DETERMINING THE EFFECTIVENESS OF USING INTELLECTUAL POTENTIAL IN THE REGIONS OF KAZAKHSTAN

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Abstract. *In recent decades, in the economic literature there has been a surge of interest in the problems of the establishment of a knowledge-based economy, with particular attention being paid to the concept of intellectual potential in order to understand how knowledge functions as a key asset that creates value for an enterprise, region or country as a whole. The intellectual potential at the regional level is considered as the ability of human activity to generate and introduce new things for the purpose of socio-economic development of the region. Intellectual potential is the main factor for the development of a knowledge-based economy. In this regard, the need arises for the effective use of intellectual potential in order to stimulate economic entities to ensure innovative development, creation and generation of new knowledge and the establishment of a knowledge-based economy. In this paper, we assessed the effectiveness of using intellectual potential in the regions of Kazakhstan using the Data Envelopment Analysis (DEA) methodology, which is used as a technique to assess the effectiveness of the functioning of homogeneous objects in various socio-economic systems. This technique allows you to identify the strengths and weaknesses of the emerging high-tech economy across the country and allows you to evaluate the effectiveness of using intellectual potential in its regions in order to identify weaknesses and points for future growth.*

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1. Introduction

The idea of creating a knowledge-based economy in the most developed countries is associated with a transition to an innovative paradigm of socio-economic development. Many scientists emphasize that new knowledge is not only an indicator of the sustainable development of national economies and the level of well-being of society, but also a decisive factor in global competition [1-5]. In developed countries, from 80 to 95% of GDP growth is due to the emergence of new knowledge embodied in technology, equipment, training, organization of production.

In order for the intellectual potential to play the role assigned to it in the growth of the national economy, it is necessary to take into account the characteristics of each region and use measures that correspond to the real needs of regional economies. Therefore, it is important to study the concept of intellectual potential at the level of the national economy, taking into account its regional specifics, as a result of which the strong and weak links of the emerging knowledge-based economy are identified throughout the country. This determines the relevance of creating

an organizational and economic mechanism for managing intellectual potential at the regional level, which is impossible to implement without adequate methods for measuring its effectiveness. So, the most important element of this mechanism is the assessment of the effectiveness of the use of intellectual potential at the regional level.
In the economic literature, research, as well as practical applications based on intellectual potential, are still in their infancy and therefore suffer from some shortcomings. Moreover, there is still no single conceptual apparatus for the category of "intellectual potential". In this context, there is a gap in the definition of methods for assessing the effectiveness of the use of intellectual potential at the regional level.
Thus, the lack of a methodology for assessing the effectiveness of the use of intellectual potential at the regional level, determining the formation and effective use of intellectual potential in the emerging high-tech economy, determines the relevance of the study.

2. Literature review

The study of the concept of intellectual potential in their works was reflected by many economists [6-8]. However, before proceeding to the analysis of the conceptual apparatus associated with intellectual potential, it should be noted that intellectual potential is closely related to the concepts of "intellectual resource" and "intellectual capital". As a rule, researchers often identify them [9]. The very concept of "potential" means the means, stocks, available sources that can be used to achieve the specific goal of a system. Therefore, unlike a resource - as a factor in stock, a potential is a combination of opportunities, often not yet disclosed, not formally fixed, but actually used to carry out some kind of action. In the process of production of a product or service as a result of intellectual labor, its accumulation takes place and intellectual capital is created. Consequently, the effective use of intellectual potential is the basis of the process of building up its intellectual capital. Thus, we can build a logical chain: intellectual resource - intellectual potential - intellectual capital. This theory is supported by the work of [3], which define intellectual potential as "the possession of knowledge, applied experience, organizational technologies, customer relationships and professional skills that provide a competitive advantage in the market".
In other words, intellectual potential is scientific knowledge, both embodied in technologies, products and other results of human activity (scientific and technological potential), and not realized, having an informational character, but fixed on a material medium (books, articles, scientific reports), and also assumes the presence of individual human knowledge. The latter constitutes the intellectual potential of a person, determined by the level of his education, professional training and depends on education, training, socialization, health and natural innate abilities (talent, genius). In this regard, M. Rutkevich [10], believing that in the intellectual potential "should find in a generalized way the level of development of two closely related areas of the intellectual life of society, namely, the state of science and education", define it as a set of educational and scientific potentials.

