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INNOVATIIVE DEVELOPMENT OF BELARUS IN THE CONTEXT OF INTERNATIONAL INDICATORS

Abstract:

The paper examines the innovative development of Belarus in the context of international indicators and ratings of innovation. International indicators of innovation are becoming an important tool for evaluating the effectiveness of innovation policy. Innovation policy often suffers, especially in developing countries, from an insufficient understanding of the complex phenomenon of innovation. Lack of a systemic approach to innovation leads to a lack of the emphasis on innovation based on knowledge from any source and not just on the knowledge formally created through R&D. Identified are the strengths and weaknesses of innovation policy of Belarus, as well as the problems of innovative development given the Global Innovation Index, the Innovation Union Scoreboard and Knowledge Economy Index. Developed are the new directions of innovation policy for Belarus.

Keywords:

Key words: innovation, performance of innovation development, resources of innovation, efficiency innovation, national innovation system, innovation policy.

JEL Classification: O31, O34, O38

Introduction

International indicators of innovation are becoming an important tool for evaluating the effectiveness of innovation policy. In his Address to the Belarusian people and the National Assembly in 2013, President A. Lukashenka of Belarus noted, «The global vortex of new ideas, technologies and inventions is drawing in Belarus as well. Despite our country being middle-sized by European standards, a country without any global ambitions, we cannot think about our future separately from the world-wide processes. Incidentally, our choice is not that broad. We can either adjust to the stormy and rapid changes, or remain off the mainstream of historic development. There is no third alternative" (Address of President Lukashenka 2013).

The evaluation of policies in the context of international trends is stipulated by the Government's Action Program to implement the goals of socio-economic development in 2011 - 2015 in Belarus. There is a set of measures for Belarus to join the leading countries in the international competitiveness ratings, business environment, the level of innovation development and the government's efficiency to improve the international image of the Republic of Belarus among domestic and foreign investors (Government's Action Program of the Republic of Belarus for 2011-2015).

In the context of these tasks it makes sense to consider some of Belarus's results in the ranking of international indicators of innovative development and to identify both the strengths of the national innovation system and the weaknesses of the innovation development that hinder problem solving. Belarus is a small country with an open economy. Exports account for 60% of GDP. The country's GNP per capita makes USD 18,385; it ranks 50th, according to the Human Development Report 2016. The process of transition from a command economy to a market economy is not finished yet.

Developed countries accepted that benchmarking and the setting of targets requires that innovation be adequately measured. Both experience and research have made it abundantly clear that the objectives of the Europe 2020 strategy would not be reached if Europe does not become a hotbed of innovation not only in its market activities, but also in its institutions and public administrations. The Europe 2020 strategy strongly reflects this view and is correspondingly ambitious (EU 2013).

Innovation policy often suffers, especially in developing countries, from an insufficient understanding of the complex phenomenon of innovation. Fred Gault notes (Gault 2010, p.3) that "while innovation has been around since markets began, understanding it and the policies that support it remains a challenge. Once the issues are reviewed, consideration is given to a research agenda for those people who create innovation policy, implement it, measure the activity of innovation in the economy, and provide the statistics and indicators which are used for monitoring and evaluating the effects of policy intervention." The better understanding of innovation and innovation

policy may result in better economic and social outcomes from these activities. Chris Freeman and Luc Soete (2007) have suggested that the link between the measurement of national STI activities and their national economic impact, while always subject to debate, particularly in the context of small countries, has now become so loose that national STI indicators are in danger of no longer providing relevant economic policy insights.

In the countries of the former Soviet Union, innovation policy practically does not measure or assess other forms innovation as “user innovation’, “public sector innovation” and “social innovation”. Lack of a systemic approach to innovation leads to a lack of the emphasis on innovation based on knowledge from any source and not just on the knowledge formally created through R&D. The global challenges are making a greater impact in developing countries than in the developed countries. Urbanization is changing the development landscape as more people live and work in cities, but agriculture, low and medium technology industries are still a driving force in development, especially when viewed as a knowledge-based industry. We agree with Fred Gault that getting innovation strategies right requires governments and other public institutions to develop the capacity to learn and use the language needed to talk about innovation and about innovation strategies, and to develop the capacity to implement the strategies. The need for these capacities is not peculiar to developing countries, but acquiring them is more urgent (Gault, 2010).

In Belarus, in spite of accepting The Concept of the National Innovation System (2006), policy making still largely tends to rely on S&T approach. The dominant mode of policymakers’ thinking about innovation was to characterize this as a problem involving the application of S&T (measured through R&D expenditures) to the economic production. The transformation of fragmented innovation system is a major challenge for Belarus. Belarus’s markets and supportive institutions are less developed and thus less responsive to enterprise needs; the entrepreneurial capacity to undertake risky technological activities is less developed, and the financial system is less geared to supporting innovation.

Improving the overall vitality of the system would require the understanding of innovation processes as well as linkages between organizations, actors and institutions. Innovation policy in developing countries has a greater need to build the initial basis of capabilities and to support their industry learning processes. The inflows of knowledge and technology from external sources are essential components in the innovation and learning processes in less developed countries. What follows from this is that policies and institutions affecting international flows of equipment and services, human capital and foreign investments, as well as global value chains also matter (Pietrobelli, Rabellotti 2012).

