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Innovative potential as a factor of socio-economic development

Abstract. *The article analyzes of existing approaches to the concept of innovative potential. There was formulated and approach for estimating an integrated indicator in the article. There was used a method of area diagrams to estimate the integrated indicator. There was calculated and the ranked the innovative potential of the regions of Kazakhstan according to the final values. It is necessary to analyze and assess the factors of innovative potential, which will help to determine the vector for development of the region for decades to build an efficiently functioning regional innovation system. The regions of Almaty, Nur-Sultan, Kostanay, Karaganda have high indicators of innovation potential in Kazakhstan. Mangistau, West Kazakhstan, North Kazakhstan, Turkestan regions have rather low rates in comparison with other regions. The authors have observed the growth of innovation potential in Pavlodar, Aktobe and the regression of innovation potential in the Akmola region.*

Keywords: *innovation potential, innovation, regional innovation system, region, scientific potential, human resource.*

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Introduction

Regional Innovation Capacity is one of the more recent concepts that is beginning to play a very important role in the knowledge economy (Schiuma and Lerro, 2008). [17]. Freeman (1995) and Nelson (1993) generally refer to innovation capacity to the theoretical and empirical research on innovation systems. This innovation system relies on the generation and transmission of knowledge as well as a scientific environment which includes different institutions such as universities, innovative firms, R&D centers (Doloreux, 2002) [7]. A lot of scientists claim that innovation capacity which originates in the innovation systems framework mainly determines the results or efficiency of innovation activities (Schiuma and Lerro, 2008). It means that this concept represents the abilities of the system to perform innovation by using regional amenities such as telecommunication, transport, etc., and environment while depending on the level of interconnections between the two of them (Cooke, 2001; Furman et al., 2002) [6]. Whereas the innovation process takes a place at a different level for example world, national and regional level current studies more and more use regions as a concentration of innovation and economic growth (Porter and Stern, 2001) [15]. The regional level poses a place where positive externalities such as spatial proximity of innovation agents lead to the availability of tacit knowledge and contribute to the integration process between local 'sticky' knowledge and global 'ubiquitous' knowledge (Asheim and Isaksen, 2002, 77) [1].

Although different studies offer a great variety of measures of innovation capacity more of them use the same indicators such as number

of patents, innovations and firms that perform in innovation (Furman et al., 2002; Riddel and Schwer, 2003) [16].

Another essential aspect of innovational potential is geographical concentration or location of innovation agents (Ashiem and Gertler 2005) [2]. Spatial proximity of knowledge externalities and innovation companies that performs nearby can foster the localized knowledge spillover, knowledge generation, productivity, and innovation (Breschi and Lissoni, 2001) [3].

Understanding of innovation stimulation is a key priority in the economy of Kazakhstan. The fact that innovation is largely focused on the regional level indicates the need for context-specific analysis to understand how a region can develop its innovation performance. In this regard, of course, the main focus of attention falls on the definition of innovation capacity, as well as the methods of its assessment at the regional level.

The goal of this article to estimate the innovation capacity of the regions f Kazakhstan and create area diagram of innovation potential on the example of West Kazakhstan region. We determine that this analysis will help to make proper managerial decision for creating efficient regional innovation system in West Kazakhstan region.

This article uses a quantitative approach to assessing the indicators of the regional innovation system to answer the following research questions: Which regions of Kazakhstan have the greatest innovation capacity? Which regions of Kazakhstan have the least innovative capacity? What set of conditions and factors contributes to the innovative activity of the region?

This approach, in comparison with an in-depth analysis of individual regions, which reflects the state of various parts of the system and their interconnections, quantitative analysis offers an additional approach that allows us to range regions by innovation activity and reveal the reserves of innovation regional indicators.

The concept of innovation capacity has had a strong impact on world politics, since it can be seen as a tool for building an effective regional innovation system that can be achieved with the support of targeted policies, turning it into a rather normative and prescriptive concept. Accordingly, the importance of such research questions is of paramount importance for the design of innovation policy.

Methodology

Literature has paid a great attention on understanding the pros and cons of nations experience in activating the economic progress through technological progress. Also, in this decade we can mention two popular theories that describe the functions of innovation in the economic development. First theory proposed by Young (1993) where he underline the great importance of investment in human and physical capital as main condition for development of innovation and prosperity of economy at national level. The second theory differentiate three variables such as entrepreneurship, the effective learning and the innovation and claim that all this variable equally important in development process of economy. (Freeman & Soete, 1997). These two theories compromise in one aspect that innovation and knowledge have a great role in development of economy [10].

