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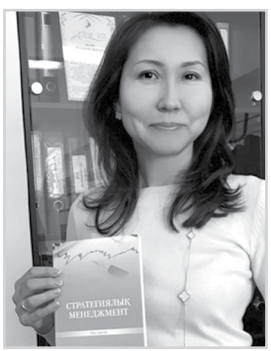

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Problems of developing the foundations of sustainable competitiveness of industrial and innovative economy in Kazakhstan

Abstract. The article deals with issues and challenges related to the transition of Kazakhstan's economy to industrial-innovative development, including the main causes for low innovation activities of enterprises, and peculiarities of the development of an effective mechanism to finance innovation activities and to strengthen the country's intellectual capital Currently, countries that implement long-term innovative development strategies satisfying the needs of a diverse market have competitive advantages in the market.

The present research enables us to identify and analyse problems of formation and development of Kazakhstan's industrial and innovative economy, namely the lack of application of research results in business, inadequate and ineffective funding (both public and private) of innovation activities, as well as little support and encouragement for scientists as major participants in innovation activities.

It has been concluded that nowhere in the world has a national innovation system been formed by the market or private sector alone. Kazakhstan is not an exception. Therefore, the state must play the leading role in both promoting the results of R&D and innovation activities in the market and creating the national innovation system.

Keywords: Innovations; Innovation Activity; R&D; Innovation Potential; Intellectual Potential; Industrial and Innovative Economy; State Regulation of Innovation Activity; Innovation Infrastructure
JEL Classification: O20; O38
DOI: https://doi.org/10.21003/ea.V168-08

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Проблеми формування засад стабільної та конкурентоспроможної індустріально-інноваційної економіки в Казахстані

Анотація. У статті розглянуто питання, які стосуються переходу економічної системи Казахстану до індустріально-інноваційного типу розвитку й пов'язані із цим проблеми, а саме: причини низької інноваційної активності підприємств, а також особливості формування ефективного механізму фінансування інноваційної діяльності та розвитку інтелектуального капіталу. Було з'ясовано, що конкурентну перевагу на ринку зараз мають країни, що реалізовують довгострокову стратегію інноваційного розвитку, орієнтовану на різноманітні потреби ринку. Авторами статті виявлено та проаналізовано основні проблеми формування та розвитку індустріально-інноваційної економіки в Казахстані: незатребуваність бізнесом результатів наукових досліджень, недостатнє й неефективне державне та приватне фінансування інноваційної діяльності, незначне стимулювання вченого як основного суб'єкта інноваційної діяльності. Зроблено висновок про те, що в жодній країні світу національна інноваційна система не була сформована виключно ринком або приватним сектором, тому і в Казахстані держава повинна відігравати суттєву роль у просуванні на ринок результатів науково-технічної та інноваційної діяльності у створенні національної інноваційної системи.

Ключові слова: інновації; інноваційна діяльність; НДДКР; інноваційний потенціал; інтелектуальний потенціал; індустріально-інноваційна економіка; державне регулювання інноваційної діяльності; інноваційна інфраструктура.

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Проблемы формирования основ устойчивой и конкурентоспособной индустриально-инновационной экономики в Казахстане

Аннотация. В статье рассматриваются вопросы перехода экономической системы Казахстана к индустирально-инновационному типу развития, а также связанные с этим проблемы, в том числе причины низкой инновационной активности предприятий, особенности формирования эффективного механизма финансирования инновационной деятельности и развития интеллектуального капитала. Было определено, что конкурентное преимущество на рынке сейчас имеют страны, осуществляющие долгосрочную стратегию инновационного развития, ориентированную на разнообразные потребности рынка. Авторами статьи были выявлены и проанализированы главные проблемы формирования и развития индустриально-инновационной экономики в Казахстане: невостребованность бизнесом результатов научных исследований, недостаточное и неэффективное государственное и частное финансирование инновационной деятельности, малое непосредственное стимулирование ученого как основного субъекта инновационной деятельности. Сделан вывод о том, что ни в одной стране мира национальная инновационная система не была сформирована рынком, частным сектором самостоятельно, поэтому и в Казахстане государство должно играть существенную роль в продвижении на рынок результатов научно-технической и инновационной деятельности, в создании национальной инновационной системы.