Erika Kraemer Mbula and Watu Wamae (2010, p.51) note that “learning as basis for acquisition of knowledge, both tacit and codified, is essential for developing and

upgrading innovation capacity. The nature of the learning process determines the extent to which innovation in both product and processes can be undertaken." The importance of learning in the innovation process was investigated by B-A Lundvall. The Lundvall DUI mode, learning by doing, using and interaction (Lundvall, 2007), describes the activity of firms that innovate without doing R&D. Lundvall's STI mode (science, technology and innovation) describes science based innovation processes and fits well with larger firms able to support an R&D unit that provides new knowledge and capacity to absorb knowledge from outside. Innovation policy for Belarus has to combine these two models, and learning should be the task of both the macro and micro levels, because learning is a highly complex social process.

The peculiarity of the national innovation system in Belarus is that it is formed on the basis of the post-Soviet model of development. It is important to distinguish between knowledge ecology and innovation systems (David and Metcalfe, 2008) in order to transform this model. The knowledge ecology is defined as involving all kinds of institutions and organizations involved in the production, dissemination and utilization of new and "superior" knowledge. The knowledge ecology determines the conditions of existence of knowledge. However, it is yet a system of innovation. The role of knowledge ecology is to form the research capabilities and the knowledge base for innovation (Foray, 2010). The major characteristic of innovation system is that its components are connected. Belarus received the knowledge ecology from the former Soviet Union; the problem of modern innovation development is the forming of the innovation system. To determine the weak links in the system, it is necessary to use a detailed set of indicators of innovation. Tasks to measure the effectiveness of innovation policy involve using benchmarking and learning new policy instruments.

Indicators of innovation and problems of their improvement in Belarus

The main goals and objectives of developing the scientific and innovative complex of Belarus were focused on implementing the 2011–2015 State Program of Innovation Development of the Republic of Belarus (GPIR), a step-by-step strategy of increasing exports share of science-intensive and high-tech products of the Belarusian exports until 2015, the Strategy of researching for the period until 2015, the tasks of State Scientific and Innovative Programs, Sectoral Scientific and Technical Programs, Regional Scientific and Technical Programs, State Programs (GP), as well as decisions of the Head of the State and the Government of the Republic of Belarus. It has become a priority direction of development of Belarus's scientific and innovative complex to create a globally competitive, innovative, high-tech, resource- and energy saving, as well as environmentally safe economy that will be able to provide the country's sustainable social and economic development and the Belarusian people's living standards' improvement. Being a part of the country's fundamental program documents, the major performance of Belarus's innovative development has been ensured to be accomplished in 2015 (Table 1):

Table 1
Key indicators of innovative development in the Republic of Belarus for 2011-2015

Indicators	Measure-ment unit	Year						
		2010	2011	2012	2013	2014	2015	
		Actual					Projection	Actual
The share of innovative products in sales (in industry)	%	15.4	22.7	24.8	17.8	13.9	20	**13.1**
Enterprises with innovation activity, % of all enterprises in industry	%	14.5	14.4	17.8	21.7	20.9	40	**21,1**
GERD	% of GDP	0.69	0.7	0.67	0.52	0.52	2.5	**0,50**
Public expenditure on R&D	% of GDP	0.4	0.32	0.29	0.23	0.20	1.2	**0.18**
The exports of high technology (goods, works, services) in 2011-2015	bn USD	–	**25,4** (Projection)					**37**

Source: GPIR and Belstat

A major part of the organizations (356 units) involved in research and development activities are located in the City of Minsk. They include research institutions of the National Academy of Sciences of Belarus, sectoral research institutions, higher education establishments. Most of the organizations performing research and development activities are a part of the system of the National Academy of Sciences of Belarus: there were concentrated 16.0 % (85 units) of all the country's research institutions, which is 30.0 % of the total number of researchers (5,791 people) there.

The Ministry of Industry ranks second by the number of researchers and organizations carrying out scientific research and development. 69 organizations carrying out research and development function here (13.0 %). 4480 researchers (23.2 %) work here. There are 25 scientific organizations (4.7 %) with the total number of researchers of 915 people (4.7 %) within the system of the Healthcare Ministry. And 16 scientific organizations (3.0 %) with the total number of researchers of 1,772 people (9.2 %) are part of the system of the State Military Industrial Committee.

In the higher education sector, 61 organizations carried out R&D works in 2015, which was less than in 2011 (70). At the end of 2016, the number of R&D personal in the higher education sector made up 2810 people or 10.8 % of the total number as a whole in the country.

Within the framework of the international scientific and technical cooperation, the overall worth of works performed under foreign contracts amounted to $67.4 billion (by 16.0 % more than in 2011). From the above volume, 55.7 % falls to the share of the National Academy of Sciences of Belarus, 34.8 % — of the industrial sector, and 9.5 % — of the Ministry of Education.

The analysis shows that growth targets of research expenditures are not met. GERD keeps less than 1% GDP in Belarus. The structure of expenditures on scientific research retains the same character. The main volume of spending on science is implemented by public institutions of the Academy of Sciences. The share of expenditures on science for the higher education sector decreased from 17% in 2005 to 10% in 2015.