In this aspect agglomeration literature also contain a lot of valuable information about the contribution of innovation to the regional economic growth. For example, Schumpeterian theory represent region as a knowledge hub where the development of economy mainly driven by innovation and the interactive learning (De Propris & Hamdouch, 2013) [8]. At the same time interactive learning is complex process that require participation of all actors and represent rather form of collective performance of whole economic system. (Narula, 2003). Hence, we can claim that the innovation in regional aspect that closely related with knowledge creation, accumulation and absorption of innovation from outside are not mere process. This process mainly depends on ability of formal and informal institutions to create innovation and perceive innovation from outside. It means that regional innovation system consists of different factors that contribute innovation such as human capital,

knowledge externalities, innovative firms, urban infrastructure, competition, regulations, institutions, legalizations. (McCann& Van Oort, 2019) [12].

Hence, the effective functioning of the regional innovation system, which is an integral part of the national innovation system, depends on the level of innovation capacity that reflects the economic growth of the region and the country as a whole.

Therefore innovation capacity is a determinant of the whole factors of innovation system. Hence innovation capacity faced with several challenges, when it comes to its assessment, and also when it comes to the dual structure of innovation: the absorption capacity and the development capacity.

A distinctive feature of the innovative development of the Republic of Kazakhstan is the uneven development of the regions. This is mainly due to the specifics of each region, geographic location, and the size of the region's innovative potential. In this regard, the value of the innovation potential and the indicator of its effective use are the key factors in the growth of the economic system.

Discussion

After analyzing and synthesizing the existing interpretations of the concept of «innovative capacity», we formulate the following interpretation: innovative capacity is determinant of the growth which represent the ability of system to create, absorb, utilize, disseminate innovations by collaborative performance of all factors of regional innovation system.

The implementation of the innovation process requires the presence of scientific and production, economic, legal, organizational, and managerial factors.

The scientific and production factor, in turn, consists of the following complex of factors: the scientific potential of the region, human resources, production potential, material and technical means, economic and scientific and technical infrastructure, progressive technologies. The economic factors include the availability and sufficiency of the region's own financial resources for the implementation of innovative activities.

Organizational and managerial factors act as indicators of the region's ability to introduce and disseminate innovations. This group includes factors of organizational potential - innovative activity of enterprises. In addition, this is the demand for the results of innovation, foreign economic cooperation, the export of innovative goods and services, technological exchange in organizations that carry out innovations.[4]

The factors of investment attractiveness of the region can also be included in this group.

The mathematical model for calculating the innovative potential is as follows

$$IP = <SPp, Ep, Lp, OMp> \quad [1]$$

Where IP is a generalized innovation potential, Ep is an integrated economic potential, SPp is an integrated research and production potential, OMp is a complex indicator reflecting organizational and management factors, Lp is a complex indicator reflecting legal support for innovation.

Most often, the Innovation Index is used as the main characteristic of the level of innovative development of the region. Most often, it is calculated as an integral indicator, which is based on various factors selected according to certain criteria and from the point of view of the authors that characterize innovations and innovative processes. We have selected the following factors which in our opinion most clearly reflect the level of innovation potential at the regional level.

At the first stage of building a mathematical model, there was a correlation analysis in groups of factors, as a result of which close relationships were revealed between some indicators. Thus, to assess the innovative potential of the region, the following variables were included in the final mathematical model of the innovative potential:

x1- The number of created and used new technologies and equipment (units)

x2 - Volume of sold innovative products (goods, services) (million tenge)

x3 - Total number of researchers in the region (people)

x4 - The number of candidates of science who performed R&D (people)

x5 - The number of doctors of science who performed R&D (people)

x6 - Number of issued patents for invention (units)

x7 - Innovative activity of organizations in the region as a percentage

x8 - Number of organizations that have created and use new technologies and equipment (units)

x9 - Volume of innovative products (million tenge)

x10 - Costs for innovations (million tenge)

Next, we analyzed the static data provided on the official website of the Bureau of National Statistics of the Agency for Strategic Planning and Reforms www.stat.gov.kz as well as data provided by the National Institute of Intellectual Property of the Ministry of Justice of the Republic of Kazakhstan for 2018, 2019. Based on the selected indicators, a table of statistical data on innovation potential was built (Table 1).

All variables included in the final model differ both in physical meaning and in absolute values, it is advisable to carry out the procedure of normalizing the values of indicator factors before plotting diagrams.

