The Innovation System of Kazakhstan in the Context of the Global Innovation Index

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ABSTRACT

Global Innovation Index (GII) is the advanced research project which assesses the development of national innovation systems worldwide. The dynamics and amplitude of the total cumulative innovation index demonstrates a sustainable innovation gap between countries that are in different stages of scientific and technological development. Study of the main components of the GII allows us to determine competitive advantages that need to be improved and problems that require adoption of adequate solutions by all actors of innovation processes. A special role in the search for new sources and development of strategies for innovative development belongs to the state.

Recent global developments showed that ensuring the stability of a country's socioeconomic development and raising the population's living standard is not possible without creating conditions for accelerated technological modernization of capital, technology and science thus improving and stimulating innovation. In this regard, taking into account national interests, formation and development of an innovation system is characterized as an important purpose of state management and regulation in the context of globalization. Based on analysis of national ratings compared to global innovation ratings, the authors determined the indicators that have the most impact on the quality and quantity of innovation development in the Republic of Kazakhstan. The authors propose measures of government influence that will improve these indicators.

Key words: Global innovation index, indicators of ranking, innovation system, Republic of Kazakhstan, state management.

Introduction

The Republic of Kazakhstan follows world tendencies of progressive development of socio-economic and political systems. Since independence, the country has been changing and improving the economic and management system, taking into account the most advanced achievements in science and technology. Kazakhstan has implemented two large-scale modernization programs, and continues to make changes in its third modernization program. Kazakhstan is a part of the world space and it systematically participates in international ratings, in order to give public authorities an opportunity to assess its current position in the global competitive, socio-economic, political and innovation spaces.

Other countries demonstrated that no country in the world can independently establish an innovation system; it can only be done on the basis of market-driven systems and relations with the private sector. The state plays an important role in improving the competitiveness of the national economies in all countries. A systematic approach to the creation of an innovation model is the basis of contemporary relations with a focus on social growth.

Public sector organizations must adapt to changing conditions and requirements in order to fulfill their functions effectively at the legislative level and in terms of providing quality public services. Authoritative analytical centers and government-sponsored international organizations such as the World Bank, the Organization for Economic Cooperation and Development (OECD) and others have repeatedly drawn attention to the importance of creating incentives and conditions for the development of innovation activities (Gieske, van Buuren, Bekkers, 2018).

Kazakhstan and many other countries participate in the global ranking of innovation, which has been calculated since 2007 by representatives of the graduate international business school INSEAD, with campuses in Europe (Fontainebleau, France), Asia (Singapore), and the Middle East (Abu Dhabi); joined later by researchers from Cornell University and the World Intellectual Property Organization (WIPO). The key objective of calculating the global innovation index is to determine the main approaches and indicators (sub-indices) that, according to the experts conducting this study, can fairly accurately reflect conditions for the spread of innovations and their significance for country development. Meanwhile, the methods used partly extend beyond the traditional understanding and measurement of innovation (Suslov, 2015: 18).

The purpose of this study is to analyze Kazakhstan's key positions, identify the main indicators and their components, and identify internal interrelations between indicators that are included in the Global Innovation Rating. This article compares the rating positions of Kazakhstan, its neighboring countries and its partners in the Eurasian Economic Union (EAEU), and the position of Kazakhstan relative to the leading countries in the region. The data used have been published as annual global innovation indices prepared by representatives of INSEAD, Cornell University and the World Intellectual Property Organization (WIPO). The subject of analysis is sections of the Global Innovation Index and their components.

Methodology and Expected Results of the Research

The data from the GII permit comparison of the innovative development of a single state in the context of the countries participating in the rating, the sub-indices included in the analysis, in the context of the time period reviewed. Like most analytical methods, the index has some subjective and simplified content, but it also does not pretend to econometrically verified and absolute results. The advantages of using the index approach are the ability to combine a variety of measures, to obtain unified data, to study the large-scale and to study heterogeneous phenomena. Based on the results of the analysis, the authors attempt to identify the most (or least) influential indicators of the index, to make proposals for their improvement, to determine opportunities of Kazakhstan and identify factors that could improve the position of the country in the ranking, and to consider the main directions for improvement of state innovation policy, whose intent is to contribute to the innovative development of the Republic of Kazakhstan.

The concept of an innovation system is a special category of public administration and regulation, which has been thoroughly studied within various fields of scientific knowledge - from the science of innovation itself, founded by J. Schumpeter, to modern management and information technology (IT). In a general sense, an innovation system is a functional element of the socio-economic system, which acquires its own structure in the process of interaction with interconnected subsystems (Vylegzhanina, 2015: 23).

The conceptual foundations of innovation systems began to develop in the late 1970s and early 1980s through the study of technological systems and innovation systems through the work of a number of scientists and experts in the field of technology in the United Kingdom, the Netherlands, Denmark and the United States of America, such as Christopher Freeman (1982, 1987, 1992; Freeman, Clark and Soete, 1982), Bengt-Ake Lundvall (1985), Philip Cooke (1992: 365–382; Cooke, Gomez Uranga and Etxebarria, 1997), Richard Nelson (1993), Charles Edquist (1992; Edquist and Johnson, 1997: 41-63), Bo Carlsson (1995), and Luc Soete (Soete, 1999).

In 1982, Professor Christopher Freeman of the University of Sussex, an OECD consultant, prepared an analytical article on the theme "Technological Infrastructure and International Competitiveness". He did this work for a group of OECD experts engaged in research on science, technology and developing competitiveness. In his article, Freeman used the notion of "national innovation system" for the first time, emphasizing the significance of a government's active position in technological infrastructure development. However, the work wasn't published because of the refusal of the expert committee chairman, who found it provocative (Smelova, 2011: 40).

A few years later, in 1985, the category "innovation system" was introduced into the scientific literature, a Danish professor at Aalborg University, Bengt-Ake Lundvall. In his research work on innovative products and the interaction of producers and consumers (users). Lundvall uses the concept of "innovation system" to consider participants in innovation processes - universities, private enterprises, government organizations and their scientific divisions, representatives of the production process (paragraph 5.2: "A system of innovation") (Lundvall, 1985: 29-30).

Along with Freeman and Lundvall, Columbia University Professor Richard Nelson is considered to have made a significant contribution to the creation of the modern theory of innovation systems. In his book *National Innovation Systems: A Comparative Analysis*, published in 1993 under the general editorship of Nelson, the authors carried out a comparative analysis of the national innovation systems of the fifteen countries with the most technological perspective. To emphasize the key source of competitiveness represented by the technological capabilities of national firms, which are developing an enabling environment also created by national institutions, they used the notion of "technonationalism" (Nelson, 1993: 3).

Thus, the concepts of innovation and national innovation systems which emerged in the 1980s and continues to evolve, is the result of a search for new sources of national competitiveness in the context of globalization and changes taking place in post-industrial societies. It should be noted that the notion of "national" in research on innovation systems was often identical to the notion of "state". At the same time, questions about the formation of information societies and "the knowledge-based economy" were becoming relevant in the scientific community.