According to Edquist (2001), in developing countries product innovations are regarded as more important than process innovations. Belarus is in line with this trend (Table 2). Product innovations are considered to have a greater effect on production structure than process innovations. For Belarus, a new product design can enable a firm to enter a new market that is important for the development of exports. Process innovations tend to ensure a market position by lowering the firm's average production costs. But the current global architecture of production which is governed by the global value chain is not yet developed in Belarus.

Table 2

Structure of innovative activities of industrial enterprises per type of technological innovations and type of economic activities in 2016 (per cent to total)

	Innovatively active organizations that incurred costs on technological innovations	Innovatively active organizations that incurred costs on technological innovations		
		product innovations	process innovations	product and process innovations
Total, of which	100	71.9	12.5	15.6
Mining industry	100	-	100	-
Processing industry	100	73.1	10.9	16.0

Source: Belstat, 2017

The analysis also shows that innovative activities are primarily associated with technological innovation (Table 3). Firms of Belarus insufficiently use marketing and organizational innovations, which complicates the problem of new products' sales.

Table 3

Innovations expenditures at industrial enterprises per type of economic activity in 2016 (BN, m)

	Total technological, organizational and marketing innovations expenditures	Of which:		
		technological innovations expenditures	organizational innovations expenditures	marketing innovations expenditures
Total expenditures, of which	779.2	774. 6	2. 0	2.5
Mining industry	2. 0	1.7	0.3	-
Processing industry	776. 4	772.2	1.7	2.5

Source: Belstat, 2017

In 2016 the expenditures on organizational innovations accounted for as little as 0.2%, and those on marketing innovations were 0.1% of the total innovation expenditures in the processing industry. These data show that market relations are poorly developed; administrative tools of the state dominate yet. Government, for example, was to force the public sector to innovate. Recent ruling[1] government set standard norms of R&D for industrial organizations in the public sector on the ten-year period. The Ministry of Economy believes that there are no economic incentives (due to poor competitive environment in the sector) for state owned entities, to active and regular innovation. The approach laid down in the decision of the government, in fact, is an administrative arm, which, nevertheless, seems acceptable in view of the competitive environment and undeveloped innovation activity of the public sector in Belarus.

Despite the fact that the statistics of Belarus innovation relies on the Oslo Manual, international standards are not fully used. For example, according to the World Bank, high-tech products export in Belarus was USD 609 m or 4.7% of manufactured exports in 2016[2]. But Belarusian statistics data show exports of high technology in the amount of USD 20 % of the total exports. The reason for the discrepancy lies in the special rules for the definition of high-tech products in Belarus. Improving of innovation policy requires understanding the role of benchmarking and new indicators of innovation.

http://news.tut.by/economics/389703.html
[2] http://wdi.worldbank.org/table/5.13

Methodology

Significant efforts have been made to organize the institutional element of the national innovation systems in Belarus. The Programs of innovation development in Belarus contain monitoring and evaluation systems with a system of statistical observations in place. Traditional S&T indicators constitute a poor basis for that analysis; moreover, statistics of innovation is far from being complete in the developing countries. The national statistics in Belarus is considerably determined by the requirements of OSLO Manual, which gives an opportunity to make an international comparison of innovation activities in the countries of CIS and developed countries. We have analysed the statistics of EU, World Bank, OECD as well as the national statistics information, describing human resources, education, systems of funding R&D and generation knowledge to develop new directions for innovation policy in Belarus.

Over the recent years, there has been expanded a practice of international comparing innovative activities of countries based on the summary indexes, of which the most well known are as follows:

- Global Innovation Index (INSEAD).
- The Summary Innovation Index (European Commission);
- Knowledge Index (World Bank);

For computing the above summary indexes, both official statistics and questionnaires data are used. The specifics of all these computations are a comprehensive characteristic of innovations as a complex, dynamic and non-linear process. Studying the experience of the world's countries with regard to monitoring indicators of innovations is of considerable interest because this process is very flexible and is influenced by the new trends of development, such as globalization, forming knowledge economy, and open innovations.

Innovation development of Belarus in the context of Global Innovation Index

One of the most widely used innovations indexes is the Global Innovation Index (GII) developed in cooperation with experts of the Swiss business school (Business School for the World - INSEAD), the World Intellectual Property Organization (WIPO), and Cornell University (Cornell University, INSEAD, and WIPO 2017). In 2017 there was published the10th edition of the Global Innovation Index, providing a rich database of detailed metrics for 127 economies, which represent 92.5% of the world's population and 97.6% of global GDP. The Global Innovation Index is comprised of 84 indicators grouped in two sub-indexes, one of which assesses the resources of innovations (Innovation Input Sub-Index), and the other – the results of innovation activities

(Innovation Output Sub-Index). The components of the Innovation Input Sub-Index, in its turn, include the assessment of institutions, human resources, infrastructure, market terms, and quality of business environment. The assessment of the results of innovation activities is based on indexes of creating knowledge, technological results and the economy's creativity.

