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## The Role of Human Capital in Innovative Economic Development

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### Abstract

The research is relevant because the human place in the economy largely determines the level of industrial, economic, and social development. The theory of human capital in its modern interpretation has certain prerequisites and logically results from the development of the world philosophical and economic thought. Therefore, before studying the modern concepts and interpretations in the field of human capital, it is necessary to investigate the evolution of scientific views of the problem of human productive capacities and their use in public production. This research aims to systematize the interpretations of the 'human capital' concept and discover the interrelations between the indicators of human development and the level of innovative activity. The study analyzes the theoretical approaches to the definition of the

'human capital' concept, presents their comprehensive assessment, and outlines the objective prerequisites for the development of scientific ideas regarding the theory of human capital. In addition, the interrelation of innovative development indicators and the human development index was proven based on economic and mathematical modeling using canonical analysis. The obtained results can be used to further develop generalized conceptual models when managing innovative and modernization processes, based on the activation of the human capital in modern economic systems.

**Keywords:** workforce, knowledge management, transition to innovation economy, human development index, European innovation scoreboard.

**JEL Classifications:** J24, A20, O15.

## Introduction

During the transition to an innovation economy, human resources play a defining role in achieving competitive advantage and provide quality parameters of growth and development (Blaug 1994). Prospects of this development communicate with the person, with his or her potential and resources as carriers of knowledge (Becker 1964, Stuart 1997, Mironova *et al.* 2016). Academician V. Vernadsky (1991) predicted that future human progress will take place in the field of knowledge and mind. According to V. Vernadsky (1991), humans and their education, skills, and experience are a very important and, at the same time, underused recourse, which is becoming increasingly important in the modern domestic economy. Modern models of knowledge management feature the concept of 'intellectual capital'. T. Stuart (1997), who is one of the founders of the modern theory of intellectual capital, developed the classic classification of the main components of intellectual capital. According to Stuart, the structure of intellectual capital has three main components, which are human capital, organizational capital, and customer capital. It is worth noting that modern conditions place special emphasis on the issues of transition to an innovation economy, the foundation whereof is the human capital or its higher form of organization – intellectual capital. Therefore, it is necessary to systematize the theoretical interpretations of the 'human capital' concept in modern science and determine the interrelations between the indicators of human development and the level of innovative activity.

## 1. Literature Review

In economic literature, the concept of 'human capital' is often defined as the concept of 'quality human resources' (Lucas 1988, Pinto *et al.* 2015). The accumulated human knowledge, qualification, and professional skills are considered an equivalent of capital along with its traditional forms (production equipment, cash, stocks, etc.) (Acs *et al.* 2016). Therefore, in the recent years, attention has been drawn to the study of human capital at different levels. However, the modern theory of economic growth considers human capital one of its key factors (Ehrenberg and Smith 2016, Lucas 1988), since human capital can ensure economic growth not only by increasing productivity, but also by generating and implementing new ideas and innovations.

It is necessary to point out that in the current socioeconomic conditions some studies emphasize the role of human capital and relations between educational institutions and employers in economic development (Kiryakova *et al.* 2016).

The foundation for the analysis and scientific knowledge of the productive capacity of people has been laid in the works of classical political economists. For instance, the first approach in economics to the analysis of economic forms of human activity can be found in the works of W. Petty (1940). He was one of the first to attempt to assess in monetary terms the useful properties of people and to include them into the concept of capital. In particular, W. Petty proposed a method for calculating the value of each person and the country's loss from the loss of life during war, epidemics, etc. According to W. Petty, the main assets of the country are the mastery and diligence of people. In addition, W. Petty noted that the wealth of the society depends on the nature of activities of people and their ability to work. He differentiated between useless activities and those that can improve the skills of people.

A. Smith (1980) studied the active population of working age. He assessed the skills, knowledge, and abilities of people as fixed assets that are realized in the personality, and, at the same time, are an element of production and income generation. A. Smith wrote that the increase in labor productivity primarily depends on increased agility and skills of the workers, who gained the ability to determine the wealth of society. He also put forth the idea that the wage is the money price of labor. For harder work, an employee is entitled to a salary supplement.

