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THE KEY DETERMINANTS OF THE INNOVATIVE ORIENTED ECONOMIES FORMING IN THE CONTEXT OF THE WORLD'S COUNTRIES PROSPERITY ENSURING

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SUMMARY

The paper is devoted to the evaluation the impact of key determinants of innovation development and ensuring the worlds' countries prosperity and working out the ways of increasing the innovative economic growth. By using the international statistic data of 40-ty countries, there were analyzed such indicators, as the level of GDP per capita and other indicators, such as expenditure on education, tertiary enrolment, graduates in science & engineering, number of researchers, gross expenditure on R&D, knowledge-intensive employment, intellectual property payments, high-tech imports, high-tech net exports and creative goods exports. As a result of calculating pairwise correlation coefficients between indicators, it was determined, that the most significant influence on the level of GDP per capita make such three variables: number of researchers, gross expenditure on R&D, knowledge-intensive employment. There were suggested the main directions of innovative development and prosperity raising for four groups of actors within the Quadruple Helix Model: state (government), universities and scientific institutions, business, civil society.
Keywords: innovation, prosperity, human resources, research activity, education, expenditure, knowledge, high-tech technology, creativity

INTRODUCTION

Under modern conditions, the development of innovative model of the economy and the worlds' countries prosperity depend on many factors. The most important among these factors are the development of human resources, research activity, quality of education, financial and organizational support for innovation and others. Nowadays a significant differentiation between the countries of the world in terms of GDP per capita, income, opportunities for intellectual development, quality of life exists. That's why it is necessary to analyze the key determinants of the impact on the level of countries economic development and prosperity, to justify the relevant areas for improvement in the current and long terms.

Literature review. The key determinants of innovative development in the international dimension are the subject of scientific research of many authors. So, some scientists focus on the "relevance of innovation oriented and human resource development policy that impacts small and medium enterprises' new markets and products" (Kuntonbutr C., Jaturat N., Tsutomu Konosu T., & Wilairatana P., 2017) [1].
The World Bank Experts emphasize on "three central determinants of innovation performance: the critical complements to innovation investment needed to realize the high potential returns; the range of firm capabilities required to undertake innovation and take it to market; and the required government capabilities for implementing effective innovation policies" (Cirera, Xavier, & William F. Maloney, 2017) [2].
It's very important to take into account, that the "innovation goes beyond science and technology, and involves investments in a wide range of knowledge-based assets that extend beyond research and development" (OECD, 2015) [3]. Under the modern conditions, "scientific development, technological development, innovations increasing competitiveness, economic growth and development lead to welfare of nations increasing" (Sefer Şener and Ercan Saridoğan, 2011) [4]. We agree with the affirmation, that the "growth or economic performance is relevant for evaluating competitiveness but a number of other factors such as environment, quality of life, technology, knowledge transfer, and scientific research could be more important" (Dima A.M., Begu L., Vasilescu M.D. & Maassen M.A., 2018) [5]. The main factors of innovation process activation also can be divided into "legislative, normative, research, personnel, financial, material and resource, technological, infrastructure, informational and communicative" (Levchenko O., Tkachuk O., Tsarenko I., 2019) [6]. So, the above mentioned actualizes the need of "increasing the flow and accessibility of investment to new ideas, inventions, human capital, increasing the level of technological transfers of innovations, innovative counseling of all participants in the innovation process" (Yurynets Z., Bayda B., Petrukh O., 2015) [7].
Despite on the significant interest of scientists in the issues of innovative development and countries' prosperity increasing, it's necessary to conduct more detailed analysis, taking into account the conditions of the external and internal environment, which are constantly changing.

Purpose of the study. The aim of the paper is to assess the impact of key determinants of innovation development and ensuring the worlds' countries prosperity through the comparative analysis of statistic data and to develop the effective measures of accelerating the economic growth on the innovative basis.