In 2012 Belarus ranked 78th according to the Global Index of Innovations out of 141 countries, in 2017 – 88th out 127 countries, i.e. its positioning changed. Belarus's innovation policy's strengths and weaknesses are shown in Table 4, which is designed according to the 2017 Global Index of Innovations.

Table 4.

Strengths and weaknesses of Belarus in the context of 2017 Global Index of Innovations

Strengths Score (0–100) or value (hard data) -ranks		**Weakness** Score (0–100) or value (hard data) - ranks	
Institutions 54.1		*Institutions 54.1*	*81*
1.3.1 Ease of starting a business - 92.9	28	1.1.2. Government effectiveness-20.9	93
Human capital & research 41.9	*36*	1.2.1 Regulatory quality-16.5	120
2.2.1 Tertiary enrolment, gross-87.9%	6	1.2.2. Rule of law-16.4	107
2.2.2 Graduates in science & engineering, 28.6 %	12	*Market sophistication 41.9*	*90*
		4.1.1. Ease of getting credit -45.0	84
		4.1.2. Domestic credit to private sector, % GDP-2.9	126
2.2.4 Gross tertiary outbound enrolment, 87.9%	6	*Business sophistication*	*27.3* *100*
Infrastructure-46.1	*67*	5.2. Innovation linkages -13.9	124
3.2.4 Gross capital formation, 26.9% GDP .	32	5.3.2. High-tech imports less re-imports, 5.2 % total trade	105
Knowledge & technology outputs-21.7	*61*	*Knowledge & technology outputs*	
6.1.1. Domestic resident patent ap/bn PPP$ GDP - 4.2	*27*	6.2.1. Growth rate of PPP$ GDP/worker, 2.4%	104
6.1.3. Utility models by origin/bn PPP$ GDP -2.3	11	*Creative outputs*	*11.7* *123*

6.2.4. ISO 9001 quality certificates/bn PPP$ GDP - 21.7	17	7.1. Intangible assets 11.0	124
Creative outputs		7.2. Creative goods & services 4.2	113
7.1.2. Industrial design by orgin/bn PPP $GDP -1.2	57	7.2.2. National feature films/mn pop. 15–69 -0.1	100

Source: The author's design based on the data presented by Cornell University, INSEAD, and WIPO 2017, p.194.

The analysis of the data shown in Table 4 makes it clear that the country's weakest positions are in its *the institutional environment.*, with the general assessment of the its institutions of innovation development being ranked 88th. The assessment was done according to the World Bank's data. The country's most stable positions are in assessing the *education potential*, the summarized ranking of this block of indicators being 12rd in the Global Index of Innovations.

The weakest point in the system of the resource indicators of innovation development of the Global index of innovations is a group of indicators that characterize *marked sophistication and business sophistication*, its general rank being 90th and 65 th out of 127 in 2017. The following two reasons for this can be identified.

First, it is lack of data for the country's positioning among the leading world rankings. The evaluation of interactions of businesses and scientific institutions, as well as the evaluation of cluster initiative is done by experts when working on designing the Global Index of Competitiveness; however, since Belarus does not participate in this ranking yet, there is no data with regard to a number of indicators that are taken into account in the process of forming the Global Index of Innovations. Belarus does not position itself in Thomson Reuters rankings considering the formation of strategic alliance, either.[3]

Second, the role of business in financing research and development is weak: in Belarus, GERD is 0.5% and the country's rank being 63th in the global context; the share of business in financing science is 28.8%,. Significant improvements are found only in China and Kazakhstan, where the share of business in financing scientific research has grown to 71.7% and 50.7%, respectively.

Belarus has the number of researchers (2134) per 1 m of the population (cf. 2474 in Italy, 2636 in Poland, and 2796 in Latvia), is significantly lagging behind other countries with comparable human resources, as far as the productivity of research (patents) in the world market is concerned. In many respects, an enclave nature of the country's scientific system hampers its integration into the world scientific area.

[3] Thomson One Banker Private Equity, SDC Platinum database; International Monetary Fund World Economic Outlook 2012 (PPP$ GDP) (2011–12)

Belarus in the context of the European Innovation Scoreboard indicators

One of the most important rankings of the European countries' innovation development is European Innovation Scoreboard (EIS), which is a set of innovation indicators on the basis of which the Summary Innovation Index (SII) is calculated for each European country. The major difference of this composite indicator from the Global Innovation Index is its forming exclusively on the basis of quantitative assessments, for which the Eurostat and other international data bases are used. The Scoreboard's advantage is characteristics of innovation development trends in all the EU countries (since 2000), as well as those of Croatia, Iceland, Macedonia, Norway, Serbia, Switzerland, and Turkey. The Innovation Union Scoreboard also makes comparison between EU-28 and Europe's major global competitors – Australia, Brazil, Canada, China, India, Japan, Russia, South Africa, South Korea and the USA. The EU Innovation Scoreboard serves as a set of instruments for informing politicians and discussing development problems on the national and EU levels; it enables to monitor the progress in innovation activities both in the EU countries and in the global world.

The computation of the EU summary innovation index (SII) is based on 27 indicators which are grouped into the blocks which characterize the possibilities of development (resources), the process of development is the firms' innovation activities, and the results and efficiency of the country's innovation development.