D. Ricardo (1955) took A. Smith's concept of production and reproduction of human abilities as a basis. In his main work titled 'Principles of Political Economy and Taxation', D. Ricardo investigated the core set of costs of the

creation of human capital, which A. Smith studied. In the formation of the nation's wealth, he assigned a special place to education, noting that the different levels of economic development of countries were caused, among other reasons, by the lack of education in various segments of the population. In his works, D. Ricardo commonly uses the terms 'labor force', including in this concept the people who work for hire. However, this concept does not take into account the creative potential of people.

G. Bekker, who worked with T. Schultz (1964) on this issue, made the greatest contribution in developing the categorical framework of the theory of human capital. His radical work 'Human Capital: A Theoretical and Empirical Analysis' is considered classical in the scientific world; its content set the direction for the research of human capital (Bekker 1964). According to G.S. Becker (1964), a new group of owners – the owners of human capital – emerged and developed alongside the owners of the means of production. For instance, unskilled workers become capitalists if the knowledge and skills they acquire have economic value. He argued that human capital is formed at the expense of investments in people. It included the cost of getting general and vocational education, expenses for the education of children, healthcare, information search, career change, migration, etc. These investments contribute to the development of human productive forces and promote cultural and intellectual growth. This shows that Mr. G.S. Becker (1964) regarded human capital in the broad sense, because it covered a set of human abilities. However, the narrowness of this interpretation is that it did not cover the natural origins of human capital. Moreover, Mr. G.S. Becker (1964) did not consider the factors that may limit any investment. For instance, in order to invest in the acquisition of professional skills, the individual should be healthy and capable of potential labor. In addition, Mr. Becker showed that many decisions made in the family (marriage, number of children, their education, etc.) are made as an investment decision.

T. Schultz and H. Becker (1964) defended the idea of the equal role of human capital and material resources in the creation of the gross domestic product. In fact, T. Schultz (1964) developed the basic model of the theory of human capital, while Mr. G.S. Becker was the first to consider the concept of human capital at the micro-level. In G.S. Becker's book 'Human Capital' (1964), he noted that the cost of the acquisition of knowledge and skills brought tangible benefits both for the employee and for the employer. For instance, he calculated the cost efficiency of education – the cost of education includes not only direct costs, but also opportunity costs – lost income during training or the value of the time spent studying. G.S. Becker (1964) calculated the return from investment in education as the ratio of revenues to costs, with about 12-14% of annual profit. He was the first to determine the cost efficiency of education using a statistically valid estimate.

J. Mincer, G. Becker's (1974) student, contributed considerably to the development of the concept of human capital. In his book 'Schooling, Experience and Earnings' he expanded the regression analysis of the relationship between the amount of income and years of schooling and introduced the indicator of time since graduation to measure production training and experience. He used extensive statistical material to prove that being educated was financially profitable primarily for students themselves.

In the Soviet political economy, the theories of Marxism regarding the reproduction of labor force were scientifically supplemented by the theory of unity of reproduction phases. For instance, A. Kotlyar (1967) substantiated the necessity of considering the reproduction of labor force in a socialist society alongside the reproduction of the social product. However, he argued that the process included the formation, i.e. production of the labor force, its distribution and utilization (Kotlyar 1976). These views were shared by a number of economists, who, based on Marx's methodology, distinguished the following phases in the reproduction of labor force: production of labor force, its exchange, distribution and utilization (Sharon 1997). At the same time, new perspectives appeared that were not based on the Western developments in the interpretation of the theory of human capital. R. Kapelyushnikov (1981) pointed out that the concept of 'human capital' explored the internal structure of human productive forces, specific processes of production and reproduction, the boundaries and the entire system of this specific economic sector, which classic authors of Marxism called 'economies of the second kind'.

The ideas of classical political economists, such as W. Petty (1940), A. Smith (1980), and D. Ricardo (1955), remained definitive for the economic thought during the nineteenth century. However, at the end of the nineteenth century, economists began to realize that society was undergoing important changes, which brought the human factor to the forefront. This formed a number of areas and schools that substantiated theoretically the socioeconomic and socio-psychological nature of people and their productive abilities.