Ключевые слова: инновации; инновационная деятельность; НИОКР; инновационный потенциал; интеллектуальный потенциал; индустриально-инновационная экономика; государственное регулирование инновационной деятельности; инновационная инфраструктура.

1. Introduction

By the end of the 20th century, it became apparent that the level of technical and scientific development, including the development of science, education, knowledge-intensive industries and the global technology market, determines the boundary between rich and poor countries and provides the basis for sustained economic growth, which is one of the key factors in establishing a locus of power. Today, setting priorities in the area of science and technology has acquired significance beyond the prospects for its own development. Countries that had adopted a systemic approach to carrying out innovation policies were able to establish effective national innovation systems, which included mechanisms for effective cooperation between the authorities, business, science and education, and increase the threshold of science intensity of GDP (Guerzoni and Raiteri, 2015; Meelen and Farla, 2013; Alkemade et al., 2011; Chaminade and Plechero, 2015; Dnishev and Alzhanova, 2013; Mukhtarova and Kupeshova, 2015).

Having passed a hard way since its independence, Kazakhstan became a stable and rapidly developing nation. Today, the country has secured its worthy place in the world community. Since the period of its state building, the Republic of Kazakhstan has been facing significant socio-economic and political challenges, including the country's problems with innovation, education and science (Dnishev and Alzhanova, 2013; Mukhtarova and Kupeshova, 2015; Satybaldin et al., 2016; Kuvandykov, 2015; Ibrayev, 2016). There has been a sharp decrease in research and development in strategically important areas of the country's scientific and technological development, as well as a fall in research careers and declining demand for the results of research and development work, which caused a decrease in innovation activity of economic entities, reduced the country's scientific and technological potential, degraded knowledge-intensive production and resulted in outdated technologies in all sectors of the economy. Nevertheless, Kazakhstan possesses the capacity required to provide grounds for a breakthrough in improving economic, scientific and technological breakthrough, which needs a favourable environment to maintain financial and legal support for innovation activity.

2. Theory and hypotheses

2.1. The need for Kazakhstan to transit to industrial and innovative economy

Technological developments aimed at overcoming technological decline and mastering equipment of the current fifth and the coming sixth technological stages is crucial to increase Kazakhstan's innovation activity. For instance, while Russia and other countries have set themselves a goal to transit national economies to an innovation-based development model, Kazakhstan sees its model based on industrial and innovative development in view of the country's underdeveloped industrial economy and its focus on the strategy in support of high-tech production, innovations and entrepreneurship (Satybaldin et al., 2016; Kuvandykov, 2015; Ibrayev, 2016) Under the Strategic Plan for the Development of the Republic of Kazakhstan until the year 2020, a transition from the extensive development model based on the export of raw materials to the model based on industrial and innovative development is one of the priority directions of the country's economic development.

How does an innovation economy differ from an industrial and innovative economy? An innovation economy is based on a regular flow of innovations, constant improvement of technologies, manufacturing exports of high-tech products with high added value and technologies themselves. This also implies that profits result from both scientists' and innovators' intellectual work, as well as the information field, and not from material production or accumulated financial resources. Some researchers (Toffler, 1980; 1989; 2006; Fukuyama, 1996; 2000; 2003) believe that it is the innovation economy that ensures economic hegemony of the country attributed to it.

Manufacturing is the leading industry in an industrial society which can be characterised by enhanced productivity, high intensity of competition, developed business environment, significant intellectual human capital and better quality of life. Bell (1973) emphasises that the innovation economy is the next economic formation that follows the industrial economy. While entrepreneurs, businessmen and chief executives of industrial plants are considered to be the key figures in the environment of an industrial society, scientists, innovators, venture capitalists, economists and other persons representing intellectual technologies play a part in the industrial and innovative economy. Industrial and innovative development includes the introduction of innovations within priority sectors, development of the system for technology transfer and commercialisation including the improvement of knowledge networks, and the creation of international-level transdisciplinary scientific and educational centres. Such a development scenario is of current concern to Kazakhstan.

The process of industrialisation in Kazakhstan, as well as the process involving the creation of an integrated and effective economy to promote innovation, has not yet been completed. Therefore, Kazakhstan will have to continue to

create its effective industrial economy with elements of an innovation economy. Today, Kazakhstan is in the fourth technological stage. The country has been unable to reach the fifth technological stage, which is an innovation economy, including microelectronics, biotechnologies, computer software, information systems, internet, etc.