Belarus does not participate in the assessment of the Innovation Union Scoreboard; however, given the prerequisites of the general historical development, the geographical proximity and volumes of trade with the EU countries, it was very interesting to assess Belarus's positions in the context of the European innovations indicators. The BSEU researchers have realized an innovation project whose findings are presented in the monograph "The Measurement of Innovations: Problems of Comparative Assessment" (Bohdan, Bokun, Bondarenko, Pekarskaia, 2011). The project in question has found a practical application: the indicators of Belarus's innovation statistics now contain the section "Certain indicators of Innovation Union Scoreboard (IUS) for the Republic of Belarus". The Project was completed in 2010. Belarus's positioning on the EU summary innovation index is presented in Fig. 2.

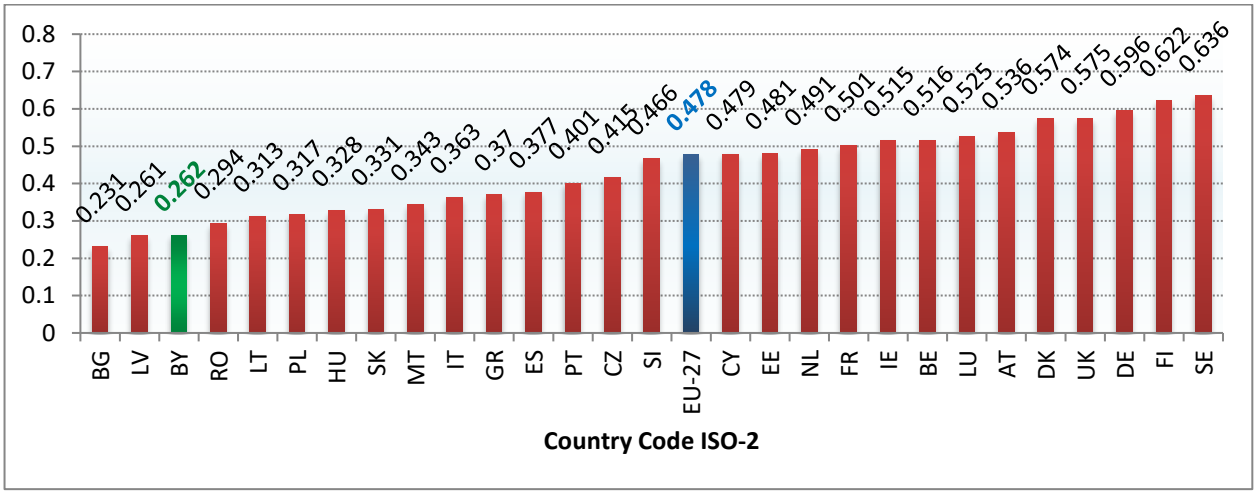

Fig.2. Belarus in the context of summary indicators of the EU innovation development, 2009

Legend: EU – European Union, BE - Belgium, BG - Bulgaria, BY – Belarus, CZ – Czech Republic, DK - Denmark, DE - Germany, EE - Estonia, IE - Ireland, GR - Greece, ES - Spain, FR - France, IT - Italy, CY - Cyprus, LV - Latvia, LT - Lithuania, LU - Luxemburg, HU - Hungary, MT - Malta, NL - Netherlands, AT - Austria, PL - Poland, PT - Portugal, RO - Rumania, RS-Serbia,SI - Slovenia, SK - Slovakia, FI - Finland, SE - Sweden, UK – Great Britain

The comparison with the EU data, the summary innovation index in 2009 being 0.478, shows that Belarus belongs to the catching–up countries, such as Bulgaria, Latvia, Rumania, and Serbia.

In the period of 2010-2012 there were certain changes in the EIS indicators aimed at improving the characteristics of innovation activities. Those changes were mostly related to the assessment of prospects and global aspects of innovations. For instance, there appeared a new indicator in the assessment of innovation resources, which characterizes the popularity of scientific activity among youth – their completing doctoral programs (for Belarus – candidates and doctors) among youth aged 25-34. The comparison of Belarus (0.8) with the EU data (1.5) shows our country's lagging behind an average European level circa 100 per cent (Table 5).

Table 5

Belarus in the context of EIS resource indicators, 2018

Indicators	**EU28**	**Belarus**
Human resources		
1.1.1 New doctoral graduates (ISCED 6) per 1,000 population aged 25-34	2.0	0.7
1.1.2 Percentage of population aged 30-34 having completed tertiary education	39	59.6
1.1.3 Percentage of youth aged 20-24 having attained at least upper secondary level education (2017)	82.6	92.6

Source: Belstat, EIS and the author's own data

Among the young people of the EU aged 30-34, 38.5% have got the third level of education, whereas in Belarus a similar indicator (specialists with higher and secondary specialized education – third level) is higher; by our estimates it accounts for 59.6%.

Thus, based on the comparative assessment of the amount of educated cadre for innovation development, the situation in Belarus is favorable; however, generally the indicators of the country's innovation development remain quite low. Lack of positive connection between the indicators of education and those of innovation development can have several explanations. *First,* there is a significant gap between formal criteria (e.g., a share of those with a university degree, the period of education and so on) and indicators of the quality of education measured by the availability of competences and skills required by the economy. *Second*, the population's educational structure significantly differs from the economy's professional and qualification structure. The structure of the human capital does not correspond to the demand for the latter, and the human capital stock available is not used productively. The surveys of enterprises show that they lack skilled cadres, which hinders innovation development (Bohdan 2012).