A unifying issue in understanding the essence of the emerged and evolving concept for researchers was to give the category "innovation (national innovation) system" the following meaning: the totality and integration of the activity of various structures, pursuing different goals and objectives that create and commercially implement scientific and technological knowledge within one national unit (state). Such structures within the national framework have distinctive features, but they are endowed with an institutional environment of a financial,

legal, and social nature, which ensures the possibility of their joint functioning (Basov, Ilyukhina, 2009: 57).

Global Innovation Index and the Position of Kazakhstan in the Annual Ranking

According to the information included in the 2018 ranking, the Global Innovation Index includes 81 indicators, grouped into 21 semantic criteria and, respectively, into 7 key sub-indices characterizing the two main directions of data accumulation - the "sub-index of input" and "sub-index of output" (Table 1).

Table 1: The Structure of the Global Innovation Index (2018)

The global innovation index is the aggregate index represented by the average value calculated between the sub-indices of input and output, characterizing the number of points scored determining the place in the innovation development ranking of countries (max - 100).			
No.	Sub-index	Index-Component	Criteria
1	Innovation Input Sub-Index (50% of the end result)	1. Institution	1.1 Political environment
			1.2 Regulatory environment
			1.3 Political environment
		2. Human capital and research	2.1 Education
			2.2 Tertiary education
			2.3 Research and development (R&D)
		3. Infrastructure	3.1 Information and communication technologies (ICTs)
			3.2 General infrastructure
			3.3 Ecological sustainability
		4. Market sophistication	4.1 Credit
			4.2 Investment
			4.3 Trade, competition and market scale
		5. Business sophistication	5.1 Knowledge workers
			5.2 Innovation linkages
			5.3 Knowledge absorption
2	Innovation Output Sub-Index (50% of the end result)	6. Knowledge and technology outputs	6.1 Knowledge creation
			6.2 Knowledge impact
			6.3 Knowledge diffusion
		7. Creative outputs	7.1 Intangible assets
			7.2 Creative goods and services
			7.3 Online creativity

Source: The Global Innovation Index, 2018

Table 1 demonstrates that the indicators affect not only the innovation system directly, but also include indirect conditions that form the causal links arising between the innovation area and general infrastructure.

Generally, the basis of any rating research is the identification of leaders, their followers and the weakest participants. Therefore, Kazakhstan is considered in comparison to other countries within the Global Innovation Index. In particular, in comparison to the absolute ranking leaders (Table 2).

The comparison shows that the most stable leading position in the ranking is held by Switzerland, which was in first place from 2011 to 2018. Undoubtedly, the Swiss experience of

high innovation achievements and stability deserves attention. Switzerland has a number of basic conditions that allow it to achieve high performance in the field of innovation. First, Article 20 of the Federal Swiss Constitution contains a provision according to which the State must respect and promote the academic freedom of individuals and institutions in scientific research (Federal Constitution of the Swiss Confederation, 2018). Second, the country is at a high level of modernization and has developed infrastructure. The provision of energy resources for priority sectors meets high international standards and uninterrupted availability. Third, Switzerland has a low level of state influence in the market, which contributes to competitiveness and active private initiative. Fourth, the country is a member of the European Patent Organization and has a strong intellectual property protection system. Fifth, Switzerland has a favorable tax regime and an investment and innovation climate, especially for new entrants to innovation processes (Sergeeva, 2018).

Table 2: The Place of Kazakhstan in the Ranking of the Global Innovation Index (GII) from 2007 to 2018 (indicating benchmark-country)

Year	Position of Kazakhstan in the rating	Number of points received of Kazakhstan	Number of participating countries	Leading country (1st position)	Number of points received of leading country
*2007**	*61*	*2.45*	*107*	*USA*	*5.80*
*2008-2009**	*72*	*2.85*	*130*	*USA*	*5.28*
*2009-2010**	*63*	*3.05*	*132*	*Iceland*	*4.86*
2011	84	30.32	125	Switzerland	63.82
2012	83	31.9	141	Switzerland	68.2
2013	84	32.73	142	Switzerland	66.59
2014	79	32.75	143	Switzerland	64.78
2015	82	31.25	141	Switzerland	68.3
2016	75	31.51	128	Switzerland	66.28
2017	78	31.50	127	Switzerland	67.69
2018	74	31.42	126	Switzerland	68.4
Note - during the periods indicated with the "*" sign, another system of scoring with gradation "1-min-7-max" was used.					

Source: Authors' elaboration based on data of the Global Innovation Index, 2007-2018

Being in the second half of the list of participants, Kazakhstan isn't included in the list of 30-50 countries with the highest innovation score. However, Kazakhstan's position is determined by the general index. If we consider its composite ratio, it can be noted that during the period of Kazakhstan's participation in this rating system, there were not only negative but also positive assessments/positions (Table 3).

The next analysis is performed mainly from 2011 to 2018. This is due to the fact that, starting from 2011, when calculating the global innovation rating, a set of similar indicators is used, which makes it possible to observe the dynamics in changing positions by key characteristics.

According to the data in Table 3, Kazakhstan holds the lowest position for indicators of "creative outputs" for almost every year, which represents a part of the sub- index output. This means that in Kazakhstan the right conditions for the development and effectiveness of

innovation activity have not been created. This is the main platform of the entire innovation system.

For example, the weakest components of the "Creative outputs" indicator were the following: 7.1.1 - Trademarks by origin (92nd position in 2011; 90th in 2015); 7.1.2 - Industrial designs by origin (94th in 2016); 7.1.3 - ICTs & business model creation (98th in 2011); 7.2.1 - Cultural & creative services exports, % total trade (65th in 2013; 81st in 2015); 7.2.5 - Creative goods exports, % total trade (125th in 2012); 7.3.1 - Generic top-level domains (117th in 2014; 119th in 2015; 113th in 2016; 112th in 2017; 113th in 2018).

Table 3: The Lowest and Highest Positions of the Republic of Kazakhstan in the GII: Key Indicators

Years	RK position in the rating	Number of points received	RK position in the rating with the lowest score ↓			RK position in the rating with the highest score ↑		
			Title	Rank	Score	Title	Rank	Score
2011	84	30.32	7 - Creative outputs	*113*	*20.2*	3 - Infrastructure	*60*	*28.5*
						5 - Business sophistication		*37.0*
2012	83	31.9	7 - Creative outputs	*119*	*21.0*	1 - Institution	*52*	*64.5*
2013	84	32.73	7 - Creative outputs	*116*	*27.9*	3 - Infrastructure	*52*	*37.0*
2014	79	32.75	5 - Business sophistication	*106*	*26.4*	3 - Infrastructure	*44*	*43.8*
			7 - Creative outputs		*23.9*			
2015	82	31.25	7 - Creative outputs	*117*	*21.1*	3 - Infrastructure	*54*	*43.3*
2016	75	31.51	7 - Creative outputs	*99*	*21.4*	1 –Institution	*54*	*66.5*
						3 –Infrastructure		*46.8*
2017	78	31.50	7 - Creative outputs	*95*	*21.9*	1 – Institution	*55*	*66.1*
2018	74	31.42	7 - Creative outputs	*100*	18.7	4 – Market sophistication	*51*	*49.7*

Source: authors' elaboration based on data of the Global Innovation Index, 2011-2018

The most common component with a low ranking is the generic top-level domains. Indeed, modern human activity increasingly depends on the conditions of their implementation in Internet space. State policy in many countries in the sphere of Internet technologies management has been significantly intensified over the last couple of decades, reflecting global development trends. This makes it possible to expand opportunities, both for communication and for business. In Kazakhstan, however, this Internet technologies are still relatively underdeveloped. The central problems are still low levels of digital and computer literacy in most of the population; lack of qualifications amongjudicial authorities controlling relations and passing judgment in the field of specific categories and concepts of information activity; lack of sustainable legislative regulation in the field of Internet technologies; problems related to intellectual property and intangible assets such as domain names (Mederkhanova, 2017).