Today, the world is on the threshold of the sixth technological stage. Its outlines are beginning to appear, primarily in the most developed countries like the USA, Japan and the People's Republic of China, and are characterised by a clear focus on development and knowledge-intensive, or as it is said «high», technologies. (Kabalov, 2010)

As predicted by specialists, the sixth technological stage will enter the mature stage in 2040s, provided that the current rate of progress of technical and economic development is maintained. Meanwhile, they predict that a new technological revolution will take place in the period between 2020 and 2025, the basis of which will be developments synthesising achievements within the abovementioned areas. Many scientists and economists argue that humanity has had five technological stages, while nowadays the sixth technological stage is about to begin (Glazyev and Kharitonov, 2009; Malinetskii, 2010; Averbukh, 2010) The main signs of the sixth technological stage include nanoelectronics; molecular and nanophotonics; nanomaterials and nanostructured coatings; nano-systems technology; socio-humanitarian, information, bio- and nanobiotechnology; cognitive sciences, as well as nano-, bio-, info- and cognitive technologies, the so called NBICS convergence (Perez, 2003)

Currently, industries related to the third technological stage prevail in Kazakhstan, accounting for almost 65%. The share of industries of the fourth technological stage is approximately 30-35%, and the share of industries of the fifth technological stage is about 1%. Almost 60% of investments is aimed at industries relating to the fourth technological stage. For instance, as shown in Table 1, the US economy is on the path of both the fifth and the sixth technological stages. The share of the fifth technological stage is 60%, whereas the sixth technological stage comprises 5%. In Russia, a country which is close to ours, the fifth technological stage is already 10%, including its electronic industry, computer software, telecommunications, robotics, alternative raw materials and information technologies (Satybaldin et al., 2016; Kuvandykov, 2015; Ibrayev, 2016).

3. Purpose and methodology

Issues related to innovative development are highlighted in works by Kazakh scholars and scientists, among whom are F. M. Dnishev and F. G. Alzhanova, A. A. Satybaldin, N. K. Nurlanova, O. Sabden, K. S. Mukhtarova, S. T. Kupeshova and others. Yet, many aspects require further study. The creation of a mechanism for the comprehensive development of innovation activity with the participation of higher education institutions, the private sector and the state is one of such areas. Both system and structural analyses based on economic and statistical data processing, expert evaluations, comparative analysis, generalisation and synthesis is the methodological framework of the current research.

4. Results and discussion

4.1. The analysis of the performance of innovation development in Kazakhstan in terms of the country's transition to the industrial and innovation development model

Moving towards its industrial and innovative development, Kazakhstan is facing a number of challenges which include the country's economy oriented towards raw materials, poor industrial and social infrastructure, overall technical and technological backwardness, absence of collaboration between science and industry, including low expenditures on research and development. To solve the abovementioned problems, achieve sustainable development based on economic diversification and modernisation and to ensure appropriate conditions for manufacturing innovative and competitive products, Kazakhstan has adopted a number of policy documents such as the Strategy of Industrial and Innovative Development of the Republic of Kazakhstan for 2003-2015, the Program on Formation and Development of the National Innovation System of the Republic of Kazakhstan for 2005-2015, 2010-2014 National Program on Accelerated Industrial and Innovative Development Of the Republic of Kazakhstan, the Program on Technological Development of the Republic of Kazakhstan until 2015, the State Program of Industrial-Innovative Development of the Republic of Kazakhstan for 2015-2019, etc.

Despite all the efforts, the state has neither comprehensive nor systemic approach to innovation management, which constrains the country's innovation activity and development. A number of indicators show that there is a significant backlog concerning the level of innovative development. For the purpose of a comparative analysis, let us reflect the level of innovative development of a number of developed economies and selected CIS countries.