A new section of the European innovation scoreboard is a block of indicators which characterize the openness, excellence and attractiveness of the national research systems (Table 6).

Table 6

Belarus in the context of new European innovation indicators (EIS 2018)

Open, excellent and attractive research systems	**EU28**	**Belarus**
1.2.1 International scientific co-publications per 1 m population	517	116
1.2.2 Scientific publications among the top 10% most cited publications worldwide as % of total	10.6	6.6
1.2.3 Non-EU doctoral students as a % of all doctorate students	26.1	5.4[4]

Source: Belstat, IUS and the author's own data

The analysis shows that the attractiveness of the Belarusian scientific system remains low, which is related to its poor integration into the world scientific area. The evidence of this is found in the amount of joint scientific per one million people (116), which is 5 times less than an average European indicator. With regard to this indicator, Belarus is significantly lagging behind not only the EU developed countries, but also the new EU countries, such as the Czech Republic (756), Rumania (182), Bulgaria (205), and Lithuania (451) (Table 7).

Table 7

Publication activity of scientists in Belarus and new EU countries

	EU-28	Belarus	Lithuania	Latvia	Romania	Bulgaria	Czech Republic
International scientific co-publications per 1 m population	517	116	451	315	182	227	756
Share of co-publications,%	-	58.4	37.9	55.8	38.0	54.8	51.1

Source: European Commission 2018 and the UNESCO

The attractiveness of the research system is manifested in the growth of international doctoral students in the country. With regard to this indicator, Belarus is significantly lagging behind the European countries (Table 5). In Europe one out of five doctoral students is from the countries beyond EU, whereas in Belarus the proportion of foreign citizens in the total amount of post graduate students accounts for 5.4%, i.e. more than four times fewer.

[4] For Belarus – the share of foreign citizens in the total amount of post-graduate students

The research of the mobility processes of scientific staff in the EU countries shoes that on average half of the university researchers are involved in international exchange and travel to broaden their scientific qualification at the cost of the European grants (Innovation Union Competitiveness Report 2011). Even though in Belarus annually over 1000 international scientific projects are carried out, and over the recent seven years their number have grown 2.5 fold, and in 2011 the total amount of contracts signed by the scientific and scientific-production organizations of the country was worth USD 57 m (Meerovskaia, Artiukhin , Liadnova 2013, p.3-4), the international comparisons show low efficiency of cooperation in comparison with other countries.

The mobility of Belarus's scientific staff for performing joint projects and raising qualification is very limited. For instance, in 2007, according to Belarus statistics, 1.5 % of the researchers' trips abroad were related to performing joint research in foreign scientific organizations; in 2010, according to Belstat data on training cadres overseas, in the science sector, as few as 54 persons raised their qualification abroad, which accounts for 0.3% of the total amount of researchers in the country being 19,870.

Given the above data, in assessing the efficiency of the country's innovation policy in the sphere of resource provision of science and innovation activities by the EU indicators, it is necessary to point out its strengths and weaknesses. Among the strengths are maintaining the human potential for building knowledge economy, i.e. educated youth and qualified cadres. Among the weaknesses are an enclave nature of the country's scientific system, its weak integration into the world scientific area, underfinancing of science, and archaic organization structure of science, meaning that the university science sector is significantly less financed than the government one, which negatively influences the quality of education and attractiveness of the education system for the outer world. The Belarusian scholars have repeatedly stressed the necessity of the new organization of science, a principally new system of motivating scientific work, raising the social status of the scientist and modernizing the system of financing science. Creating scientific-research laboratories at universities and forming national research universities is one of the solutions of this problem (Kryukov 2010).

Assessing the innovation indicators in the section "Firm activities" of UIS, it should be underscored that the measurements of this sections are related to the characteristics of financing science by sectors of economy, involving SMEs in innovation activities and the countries' patent activities. The "level of innovation business activity" indicator (the main one in terms of Belarus) is not used in the EIS. This indicator is not informative enough, as it reflects only the "top of the iceberg" of the innovation process. Not all the EIS indicators can be compared with the Belarus data (Table 8).

Table 8

Belarus in the context of the European indicators of assessing innovation activities (EIS-2018)

FIRM ACTIVITIES	**EU28**	**Belarus**
Firm investments		
2.1.1 R&D expenditure in the business sector as % of GDP	1.32	0.34
2.1.2 Non-R&D innovation expenditures as % of turnover	0.76	1.73
Linkages & entrepreneurship		
2.2.1 SMEs innovating in-house as % of SMEs	27.8	4.4
2.2.2 Innovative SMEs collaborating with others as % of SMEs	11.2	0.48
2.2.3 Public-private co-publications per million population	40.9	-
Intellectual assets		
2.3.1 PCT patents applications per billion GDP (in PPS€)	3.53	0.13
2.3.3 Community trademarks per billion GDP (in PPS€)	7.86	-
2.3.4 Community designs per billion GDP (in PPS€)	4.44	-

Source:Belstat, EIS 2018 and the author's data

According to the analysis, Belarus is significantly lagging behind the European countries in terms of financing science by commercial organizations; this situation, however is common for many transformational economies, e.g., in Lithuania and Latvia the state sector finances science to a greater extent than the business one. Changes in the structure of financing expenditures on science are obvious in the Check Republic and in Estonia (in the Czech Republic the share of public sector in financing is 0.64% of GDP, and that of business sector is 1.03% of GDP, whereas in Estonia it is 0.61% and 0.66% of GDP, respectively). It should be pointed out that in the Belarusian business sector's expenditures (0.34% GDP) the input from the budget is quite large. It amounted to over 30%.

