



Scientific Potential as the Basis of Innovation Development of Kazakhstan

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ABSTRACT

The article describes the development of market mechanisms of high-tech sector of innovation system of the Republic of Kazakhstan. The structure of domestic expenditure on research and development of different countries is analyzed. The article revealed that the main problem for Kazakhstan science is the low level of development of innovation system, i.e., research and development are still not getting the production application. The results of the research activities and the estimation of the impact of research are considered. The relationship between the structure of domestic expenditure on research and development and the number of patent applications was investigated. Positive correlation between the number of patent applications and the financing of science business sector was revealed.

Keywords: Innovation, Science, Research

JEL Classifications: N15, O32

1. INTRODUCTION

The changes taking place now in the whole system of industrial relations in Kazakhstan are connected with the new stage of economic reform - economic growth through innovative modernization of the national economy. Transition to innovative economy is one of the key factors in the sustained economic growth of the country and has a complex influence on all spheres of society. For successful implementation of the planned changes associated with the construction of a new economic model, it is necessary to consider objective tendencies both in the world, and inside of the country.

Under the influence of innovative development the economies of industrialized countries take on a qualitatively different state, which is based on information, which transforms not only production, but also all other aspects of life, dramatically expanding the boundaries of possibilities, both nationally and globally. Science and technological progress have become the systemically important factors of “information society.”

The number of ideas that is used for the creation of innovation, the search for technical solutions directly depends on the status of scientific potential of the country. Unfortunately, the comparison Kazakhstan and the developed countries in capacity-building indicates shows the backlog of Kazakhstan. The intellectual capacity of our republic is the result of a significant decrease in funding science in the years of reforms. And this, of course, is objective cause of the backlog in the competitiveness of the production.

The purpose of this study is to determine the characteristics of the formation of the scientific potential of Kazakhstan within the development of the national innovation system (NIS). To achieve this goal it is necessary to solve the following problems:

- To analyze the structure of domestic expenditures on research and development;
- To consider the results of research activities;
- Assess the impact of research.

The object of research is knowledge-intensive sector of the economy of the Republic of Kazakhstan. During the study the

techniques of economic research has been used: Comparison, generalization, calculation, analytical, statistical and other methods. In the current statistical surveys all enterprises and organizations are classified according to the following sectors of activity (in accordance with official recommendations of the Organization for Economic Cooperation and Development (OECD) on statistics research and development): The public sector, the business sector, the higher education sector, the private for-profit sector. The study based on selected 25 countries belonging to different categories of groups (CIS countries, OECD countries, European Union countries, non-OECD countries and other countries) with which Kazakhstan cooperate in different sectors of the economy.

2. LITERATURE REVIEW

The concept of NIS allows understanding innovation processes on regional and national level between individuals, enterprises, research institutions and government. Creation of effective NIS in Kazakhstan demand understanding theoretical aspects of innovation systems, its elements and criteria of estimation.

The NIS concept first appeared in work by Freeman (1987, 1995, 2002), Lundvall (1992) and Nelson (1993). Initially the concept of innovation system was used in 1987 by Freeman, in his study of technology policy in Japan. Freeman described the most important elements of the Japanese innovation system, which provided the economic success of the country in the postwar period.

Three books edited by Lundvall (1992, 2002), Nelson (1993) and Edquist (1997) was published devoted to references on NIS.

The question about measurement of NIS performance emerged in studies of Patel and Pavitt (1994), Autio (1998), Metcalfe and Miles (2000), Carlsson et al. (2002), Fritsch (2002).

In most recent period the views of these scientists were developed in the works of the researchers as Mowery (1998), Martin and Johnston (1999), Chang and Chen (2004), Balzat and Hanusch (2004), Edgington (2008) in which the different actors and features of interactions between them were considered. In Kazakhstan the issues on the development of NIS are considered in the works by Radosevic (2009), Barlybayeva (2006), Bishimbayeva (2009), Kenzheguzin (2005), Sitenko (2011), Yessengeldin et al. (2013).