4.1.1. The evaluation of the level of innovation activity in Kazakhstan

Regrettably, the level of innovation activity in Kazakhstan has been consistently low over the years. According to the Global Innovation Index 2016 published by Cornell University, INSEAD and the World Intellectual Property Organisation (WIPO), China is among the 25 most innovative countries, Switzerland, Sweden, the United Kingdom, the United States of America, Finland and Singapore topped the list. Based on the study of the Global Innovation Index 2015, Switzerland ranked first by the level of innovation activity with its 66.3 points of the Global Innovation Index, followed by the USA - 61.4, South Korea - 57.1, Japan - 54.5, Russia - 38.5, Belarus - 30.39 and Kazakhstan - 31.5 points, respectively (Dutta et al., 2016).

In 2015, the aggregate level of innovation activity of organisations in Kazakhstan was 8.1%. In Russia, it was 9.7%, whereas the relevant indicator was higher than 50%, including Germany with its 61.5%, Belgium with its 52.8%, Finland with its 50%, as well as France and Austria with their 41-43% (See Figure 1) (Dutta et al., 2016; http://stats.oecd.org; http://www.stat.gov.kz).

Many experts are of the opinion that the existing level of innovation activity will not help to overcome a technological handicap, change production patterns and volumes in all areas of the economy of Kazakhstan (Satybaldin et al., 2016; Kuvandykov, 2015; Ibrayev, 2016).

The lack of application of research results in business is one of the major problems of the development of innovation activities in Kazakhstan. Experience shows that innovations are based on the existing technological platform, with the needs of the production sector being a major factor contributing to innovation activities.

4.1.2. The level of R&D funding and funding for innovation activity in Kazakhstan as compared with developed countries

Poor funding for the development of science and innovations, which is 0.17% of GDP (2015), makes the country's budgetary funding insufficient and ineffective.

The share of budget spending on R&D was approximately 3-4% of total GDP in most advanced economies in 2015. For instance, the relevant share is 4.29% of GDP in South Korea, 3.59% in Japan, 3.16% in Sweden, 2.74% in the USA, 1.13% in

Tab. 1: **Share of technological stages in the economy of the USA and selected CIS countries**

Country	Third technological stage	Fourth technological stage	Fifth technological stage	Sixth technological stage
USA	-	20 %	60 %	5 %
Russia	30%	50%	10%	-
Ukraine	57.9 %	38 %	4 %	-
Kazakhstan	65%	35%	1%	-

Source: Compiled by the authors based on Satybaldin et al., 2016; Kuvandykov, 2015; Ibrayev, 2016; Kablov, 2010; Vasylenko, 2013

Russia, as opposed to 0.17% in the Republic of Kazakhstan (Figure 2) (http://stats.oecd.org; http://www.uis.unesco.org; http://www.stat.gov.kz).

Scientists and representatives of research centres and rating agencies agree that if spending on research and development does not exceed 0.20% of GDP for 5-7 consecutive years, the country may exhaust its scientific and intellectual capacity. Therefore, Kazakhstan urgently needs to increase funding for science and innovation, as well as to increase financial activity in the field of innovations in the private sector.

The UNESCO Institute for Statistics has calculated the amount of money that countries spend on R&D. In 2015, global investments in new R&D projects reached record USD 1.7 trillion, 80% of which is accumulated in 10 most developed countries. As can be seen in Figure 3, the USA, China, Japan, Germany and South Korea are in the five leading countries.