Belarus's lagging behind in terms of patent activity is quite noticeable on foreign markets – with regard to the number of PCT applications, the country is lagging behind thirty-fold. Lithuania, Latvia and Estonia, with their smaller scientific potentials,

are much better represented internationally: 0.81, 0.82 and 1.01 of applications per Euro1 bn.

Belarus's positions in SMEs innovation activities are weak. By SMEs innovation activity index, the country is lagging behind the European practice six-fold, and by joint scientific activity – 17-fold. This data confirms acute necessity in regulating the mechanisms of cooperation between state and business and legal provision of public-private partnership, in which innovation activity should be a priority.

The third section of the European Scoreboard indicators reflects the efficiency of the innovation policy through changes in the economy's structure, efficient employment, and export growth of high, medium-high technologies and knowledge intensive services (Table 9)

Table 9.Assessment of innovations efficiency in the context of EIS 2018 data

IMPACTS	**EU28**	**Belarus**
Innovators		
3.1.1 SMEs introducing product or process innovations as % of SMEs	30.9	3.49
3.1.2 SMEs introducing marketing or organizational innovations as % of SMEs	34.9	1.54
Economic effects		
4.1.1 Employment in knowledge-intensive activities (manufacturing and services) as % of total employment	14.2	28.49
4.2.2. Knowledge-intensive services exports as % total service exports	69.2	33.4
4.2.3. Sales of new to market and new to firm innovations as % of turnover	13.37	12.34

Source: Belstat , EIS 2018 and the author's data

The analysis of Table 9 data shows certain discrepancy between the Belarusian and European statistics. Belarus's statistics of the proportion of new products to the shipped one raises doubt. This controversy can be accounted for by the fact that the "new" products differ in terms of their newness: "new of the firm" and "new for the market". The fact of sale is also important. In Belarus, according to Belstat, "new products for the market" characterize as little as 1% of the output. In addition, the knowledge-intensive types of activity should be more specifically and clearly defined, which can be done when Belarus completely transfers to the classification of economic activities harmonized with the European.

Dynamics of Belarus' assessment by the Knowledge Economy Index

The analysis of Belarus's positioning in the context of international rankings by the Global Innovation Index and the Union Innovation Scoreboard shows similarity of assessments of the national innovation system. The country is strong in terms of assessing its qualities of human resources, whereas it is weak in terms of interaction characteristics within the national innovation system and lacking strategic foundations of forming a single area for education, scientific research and innovations.

Institutional building of the national innovation system does not meet the targets of forming knowledge economy. This is shown by another critical indicator – the country's positioning in the world ranking of preparedness for building the Knowledge Economy Index applied by the World Bank. In 2012 Belarus ranked 59th among 145 countries and in comparison with 1995 it lost 4 positions, which shows a high dynamics of the world movement to economics based on knowledge, where the country is lagging behind (Table 10).

The main factor that had a negative impact is lack of progress in the process of forming the institution of modern growth, which resulted in the country's lagging behind in the education and information contexts of modern innovation development. The country's growth of positions in the section "innovations" was not able to become a driving force for increasing its ranking by the Knowledge Economy Index.

Table 10

Belarus's ranking by Knowledge Economy Index (1995-2012)

Country and ranking in 1995-2012	KEI (Knowledge Economy Index)		KI (Knowledge Index)		Economic Incentives and Institutional Regime		Innovations		Education		IT	
	1995	2012	1995	2012	1995	2012	1995	2012	1995	2012	1995	2012
Беларусь (55-59)	5.81	5.59	6.92	6.52	2.51	2.5	5.42	5.7	8.29	7.37	7.03	6.79

Source: Knowledge for Development (K4D) Program of the World Bank Institute www.worldbank.org/kam

Conclusions

Modern innovation process is very complicated, dynamic and global; it requires new indicators for forming an efficient innovation policy. The testing of the innovation indicators system, which takes into account the practice of international comparisons for determining the efficiency of the innovation policy, shows that its application enables to identify both the strength and the weakness of measures aimed at forming the national innovation system and makes it possible to develop the new directions of the innovation policy mentioned below:

- Expansion of Belarus's participation in international rankings of innovation development and its competitiveness, for which it is expedient to apply mechanisms of international projects within the framework of Eastern partnership;

- Harmonization of innovation statistics on the basis of requirements if international assessment standards;

- Improving and developing indicators characterizing innovation activities, as well as taking into account the completeness and complexity of the current innovation process, its dynamics and globalization processes;

- Enlivening the formation of integration processes in scientific-innovation sphere and applying various forms of cooperation within a scientific and research sector, education and business, overcoming an enclave nature of the scientific sphere;

- Applying mechanisms of public-private partnership for involving small business in the innovation processes, as well as developing new forms of cooperation;

- Overcoming barriers hindering the mobility of highly qualified staff by means of creating favorable conditions for international cooperation and simplifying the exchange procedures;

- Expansion of the number of instruments stimulating innovations. Most of the existing instruments are aimed at traditional sectors of economy and companies oriented at the public sector, which limits the objectives of the economy's structural reorganization.