The highest positions in the GII for Kazakhstan were indicators 1 –"Institutes" and 3 – "Infrastructure" (parts of input-index). Thus, the highest positions in the rating went to: 1.2.3 –

Cost of redundancy dismissal, salary weeks (23rd position in 2012; 21st in 2016; 22nd in 2017); 1.3.1 – ease of starting a business (21st in 2016); 1.3.2 – ease of resolving insolvency (34th in 2017); 1.3.3 – ease of tax payments (23rd in 2012; 17th in 2016); 3.1.3 – government's online service (24th in 2011; 21st in 2013 and 2014; 23rd in 2015 and 2016); 3.1.4 –E-participation (19th in 2011; 3rd in 2013 and 2014; 22nd in 2015 and 2016); 3.2.3–Gross capital formation, % GDP (17th in 2011; 31st in 2015; 16th in 2016). And finally, in 2018, the component with the highest score was in Section 4 "Market Development" (also part of input-index): 4.2.1 - ease of protecting minority investors (1st position among all participating countries with scores equalling 85.0).

Over years of reform, Kazakhstan has succeeded in such areas as the creation of the institutional bases for the functioning of the state and the formation of the necessary infrastructure that facilitate the development of market relations in the country. Thus, in 2004, the Government of Kazakhstan approved the State Program of Forming an "Electronic Government" in the Republic of Kazakhstan for 2005–2007, which was implemented in practice by opening an information web portal (www.e.gov.kz) in 2006 and had long-term prospects (Decree of the President of the Republic of Kazakhstan, 2004). At the end of 2017 the Government of Kazakhstan approved the State Program "Digital Kazakhstan". It aims to improve the quality of life of the population and the economic competitiveness of the republic through the development of a progressive digital ecosystem (State Program of RK, 2017a). In 2018, taking into account some changes in leading positions, the results of the international exhibition EXPO-2017 held in Kazakhstan can gradually be seen: the Kazakhstan real sector of the economy, represented by interested investors, has signed numerous contracts for joint projects, especially high-tech and renewable industries. These tendencies are still not strong, however.

Of course, comparison of such countries as Switzerland and Kazakhstan may not be appropriate, because these countries have a number of significant and fundamental differences. Firstly, Switzerland is a European federal state with a developed market system, whose neighboring countries are members of the EU (European Union), most part of the OECD. The Republic of Kazakhstan is a young unitary state of Central Asia, whose important partners are the countries of the EAEU, the post-Soviet countries and a number of Asian countries. Secondly, Switzerland is a country with a high per capita income and a developed innovation system, social sphere and service industries. Kazakhstan, on the other hand, belongs to the countries with average incomes and has a sustainable industrial and raw materials orientation (4th technological context). It could be said that Switzerland and the Republic of Kazakhstan are in different economic and technological conditions. Kazakhstan will need at least 15-20 years to get closer to Switzerland's level of development.

Since 2012, GII experts have evaluated Kazakhstan's ranking positions relative to the states of Central and South Asia in the context of territorial and geographical affiliation. Kazakhstan is a Central Asian state. It is included in the geographic group of countries that constantly participate in the innovation ranking. These are Iran, India, Pakistan, Nepal, Sri Lanka, Bangladesh, Tajikistan, Kyrgyzstan.

The GII data shows that India is a benchmarking country on this list. Kazakhstan is annually among the top three regional leaders and takes the 2nd to 3rd positions. Since 2016, has strengthened its positions and starting in 2017 displaced Kazakhstan in 2nd place so that Kazakhstan is now in 3rd place (Table 4).

We want to emphasize that rankings measure the effectiveness of state policy in countries, in particular for innovation.

Table 4: The GII Lead Countries among the States of Central and South Asia, 2012-2018

Year Position	2012	2013	2014	2015	2016	2017	2018
1st	India	India	India	India	India	India	India
2nd	Kazakhstan	Kazakhstan	Kazakhstan	Kazakhstan	Kazakhstan	Iran	Iran
3rd	Sri Lanka	Sri Lanka	Bhutan	Sri Lanka	Iran	Kazakhstan	Kazakhstan
…							

Source: authors' elaboration based on data of the Global Innovation Index, 2012-2018

Thus, the government in India is traditionally an active actor in the innovation system. From 2010 to 2020, the Decade of Innovation began in India. And, since 2013, the country has been implementing the New Science, Technology and Innovation Policy, which continues the main course of previous state programs in this area. A new paradigm for the development of the Indian innovation sector is "Science, technology and innovation for people" (Ustyzhantseva, 2013a: 77; 2013b: 276).

The development of the innovation system of Iran is based on the implementation of "three waves" of science, technology and innovation policy. The first wave (since the 1990s) focused on the development of higher education. The second wave (since the 2000s) was devoted to the development of the technological research and related infrastructure. In 2010, Iran initiated the implementation of the main directions of the third wave, which are aimed at the transition to the innovative economy based on knowledge. In 2014, the policy of "Sustainable Development" in Iran came into effect (United Nations, 2016).