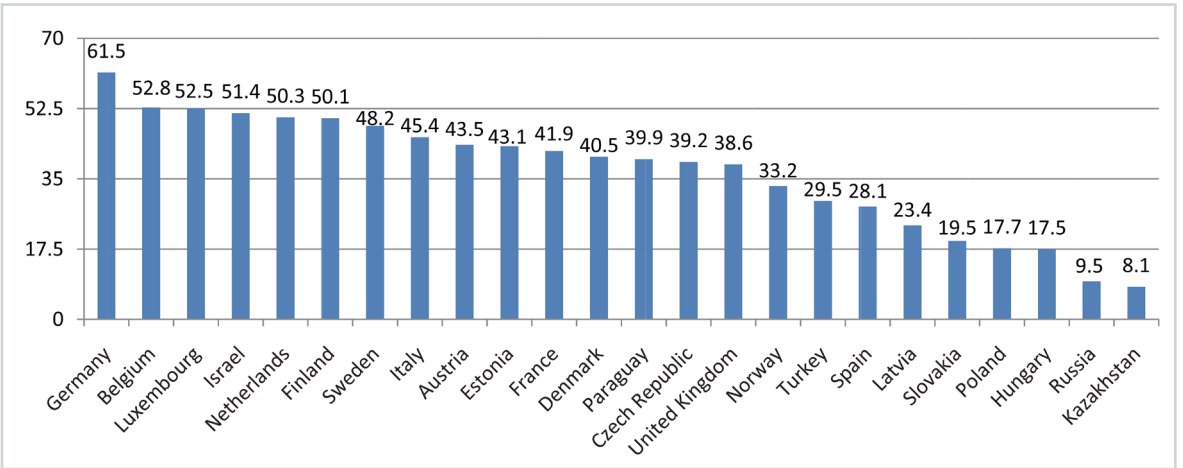

Fig. 1: **Share of organisations implementing technological innovation in the total number of industrial production organisations by country: 2015 (%)**
Source: Dutta et al., 2016; http://stats.oecd.org/; http://www.stat.gov.kz

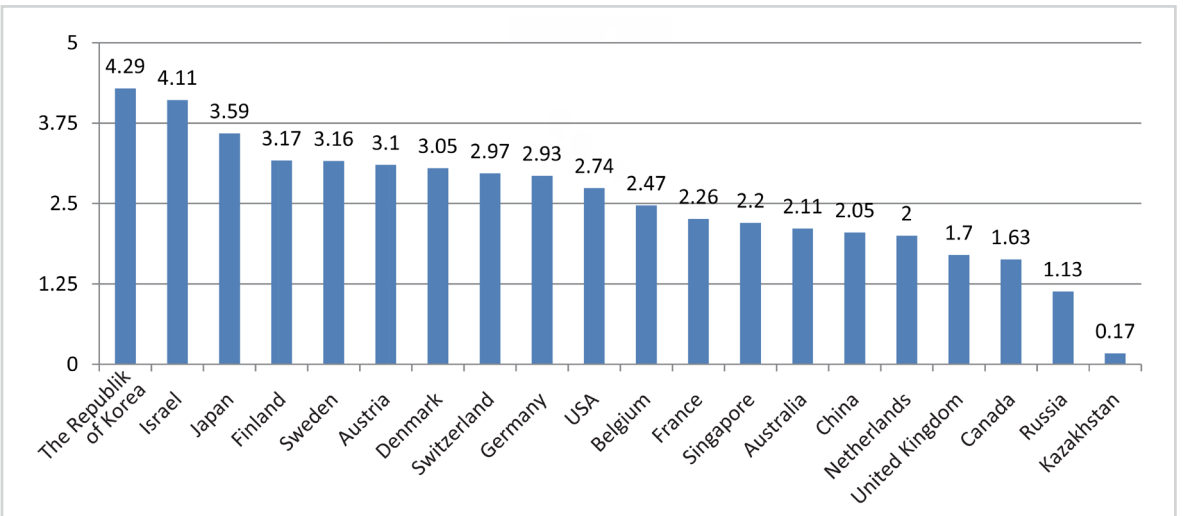

Fig. 2: **Gross domestic expenditure on R&D as a percentage of GDP by country: 2015**
Source: Dutta et al., 2016; http://stats.oecd.org/; http://www.stat.gov.kz