Results. The working hypothesis of our study is to predict the relationship between the level of GDP per capita and other indicators, such as expenditure on education, tertiary enrolment, graduates in science & engineering, number of researchers, gross expenditure on R&D, knowledge-intensive employment, intellectual property payments, high-tech imports, high-tech net exports and creative goods exports. For the analysis, we selected 40 countries, including the most developed countries in Europe and the world, as well as post-Soviet countries (Table 1).

Table 1 – The data for analysis of innovation development and the worlds' countries prosperity

	GDP per capita, PPP$	Expenditure on education, % GDP	Tertiary enrolment, % gross	Graduates in science & engineering, %	Researchers, FTE/mn pop	Gross expenditure on R&D, % GDP	Knowledge-intensive employment, %	Intellectual property payments, % total trade	High-tech imports, % total trade	High-tech net exports, % total trade	Creative goods exports, % total trade
Armenia	10176,1	2,8	52,2	14,7	x	0,2	29,4	0,0	4,8	0,6	0,6
Austria	52137,4	5,5	86,3	30,3	5439,8	3,2	41,6	0,8	8,2	7,5	0,9
Azerbaijan	18075,9	2,9	27,1	23,6	x	0,2	23,3	0,1	2,8	0,1	0,0
Belarus	20003,0	4,8	86,7	33,2	x	0,6	39,2	0,4	5,1	1,8	0,4
Belgium	48244,7	6,6	75,9	17,1	4905,5	2,6	47,6	0,8	7,4	8,1	1,6
Bulgaria	23155,6	4,1	71,2	19,7	2130,5	0,8	31,4	0,5	6,7	3,8	0,8
Canada	49651,2	5,3	67,0	21,3	4274,7	1,7	43,7	2,2	10,0	4,9	1,0
China	18109,8	x	51,0	x	1234,8	2,1	x	1,1	23,3	27,9	11,9
Croatia	26221,4	4,6	67,5	25,3	1865,4	0,9	36,3	1,1	6,1	3,1	0,8
the Czech Republic	37371,0	5,8	63,7	23,5	3689,9	1,8	38,0	0,8	17,4	17,1	10,1
Denmark	52120,5	7,6	81,1	21,0	7923,2	3,1	46,3	1,0	5,7	5,2	1,6
Estonia	34095,8	5,2	71,4	27,5	3568,9	1,3	45,5	0,3	9,6	8,6	1,4
Finland	46429,5	7,1	87,0	29,5	6707,5	2,8	47,4	1,0	7,7	4,4	0,5
France	45775,1	5,5	64,4	25,6	4441,1	2,2	45,1	1,9	10,8	12,8	1,7
Georgia	11485,4	3,8	57,5	21,9	1336,6	0,3	25,3	0,2	7,5	0,3	0,1
Germany	52558,7	4,8	68,3	36,0	5036,2	3,0	44,7	0,8	9,6	11,5	2,2
Greece	29123,0	x	x	28,2	3152,8	1,1	29,8	0,5	5,4	2,0	1,1
Hungary	31902,7	4,6	48,0	22,8	2924,0	1,4	34,3	1,5	13,2	12,5	6,1
Italy	39637,0	4,1	63,0	23,3	2294,5	1,4	36,1	0,9	6,7	5,3	2,2
Japan	44227,2	3,5	x	x	5304,9	3,2	25,2	2,4	13,8	12,1	2,0
Kazakhstan	27549,8	2,9	53,3	24,8	687,6	0,1	33,3	0,3	6,5	3,6	0,1
Latvia	29901,3	5,3	88,1	20,5	1785,9	0,5	42,1	0,2	11,9	7,4	3,1
Lithuania	34825,8	4,2	71,1	23,8	3013,2	0,9	41,8	0,2	6,5	5,9	2,0