A. Marshall (1993), one of the most influential leaders of neoclassical economics, had a significant impact on the development of the human capital theory in the early twentieth century. In his work titled 'Principles of Economics', he noted that all economic studies should be aimed at developing the human race, i.e. at increasing the population, promoting health, increasing human knowledge and abilities, and enriching the traits of the human character. At the same time, he abandoned the idea of 'human capital' and called it unrealistic. A. Marshall (1993) went back to the

neoclassical position, which regarded the production factor of labor as an economic form of human productive abilities movement. At the same time, he understood labor as any mental or physical efforts, aimed at achieving any result. He introduced the concepts of 'marginal worker' and 'marginal productivity' to describe the mechanism of demand on the labor market.

Labor is undoubtedly the main driving force of production. Public reproduction in the wide macroeconomic aspect is the return to the production of commodities and reproduction of the workforce itself. However, the concept of 'labor' does not reflect the aspect of investment and does not show capital investments in the development of working abilities. It does not fully reflect the major role of people in the economy, who not only affect the real capital, but also manage it. The individual is required to have not only professional knowledge, but also the ability to make economically reasonable managerial decisions. At that, the quality of workforce reflects the aggregate of human traits, including skills and such personality traits as physiological and socio-psychological traits (state of health, mental abilities), adaptability, flexibility, mobility, motivation, etc. (Billsberri 1999).

The concepts of 'human capital' and 'labor force' denote a single entity of a producing human, a human as a productive force of the society and the subject of production relations. At that, 'labor force' acts as the basic category, *i.e.* labor force is the beginning and substance with respect to human capital. A. Kotlyar (1976) noted that this role belonged to labor force due to the fact that it had the highest level of abstraction, and thus expressed the substance of a higher order. All other related categories are closer to the surface of the studied object and characterize only one of its many aspects. The common point that unites the categories of 'labor' and 'human capital' is the person's ability to work.

Certain elements of the theory of human capital were developed by the first half of the twentieth century. However, these developments were not organized into any system. Scientists were more interested in the use of labor, rather than issues of human capital formation. Despite the existence of theoretical prerequisites for the formation of the theory of human capital, the necessary and objectively determined practical conditions had not yet emerged.

In the 1960s, disjointed scientific knowledge evolved into a holistic concept of human capital. This resulted from development of both the economy theory in general and practice of national economic management in particular. In this context, the theory of human capital can be viewed as a manifestation of the general trend, dubbed 'economic imperialism' (Kapelyushnikov 1981). At that time, the 'human capital' concept was based on two independent theories: the theory of 'investment in people' and the theory of 'production of human capital'.

## 2. Methods and Materials

The research used the following methods: systems analysis, synthesis, systematization and generalization of facts, modeling, comparison, description, and analogy.

The research was based on the 2015 Human Development Report. The Human Development Index (HDI) is a composite indicator of the level of human development in this or that country. HDI measures the achievements of a country in terms of health, education, and gross national income (GNI) per capita by three main dimensions, which implies the assessment of individual indexes:

- (1) Life expectancy index: long and health life, measured by the life expectancy at birth.
- (2) Education index: accessibility of education, measured by mean years of schooling and expected years of schooling.
- (3) GNI per capita index: a decent standard of living, measured by GNI per capita by purchasing power parity in US dollars (PPP \$).

In addition, the Innovation Union Scoreboard (1) was used to assess the level of innovation development of national systems. In this Scoreboard, the indicators of innovation activity are grouped into three blocks: enablers; firm activities; outputs.

This methodology of assessing the innovation activity of national economic systems is based on the determination of trends in the main economic indicators, the most important of which are the analysis of human capital, new doctorate graduates, population completed tertiary education, international scientific co-publications, and scientific publications among top 10% most cited.

Canonical analysis was used to assess the interrelation of the three groups of indicators (effect of costs on the innovation activity, the economic results of innovation activity, and living standard).

## 3. Results

The analysis of scientific publications enabled distinguishing three stages in the development of theories of human capital.

The first stage (early 1960s) is characterized by the appearance of the 'human capital' concept and increased scientific interest to studying this concept. During the first stage, researchers interpreted human capital simply as knowledge, skills, and abilities of an individual. Financial methods of human capital estimation were used in the analysis. In addition, issues of accounting investment in human capital and assessing its effectiveness were investigated in the works of several researchers (Hermanson 1964).

The second stage (1970-1990) featured a loss of the interest in 'human capital'. The structure of human capital included such components as investments and professional mobility. 'Investments' implied the investments in health protection and support, occupational training and development, population mobility for changing conditions of employment, and the search for necessary information.