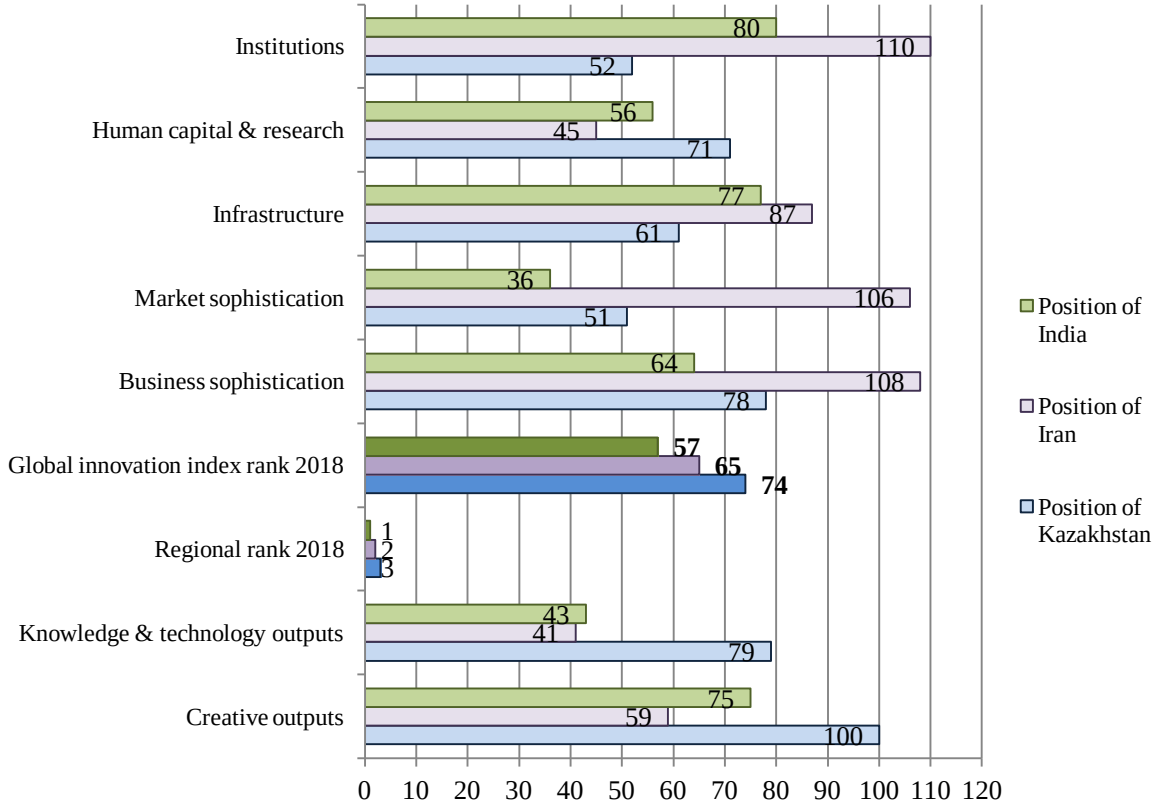
The state represented by the Government of Kazakhstan is the main initiator of innovative processes in the country. In 2003, Kazakhstan adopted the Strategy for Industrial Innovation Development. Its main goal was to achieve sustainable development through the diversification of industriesaway from raw materials. In 2010, the state policy in the field of innovations was developed with the adoption of the State Program of Enhanced Industrial-Innovation Development for 2010-2014. And in 2014, the State Program of Enhanced Industrial-Innovation Development of Kazakhstan for 2015-2019 was adopted. The main purposes of these programs are the diversification of the economy and the increase of competitiveness, as well as the development of manufacturing industries.

Although all are participants in the GII, India, Iran and Kazakhstan hold different positions in the main sections of the rating (Figure 1).The Figure 1 data demonstrates that Kazakhstan lags behind rivals in such criteria as "Knowledge and technology outputs" and "Creative outputs". However, it has advantages in the "Institution" and "Infrastructure" parameters. In 2018, Kazakhstan held a decent position in the "Market sophistication" section.

The comparison of innovation systems and innovative development of countries with which Kazakhstan carries out close cooperation, forming a common interstate space, also seems relevant. We are talking about the countries of the EAEU (a Treaty officially entered into force January 1, 2015) – Russia, Belarus, Armenia and Kyrgyzstan (Figure 2). The Treaty on the Eurasian Economic Union states that the EAEU is an international regional integration organization, one of the goals of which is comprehensive modernization, cooperation and

improving the competitiveness of national economies in the global economy (the Treaty on the EAEU, 2014, article 4).

Figure 1 - Distribution of 2018 Positions in the GII among India, Iran and Kazakhstan according to 7 Main Parameters of the Rating



Source: authors' elaboration based on data from the Global Innovation Index – 2018.

Kazakhstan is striving to strengthen its relations with partner countries, realizing the importance of the development of their innovation models for the prospects for the formation of a supranational innovation system. Nonetheless, mutual adjustment takes a long time due to differences in socio-economic and innovative development of the participating countries, as well as various in-country events that affect inter-country relations.

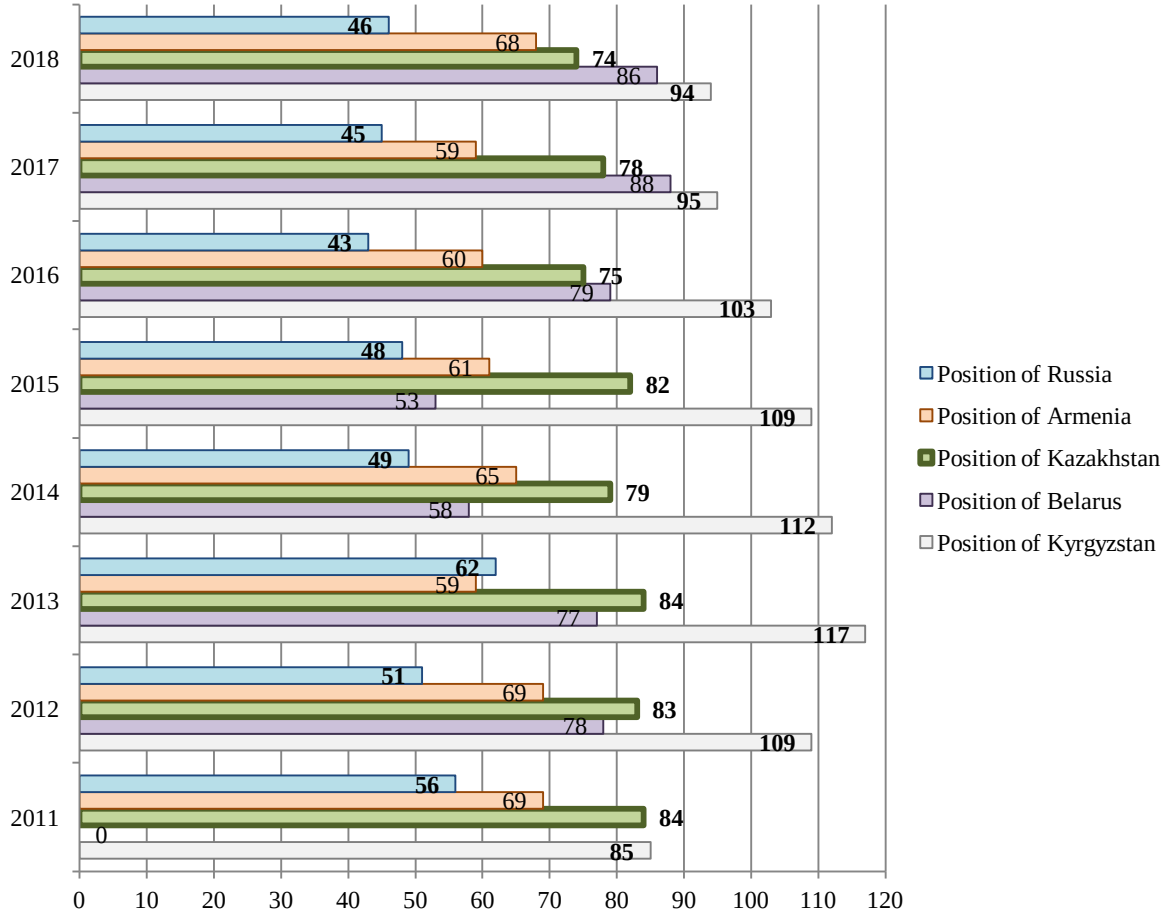
Every year the leading positions in the field of innovation in the EAEU are held by Russia. It has been included among the 50 countries with the best GII rating since 2014. To date, Armenia takes second place, and Kazakhstan third. The positions of Belarus and Kyrgyzstan are slightly weaker. Kyrgyzstan, in general, has improved its positions since becoming a member of EAEU. In addition, general trends show that since the establishment of EAEU all participating countries have slightly improved their positions in the GII.