Linear normalization of values was performed using the formula:

$$n_{ir} = \frac{x_{ir} - x_{i\min}}{x_{i\max} - x_{i\min}} \quad [2]$$

Table 1

Statistical data of factors of innovative potential for 2019

The Republic of Kazakhstan	The level of activity in the region for all types of innovations, in%	The level of activity in the region on product and process innovations, in%	The volume of innovative products (goods, services) million tenge	Number of issued patents for inventions	Number of granted patents for utility models	Internal expenditures on R&D in million tenge
Total Number	11,3	12,0	1 113 566,5	544	925	72 224 ,5
Akmola region	7,7	11,5	17 793,0	10	15	1 694 ,3
Aktobe region	10,6	20,1	51 421,7	10	8	974 ,6
Almaty region	9,3	14,1	20 443,6	14	39	1 121 ,1
Atyrau region	9	12,9	7 536,3	4	2	4 494 ,5
West Kazakhstan region	5,3	8,7	24 713,4	2	12	878,2
Zhambyl region	13,1	15,2	77 092,5	4	40	731,5
Karaganda region	13,5	10,5	74 007,0	51	77	3 508,3
Kostanay region	12,8	8,9	211 088,3	9	13	827,4
Kyzylorda region	12,3	9,2	16 425,2	2	15	301,8
Mangystau region	3,4	4,9	7 971,3	4	16	9 848,7
Pavlodar region	9,1	10,0	44 503,7	13	29	290,1
North Kazakhstan region	9,5	8,3	8 652,1	5	60	226,2
Turkistan region	9,1	9,4	13 797,5	2	6	273,6
East Kazakhstan region	14,9	8,9	223 618,8	31	34	5 319 ,0
Nur-Sultan	14,8	8,6	129 468,7	60	124	14 094,2
Almaty	12,2	18,2	48 948,4	309	391	26 586,5
Shymkent	7,3	7,0	136 084,8	14	44	1 053 ,9

Note source: [4],[12]

where nir is the normalized value of the i-th indicator factor for the r-th region in the considered data array, 0 ≤ nir ≤ 1; xir - absolute or relative (actual) value of the i-th factor for the r-th region in the considered data array; ximin and ximax are the minimum and maximum values of the i-th factor in the considered data array.

The calculation of the integrated indicator was perfomed by using the method of area diagrams. This method determine estimating complex value by defining the area of a flat figure that formed by rays, the length of which is determined by the values of the indicator factors (Figure 1).

The graphical presentation of the diagram is necessary solely for the clarity of the method; all calculations were performed using analytical methods.

The estimation of the areas of the diagrams was performed according to the following formula:

$$S_n = \sum_{i=1}^{i} \frac{k_{ms} * k_{(m+1)s} * \sin(360/i)}{2} \qquad [2]$$

where S_n is the area of the plotted diagram for the n-th region, k_{ms} is the normalized value of the m-th indicator-factor for the s-th region in the data array under consideration, i is the number of indicator-factors selected for modeling.

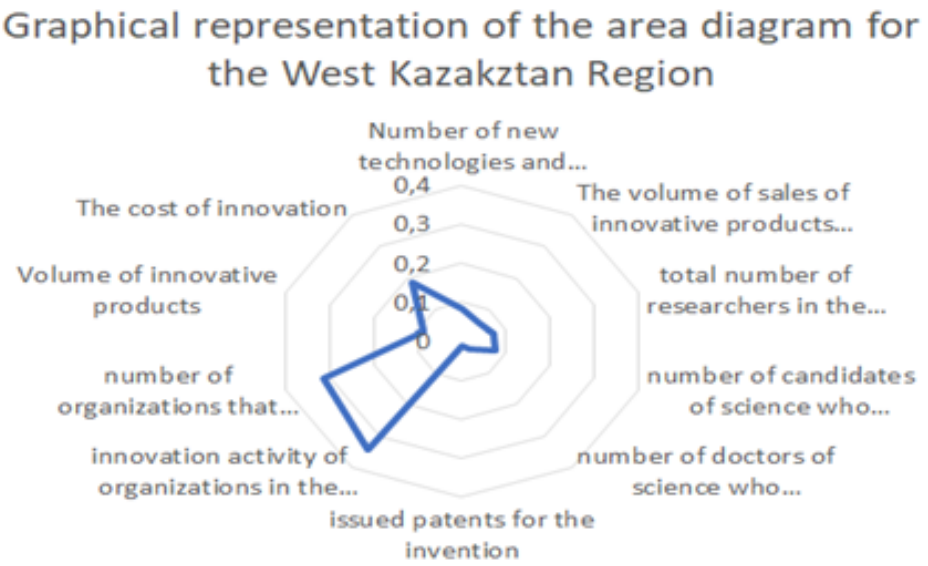
Results

All final values of the innovational potential of Kazakhstan regions were estimated and ranked. (Table 2)

Table 2

Values of the innovation potential of the regions of Kazakhstan

Coefficients of innovations		
	2019	rank
Akmola Region	0,04524147	10
Aktobe Region	0,12753491	7
Almaty region	0,03076862	12
Almaty city	1,77125254	1
Atyrau Region	0,0792606	8
West Kazakhstan Region	0,00394375	15
Jambyl Region	0,03268944	11
Karaganda Region	0,1389161	6
Kostanay Region	0,35051013	3
Kyzylorda Region	0,05017063	9
Mangystau Region	1,58E-05	16
Nur-Sultan city	0,4720492	2
Pavlodar Region	0,29698291	5
North Kazakhstan Region	0,02145586	13
Turkistan Region	0,0168551	14
East Kazakhstan Region	0,30091441	4