The third stage of the evolution of the 'human capital' concept began in the early 1990s. This stage is ongoing. During this stage, the studied concept is regarded in the 'broad' interpretation, as a source of competitive advantage. Initial components of human capital (education, healthcare, and professional mobility) are supplemented by motivation, obligations, and peculiarities of workers' behavior. Since the problem of estimating human capital using financial indicators was not solved, scientists suggested considering not only the amount of human capital, but also that, which was created using human capital.

During all three stages, the structure of the 'human capital' concept became more complex – from a single basic component (education) to the inclusion of health, cultural, and economic components (Table 1). Changes also occurred in the assessment of human capital. Initial indicators, which took into account the financial aspects, were supplemented by indicators that characterized the intangible aspect of human capital. In addition, estimations now concerned not only the amount of human capital, but also the added value, created by it.

**Table 1.** Evolution of the 'human capital' concept and changes in approaches to its assessment

| Stage period  | Early 1960s   | 1970-1990  | Early 1990s –present day                           |
|---|---|--|--|
| Change of interest in studying the 'human capital' category | Great interest in the new concept                         | Loss of interest in the concept  | Renewed interest in the concept                    |
| Interpretation of the 'human capital' concept               | Human capital as knowledge and skills                     | Investments in education and health  | Human capital as a source of competitive advantage |
| Research methods and features                               | Predominance of financial methods assessing human capital | Not only the amount of human capital, but also that, which was created using it was considered. Financial indicators and parameters were used to estimate intangible components. |  |

**Source:** Česynienė and Stankevičienė (2001).

According to the Human Development Report (Human Development Report ), published by the UN, 49 states had a very high level of human development, including Norway (0.944), Australia (0.935), Switzerland (0.930), and other countries; 56 states had a high level of human development, including Belarus and the Russian Federation – 0.789, Oman, Romania, and Uruguay – 0.793, Bahamas – 0.790, and other countries; 39 countries had a medium level of human development, including Botswana – 0.698, Moldova – 0.693, Egypt – 0.690, and other countries; 44 countries had a low level of human development, including Kenia and Nepal – 0.548, Pakistan – 0.539, Myanmar – 0.536, and other countries (Table 1).

**Table 2.** Human Development (2) Index and its components (2015)

| HDI rank                    | Country   | Human Development Index (HDI) | Life expectancy at birth, years | Expected years of schooling, years | Mean years of schooling, years | Gross national income (GNI) per capita, (2011 PPP \$) | GNI per capita rank minus HDI rank |
|-----------------------------|-----------|-------------------------------|---------------------------------|------------------------------------|--------------------------------|---|------------------------------------|
| Very High Human Development |           |                               |                                 |                                    |                                |   |                                    |
| 1                           | Norway    | 0.944                         | 81.6                            | 17.5                               | 12.6                           | 64,992  | 5                                  |
| 2                           | Australia | 0.935                         | 82.4                            | 20.2                               | 13.0                           | 42,261  | 17                                 |



