Methodology for assessing the state and level of use of innovative potential of regional development

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Abstract - The innovative activity of enterprises varies by region and depends on the existing innovative potential. The article offers the author's methodology for assessing the state of innovation potential and the level of its use on the example of regions of Kazakhstan.

Keywords - innovation potential, capacity evaluation, regional development

Introduction

According to the Global innovation index 2019, formed on the basis of 80 indicators for 129 countries, Kazakhstan ranks 76th in the overall ranking of countries and 26th out of 34 in the group of upper-segment middle-income countries [1]. The efforts of the government of Kazakhstan to join

the 50 countries with innovative economies over the past 10 years have not led to the desired results. In this regard, the issue of studying the innovative opportunities of Kazakhstan and the grounds for innovative development of its economy is relevant.

The large territory of Kazakhstan (9th place in the world by area) is highly differentiated by its geographical, climatic and resource composition. Economic and innovative activity in Kazakhstan also varies by region. Therefore, the analysis and assessment of the innovative potential of regions allows us to identify uneven innovation processes and determine the prospects for innovative development of the country's economy as a whole.

Research methods

Innovation activity in Kazakhstan is understood as a type of activity related to the transformation of ideas into a new or improved product introduced on the market; into a new or improved technological process used in practice; a new approach to social services, which involves a set of scientific, technical, organizational, financial and commercial measures that together lead to innovation [2]. Under the innovative potential, we will understand the opportunities for implementing innovative activities that exist in the form of resources, subjects and objects of research and practical innovation that affect the resulting indicator of innovation - the volume of innovative products (works, services).

In General, the innovative potential of a country is equal to the aggregate of the innovative potential of its regions [3]. Determining the innovative potential of regions will help to identify the problems of resource allocation (factors)of innovation activity in the country and adjust accordingly the economic, industrial, scientific and technical policies to achieve the best results of innovation.

We will determine the specific characteristics of the innovation potential of each region by correlating it with the national average value taken as 100.

The score of the innovation potential of regions is defined as the sum of the characteristics of the innovation potential indicators adjusted for the coefficient of determination, which shows the strength of the relationship of each indicator with the resulting indicator (the volume of innovative products) according to the formula:

$$W_i = \frac{\sum W_{ij} \times d_j}{\sum d_j},$$

where W_i - assessment of the innovative potential of the i-th region, points;

W_{ij}-points of individual innovation indicators (j) in the context of I- th regions;

d_j-determination coefficients that characterize the weight of j- th innovative indicators (the significance of the considered indicators $d=r^2 \cdot 100$).

The estimated (potential) volume of innovative products is found by constructing a model of multi-factor linear regression that takes into account the real patterns between the factors of innovative potential, which were previously used to determine the innovative potential of regions.

To determine the level of use of the innovative potential of regions, it is necessary to compare the actual volume of innovative products in the country's regions with the estimated potential.

Research result

In accordance with the available statistical information, the following indicators were considered as components of the innovative potential of the regions of Kazakhstan:

x_1-internal R & d expenditures, million tenge;

x_2 - cost of innovation, million tenge;

x_3 – number of innovative and active enterprises, units;

x_4 – number of organizations engaged in R&D, units;

x_5-number of employees who performed R&D, people;

x_6 – the number of new technologies and equipment objects created and used, units;

x_7 – the number of issued security documents, units.

The actual values of indicators for 2018 are shown in table 1. As can be seen from table 1, the leaders of innovation performance in 2018 were the Pavlodar region, Shymkent, East Kazakhstan and Kostanay regions. Moreover, these regions are not leaders in any indicator of innovation potential characteristics, except for Shymkent, which is the leader in terms of costs for innovation.

In this situation, we can assume a more effective use of factors of innovative potential and the quality of innovation management than in other regions.

The leaders in the number of new technologies created and used are the cities of Nursultan and Almaty. These cities are also the leaders in terms of involvement of subjects of scientific and innovative activity: the number of innovative enterprises, the number of organizations engaged in R&D, the number of employees who performed R&D.

The calculation of the innovation potential in an integral form according to the method discussed above is shown in table 2. As can be seen from table 2, the variation in the assessment of innovative potential is 35 times – from 13 in Mangistau region to 456 in Shymkent. Only in 2 regions, the innovation potential is almost equal to the average Republican one – in Aktobe (104) and Karaganda (109). In another 5 regions, the innovation potential is significantly higher than the national average. In the other 10 regions, the innovation potential does not exceed half of the national average.

The STADIA software was used to search for a multi-factor linear regression model that takes into account the real patterns between the factors of innovation potential and the volume of innovative products produced.