Nevertheless, all the EAEU countries have both strengths and weaknesses regarding their participation in the rating and, therefore, the formation of their own innovation systems. Consider them using the example of the detailed components of the 2018 rating (Table 5).

All participating countries have weaknesses in sections 4 – "Market sophistication" and 6 – "Knowledge & technology outputs", but they also have a number of strengths in section 6 – "Knowledge & technology outputs". Countries have different components in these sections,

however, which determine their strengths and weaknesses. The governments of the participating countries have not established a common understanding that a developed innovation system is formed on the basis of interaction between key agents of innovation processes within and outside countries. If innovations are the basis for the development of the whole society, then these needs should be able to stimulate and define joint directions for research and development, as well as the content of innovation policy for partner countries (Slavnetskova, 2016: 95). However, there is still no agreement that indicators can fully assess the innovation systems of the EAEU member countries. Approaches and tools for achieving the indicators are controversial issues in the scientific community. This pattern is typical for all members of the EAEU.

Figure 2: Position of the member countries of the EAEU in the Global innovation index in 2018



Source: Authors' elaboration based on data of the Global Innovation Index, 2011-2018

The information in Table 5 gives an idea of Kazakhstan's strengths and weaknesses in forming and developing a national innovation system, compared to other countries in the EAEU. The positions occupied in the annual rankings represent the relationship between the dynamics of Kazakhstan's indicators and the indicators for other countries, especially with country benchmarking, country regional strategic partners and country geographic regional leaders. This analysis can be taken as a conditional reading of where Kazakhstan needs to develop strategic and operational actions that would contribute to improving Kazakhstan position in the ratings. An active role in such matters, as a rule, should be the responsibility of bodies representing state power and administration, especially at first, when the significance

Table 5: National Innovation System Strengths and Weaknesses - EAEU Members in GII 2018

##	Member of EAEU	Weaknesses	Strengths
1	Russia	1 - Institutions: Political stability and safety (105th), Rule of law (110th); 3 - Infrastructure: Logistics performance (97th), GDP per unit of energy use (111th), ISO 14001 environmental certificates (107th); 4 - Market Sophistication: Microfinance gross loans (75th), Venture capital deals (71st); 6 - Knowledge & Technology Outputs: Productivity growth (89th), ISO 9001 quality certificates (101st); 7 - Creative Outputs: ICTs &business model creation (94th).	2 - Human Capital & Research: Pupil-teacher ratio (16th), Tertiary enrolment (13th), Graduates in science & engineering (15th), Quality of universities (22nd); 4 - Market Sophistication: Domestic market scale (6th); 5 - Business Sophistication: Knowledge-intensive employment (17th), Intellectual property payments (18th); 6 - Knowledge & Technology Outputs: Patents by origin (16th), Utility models by origin (9th), Quality of scientific publications (22nd).
2	Armenia	2 - Human Capital & Research: Expenditure on education (107th), Graduates in science & engineering (90th), Global R&D companies expenditures (40th), Quality of universities (78th); 3 - Infrastructure: Logistics performance (120th); 4 - Market Sophistication: Market capitalization (86th), Domestic market scale (113th); 5 - Business Sophistication: Firms offering formal training (82nd); 6 - Knowledge & Technology Outputs: ISO 9001 quality certificates (108th), High- & medium-high-tech manufactures (95th).	1 - Institutions: Ease of starting a business (13th); 4 - Market Sophistication: Microfinance gross loans (21st); 6 - Knowledge & Technology Outputs: Patents by origin (23rd), Utility models by origin (21st), Scientific & technical articles (15th), ICT services exports (18th); 7 - Creative Outputs: Trademarks by origin (20th), National feature films (8th), Printing & other media (22nd), Wikipedia edits (6th).
3	Kazakhstan	2 - Human Capital & Research: Global R&D companies expenditures (40th); 4 - Market Sophistication: Intensity of local competition (106th); 5 - Business Sophistication: Innovation linkages (116th), State of cluster development (111th); 6 - Knowledge & Technology Outputs: Scientific & technical articles (113th), Computer software spending (118th), Intellectual property receipts (96th), ICT services exports (111th); 7 - Creative Outputs: Industrial designs by origin (106th), Cultural & creative services exports (77th), Generic top-level domains (TLDs) (113th).	1 - Institutions: Cost of redundancy dismissal (20th); 2 - Human Capital & Research: Pupil-teacher ratio ranks (1st); 3 - Infrastructure: Government's online service (31st), Gross capital formation (25th); 4 - Market Sophistication: Ease of protecting minority investors (1st); 5 - Business Sophistication: Females employed with advanced degrees (30th), FDI inflows (22nd); 6 - Knowledge & Technology Outputs: Utility models by origin (17th), Hightech exports (34th), FDI outflows (35th).
4	Belarus	1 - Institutions: Regulatory quality (120th), Rule of law (109th); 2 - Human Capital & Research: Global R&D companies expenditures (40th); 3 - Infrastructure: Logistics performance (112th); 4 - Market Sophistication: Credit (114th), Domestic credit to private sector (105th), Venture capital deals (67th); 5 - Business Sophistication: Innovation	1 - Institutions: Ease of starting a business (27th); 2 - Human Capital & Research: Pupil-teacher ratio (12th), Tertiary Enrolment (7th), Graduates in science & engineering (5th); 3 - Infrastructure: ICT access (31st); 5 - Business Sophistication: Knowledge-intensive employment (27th), Firms offering formal training (18th), Females employed with advanced degrees (2nd);

##	Member of EAEU	Weaknesses	Strengths
		linkages (114th); 6 - Knowledge & Technology Outputs: Productivity growth (95th), Computer software spending (106th), ISO 9001 quality certificates (110th); 7 - Creative Outputs: Intangible assets (122nd) and Creative goods & services (108th).	6 - Knowledge & Technology Outputs: Utility models by origin (12th), ICT services exports (23rd).
5	Kyrgyzstan	1 – Institutions: Rule of law (119th); 2 - Human capital & research: Global R&D companies (40th),QS university ranking (78th); 3 - Infrastructure: Logistics performance (122th), GDP per unit of energy use (107th), ISO 14001 environmental certificates (124th); 4 - Market sophistication: Market capitalization, % GDP (85th), Trade, competition, & market scale (107th), Intensity of local competition (115th), Domestic market scale (119th); 5 - Business sophistication: University/ industry research collaboration (117th), State of cluster development (116th); 6 - Knowledge & technology outputs: Citable documents H index (121st), ISO 9001 quality certificates (124th); 7 - Creative outputs: ICTs & business model creation (118th), ICTs & organizational model creation (116th).	1 - Institutions: Ease of starting a business (26th); 2 - Human capital & research: Expenditure on education, % GDP (22nd); 3 - Infrastructure: Gross capital formation, % GDP (13th); 4 - Market sophistication: Ease of getting credit (26th), Microfinance gross loans, % GDP (10th); 5 - Business sophistication: Firms offering formal training, % firms (6th), FDI net inflows, % GDP (14th); 6 - Knowledge & technology outputs: Patents by origin (29th), Growth rate of PPP$ GDP per worker, %, ICT services exports, % total trade (35th).