| HDI rank                        | Country               | Human Development Index (HDI) | Life expectancy at birth, years | Expected years of schooling, years | Mean years of schooling, years | Gross national income (GNI) per capita, (2011 PPP \$) | GNI per capita rank minus HDI rank |
|---------------------------------|-----------------------|-------------------------------|---------------------------------|------------------------------------|--------------------------------|---|------------------------------------|
| 3                               | Switzerland           | 0.930                         | 83.0                            | 15.8                               | 12.8                           | 56,431  | 6                                  |
| 4                               | Denmark               | 0.923                         | 80.2                            | 18.7                               | 12.7                           | 44,025  | 11                                 |
| 5                               | Netherlands           | 0.922                         | 81.6                            | 17.9                               | 11.9                           | 45,435  | 9                                  |
| 48                              | Kuwait                | 0.816                         | 74.4                            | 14.7                               | 7.2                            | 83,961  | -46                                |
| 49                              | Montenegro            | 0.802                         | 76.2                            | 15.2                               | 11.2                           | 14,558  | 27                                 |
| <b>High Human Development</b>   |                       |                               |                                 |                                    |                                |   |                                    |
| 50                              | Belarus               | 0.798                         | 71.3                            | 15.7                               | 12.0                           | 16,676  | 14                                 |
| 50                              | Russian Federation    | 0.798                         | 70.1                            | 14.7                               | 12.0                           | 22,352  | -1                                 |
| 56                              | Kazakhstan            | 0.788                         | 69.4                            | 15.0                               | 11.4                           | 20,867  | -1                                 |
| 104                             | Maldives              | 0.706                         | 76.8                            | 13.0                               | 5.8                            | 12,328  | -19                                |
| 105                             | Samoa                 | 0.702                         | 73.4                            | 12.9                               | 10.3                           | 5,327   | 24                                 |
| <b>Medium Human Development</b> |                       |                               |                                 |                                    |                                |   |                                    |
| 106                             | Botswana              | 0.698                         | 64.5                            | 12.5                               | 8.9                            | 16,646  | -41                                |
| 107                             | Moldova (Republic of) | 0.693                         | 71.6                            | 11.9                               | 11.2                           | 5,223   | 23                                 |
| 143                             | Sao Tome and Principe | 0.555                         | 66.5                            | 11.3                               | 4.7                            | 2,918   | 8                                  |
| <b>Low Human Development</b>    |                       |                               |                                 |                                    |                                |   |                                    |
| 145                             | Kenya                 | 0.548                         | 61.6                            | 11.0                               | 6.3                            | 2,762   | 9                                  |
| 145                             | Nepal                 | 0.548                         | 69.6                            | 12.4                               | 3.3                            | 2,311   | 16                                 |
| 188                             | Niger                 | 0.348                         | 61.4                            | 5.4                                | 1.5                            | 908   | -5                                 |

The descriptive statistics of the four categories of countries by human development showed the following. In the group of countries with very high HDI, this index was 0.87 on average, standard deviation of 0.03, with explicit excess (-1.2). In general, it is worth noting that the distribution of countries by HDI in this group is close to the standard normal distribution of values.

In the group of countries with high HDI, the mean value was 0.751, while the dispersion of the analyzed index was minimum when compared to other studied groups – the standard deviation was 0.02, excess was also explicit, as in the previous group (-1.2).

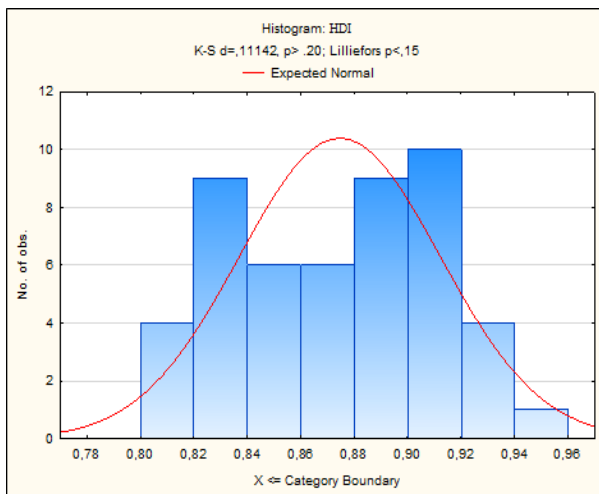
The mean value for the group of countries with medium HDI was 0.632, with 0.04 standard deviation and explicit excess (-1.2). Asymmetry was virtually absent in the distribution of countries by HDI in these three groups; it was close to the standard normal distribution of values.

However, in the group of countries with low HDI, the mean value was 0.467 with 0.05 standard deviation (the highest among the analyzed groups), which shows a considerable dispersion of this index. This hypothesis is confirmed by the asymmetry value (-0.47), hence, this distribution series is characterized by right asymmetry (Table 2, Table 3).