3. ANALYSIS OF DOMESTIC EXPENDITURE ON RESEARCH AND DEVELOPMENT

Currently, innovation has not yet become the basis of socio-economic development of the country in the domestic economy is not observed any significant technological breakthroughs, no signs of mass development of intensive research and development results.

The science in modern conditions covers all areas of public reproduction. The science in economy of knowledge, first of all, fundamental, is the generator of human potential. In this context

a science and spanning tree protocol define possibilities of any country in the decision of social and economic problems, its competitiveness on foreign markets, and, consequently, and the place in the world economy. Creating intellectual innovations for a society, the science makes national human potential.

Research and development expenditures reflect the resources that are allocated for the development of knowledge and technology. In all developed countries, R&D expenditures are constantly rising. Share of high-tech products, and spending on science in total GDP are key indicators of the economy based on knowledge (Table 1).

The data of the Global Innovation Index Report (2012) show, that in the most advanced economies, the share of domestic expenditures on research and development amounted to an average of the total gross domestic product (GDP) of 3.0% (Sweden - 3.37%, Finland - 3.78%, Japan - 3.39%, Switzerland - 2.87%, USA - 2.85%, Germany - 2.88%, while the share of the business sector in these costs was on average 70%).

The figures of Statistical Committee of Republic of Kazakhstan (2014) confirm, that in Kazakhstan, the share of domestic expenditures on research and development is less than 0.2% of an average of the total GDP (Figure 1). Expenditures on research and development (per capita) in the Republic of Kazakhstan is about 15 dollars, whereas in developed countries - from 50 to 150 dollars.

Large role here belongs to the state's economic policy. In countries that are leaders in the world market of high technology products, the share of spending on science in the total GDP is tightly controlled, including through the use of economic instruments such as tax rebates, low duties, budget support, promotion of investment, scientific equipment leasing. The experience of developed countries shows that the share of new or improved technologies, products, equipment containing new knowledge or solutions is around from 70% to 85% of GDP growth.

Present wealth of our country, accumulated in the form of knowledge and skills comes now to degradation, morally obsolete. Therefore there is an urgent need to achieve the suspension of the negative dynamics in human potential development. Amount of spending on science in recent years indicate that Kazakhstan has not yet created the conditions for the conversion of intellectual production in the systematic managed process for profitable development of the business sector.

Low development of innovation system is still a great problem for domestic science. Research and development are not getting the production application. Industry of Kazakhstan, residing on industrial stage according to experts and statistics, almost do not send impulses to science.

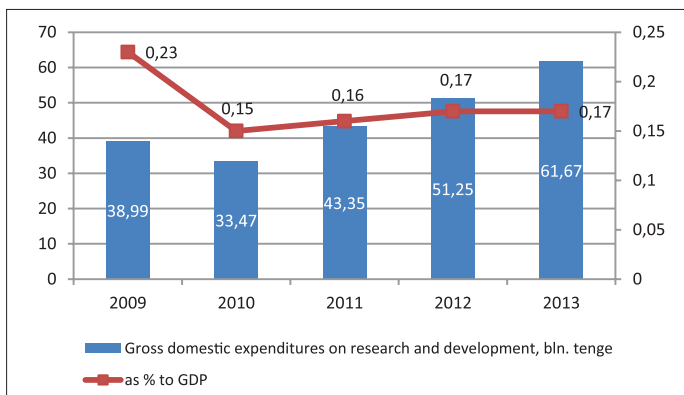
4. THE RESULTS OF THE RESEARCH ACTIVITY

One of the key indicators of research and development effectiveness is patent activity.