the Netherlands	56383,2	5,4	80,4	14,1	5007,1	2,0	46,8	8,1	11,5	11,2	4,1
Norway	74356,1	7,6	82,0	20,5	6407,5	2,1	52,5	0,4	6,6	3,0	0,5
Poland	31938,7	4,8	66,6	22,9	3001,9	1,0	38,6	1,1	9,3	6,5	4,4
Portugal	32006,4	4,9	62,9	29,0	4350,5	1,3	36,1	0,9	6,9	2,7	1,5
the Republic of Moldova	7304,5	6,7	41,1	22,3	723,9	0,3	26,5	0,5	7,4	0,7	0,2
Romania	26446,7	3,1	48,0	28,8	890,2	0,5	23,3	1,0	9,8	4,2	0,7
Serbia	17555,2	3,9	66,5	26,6	2079,1	0,9	28,5	1,0	5,4	1,6	0,7
Slovakia	35129,8	4,6	47,8	21,1	2795,0	0,9	32,0	0,8	13,4	9,2	8,5
Slovenia	36745,9	4,9	77,6	25,0	4467,8	1,9	43,1	0,7	5,4	4,5	1,0
Spain	40138,8	4,3	91,2	23,9	2873,4	1,2	33,2	1,2	6,8	3,9	0,9
Sweden	52984,1	7,6	63,5	26,6	7268,2	3,4	52,3	1,7	7,8	7,3	1,8
Switzerland	64649,1	5,1	57,9	24,5	5257,4	3,4	52,9	3,1	6,1	7,2	3,8
Tajikistan	3415,8	5,2	30,9	22,0	x	0,1	16,1	0,0	x	x	x
Turkey	27956,1	4,3	x	20,2	1385,8	1,0	21,0	0,3	9,9	1,4	2,9
Ukraine	9283,4	5,0	83,4	24,2	1119,5	0,4	36,9	0,7	8,8	2,0	0,2
the United Kingdom	45704,6	5,5	59,4	26,3	4377,0	1,7	48,6	1,5	11,9	9,0	2,9
the United States of America	62605,6	5,0	88,8	17,9	4256,3	2,8	47,3	1,8	17,2	5,8	3,3

Source: formed by the authors at the base of The Global Innovation Index 2019 [8].

As we can see from the Fig. 1, the level of GDP per capita among the selected countries is very different. So, in Norway the meaning of this indicator is 74356,1 PPP$, in Switzerland – 64649,1 PPP$, in the United States of America – 62605,6 PPP$, in the Netherlands – 56383,2 PPP$. At the same time, the majority of post-Soviet countries have much lower level of GDP per capita. The most positive situation among them is observed in Lithuania (34825,8 PPP$), Estonia (34095,8 PPP$) and Latvia (29901,3 PPP$). Lower meanings take place in Georgia (11485,4 PPP$), Armenia (10176,1 PPP$), Ukraine (9283,4 PPP$), the Republic of Moldova (7304,5 PPP$), Tajikistan (3415,8 PPP$).

Another important indicator is the expenditure on education (% of GDP). From Fig. 2 we can predict, that the quality of education in different countries depends mostly on the value of absolute expenditure on education for one student, than on the percentage value