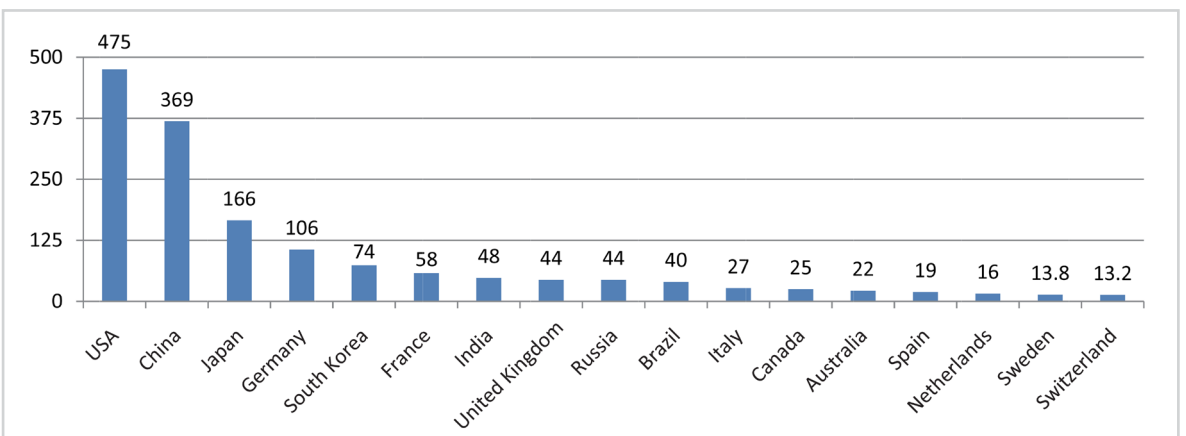

Fig. 3: **Countries leading in terms of domestic expenditures on research and development in 2015, USD billion**
Source: http://www.uis.unesco.org Schwab, 2016

When calculated in US dollars, the expenditures on R&D in Kazakhstan equalled approximately USD 20 per year in 2013. In contrast, the annual expenditures on R&D in Sweden equalled USD 1,380.9 per capita, with the relevant amount of USD 1,335.9 in Finland, USD 1,307.6 in the USA, USD 1,287.0 in Switzerland, USD 1,168.5 in Japan, and USD 166.7 in Russia. In this regard, Kazakhstan falls behind the developed countries by over 60 times (Zhurinov, 2014; http://www.uis.unesco.org; http://www.battelle.org/docs).

In developed countries, innovation activity is mostly funded from non-governmental sources. Today, the private sector accounts for 50-70% of total funding for science development in Japan, The USA, Germany and France. The private sector implements from 60% to 75% of the total number of R&D projects in those countries. The share of the public sector in terms of funding for R&D is 1.5-2 times less than that of the private sector. In the USA, it is 30% of the overall funding for R&D, with the relevant indicators being 32% for Germany, 36% for France, and 23% for both China and Japan.

Figure 4 shows that Volkswagen (Germany) and Samsung (South Korea) invested in R&D, respectively, USD 13.2 billion and USD 12.7 billion in 2016, which only confirms that the two countries have been leading in this regard for many years. Intel and Microsoft spend over USD 12 billion on R&D every year. Meanwhile, Toyota (Japan), which was ranked the 8th in terms of its investments in R&D, closes the list of the top ten countries. As follows, large companies on different continents spend billions of US dollars to sustain their competitive strength and to increase sales volumes (http://www.strategyand.pwc.com/innovation1000; Casey and Hackett, 2014).

Budgetary funding is currently one of the main sources of funding for scientific research and innovation in all CIS countries. In 2015, the budgetary funds aimed at the development of R&D in Kazakhstan accounted for more than 70%.

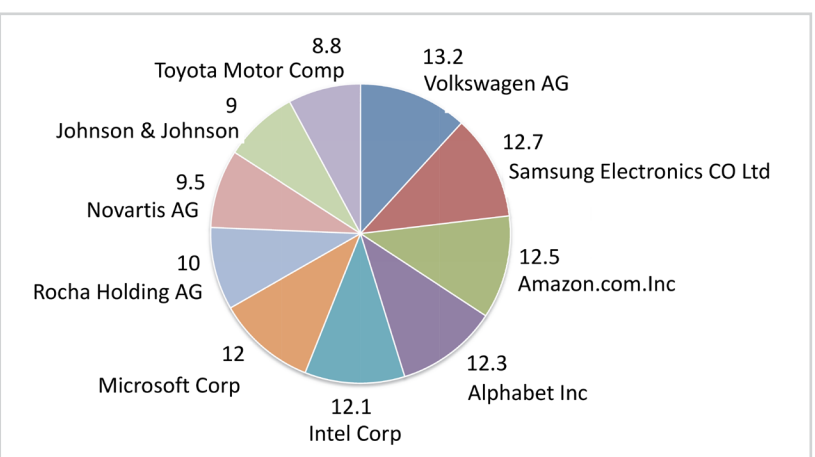

Fig. 4: **10 Most Innovative Companies vs. Top 10 R&D Spenders**
Source: http://www.strategyand.pwc.com/innovation1000; Casey and Hackett, 2014

4.1.3 Staff working on research and development

A proportion of scientists and R&D specialists is an important indicator of the innovation economy. According to the UNESCO Science Report: towards 2030, the number of scientists participating in R&D worldwide is approximately 7.8 million, which means that their number has grown by 21% since 2007 (http://unesdoc.unesco.org).