**Table 3.** Descriptive statistics for groups of countries by HDI

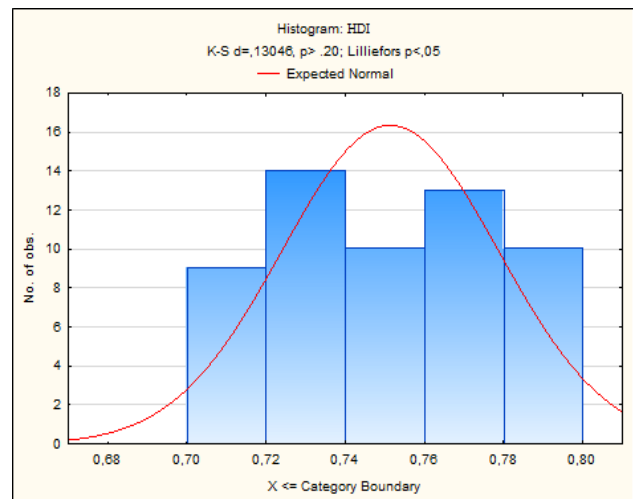
| Descriptive statistics | Very High Human Development | High Human Development | Medium Human Development | Low Human Development |
|------------------------|-----------------------------|------------------------|--------------------------|-----------------------|
| Valid N                | 49                          | 56                     | 39                       | 44                    |
| Mean                   | 0.875                       | 0.751                  | 0.632                    | 0.468                 |
| Geometric              | 0.874                       | 0.751                  | 0.631                    | 0.465                 |
| Harmonic               | 0.873                       | 0.750                  | 0.629                    | 0.462                 |
| Median                 | 0.880                       | 0.752                  | 0.631                    | 0.480                 |
| Mode                   | Multiple                    | Multiple               | 0.666                    | 0.483                 |
| Frequency              | 2.000                       | 3.000                  | 3.000                    | 3.000                 |
| Sum                    | 42.859                      | 42.078                 | 24.656                   | 20.589                |
| Minimum                | 0.802                       | 0.702                  | 0.555                    | 0.348                 |
| Maximum                | 0.944                       | 0.798                  | 0.698                    | 0.548                 |
| Range                  | 0.142                       | 0.096                  | 0.143                    | 0.200                 |
| Variance               | 0.001                       | 0.001                  | 0.002                    | 0.003                 |
| Std.Dev.               | 0.038                       | 0.027                  | 0.043                    | 0.052                 |
| Skewness               | -0.089                      | 0.072                  | -0.148                   | -0.479                |
| Kurtosis               | -1.207                      | -1.242                 | -1.236                   | -0.511                |

Very High Human Development



Medium Human Development

High Human Development



Low Human Development

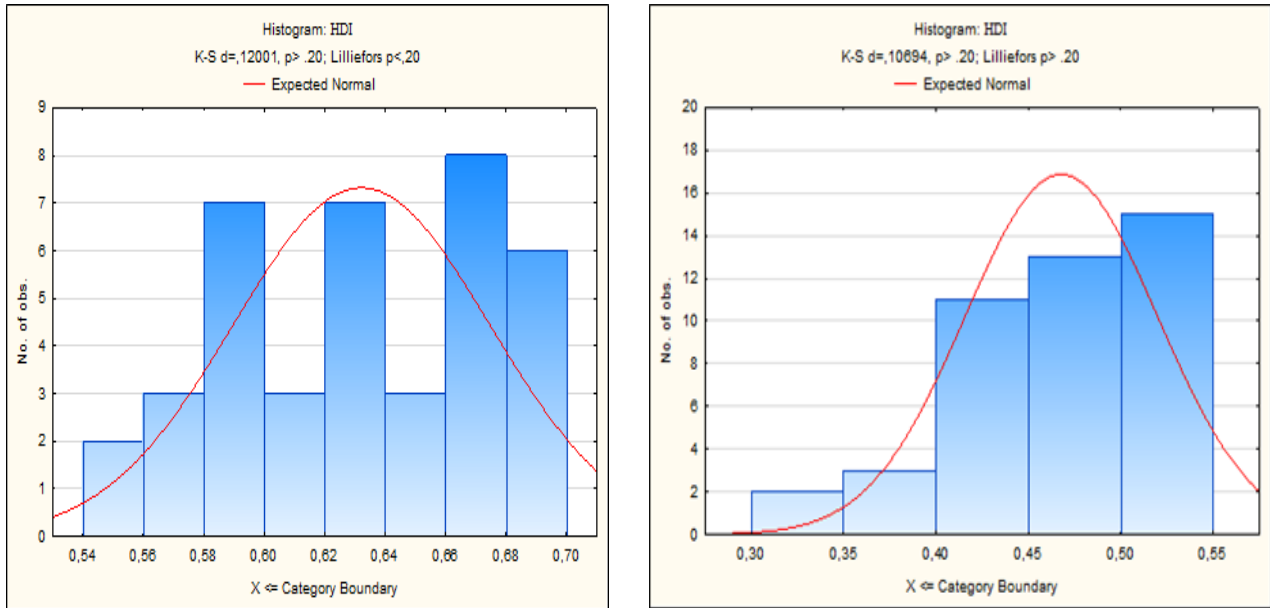


Figure 1. Histograms of distribution for groups of countries by HDI

Nowadays, most national economic systems are in a state of transition as they try to achieve a new level of growth in an innovation economy. The European Innovation Scoreboard best characterizes the level of innovation development of national innovation systems in comparable assessments.