Table 1: The structure of domestic research and development expenditures by country

Country	Domestic research and development expenditures in % to GDP 2011 year or last available	The structure of domestic research and development expenditures (%)			
		Public sector	Business	High education	Private non-profit sector
Australia	2.20	12.3	60.8	24.2	2.7
Austria	2.75	5.3	70.6	23.8	0.3
Armenia	0.27	69.5	20.4	10.1	0
Belarus	0.76	27.1	61.4	11.5	0
United Kingdom	1.77	9.2	62.0	26.5	2.4
Germany	2.88	14.5	68.2	17.3	0
Georgia	0.18	73.2	0	26.8	0
India	0.76	66.0	29.6	4.4	0
Iran	0.79	55.3	14.2	30.5	0
Kazakhstan	0.16	38.5	13.5	15.2	32.7
Canada	1.74	10.4	54.1	34.9	0.6
Kyrgyzstan	0.16	59.6	28.4	12	0
China	1.84	18.3	73.3	8.5	0
Latvia	0.80	24.7	36.4	38.9	0
Lithuania	0.60	23.6	23.7	52.7	0
Russia	1.12	30.3	62.4	7.1	0.2
USA	2.85	10.6	72.6	12.8	3.9
Turkey	0.86	12.6	40.	47.4	0
Ukraine	0.86	37.7	55.4	6.9	0
Switzerland	2.87	0.7	73.5	24.2	1.6
Sweden	3.37	4.4	70.5	24.9	0.2
Finland	3.78	9.1	71.4	18.9	0.6
France	2.24	16.3	61.9	20.6	1.2
Estonia	1.62	11.0	44.7	42.2	2.2
Japan	3.39	8.3	78.5	11.6	1.6

Sources: Science and Engineering Indicators 2014.-National Science Board. GDP: Gross domestic product, The Global Innovation Index (2012), Stronger Innovation Linkages for Global Growth. - INSEAD and WIPO, in 2012, France by INSEAD. - 464p.; Science. Innovation. Information Society. (2014), Statistical materials. Astana: Statistical Committee of Republic of Kazakhstan. – 45p.

Figure 1: Gross domestic expenditures on research and development in the Republic of Kazakhstan

Source: Compiled by authors based on Science. Innovation, Information Society 2014. Statistical Committee of Republic of Kazakhstan

In recent years Kazakhstan conducts extensive work to harmonize national patent laws in line with modern international requirements. It was formed a national database of industrial designs registered in Kazakhstan with advanced search options in 2010. Annually there are working on updating the database “inventions of the world,” including patent information of leading countries such as Japan, USA, Russia, France, Germany, Switzerland and others. That contributes to the fact that Kazakhstan is becoming attractive for both domestic innovation applicants and for applicants from near and far abroad.

However, despite increased demand for licensing agreements and patents, patent deals on the market are not well developed due to the lack of motivation of scientists to create inventions, underdeveloped innovative infrastructure, weak links between production and research organizations.

Table 2 shows the trend in the number of patent by country.

According to the patent application statistics, the highest activity was observed in China (8,54,281 patents for 2013), the USA (7,84,943), Japan (5,29,842), Germany (2,00,289) and Russia (50,214).

Kazakhstan is not at leading position in patenting. Number of patent application per 1 million of population in the country is only 162.6 patents while developed countries like Japan that indicator is much higher.

Foreign countries has a system of state measures for innovation stimulation which target financing of studies, providing preferential tax treatment for inventors and research organizations, various loan subsidies.

Weak competitiveness of the country in terms of technology is explained the lack of R&D of world level in the country. According to WIPO, in 2013 Kazakhstan registered 500 international patents, then, for example, Finland, which the population is 3 times less - 9213 international patents. Main reason for the lag in Kazakhstan in terms of patent activity is that Kazakhstan’s

individuals and entities have significant financial constraints and low literacy in the field of intellectual property, patenting abroad. This situation was formed in Soviet times and has not yet been overcome, despite the marked upward trend of patenting in the country.

One of the mechanisms to measure the impact of research and development are considered patent applications for inventions filed in the patent offices of the country. Absolute leader in patent applications is the U.S., followed by Japan, China and Germany. In this article we will try to identify the relationship between patent applications and sectors of R&D funding.