Recommendations for innovation policy:

1. Policy should be based on the understanding that innovation: a) a systemic phenomenon that is influenced by scientific and technological forces, as well as demand and market incentives; and b) are formed by training and business practices, which in turn are influenced, among other factors, by a legal and regulatory framework.

2. The government is called upon to recognize the need to increase the accountability of policies and assess the impact of policy outcomes on the well-being of society. Belarus should move forward in its ability to assess the impact of innovation policy on structural changes in the economy and the growth of effective employment.
3. A simple cost-benefit analysis produced by the cost-benefit ratio is not suitable for accounting for additional costs aimed at innovation. A set of new indicators is required, characterizing a complex, dynamic, global innovation process.
4. Building institutional capacity for policy accountability, along with monitoring outcomes (as opposed to simply measuring how many funds were spent on research and development or tax credits) is an expensive but necessary procedure.

References

Address of President A. Lukashenka of Belarus to the Belarusian people and the National Assembly, (2013) http://www.belta.by/ru/all_news/president/Stenogramma-poslanija-Prezidenta-Aleksandra-Lukashenko-belorusskomu-narodu-i-Natsionalnomu

Bohdan N.I., Bokun N.Ch., Bondarenko N.N.,Pekarskaia N.E.(2011*), Izmerenie innovatsii: problem sravnitel'noi otsenki*. Pod red. N.I. Bohdan.[Measurement of innovations: problems of a comparative assessment]. Minsk: Misanta.

Bohdan N.I. (2012), *Innovatsionnaia dinamika: global'nye tendentsii i perspektivy Belarusi* [Innovative dynamics: global trends and prospects for Belarus]. Minsk: UP Ensiklopediks.

Cornell University, INSEAD, and WIPO (2017*), The Global Innovation Index* 2017: Geneva, Ithaca, and Fontainebleau.

David ,P.A. and Metcalfe,S.(2008) *Universities and Public Research Organizations in The ERA*, Draft Report prepared for the EC Expert Group"Knowledg for Growth", Brussels.

Edquist, C. (2001) "*Systems of Innovations For Development SID*" Background paper for the UNIDO World Industrial Report (WIDR).

European Commission. (2013). *EU Innovation Union Scoreboard* http://ec.europa.eu/enterprise/policies/innovation/facts-figures-analysis/innovation-scoreboard/index_en.htm

EU (2013), *Elements for the setting-up of headline indicators for innovation in support of the Europe 2020 strategy*. Report of the High Level Panel on the measurement of Innovation.

EU (2011), *Innovation Union Competitiveness report*. Directorate-General for Research and Innovation. Luxembourg: Publications Office of the European Union.

Freeman, C., Soete, L. (2007), '*Developing Science and Technology and Innovation Indicators: The Twenty-First Century Challenges'*, in OECD, Science, Technology and Innovation Indicators in a Changing World: Responding to Policy Needs, Paris: OECD, pp. 271–84.

Foray, D. (2010), *Knowledge for Development* in Innovation and Development Agenda. OECD/ IDRC.

Gault, F. (2010), *Innovation Strategies for a Global Economy. Development, Implementation, Measurement and Management*. IDRC. Edward Elgar.

Government Action Program of the Republic of Belarus for 2011-2015 (2011) http://www.pravo.by/main.aspx?guid=3871&p0=C21100216&p2={NRPA}

Kryukov, L.M. (2010), *Perekhod k innovatsionnomu razvitiiu natsional'noi ekonomiki:kharakter problem i khod ikh resheniia*. Nauchnye trudy BGEU. [Transition to innovative development of national economy: character of problems and course of their decision]. Minsk: BGEU.

Lundvall, B.-Å (2007), *Innovation System Research, Where it Came From and Where it Might Go*, Globelics Working Paper Series, No. 2007–01, Aalborg, Denmark: Globelics.

Mbula,E. Wamae,W. (2010), *Key Issues for Innovation and Development* in Innovation and Development Agenda. OECD/ IDRC.

Meerovskaia,O.A., Artiukhin M.I., Liadnova T.O. (2013), *Belorusskaia nauchnaia diaspora: shag navstrechu*. Pod red. P.I. Baltrukovicha, O.A. Meerovskoi. [Belarusian scientific diaspora: step towards].Minsk: GU «BelISA».

Pietrobelli, C. and Rabellotti, R. (2012), *Innovation Systems and Global Value Chains* in Evidence-based development economics: Essay in Honor of Sanjaya Lall ed. Carlo Pietrobelli and Rajah Rasiah.