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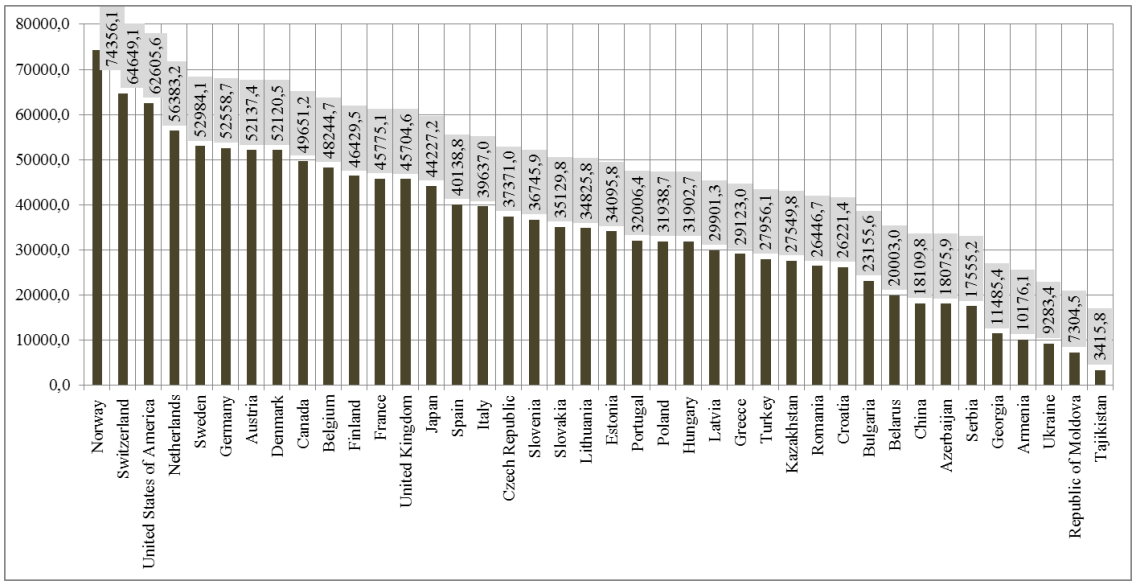

Figure 1. The rating of the countries by level of GDP per capita in 2019, PPP$
Source: formed by the authors at the base of The Global Innovation Index 2019 [8].

For example, the percentage value of expenditure on education is the same in Ukraine (5,0% GDP) and in the United States of America (5,0% GDP). But, the countries with a low level of GDP spend on the education much smaller, even if the percentage value of expenditure is rather high.

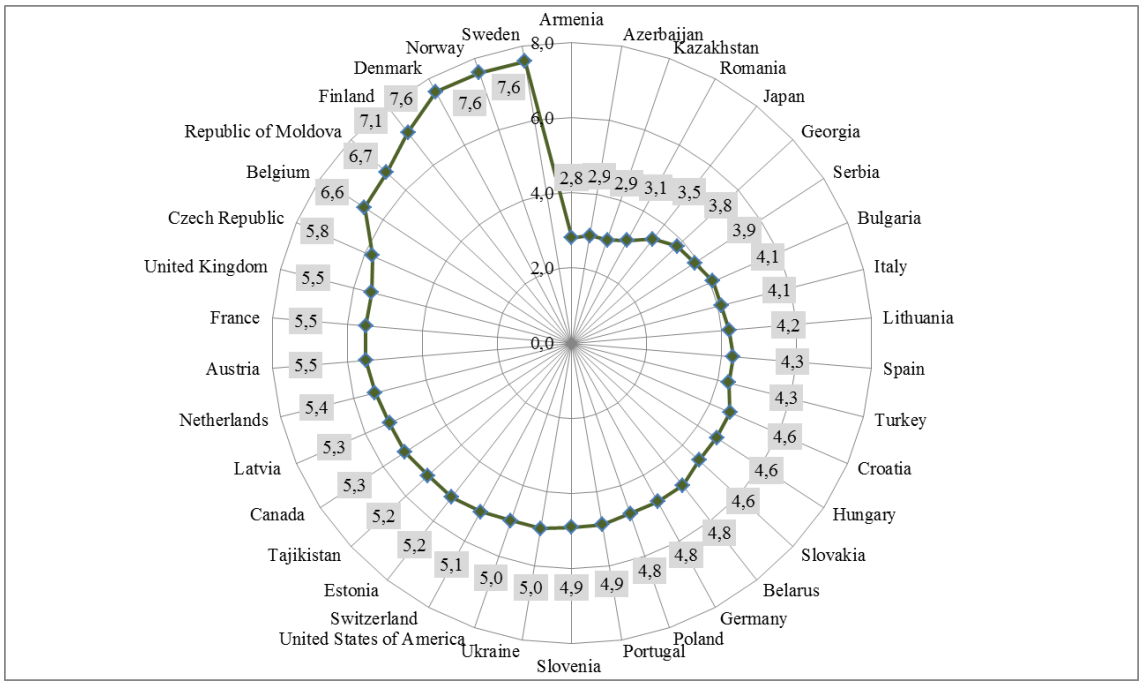

Figure 2. The rating of the countries by level of expenditure on education in 2019, % GDP
Source: formed by the authors at the base of The Global Innovation Index 2019 [8].