Source: Authors' elaboration based on data of the Global Innovation Index 2018

and scope of innovation processes are not adequately acknowledged by the business sector. For a number of objective reasons business sometimes resists innovations because it doesn't want to lose accumulated stability. State authorities are authorized to make decisions in the field of innovations. They need to develop plans for strategic and operational measures at the level of republic and regions. These actions for improvement of innovation mechanisms and relations in the innovative sphere will promote risk reduction, which is connected with introduction of innovations. Following introduction, authorized bodies have to transfer the strategic and operational plans to the business environment, generally as requirements and recommendations.

Correlation analysis of indexes and their components

While investigating the innovation system of Kazakhstan based on GII indicators, we tried to expand the analysis to defining the correlation dependence between components of the indexes. However in our opinion, such research has a subjective character for a number of reasons: (1) The data array over the countries increases every year; (2) A rather stable set of tools for rating of global innovations was created since 2011 but it does not separate the orginal data from the changed data; (3) Correlations between the total rating of the country and the main sections of indexes could give incorrect results because the position of the country in the ratings also depends on the rating positions of other countries.

We therefore used the direct correlation as the definition of communication between key parameters of the Input Sub-Index and the Output Sub-Index and their internal components for Kazakhstan during participation in the ranking (Table 6).

Table 6: Direct Correlation of the Main Indicators with their Internal Components for Kazakhstan (according to the GII for 2011-2018)

Main Indicators and Internal Components	Basic coefficient	*1st component correlation*	*2nd component correlation*	*3rd component correlation*
	1 – Institutions	*1.1*	*1.2*	*1.3*
1 – Institutions	1			
1.1 – Political environment	0.891259	1		
1.2 – Regulatory environment	0.198656	-0.1084	1	
1.3 – Business environment	0.300185	0.405282	-0.8086	1
	2 – Human capital & research	*2.1*	*2.2*	*2.3*
2 – Human capital & research	1			
2.1 – Education	0.568991	1		
2.2 – Tertiary education	0.393355	-0.52622	1	
2.3 – Research & development (R&D)	-0.44296	0.325526	-0.8781	1
	3 – Infrastructure	*3.1*	*3.2*	*3.3*
3 – Infrastructure	1			
3.1 – Info & comm. technologies (ICT)	0.55935	1		
3.2 – General infrastructure	0.574205	-0.34707	1	
3.3 – Ecological sustainability	0.993103	0.633931	0.484147	1
	4 – Market sophistication	*4.1*	*4.2*	*4.3*
4 – Market sophistication	1			
4.1 – Credit	-0.01179	1		
4.2 – Investment	0.826789	-0.0718	1	
4.3 – Trade & competition	0.707916	-0.5177	0.343394	1
	5 – Business sophistication	*5.1*	*5.2*	*5.3*
5 – Business sophistication	1			
5.1 – Knowledge workers	0.270887	1		
5.2 – Innovation linkages	0.893408	0.130949	1	
5.3 – Knowledge absorption	0.930082	-0.01439	0.757971	1
	6 – Knowedge & tech. outputs	*6.1*	*6.2*	*6.3*
6 – Knowledge & technology outputs	1			
6.1 – Knowledge creation	0.060556	1		
6.2 – Knowledge impact	0.79302	-0.36098	1	
6.3 – Knowledge diffusion	0.556452	0.145311	0.158511	1
	7 – Creative outputs	*7.1*	*7.2*	*7.3*
7 – Creative outputs	1			
7.1 –Intangible assets	0.026906	1		
7.2 – Creative goods & services	0.774537	0.233762	1	
7.3 – Online creativity	0.710515	-0.56723	0.194193	1

Source: Authors' calculation based on Kazakhstan data from the GII for 2011-2018. Note: the commas in the correlations should be read as decimals in North America.

The contents of Table 6 demonstrate that all seven indicators include components with which they are consistently correlated. Moreover, in some cases, not only a positive, but also negative relationships were found. Consider them in detail.

The most significant influence on indicator 1 – Institutions is rendered by the political environment. This indicator has rather steady positions in the ratings for different years. The political environment of Kazakhstan in general, therefore, provides society with the necessary conditions at this stage of its sovereign development for formation of a modern constitutional state. Kazakhstan's political environment, defined as public authorities, those in power; the state; and public institutes, is key at this stage of its sovereign development. Together they develop and accept standard and legal documents, strategic programs for development. The weak correlations between institutes and such components as "The regulatory environment"

and "Business environment" could be a consequence of the fact that the regulatory mechanism is not well developed, and business has little influence on the institutional sphere.

Indicator 2 Human capital and research is most correlated with general education. Communication between it and higher education is positive, but is weaker than with general education. In our opinion, it is connected to reforming the higher education system in Kazakhstan. In recent and current periods the education system has been changing because of implementation of new educational technologies. General preprofessional education is obligatory in Kazakhstan, is an important priority of state policy and has been implemented in all regions, with funding from the state budget, thus making it available to the whole population. Availability of higher education in the country is lower because it is located in higher education institutions of commercial offices. It also depends on the quantity of grants and specialties for which they are available each year from the Ministry of Education and Science. According to the Kazakhstan law, citizens of the country can receive free of charge an average and initial professional education, and more after passing competitions – grants for secondary professional, higher and postgraduate education. Those who fail a competition can still use the services of commercial offices of higher education institutions, however, it is not an obligatory process and depends on the social and economic opportunities available to citizens.

"Human Capital and Research" includes a "Research and Development" component, which has a negative correlation. However, the negative dependence is paradoxical. Carrying out research and development is set as the purpose through increases in innovative potential and returns from it in the future. Therefore, such an interrelation can logically be described as dependent on a time factor. Indeed, now, investments in R&D can be compared with savings or accumulation, the increase of which does not lead to current and momentary growth of gross domestic product. The point is to make the animation mechanism work in the future. Changes in science and the cost of its development will have an impact only after some time. This will happen when highly qualified personnel have been trained, and the results of fundamental and applied science pass into the stage of practical application.