Picture 1

Conclusion

In the article we have underlined a great importance of innovations in economic development of Kazakhstan. We have proposed that Kazakhstan could achieve significant competitive advantage by developing its absorption capacity which means improving the ability of system to perceive and anchor innovation outside due to the fact that Kazakhstan in our study demonstrate very weak position in terms of creation of innovation. By estimating the indicators of the regional innovation Index we have revealed that the following cities as Almaty, Nur-Sultan, Kostanay, Karaganda have high indicators of innovation capacity in Kazakhstan. It means that these regions have huge potential to form innovation clusters and appropriate infrastructure to gain innovation from outside. Mangistau, the West Kazakhstan, the North Kazakhstan, Turkestan regions have rather low rates in comparison with other regions. These regions should develop innovation capacity by investment into human and physical capital. The growth of innovation potential in Pavlodar, Aktobe and the regression of innovation potential in the Akmola region.

We suppose that Kazakhstan can significantly change its absorption capacity by next steps. First, it is necessary to rise number of publications with co-authorships, organize better connectivity between innovation actors, develop existing regional innovation infrastructure where the innovation from abroad would be naturally perceived, rise the frequency of international flights, organizing international conference and scientific meeting to join global stream of knowledge. Then it is necessary to create suitable conditions for clustering of innovational international firms, attract foreign investment by high economic stability and advanced infrastructure, it will stimulate knowledge spillover and facilitate the development of economy. Next step is to enhance the quality of higher education and retention of graduates which one of the main resources for human capital that play crucial role in dissemination of inno-vation.

The innovative potential of the region consideration can help to reveal the level of innovative development of the economy, as well as the existing opportunities for the innovative development of organizations operating in this territory.

It should be noted that the approach used is acceptable for assessment the innovative potential of various organizational systems. However, the system of factors included in the components of the generalized indicator will differ depending on the object of study.

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Инновациялық әлеует әлеуметтік-экономикалық дамудың факторы ретінде

Аннотация. Инновациялық потенциал тұжырымдамасына қолданыстағы тәсілдерге талдау жүргізіліп, осы негізде интегралдық индикаторды қалыптастыруға көзқарас қарастырылды. Аймақтық диаграмма әдісі интегралдық көрсеткішті есептеу үшін қолданылады. Қазақстан аймақтарының инновациялық әлеуетінің мәндері есептеліп, қорытынды мәндерге сәйкес рейтинг құрылды. Қорытынды. Тиімді жұмыс істейтін аймақтық инновациялық жүйені құру үшін инновациялық әлеуеттің факторларын талдау және бағалау қажет, бұл аймақтың дамуын ондаған жылдарға болжауға мүмкіндік береді. Келесі аймақтар: Алматы, Нұр-Сұлтан, Қостанай, Қарағанды өңірлері Қазақстанда инновациялық әлеуеттің жоғары деңгейіне ие. Маңғыстау, Батыс Қазақстан, Солтүстік Қазақстан, Түркістан облыстарының көрсеткіштері басқа аймақтармен салыстырғанда салыстырмалы түрде төмен. Сонымен қатар, Павлодар, Ақтөбе қалаларында инновациялық әлеуеттің артуын және Ақмола облысында инновациялық әлеуеттің регрессиясын байқауға болады.

Түйін сөздер: инновациялық әлеует, инновация, аймақтық инновациялық жүйе, аймақ.

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Инновационный потенциал как фактор социально-экономического развития

Аннотация. Проведен анализ существующих подходов к концепции инновационного потенциала, и на основе этих концепций сформулирован подход к формированию интегрального показателя. Для расчета интегрального показателя используется метод площадных диаграмм. Были рассчитаны значения инновационного потенциала регионов Казахстана и составлен рейтинг по окончательным значениям. Для построения эффективно функционирующей региональной инновационной системы необходимы анализ и оценка факторов инновационного потенциала, что позволит прогнозировать развитие региона на десятилетия. Города Алматы, Нур-Султан, Костанай, Караганда имеют высокие показатели инновационного потенциала в Казахстане. Мангистауская, Западно-Казахстанская, Северо-Казахстанская, Туркестанская области имеют относительно низкие показатели по сравнению с другими регионами. Мы также можем наблюдать рост инновационного потенциала в Павлодаре, Актобе и регресс инновационного потенциала в Акмолинской области.

Ключевые слова: инновационный потенциал, инновации, региональная инновационная система, регион, научный потенциал, кадровые ресурсы.

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