The rating of the countries by the number of researches in 2019 (FTE/mn pop.) is presented on Fig. 3. As we can see, in Denmark this indicator reaches the meaning 7923,2 researches, in Sweden – 7268,2 researches, in Finland – 6707,5 researches, in the Norway – 6407,5 researches, while in Ukraine – 1119,5 researches, in Romania – 890,2 researches, in the Republic of Moldova – 723,9 researches, in Kazakhstan – only 687,6 researches.

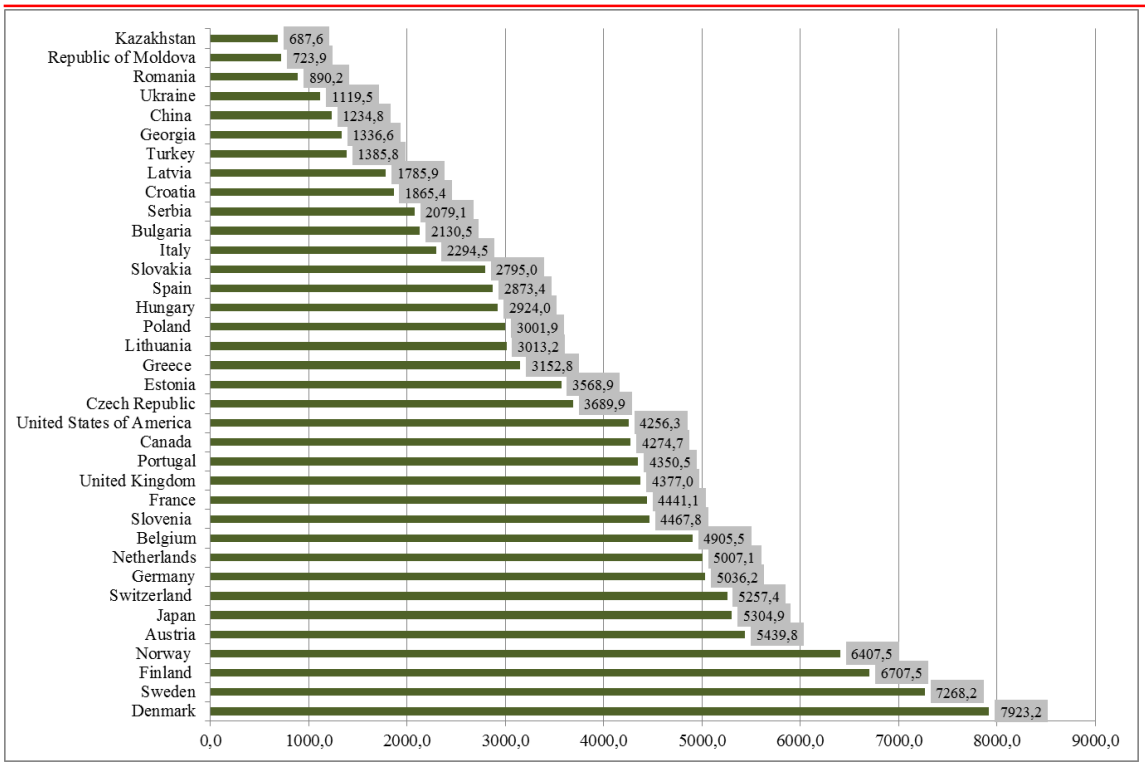

Figure 3. The rating of the countries by the number of researches in 2019, FTE/mn pop.
Source: formed by the authors at the base of The Global Innovation Index 2019 [8].