For calculations of relationship authors used data in Tables 1 and 2. More sophisticated is the linear correlation coefficient (r_{yx}). Analysis includes the following correlation calculations:

1. Between the cost of public sector research and patent applications;
2. Between the cost of the study of the business sector and patent applications;
3. Between the cost of the higher education sector research and patent applications;
4. Between the cost of the research sector, nonprofit organizations, and patent applications.

Correlations were calculated using the formula below (Stock, 2007):

$$r_{yx} = \frac{\overline{xy} - \bar{x}\bar{y}}{S_x S_y} = \frac{\overline{xy} - \bar{x}\bar{y}}{\sqrt{(x^2 - (\bar{x})^2)(y^2 - (\bar{y})^2)}}$$

Where x_i, y_i – Individual values of factor and efficiency attributes;

\bar{x}, \bar{y} – Average values of attributes;

\overline{xy} – Average value from multiplication of the individual values of attributes;

S_x, S_y – Sample standard deviations of attributes.

The results of calculations are presented in Table 3.

Calculated by authors on the base of Tables 1 and 2.

These results show that:

- Correlation between the expenditures of public sector research and patent applications has a negative relationship;
- Correlation between the expenditures of the research and the business sector patent applications indicates a positive relationship between two variables;
- Correlation between the expenditures of research and higher education sector patent applications has a negative relationship;
- Correlation between the expenditures of the research sector non-profit organizations and patent applications indicates a negative relationship between the variables.

Table 2: Patent applications by country

Country	Patent applications applied in patent offices					
	2009	2010	2011	2012	2013	Average
Australia	31843	34037	34679	35450	39171	35036
Austria	10266	11314	11879	12692	13579	11946
Armenia	171	198	219	188	181	191.4
Belarus	3402	3067	2514	2891	2468	2868.4
United Kingdom	55189	57318	57721	59427	59262	57783.4
Germany	174056	185817	188064	197768	200289	189198.8
Georgia	485	368	418	386	338	399
India	38964	45778	49346	52604	53269	47992.2
Iran	12760	11725	12131	11132	11681	11885.8
Kazakhstan	2103	2194	2138	504	2764	1940.6
Canada	54511	55115	55327	57361	56478	55758.4
Kyrgyzstan	177	187	202	131	133	166
China	326942	406437	546753	678872	854281	562657
Latvia	506	461	335	371	487	432
Lithuania	155	160	157	211	240	184.6
Russia	41825	46615	46383	49889	50214	46985.2
USA	629113	681448	696464	747522	784943	707898
Turkey	3496	4388	5511	6215	6062	5134.4
Ukraine	5248	5794	5922	5533	6055	5710.4
Switzerland	36122	39946	39222	43523	45627	40888
Sweden	21102	22802	22351	21873	22810	22187.6
Finland	11554	13149	11826	13069	12846	12488.8
France	62427	67528	69265	72077	73269	68913.2
Estonia	290	317	290	296	290	296.6
Japan	516882	522934	530081	546054	529842	529158.6

Source: WIPO (http://www.wipo.int/ipstats/en/statistics/country_profile/)

Table 3: The results of correlation between patent applications and domestic expenditures on research and development

Indicator	Correlation coefficient
The correlation between public sector research expenditures and patent applications	-0.2791
The correlation between business research expenditures and patent applications	0.4728
The correlation between high education research expenditures and patent applications	-0.3433
The correlation between private non-profit sector research expenditures and patent applications	-0.0244

Based on the results, we can conclude that the larger share of the business sector in the financing of science, the greater the number of patent applications, whose subsequently leads to higher innovation performance in the country. Conversely, the significant proportion of research funding by the public sector, higher education sector and non-profit institutions do not lead to the increase in the number of patent applications. Bucking the trend is seen.

5. CONCLUSIONS

1. Stable economic growth in Kazakhstan can be achieved only on the basis of innovations, with the active use of modern scientific and technological achievements. Only in that case the country will have chances for high-quality growth, resource conservation, efficiency of production, competitive goods on domestic and world markets.

