capita and per capita GDP. Thus, it was revealed that historical human capital is the most important component for the economic development of European regions [8]. The Valero, A., & Van Reenen, J. study shows that a 10% increase in the number of universities per capita in a region contributes to a 0.4% increase in per capita GDP in this region. Also, universities have a positive side effect for nearby neighboring regions [9]. Studies on the impact of migration on innovation networks between regions show that immigrants (emigrants) act as a transnational knowledge bridge between host (home) regions and their countries of origin (destination), contributing to the creation of joint inventive networks. Thus, the policy of promoting interregional innovation networks should go beyond science and technology and cover regional immigration policies. International mobility and intercultural networks support regional knowledge flows related to innovation [10]. At the same time, in work analyzing the dependence of the share of immigrants in the population of the Italian regions on the number of patents, no evidence was found of either the positive or negative impact of migrants on innovation [11]. Significant differences within a country in levels of human and social capital often exist and lead to inequalities in the benefits received by regions and communities in a given country [12]. Research conducted in Ireland showed the difference between firm sizes and the determining factors of innovation at the firm level for different firm sizes. The authors put forward the concept of innovative human capital and emphasize its impact on the innovation of small enterprises and, therefore, on growth (jobs, sales and productivity). The innovative human capital they offer covers the elements: education, training, readiness for changes in the workplace and job satisfaction [13]. Florida, R., Adler, P., & Mellander, C. Claim that the city and region are a key socio-economic organizational unit for innovation processes, bringing together diverse firms, talents, regional knowledge institutions, infrastructure, and other resources necessary for their occurrence. In their opinion, innovation, entrepreneurship and creativity are more typical at the level of the city and region in comparison with the individual level or the level of the company [14].

## **3. Problem statement**

Our study is devoted to the analysis of human capital indicators that affect the innovative activities of organizations in the region. Information base of the research was made by the data of the Federal State Statistics Service for 2017. in 86 regions of the Russian Federation. The following innovation indicators were used: domestic research and development costs, the number of patent applications filed for inventions and utility models, the number of patents issued for inventions and utility models, developed advanced production technologies, used advanced production technologies, innovation activity, number of personnel employed research, the number of graduate students, the number of doctoral students, the cost of technological innovation, the volume and novation of goods and services.

As indicators of human capital, the following were taken: population size, total fertility rates, migration growth rates, total marriage rates, average annual number of employees, unemployment rate,

average per capita incomes of the population, consumer spending on average per capita, life expectancy at birth.

The hypothesis of this study is the thesis that innovative activity in the region depends on the human capital that this region possesses.

To test the hypothesis, we apply the method of correlation and regression analysis, which allows both to check the existence of a relationship and to determine the form of this relationship.

#### **4. Theoretical part**

Human capital, its quality and structure are crucial for innovation processes, dissemination and knowledge generation. The quality of human capital in the region may vary. The availability of institutions and programs for professional retraining of adults and the number of graduates with qualifications for university entrance is also an important factor, since it determines the quality of human capital in the region. The structure of the regional workforce in relation to certain socio-economic groups in the region also affects its innovative development. It can be argued that young employees are more actively engaged in innovation activities and provide ideas and their creative abilities, moving directly from the education system to firms. The share of working women and the share of potential employees and the level of unemployment correlate with the level of human capital in the region. The distance from the place of work to the place of residence and the number of suburban residents migrating to or from the region also affects human capital. The ability of a region to absorb human capital from other regions enhances the quality of total human capital through the selection and accumulation of highly qualified personnel [15]. The success of the modernization of the economy is largely determined by the level of development of labor potential. In this regard, it is important to answer the question of the adequacy of the accumulated human capital for the implementation of innovative transformations from the standpoint of quantitative and qualitative characteristics. In the context of the projected reduction in the number of able-bodied population, the emphasis on the development of the latter should increase. In addition, it should be borne in mind that similar in terms of stocks of human capital are often incomparable in terms of quality parameters [16]. An important role here is also played by labor rationing, which makes it possible to reduce production costs, increase labor productivity, improve work organization and production management, establish the dependence of wage sizes on final results, increase production efficiency and product competitiveness [17]. Labor productivity is an indicator linking the ability to work and the results of labor. In turn, the ability to work depends largely on human capital and the conditions for its formation and implementation, and the results of labor are associated with innovative activity. Therefore, when analyzing the relationship between human capital and innovation activity, the problems of labor productivity cannot be ignored [18]. The effectiveness of innovation activity in the region is largely dependent on the effectiveness of the regional intellectual property system [19]. Innovative activity is influenced by many factors, both positive and negative. One of the most important negative factors is corruption [20], and the fight against it can have a very positive effect on the growth of innovation activity.