Table 1. Factors of innovative potential of Kazakhstan's regions in 2018

	Administrative regions	Indicators							
		Volume of innovative products (goods, services), million tenge	Domestic expenditures on R&D, million tenge	The expense for innovations, million tenge	Number of innovative and active enterprises, units	Number of R&D organizations, units.	Number of employees who performed R&D, people	The number of new technologies and equipment objects created and used	Number of issued protection documents for inventions
1	Akmola region	25 644,6	1 694,3	17 016,3	93	11	739	166	36
2	Aktobe region	44 299,9	974,6	57 351,5	125	16	351	107	20
3	Almaty region	18 351,2	1 121,1	26 964,4	151	9	970	68	67
4	Atyrau region	8 819,8	4 494,5	90 719,9	96	10	466	124	15
5	West Kazakhstan region	23 398,7	878,2	12 154,3	50	10	442	10	18
6	Zhambyl region	66 782,3	731,6	6 945,6	96	9	280	134	56
7	Karaganda region	54 778,0	3 508,3	55 131,8	336	28	1 349	64	90
8	Kostanai region	124 014,9	827,4	15 406,8	163	12	590	331	23
9	Kyzylorda region	6 401,7	301,9	19 688,5	92	7	222	179	18
10	Mangistau region	651,0	9 848,7	2 553,8	45	6	694	0	15
11	Pavlodar region	250 032,0	290,2	30 128,3	116	14	533	96	76
12	North Kazakhstan region	9 396,5	226,3	16 071,2	119	5	90	0	30
13	Turkestan region	13 375,7	273,6	9 207,1	60	6	202	92	21
14	East Kazakhstan region	174 068,8	5 319,1	80 270,9	317	35	2 295	172	73

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15	Nursultan	112 146,2	14 094,2	81 815,6	583	60	3 081	2 813	226
16	Almaty	30 228,4	26 586,5	76 061,8	670	135	9 407	1 018	731
17	Shymkent	216 760,7	1 054,0	264 427,3	118	11	667	0	71
	average value	69 361,8	4 248,5	50 700,9	190,0	22,6	1 316,4	358,3	93,3

Table 2. Innovative potential of Kazakhstan's regions in 2018

	Administrative regions	Indicators							
		Domestic expenditures on R&D	The expense for innovations	Number of innovative and active enterprises	Number of R&D organizations	Number of employees who performed R&D, people	The number of new technologies and equipment objects created and used	Number of issued protection documents for inventions	Innovative potential
1	Akmola region	39,88	33,56	48,95	48,70	56,14	52,51	38,59	35
2	Aktobe region	22,94	113,12	65,79	70,83	26,66	33,85	21,44	104
3	Almaty region	26,39	53,18	79,47	39,84	73,69	21,51	71,82	53

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4	Atyrau region	105,79	178,93	50,53	44,27	35,40	39,23	16,08	163
5	West Kazakhstan region	20,67	23,97	26,32	44,27	33,58	3,16	19,29	23
6	Zhambyl region	17,22	13,70	50,53	39,84	21,27	42,39	60,03	17
7	Karaganda region	82,58	108,74	176,84	123,96	102,48	20,25	96,47	109
8	Kostanai region	19,48	30,39	85,79	53,13	44,82	104,71	24,65	36
9	Kyzylorda region	7,11	38,83	48,42	30,99	16,86	56,62	19,29	39
10	Mangistau region	231,82	5,04	23,68	26,56	52,72	0,00	16,08	13
11	Pavlodar region	6,83	59,42	61,05	61,98	40,49	30,37	81,46	57
12	North Kazakhstan region	5,33	31,70	62,63	22,14	6,84	0,00	32,16	31
13	Turkestan region	6,44	18,16	31,58	26,56	15,35	29,10	22,51	19
14	East Kazakhstan region	125,2	158,32	166,84	154,95	174,35	54,41	78,25	154
15	Nursultan	331,75	161,37	306,84	265,63	234,06	889,86	242,24	204
16	Almaty	625,79	150,02	352,63	597,66	714,63	322,03	783,54	186

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		Domestic expenditures on R&D	The expense for innovations	Number of innovative and active enterprises	Number of R&D organizations	Number of employees who performed R&D, people	The number of new technologies and equipment objects created and used	Number of issued protection documents for inventions	Innovative potential
17	Shymkent	24,81	521,54	62,11	48,70	50,67	0,00	76,10	456

Using step-by-step regression and multiple linear regression, a functional relationship is constructed, which has the following form:

$$Y= -41+5,061x_1-0,936x_2-424,58x_3+862,4x_4-117,54x_5+393,75x_6+2722,9x_7$$

$$R= 0,8093;\ D=0,65496;\ F=1,0847.$$

The presence of a link between the volume of innovation output and innovation potential (0.51) allows us to determine the estimated values of the volume of innovation output by region, with the actual characteristics of innovation potential and other equal conditions (table 3).