Tertiary enrolment (% of gross) among the selected group of countries fluctuates from 27,1% in Azerbaijan to 91,2% in Spain. In Ukraine this indicator is rather high – 83,4%. The weight of graduates in science & engineering reached the value 14,1% in the Netherlands (the lowest meaning among 40-ty selected countries) and 36,0% in Germany (the highest meaning among 40-ty selected countries), while in Ukraine – 24,2%.

The rating of the countries by the level of gross expenditure on R&D in 2019 (% of GDP) is shown on the Fig. 4. The lowest meanings of this indicator can be observed in Kazakhstan (0,1%), Tajikistan (0,1%), Armenia (0,2%), Azerbaijan (0,2%), Georgia (0,3%), the Republic of Moldova (0,3%) and Ukraine (0,4%). At the same time, the level of gross expenditure on R&D is much higher in Germany (3,0%), Denmark (3,1%), Austria (3,2%), Japan (3,2%), Sweden (3,4%) and Switzerland (3,4%). It's worth to highline, that the level of gross expenditure on R&D is one of the most important indicators, which significantly affects the pace of innovative development.

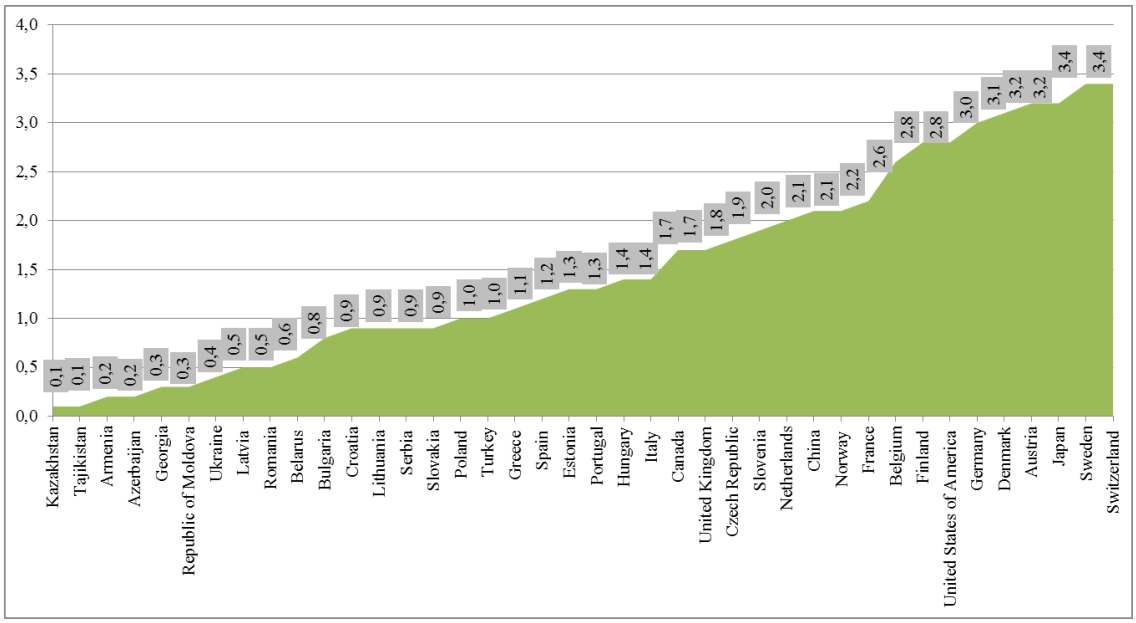

Figure 4. The rating of the countries by the level of gross expenditure on R&D in 2019, % GDP
Source: formed by the authors at the base of The Global Innovation Index 2019 [8].