Indicator 3 "Infrastructure" all its components showed close correlation connections with the other indicators. Ecological sustainability possesses especially close connections with infrastructure. Therefore one of the main tasks of the state is creation of a favorable ecological environment for both the population and business, at the same time. The ecological situation in Kazakhstan remains rather difficult. So, in 2017 Kazakhstan took the 99th place of 136 participants in the rating of ecological sustainability, and in 2018, 101st place of 180 participants. It rated below its partners in the Eurasian Economic Union (Indeks ekologicheskoi effektivnosti, 2018). The main environmental problems in Kazakhstan remain air pollution, water and land resources, resulting from use of inefficient technologies.

ICT and the condition of the general infrastructure provide stability and improve the position of the indicator "Infrastructure". Development of relations in the sphere of ICT represents for Kazakhstan a significant direction in carrying out state policy regarding sustainable development. At the end of 2017 the Government of Kazakhstan approved a State program "Digital Kazakhstan" with five main directions: 1) "Digitalization of the branches of (the) economy". This direction assumes transformation of traditional industries by use of breakthrough technologies and opportunities. They will increase labor productivity and capitalization in industry; 2) "Transition to the digital state". The state will execute the function of offering services to the population and business, anticipating their requirements; 3)

"Realization of a digital Silk way". This is aimed at development of the high-speed and protected infrastructure of transfer, storage and data processing; 4) "Development of human capital". This direction covers creation of a "creative" society allowing transition to a knowledge economy; 5) "Creation of an innovative ecosystem". This is directed to formation of favorable conditions for development of technological business and innovations with stable horizontal relations between business, the scientific sphere and the state (The State Program, 2017b).

Section 4 "Market sophistication" reveals a close relationship between the key indicator and the "Investments" component, as well as "Trade and Competition". Foreign direct investment has played a significant role in the development of Kazakhstan since independence. Considering the period included in the range of global innovation rankings, we note that from 2007 to 2017, the gross inflow of investments amounted to $244,462 million, and in the first quarter of 2018 $6,682 million were contributed to the country's economy (The National Bank of the RK, 2018a). The peak of investment activity was in 2010-12. This period was characterized by a weakening of the Tenge after its devaluation in 2009; as a result, there was an increase of the macroeconomic attractiveness of the Kazakh economy for foreign investors. Over the past five years, however, the tendency towards a decrease in foreign investment has intensified. This decline has economic reasons (for example, the tax and financial regimes in Kazakhstan and related financial risks, as well as volatility in the foreign exchange market) and non-economic reasons (for example, bureaucracy and instability of the legal system). The effect of each influence depends largely on the actions of state authorities (Tulemetova, 2016). Countries such as the Netherlands, USA, Switzerland, France and China were investment leaders in Kazakhstan for several years (Kanabekova, 2018).

In our opinion, the state and its authorities should stimulate business and develop the market, not only as a system, but also as a way of encouraging creative and innovative thinking. They need to pursue effective macroeconomic policy, which can affect the innovation system of the whole country. For example, by implementing stimulation through monetary or trade policies, the state can increase investment expectations and increase turnover in the real economy. This in turn would increase motivation for innovation and survival in a competitive environment. It is, however, necessary to consider monetary instability, which has increased in the context of globalization; this has adjusted market processes. In this regard, the National Bank of Kazakhstan, as an authorized state institution, should not intervene in the situation in the foreign exchange market, since Kazakhstan has a floating exchange rate regime. However, the responsibilities of the National Bank include the suppression of a currency profiteering. We consieder that the weakening of the Tenge has been influenced by currency profiteering, oil prices, a reduction in the base interest rate of the National Bank of Kazakhstan by 1.25% (from 10.25% to 9%), growth in lending in the first half of 2018 (The National Bank of the RK, 2018b), and the interdependence of the Kazakh economy with the economic situations in neighboring countries and partner countries (in particular, the countries of EAEU).

In indicator 5 "Business sophistication", two components are also closely related to the main index of the section; thus, to a large extent, the absorption of knowledge and innovative connections determined the sensitivity of business to change. Kazakhstan has great potential to form links among the main actors in innovation activity: the sphere of fundamental and applied science, production, the state, as well as civil society institutions. However, there are currently weak links among them. This is due to low innovation activity and varying degrees of interest on the part of the innovation elements; they also have different sectoral foci and financial capabilities. There are difficulties in the development of horizontal innovation relations. The

objects of these relationships are innovations: they are a priori specific for such issues as "Who is the rightholder?", "What is the degree of risk?", "Who bears the main costs of implementation and diffusion?", "What is the possible profit and how to distribute it?" etc. Unfortunately, most Kazakh businesses are not ready for risky projects. This is largely due to the fact that there is no venture capital market or business angels in the country.

Indicator 6 – "Knowledge and technology outputs" showed the strongest correlation with such components as "the influence of knowledge" and "diffusion of knowledge". In our opinion, the influence of and diffusion of knowledge is manifested in the creation and development of knowledge-intensive industries and products, in the growth of innovative products, the intensification of production processes and increases in internal and external trade. However, taking into account the specificity of the category of "Knowledge", there should not only be material, but also intangible effects. This could be characterized by development and improvement of management, emergence of new intangible benefits, increasing interest of the international community in the scientific works of Kazakhstani scientists, and the development of virtual connections and markets.

In general, the indicator "Knowledge and technologies outputs" is one of the weak elements for Kazakhstan, influenced by the Ministry of Education and Science of Kazakhstan changing the rules for the award of scientific degrees in 2011 to require publication in highly cited journals. This led, however, to the appearance of unscrupulous publishers, whose activities unfairly questioned the quality of the articles of Kazakhstan scientists. Many of the publications in which the scientific works of Kazakhstan were published were recognized as "predatory". This influenced such components of the indicator as the number of scientific and technical articles published in journals with high citation indices.

The correlation analysis of indicator 7 "Creative outputs" showed a high level of interaction between the general index of this section and its components "Creative goods and services" and "Online performance". This section of the innovation index shows how quickly society is ready to be changed, how these changes influence the guidelines and the interrelation between traditional and creative products consumption. In net, it has changed the scope of their exchange. At present, this process is developing very slowely in Kazakhstan, largely due to the fact that its participants prefer to operate offline or in the real market.