2. In the republic of Kazakhstan the share of domestic expenditure on research and development is less than 0.2% of GDP, while in developed economies it is an average of 3.0% in GDP.
3. In technologically advanced countries, the business spending on research is far superior to public spending on R&D. Kazakhstan yet has a different structure with a predominance of the public sector in funding research and development.
4. Kazakhstan has a very low activity of patent applications in local and international patent offices which is due to their lack of preparation for practical implementation. According to this indicator, the leading countries are China (8,54,281 patents in 2013), the USA (7,84,943), Japan (5,29,842), and others. Most of the commercial transactions in the domestic technology market are agreements on developments in the stage of technical solutions. Serious deficiencies such transactions are the significant costs of implementation, the associated risks for the companies, and lack of guarantees for technical and economic characteristics of objects of implementation.
5. The results of the correlation between patent applications and internal costs for research and development shows that the NIS of Kazakhstan will be effective and bring high returns only if the country will develop the strong business sector. The trend towards greater competition is clearly visible in the world market of high technology products. An increasing proportion of the costs of entrepreneurs of developed countries transferred from the sphere of industrial production into the sphere of research and development of new technologies and products. In these circumstances, Kazakhstan could become a technologically backward country, only accept new innovative technologies from developed nations. Therefore, Kazakhstan should: Create corresponding infrastructure for regular renewal of public database of knowledge, according to the level of world technological development; expand the practice of participation of universities in tenders for state orders and the business sector on research and development activities; develop a preferential tax regime for businesses which direct the funds to finance scientific research.

6. SUMMARY

The article describes the development of market mechanisms of high-tech sector of innovation system of the Republic of Kazakhstan. Stable economic growth can be achieved only on the basis of innovation, with the active use of modern scientific and technological achievements. In that case the chances for high-quality growth, resource conservation, efficiency, produce competitive in domestic and world markets production may be realized.

The structure of domestic expenditure on research and development of different countries is analyzed.

At the end of the last decade in most advanced economies, the share of domestic expenditures on research and development amounted to an average of the total GDP of 3.0% (Sweden - 3.37%, Finland - 3.78%, Japan - 3.39%, Switzerland - 2.87%, USA - 2.85%,

Germany - 2.88%, while the share of the business sector in these costs was on average 70%).

The article revealed that the main problem for Kazakhstan science is the low level of development of innovation system, i.e., research and development are still not getting the production application. No wonder that the country created lack of new equipment using licenses, patents and other legal protection of intellectual property. It also be noted that many of these objects are not implemented in the production, aging and mentally impaired. The results of the research activities are considered and the estimation of the impact of research was made.

Weak competitiveness of the country in terms of technology is explained including the lack of R&D in the country of the world level. In 2013 Kazakhstan registered 500 international patents, then, for example, Finland, which the population is 3 times less - 9213 international patents. Main reason for the lag in Kazakhstan in terms of patent activity is that Kazakhstan's individuals and entities have significant financial constraints and low literacy in the field of intellectual property, patenting abroad.

The relationship between the structure of domestic expenditure on research and development and the number of patent applications is investigated. Positive correlation between the number of patent applications and the financing of science business sector was revealed. It should be noted that in technologically advanced countries, the cost of the business sector in research (60-70%) is far superior to the public spending on research and development. Kazakhstan is still preserved a different structure with a predominance of the role of the public sector of R&D funding.

In the world market of high technology products visible tendency to increased competition is obvious. Most of the expenses of the business sphere is transferred from industrial production in the sphere of research and development, modeling of new technologies and products. The importance of legal protection of intellectual property for global economic market is dramatically increases. In these circumstances, Kazakhstan can become a technologically backward country, the recipient of new and innovative technologies.

In addition, it should be noted that in most countries, basic research has traditionally taken place primarily in the public sector and the business sector engaged in applied research. From the experience of foreign countries, we can conclude that the NIS of Kazakhstan will be effective and bring high returns only if the country will have developed business sector.

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