The level of knowledge-intensive employment among the selected group of countries we can see on Fig. 5. The leading positions by this indicator occupy Switzerland – 52,9%, Norway – 52,5%, Sweden – 52,3% and the United Kingdom – 48,6%. The lowest meanings are observed in Azerbaijan (23,3%), Romania (23,3%), Turkey (21,0%) and Tajikistan (16,1%). In Ukraine the level of knowledge-intensive employment is 36,9%.

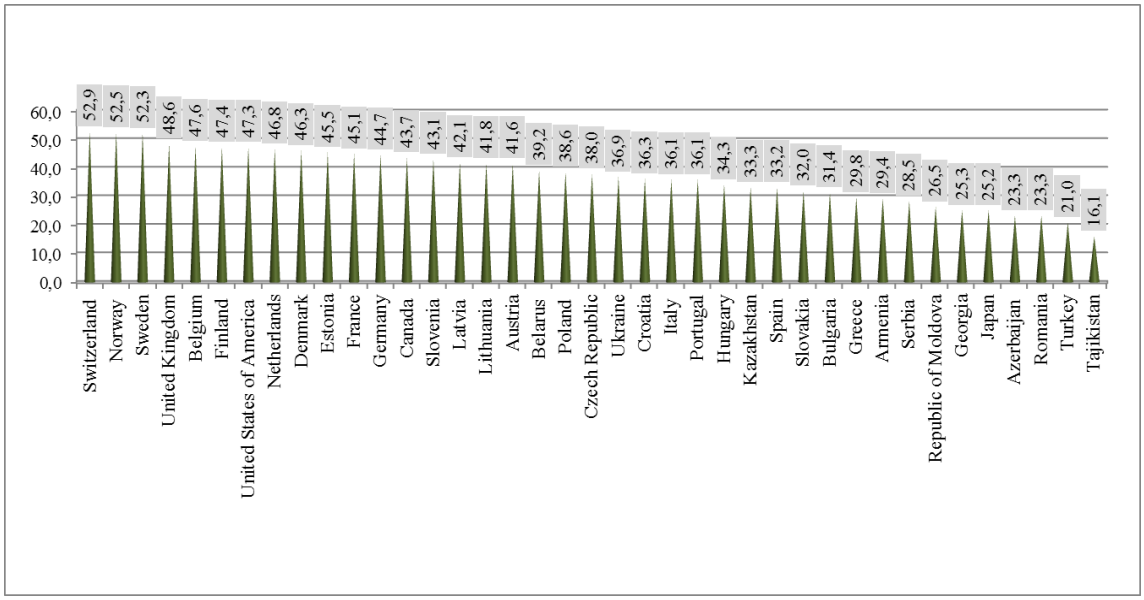

Figure 5. The rating of the countries by the level of knowledge-intensive employment in 2019, %
Source: formed by the authors at the base of The Global Innovation Index 2019 [8].

The highest level of intellectual property payments is observed in the Netherlands – 8,1% of total trade. The meanings of high-tech imports (% of total trade) fluctuate from 2,8% in Azerbaijan to 23,3% in China. The similar situation is about the level of high-tech net exports (% total trade) – 0,1% in Azerbaijan and 27,9% in China. China is also the leader of the level of creative goods exports – 11,9% of total trade.

By using the program STATISTICA 10.0, there were calculated the pairwise correlation coefficients between the above mentioned 11 indicators (Table 2).

Table 2 – The matrix for calculating pairwise correlation coefficients between indicators