Table 3. Factors of innovative potential of Kazakhstan's regions in 2018

	Administrative regions	Actual volume of innovative products, million tenge	Estimated volume of innovative products, million tenge	Level of use of innovative potential, %
1	Akmola region	25644,6	140492,7	18,25
2	Aktobe region	44299,9	101688,9	43,56
3	Almaty region	18351,2	196017,2	9,36
4	Atyrau region	8819,8	72117,1	12,23
5	West Kazakhstan region	23398,7	76881,2	30,43
6	Zhambyl region	66782,3	190575,4	35,04
7	Karaganda region	54778,0	290695,1	18,84
8	Kostanai region	124014,9	112508,3	110,23
9	Kyzylorda region	6401,7	78974,2	8,11
10	Mangistau region	651,0	51561,6	1,26
11	Pavlodar region	250032,0	256480,4	97,49
12	North Kazakhstan region	9396,5	79208,7	11,86
13	Turkestan region	13375,7	80421,0	16,63
14	East Kazakhstan region	174068,8	277224,3	62,79

	Administrative regions	Actual volume of innovative products, million tenge	Estimated volume of innovative products, million tenge	Level of use of innovative potential, %
15	Nursultan	112146,2	1082761,7	10,36
16	Almaty	30228,4	2544997,7	1,19
17	Shymkent	216760,7	216491,0	100,12

As can be seen from table 3, the level of innovative potential utilization ranges from 1.26% in Mangistau region to 110.23% in Kostanay region. Analyzing these data, we can identify groups of areas with different levels of use of innovative potential:

- high level of usage is characterized by Kostanay, Pavlodar regions and Shymkent;
- the average level of use is typical for East Kazakhstan, Aktobe, West Kazakhstan and Zhambyl regions;
- the remaining 10 regions are characterized by a low level of usage.

Figure. 1 gives a clear idea of the size of the innovation potential and the level of its use.

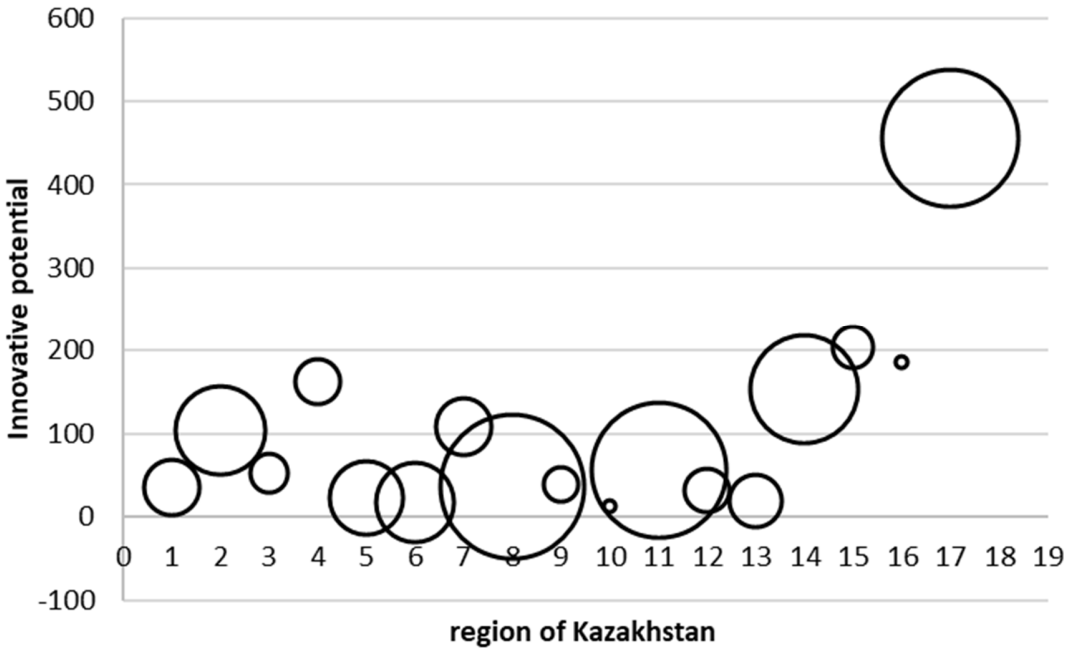

Fig. 1. Innovative potential of Kazakhstan's regions and the level of its use in 2018

In fig. 1, the regions are arranged horizontally in the order shown in table 3.the vertical arrangement of the circles shows the size of the innovation potential. As you can see from the figure, only 7 regions have a potential equal to or greater than the national average (100 or more). The area of the circle represents the level of use of innovative potential. Full use of innovative potential is typical for region 11-Pavlodar region. Kostanay region and the city of Shymkent, which has used its innovative potential by more than 100%, indicates the intensification of the use of its innovative factors and / or the attraction of innovative factors and resources of neighboring regions or countries to the territory of the region.

The obtained research results allow not only to assess the factors of innovative potential of the regions, but also can be used to develop measures to stimulate innovation, adjust the regional scientific and technical, innovation and industrial policy of Kazakhstan.

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