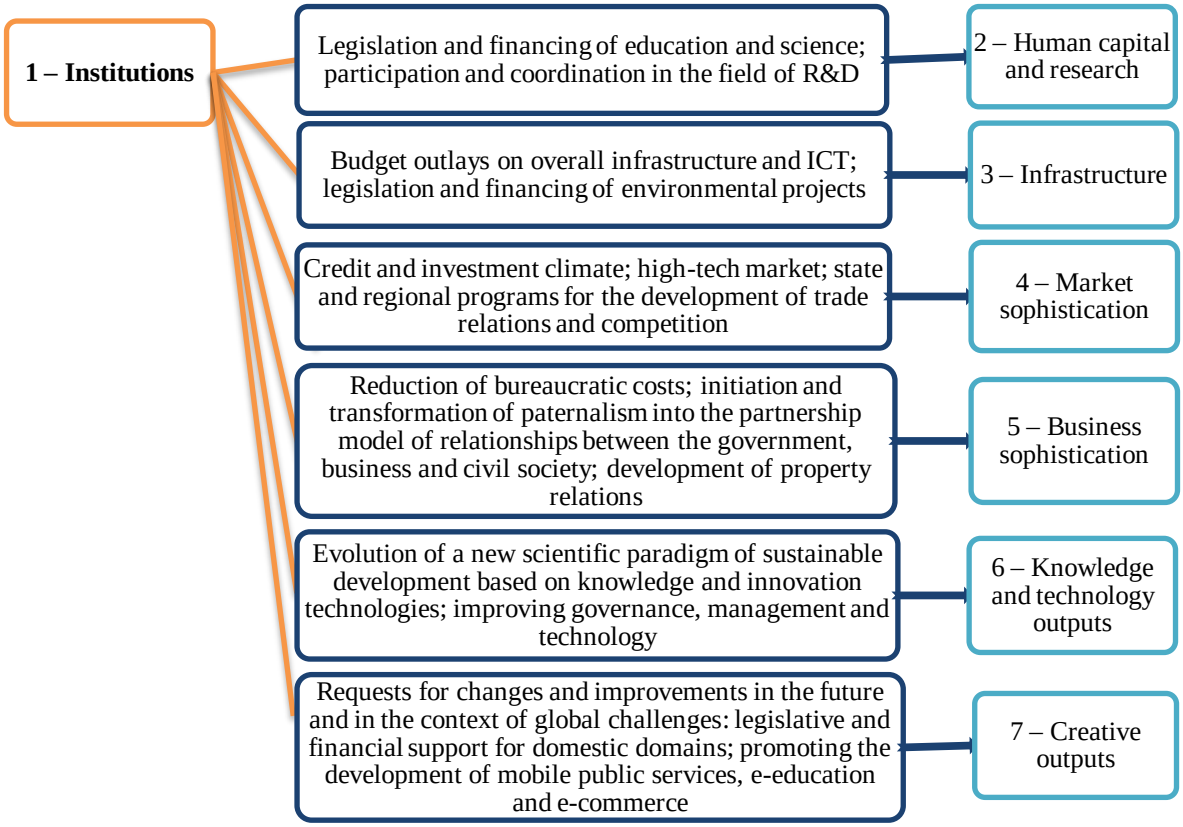
The state, whose mandate includes making adjustments and improving innovation policy once it is implemented, should accept this provision as a signal. It can also identify a number of areas in the conduct of related policies (such as macroeconomic, information, science and technology, investment, and intellectual property protection policies), which will improve the assessment of the criteria that make up the "Creative Outputs" indicator.

In general, the analysis of the GII indicators identified key trends in Kazakhstan's innovative development in the context of globalization, which has a significant impact on interdependence, interactions and interaction between countries. Our study showed the strengths and weaknesses of the innovation system of Kazakhstan in terms of the GII. In addition, a comparison of the main sections of the GII and their constituent components helped to analyze the completeness of the links between them.

We propose a model of government influence, where the state plays a primary role because it is the main institution that influences all components of the innovation system. Indeed, these links could be more efficient if we consider them as horizontal. However, at this

time (2019) in Kazakhstan, the state is the main initiator of innovation processes. Therefore, the interaction in the model is mainly vertical or hierarchical from the government to the market, business, social and scientific-technical spheres (Figure 3).

Figure 3: Influence of state management on the main indicators of the Global Innovation Index



Source: Authors

The state is a specific actor in innovation processes. Currently, it has a leading role because the business sector is not interested in innovations that cause uncertainty. The state does not take the place of producers of innovative products; it uses its usual tools (laws, budget financing, coordination and management, state strategic programs, etc.) in order to stimulate actual participants in innovation activities. The state also carries out a comprehensive analysis of regional innovation systems, planning and forecasting the development of the national innovation system. Sometimes the state acts rigidly and "forces" business and the market to innovate.

Conclusion

The system and instruments of state administration in Kazakhstan have been formed in light of global trends. Participation in international rankings provides an opportunity to identify the weaknesses inherent in a country in a certain period. This analysis showed that the weak sides of the innovation system of Kazakhstan are the lack of effective mechanisms to encourage interaction among the main innovation actors (including the institutions of the innovation system), the weak link between the R&D and production, the low share of high-tech industries, the low rate of adaptation of the business community to low domestic R&D, etc.

Kazakhstan should develop its strengths and opportunities to strengthen its position not only in international rankings, but, most importantly, within the national system. These should include:

- A stable political and social situation;
- Favorable geo-economic and geopolitical conditions;
- Active state support in the field of industry, innovation, public-private partnership;
- Availability of resources that can be applied in the field of high technologies;
- Transparency and high rates of integration of the Kazakhstan innovation system into the regional and international high-tech space;
- Favorable financial and investment conditions for attracting foreign capital;
- The presence of a large number of development institutions formed in the innovation sphere.

The state should also consider the requests of other participants who are able to develop an innovation system. We offer the following recommendations:

1) For example, if a state wants to improve its position in the global innovation index in criterion 7.3.1 (Generic top-level domains), it should:

– take into account international experience and amend the legislation on determining priority when registering a domain name;
– create conditions for participation for all interested companies in public-private partnerships;
– reduce transaction costs for registering a domain name;
– increase the number of companies that have the right to register domain names in order to create competition.

2) In order to increase the number of scientific and technical articles published (6.1.4), authorized state bodies should develop a space of scientific and academic mobility, expand the range of activities for the formation of social capital involving domestic and foreign scientists, and actively involve business representatives.

3) In order to develop a general strategy for computer software spending, % GDP (6.2.3), authorized authorities of Kazakhstan should assist by:

– In the field of education: developing skills in working with modern software, introducing and diversifying relevant subjects in general and in higher education; improving computer literacy among the adult population by organizing special courses at employment centers in the regions;
– In the sphere of legislation: creating effective mechanisms to control and toughen responsibility for using “pirated” software, improving methods of protecting property rights in the field of computer technology;
– In the financial sphere: thoroughly examining the needs of the state and business for the implementation of joint financing programs for the introduction of new software, as well as envisaging the possibility of government subsidies for costs of updating software in developing enterprises.

The public sector in Kazakhstan is often criticized for paying great attention to institutional development. However, as our descripotion of the current situation has shown, the government is the main institution influencing innovation—it still plays a key role in the innovative development of the country. The state forms the basis of the modern innovation

system: innovative hubs and techno park structures are being opened; legislation is being improved; billions are being invested in support of innovative projects; favorable conditions are being created for venture businesses.

Nevertheless, it is time to develop the competency of forming horizontal relations in the innovation sphere. The state cannot constantly make stipulations to business. Business should become the main actor in the innovation process, using all the platforms created by the state. The government should promote information exchange, solving problems of coordination, financing and interaction of the state and business at the regional and republic levels. State authorities should monitor the effectiveness and efficiency of state strategic programs and direct the rest of the participants in the innovation infrastructure towards advanced technologies in production, the social sphere and the exchange sphere, including the Internet space.

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