According to the results of 2015, the leader in terms of the Summary Innovation Index (SII) was Switzerland (0.810), followed by Sweden (0.740), and Denmark (0.736). Of the 34 countries included in the European Innovation Scoreboard, the ‘outsiders’ were FYR of Macedonia (0.247), Bulgaria (0.229), and Romania (0.204) (Figure 2).

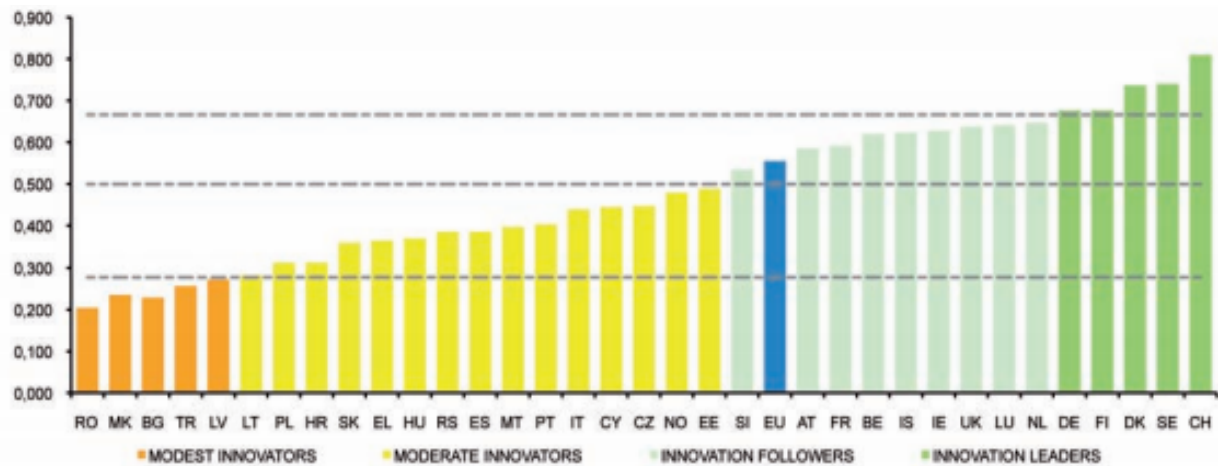


Figure 2. Country rankings by Summary Innovation Index

The analysis of the inequality-adjusted human development index in combinations with the indexes that characterize the level of innovation development lays a scientific foundation for the discovery of negative processes in the post-crisis restoration of national economic systems.

It is expedient to investigate the concept of ‘living standard’ in combination with the innovation development indexes, since in a humanism-oriented socioeconomic system, the realization of the innovation potential manifests in the improvement of the standard of living. The income index, the life expectancy index, and the Gini index were the social indicators of choice.

The research, based on the economic and statistical modeling, found a significant dependency between the three groups of indicators. By using the values of all canonical roots and the values of variables in the right set (indicators of



innovation activity results and indicators of the standard of living), it is possible to explain the mean 62.1% dispersion of variables in the left set (indicators of innovation activity cost).

Similarly, it is possible to explain the 48.4% variability in the right group by the values of variables in the left set. These results show a significant dependency between the variables in the two sets. The adequacy of obtained results confirms the high canonical value of the correlation coefficient (0.94), which is statistically significant ( $p < 0.01$ ) (Table 4).