#### **5. Results**

The data of Rosstat in the context of 86 subjects of the federation for 2017 are used as initial data. The data on the following parameters were used, each of which will appear in the analysis as a separate attribute: factor or resultant: X1 - population, thousands of people; X2 - the number of births per 1000 population, people; X3 - migration growth rates per 10,000 people; X4 - total marriage rates per 1000 population; X5 - the average annual number of employed, thousands of people; X6 - the unemployment rate, in%; X7 - per capita income of the population per month, rubles; X8 - consumer spending on average per capita, per month, rubles; X9 - life expectancy at birth, the number of years; X10 - internal expenses for research and development, million rubles; X11 - patent applications for inventions, pcs; X12 - patent applications for utility models filed, units; X13 - patents granted for inventions, units; X14 - issued patents for utility models, units; X15 - developed advanced production technologies; X16 - used advanced production technologies; X17 is the number of organizations implementing

innovations; X18 - the number of personnel engaged in scientific research, people; X19 - the number of graduate students, people; X20 - the number of doctoral students, people; X21 - the cost of technological innovation, mln. Rub .; X22 - the volume of production of innovative goods and services, mln. Rub. Some of these parameters (X1 - X9) characterize human capital, the remaining (X10 - X22) - innovative activity in the region.

The first stage of the study is to conduct a correlation analysis, which determines the presence of statistical dependence between the factors in pairs. This will eliminate those parameters that are weakly related to the others. According to the results of the correlation analysis, it was decided to exclude the following parameters from the model: X2, X3, X4, X6, X7, X9, X17.

For the remaining parameters, we conduct a regression analysis to determine the form of dependence. As a resultant attribute Y, we select the indicator from the group of innovative activity that has the closest connection with the other parameters - the number of applications submitted for utility models X12.

According to the results of regression analysis, we have the following dependency model:

$$Y(X12) = 10.56 - 0.004 * X1 + 0.01 * X5 - 0.0004 * X8 - 0.0003 * X10 + 0.04 * X11 - 0.12 * X12 + 1.07 * X13 - 0.27 * X14 + 0.0006 * X15 + 0.002 * X16 + 0.015 * X18 - 0.09 * X19 - 0.0002 * X20 + 0.0001 * X21 \quad (1)$$

The coefficient of multiple regression, equal to 0.99, as well as analysis based on the Fisher criterion, allows us to conclude that the model is significant, the relationship is close, and the relationship exists. An increase in innovation activity is possible by improving the quality of human capital.

We will also conduct a regression analysis, excluding the factors of innovation activity from the model, except for the resultant one. This will make it possible to identify the most strongly influencing factors of human capital.

As a result of the analysis, we obtain the following dependency model:

$$Y(X12) = -6.78 - 0.148 * X1 + 0.488 * X5 - 0.002 * X8 \quad (2)$$

The coefficient of multiple regression, equal to 0.96, as well as analysis based on the Fisher criterion, allows us to conclude that the model is significant, the relationship is close, and there is a relationship. The indicator of the average annual number of employment X5 has the greatest positive impact on innovation activity in the region.

## 6. Conclusion

Human capital is the most important factor contributing to the revitalization of the region's innovation activities. Based on the method of correlation and regression analysis, we investigated the effect of such human capital indicators as population, total fertility rates, migration growth rates, total marriage rates, average annual number of employees, unemployment rate, average per capita incomes of the population, per capita consumer spending population, life expectancy at birth. Also, indicators of innovation activity were used, such as domestic expenditures on research and development, the number of patent applications filed for inventions and utility models, the number of patents issued for inventions and utility models, developed advanced production technologies, used advanced production technologies, innovative activity, number of personnel employed in research, the number of graduate students, the number of doctoral students, the cost of technological innovation, about Capture innovative products and services. As a result of the correlation analysis, factors weakly related to the others were identified: these include the number of births per 1000 people, migration growth rates, general marriage rates, unemployment rate, average per capita cash income of the population per month, life expectancy at birth, number of organizations innovating. The closest connection with the other parameters is the indicator of the number of applications submitted for utility models, selected as the final attribute for the construction of a regression model.

Thus, according to the results of the analysis, we can conclude that the indicators of innovation activity in the region depend on the quality of human capital, the average annual employment rate has the most significant effect, and the creation of new jobs will allow a positive impact on innovation activity.

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