The EU with its share of 22% is still a world leader in the number of researchers. In 2013, researchers China accounted for 19.1% of world researchers. In this regard, China surpassed the USA (16.7%) The share of Japan decreased from 10.7% (2007) to 8.5% (2013).The Russian Federation also showed a decline in its share from 7.3% (2007) to 5.7% (2013).

Finland with its 164 scientists per 10,000 of the population, Japan with its 99 scientists per 10,000 of the population, the USA with its 86 scientists per 10,000 of the population and Russia with its 75 scientists per 10,000 of the population, as compared with 20 scientists per 10,000 of the population in Kazakhstan, held the leading positions.

In 2015, the number of staff working on research and development in Russia reached 738.9 thousand people, which is slightly more than 1% of the country's employed population. In Kazakhstan, the relevant number was 24,735 persons or 0.3% of the country's population. In this regard, particular attention needs to be given to support and encouragement for scientists as major participants in innovation activities.

Even the most talented hardworking scientist who generates new knowledge or creates essential products is unable to do science and to implement scientific results in business equally well and at the same time. To provide this, it is necessary to engage relevant structures and specialists. In this respect, it is possible to establish development and production centres for piloting and subsequent introduction of innovations, which is possible only with regard to different entities of the real sector of economy (Guerzoni and Raiteri, 2015).

In this perspective, the experience of Norway, a country in which corporations operating there order R&D services on the local market, is indicative. It is concerned with orders for practical developments by local research institutes. Norway gives significant reliefs and exemptions to those investors who adhere to the existing policy. The state reduces tax deductions by 18-20%, depending on the number of company employees, with regard to the relevant expenditures on R&D (Asheim and Coenen, 2005).

The role of government in simulating innovative activities and funding R&D was proven through the concept of the triple helix by H. Etzkowitz from Stanford University. This concept has been evolving since 1980s. Its essence refers to a set of close interactions between subjects associated with innovation development. Under this concept, science interacts with the state and the private sector forming equal partnership. Modern universities become research and business organisations, while companies act partly as universities by establishing new partnerships with educational institutions. The state becomes an equal partner for science and business, playing a convening and stimulating role in the development of partnership between the latter. This is the basis of the so called triple helix, by analogy with the DNA structure (Etzkowitz, 2011)

To stimulate innovation activity, it is necessary to create conditions, under which its implementation is equally beneficial for both the actors engaged in such an activity and the economy as a whole. If the share of manufacturing in Kazakhstan rises, and production facilities producing finished products work, then the need to produce new products and to use resource-saving technologies will increase. The need for innovations will boost the R&D growth in the private sector and higher education institutions. The role and status of science and scientific staff will gain in significance, due to which R&D will get sufficient finding from the part of the state and business, which in turn will increase the number of those who work on research and development and result in a positive impact on the growing demand for innovative products. An increase in the number of those who work on research and development contributes to the development of competitive production based on the use of progressive achievements in the area of science and technology, which increases the share of innovative products in the structure of production.

5. Conclusions

Low innovation activity of business entities in Kazakhstan, a lack of demand for innovations, poor interaction between science, education and business, as well as insufficient funding for R&D from the part of the state and the private sector are the main problems of the innovation activity in Kazakhstan.

To root out the causes that stifle the country's economic development, it is essential to develop a policy of government intervention, using the advanced experience of foreign countries. At the same time it is appropriate to apply the principles of coordination, harmonization and motivation, enabling all actors to align their actions. The foundations of the sustainable and competitive innovation economy in Kazakhstan should include:

- capacity building for manufacturing;
- improvement of the quality of the country's intellectual and innovative potential;
- increasing expenditures on R&D from the part of business entities;
- greater collaboration between higher education institutions and businesses in the field of research and development;
- development of public-private partnerships in the area of R&D and innovation activity.

Being a state with significant oil and gas reserves and having sufficient amount of such natural resources as ferrous and non-ferrous metals, Kazakhstan can succeed in increa–sing its knowledge-intensive products, investing in social infrastructure, developing innovations, improving its tax and financial system including the efficiency of public management, and creating favourable conditions for business development.

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Received 15.09.2017