**Table 4.** Results of the canonical analysis

| Results of the canonical analysis          |   |   |
|--|---|---|
| Canonical correlation coefficient: 0.94253 |   |   |
| Chi-squared (117)=178.99 $p=0.00015$       |   |   |
| N=34                                       | Left set  | Right set   |
| Number of variables                        | 10  | 13  |
| Derived dispersion                         | 100.0%  | 74.0%   |
| Total excess                               | 62.1%   | 48.4%   |
| Variables                                  |   |   |
| 1  | Graduates with specializations in S&E and SSH             | Income index  |
| 2  | Doctors of Sciences in S&E and SSH                        | Life expectancy index                                   |
| 3  | Level of tertiary education                               | Gini index  |
| 4  | Continuous education                                      | Technological innovators                                |
| 5  | Level of youth achievements in education                  | Marketing and organizational innovators                 |
| 6  | Public expenses on research and development               | Workforce-cost-reducing innovators                      |
| 7  | Venture capital, in % of GDP                              | Innovators that saved raw materials and energy          |
| 8  | Investment of loan proceeds in fixed capital, in % of GPD | Employment in medium-tech and hi-tech production        |
| 9  | Broadband Internet access in companies                    | Employment in the field of knowledge-intensive services |
| 10   |   | Medium- and hi-tech export                              |
| 11   |   | Export of knowledge-intensive services                  |
| 12   |   | 'New to the market' products                            |
| 13   |   | 'New to the company' products                           |

The analysis of the factor structure showed that if the cost of innovation activity is regarded as an explanatory variable, it is possible to argue that it largely affects employment in the field of knowledge-intensive services (0.7 correlation coefficient), technological innovation (0.6), export of knowledge-intensive services (0.4), and, in terms of social indicators, the life expectancy index (0.9). With that, the largest cost of innovation activity is characteristic of public expenses on research and development (0.6), venture capital (0.5), investment of loan proceeds in fixed capital (0.5), and continuous education (0.5).

#### 4. Discussion

It is worth noting that the European Innovation Scoreboard methodology analyzes the results of innovation activity by economic effects only. This does not reflect fully the specificity of national innovation systems, since the ultimate goal of an innovation economy is to ensure the wellbeing of people. Production and diffusion of innovation are the intermediate

tools for improving the standard of living. In order to assess the results of innovation activity, it is necessary to take into consideration the social indicators that characterize the standard of living, in addition to economic effects.

It became clear that the economic returns of employee training costs significantly exceed the investment in new machinery and equipment. The confirmation of these findings led to an intensive development of occupational training at enterprises in Western countries. Improved general and, especially, occupational training not only generated profit for entrepreneurs, but also helped improve job satisfaction and employee productivity. Later studies lack consensus regarding the definition and content of human capital, which can be explained by the complexity of this phenomenon. For instance, E. Dolan and J. Lindsay (1992) regarded human capital as a form of intelligence, obtained through formal training or experience.

In the late nineteenth and early twentieth century, some economists argued that capital was not the person himself, but his or her inherited and acquired ability to work, and such qualities as education and skills. For instance, according to J. Mill (1980) the human being in and of itself is not capital. However, his or her acquired abilities, which can be realized only through labor, rightly belong to the category of capital. This confirms the thesis that the wealth of the country should include skills, energy, and determination of workers.

## Conclusion

The existence of a narrow, extended, and broad definition of human capital indicates the gradual development of this concept as an economic category. During the first stage, human capital included only education. Its extended interpretation included education, training, knowledge (science), health, information services, culture, and art. In its broad sense, human capital is an intensive production factor of economic, social and family development. It includes the educated part of the labor force, knowledge, tools of intellectual and managerial labor, and the living and labor environment. In other words, the broad definition of human capital, which includes investment in training specialists from their birth, investment in the quality of their life and work, makes the concept of human capital systematic and comprehensive. This corresponds with its real essence and the leading role in the formation and development of the innovative economy.

The economic and mathematical modeling found a canonical relation between the innovation activity indicators and the human development indexes. The analysis found that leading countries were characterized by a correspondence of high cost and results of innovation activity. At that, the leading countries in terms of human and intellectual capital development and also the leaders in terms of innovation activity results, standard of living, and human development. The task of regulating and developing the human potential is a strategically important function of the state. It is worth noting that the establishment of an innovation economy in developing countries could help to solve not only economic, but also social problems, including the improvement of the standard of living, emergence and development of new economic sectors, and improvement of the effectiveness and competitiveness of innovation activity. In addition, the transition to a postindustrial economy will help developing countries to 'catch up' to the developed ones and intensify international integration.

The obtained results can be used to further develop the generalized conceptual models in the management of innovation and modernization, based on the activation of the human capital in modern economic systems.

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