	Var1	Var2	Var3	Var4	Var5	Var6	Var7	Var8	Var9	Var10	Var11
Var1	1,000	0,472	0,341	0,041	0,857	0,818	0,745	0,463	0,217	0,289	0,118
Var2	0,472	1,000	0,510	0,276	0,578	0,392	0,700	0,134	-0,157	-0,137	-0,193
Var3	0,341	0,510	1,000	0,289	0,309	0,211	0,596	0,123	0,017	0,047	-0,071
Var4	0,041	0,276	0,289	1,000	0,050	-0,102	0,420	-0,263	-0,484	-0,435	-0,412
Var5	0,857	0,578	0,309	0,050	1,000	0,882	0,703	0,384	0,139	0,278	0,065
Var6	0,818	0,392	0,211	-0,102	0,882	1,000	0,519	0,404	0,311	0,476	0,215
Var7	0,745	0,700	0,596	0,420	0,703	0,519	1,000	0,293	-0,124	-0,064	-0,199
Var8	0,463	0,134	0,123	-0,263	0,384	0,404	0,293	1,000	0,271	0,324	0,213

Var9	0,217	-0,157	0,017	-0,484	0,139	0,311	-0,124	0,271	1,000	0,825	0,802
Var10	0,289	-0,137	0,047	-0,435	0,278	0,476	-0,064	0,324	0,825	1,000	0,822
Var11	0,118	-0,193	-0,071	-0,412	0,065	0,215	-0,199	0,213	0,802	0,822	1,000

Marked correlations are significant at the level p <0,050.

Var1 – GDP per capita, PPP$; Var2 – expenditure on education, % GDP; Var3 – tertiary enrolment, % gross; Var4 – graduates in science & engineering, %; Var5 – researchers, FTE/mn pop.; Var6 – gross expenditure on R&D, % GDP; Var7 – knowledge-intensive employment, %; Var8 – intellectual property payments, % total trade; Var9 – high-tech imports, % total trade; Var10 – high-tech net exports, % total trade; Var11 – creative goods exports, % total trade.

Source: calculated by the authors at the base of The Global Innovation Index 2019 [8].

According to the results of calculating, we can make a conclusion about the presence of significant dependence between the GDP per capita with such indicators, as researchers, FTE/mn pop (r = 0,857), gross expenditure on R&D, % GDP (r = 0,818) and knowledge-intensive employment, % (r = 0,745). So, it can be supposed, that if the influence of other factors remains unchanged, these factors themselves have the greatest influence on the level of GDP per capita, consequently, on the pace of innovative development and the level of welfare of the population.

The main directions of innovation development and ensuring the worlds' countries prosperity, in our opinion, it is advisable to classify for four groups of actors within the Quadruple Helix Model:

(a) State (government): development of national innovation systems; diversification of sources of funding for research and development; preservation and development of human potential; international cooperation in the field of realization of innovative projects; protection of intellectual property rights; initiating the development of partnership on the basis of social dialogue; stimulating the development of entrepreneurial initiative; promoting the formation and development of innovative-integrated structures.

(b) Universities and research institutions: improving the quality of educational services; increasing the practical orientation of vocational education; active participation in research and development, international projects and grants; increasing the academic mobility of scientists and students; teaching students entrepreneurial skills; development of information and innovation culture; training the skills of modern information and communication technologies using; formation of powerful research centers on their base.

(c) Business: participation in the financing of research and development; introduction of modern equipment and technologies; ensuring decent pay for professionals; encouraging staff to implement innovative ideas and innovations; development of the system of continuous vocational education and dual education; effective knowledge management; quality management.

(d) Civil society: active civil position; upholding the priorities of environmental friendliness, resource conservation, energy efficiency; monitoring of innovation activity, its efficiency.

Conclusions and prospects for further research. Thereby, the efforts of countries seeking to accelerate the forming of the innovative economic model should be aimed at intensifying research and development, the introduction of knowledge management, training of innovative specialists and continuous professional development of human resources. It is necessary to create favorable working conditions for researchers, establishing effective cooperation between the state, business, universities and communities. In modern conditions, availability of the qualified human resources, who are capable for generating and implementing a new knowledge, is one of the most important determinants of innovative development. This fact should be taken into account during the forming of strategies, plans and programs of innovative development.

The prospect of further research lies in the field of identifying the key growth points for each country, taking into account its external and internal innovation potential, development of measures of stimulation the effective interaction of all participants in the innovation process.

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