3. Research methodology

To assess the effectiveness of using intellectual potential at the regional level, in this study we propose Data Envelopment Analysis (DEA) - a linear programming method. The DEA methodology is widely and effectively applied in various fields of research, in particular, in the field of applied economic geography and has potential value for politicians and practitioners of economic development.
In our study, the process of selecting variables for DEA models is mainly based on systems for evaluating the effectiveness of using intellectual potential, proposed by a number of different authors [11-12]. A fundamental step in the process of economic development is the assessment

of the effectiveness of the use of intellectual potential at the regional level. As is the case with enterprises, the effectiveness of the region's intellectual potential is largely based on intangible assets and unique skills. Most authors who assess intellectual potential on a regional scale use models developed at the organizational or business levels [13-14] defines intellectual potential as the hidden values of people, firms, institutions, current and / or potential source of wealth creation. Andriessen [15], discussing the transfer of the concept of intellectual potential from organizational to spatial level, defines the national intellectual potential as all intangible resources available to the state, which provide a comparative advantage and which, with a strategic combination, provide future growth. Regional intellectual potential includes intangible assets that create value for the region and create a competitive advantage that can contribute to its future development [16]. Similarly, Schiuma and Lerro [17] define regional intellectual potential as a collection of knowledge assets in a region that support innovative momentum and mechanisms that contribute to value added in the region.

4. Results

In order to assess the functioning of the education system by region based on the DEA CCR model. The production function shows the maximum number of output (products) that can be produced from a given number of input factors of production (inputs) using this technology. If the optimal DMU value is 1, then the DMU is effective, from the CCR point of view, and lies on the border of CCR efficiency, otherwise the block is not effective from the CCR point of view. The following parameters are considered as input parameters: the share of employed people with higher education (X1), the Number of students in higher educational institutions per 10,000 population (X2), the share of educational expenses in GRP (X3), the number of research specialists per 1 million people (X4), The Number of researchers with a degree of 1 million people (X5), the Share of internal research costs in GRP (X6), The number of personal computers per 1000 workers (X7), the proportion of computers with Internet access (X8). The following indicators were selected as output files: Number of patents (Y1), Number of scientific articles (Y2), Share of innovative products in GDP (Y3), Number of new technologies and equipment created and used (Y4).

Initially, before constructing the boundaries of the effectiveness of the functioning of the education system, factor selection was made among the input parameters by means of analysis of variance and regression. The results are shown in Table 1.

Table 1. Analysis of variance and regression

	Y1	Y2	Y3	Y4
Factor	Pr(>|t|)	Pr(>|t|)	Pr(>|t|)	Pr(>|t|)
X1	0.7433	0.6216	0.976	0.82158
X2	0.2473	0.5525	0.926	0.35049
X3	0.9032	0.0106*	0.928	0.00316**
X4	1.31e-05***	0.0373*	0.839	0.94857
X5	0.5105	0.4950	0.577	0.22683
X6	0.0126*	0.7914	0.704	0.50515
X7	0.6046	0.1066	0.735	0.06345.
X8	0.5276	0.6741	0.460	0.27162
Adjusted R^2	0.9441	0.8841	-0.04172	0.8097
p-value	1.991e-05	0.000343	0.5455	0.002265

Significance Level: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

As a result of assessing the influence of the considered input parameters on the output parameters, there is a lack of statistical significance of the regression equation with the explanatory variable U3, in view of the value p-value = 0.5455, the indicator U3 will not be considered as an output parameter. In addition, due to the lack of statistical significance, the following indicators will not be considered as input parameters: X1, X2, X5, X8.
In order to assess the effectiveness of the functioning of the education system, the following input and output parameters were used in Table 2.

Table 2. Input parameters

Regions	**The share of education costs in GRP,%**	**The number of research specialists per 1 million people**	**The share of internal research costs in GRP,%**	**Number of personal computers per 1000 employees**
Akmola	4,63	610,33	0,10	25,87
Aktobe	3,29	338,11	0,04	23,38
Almaty	5,27	349,98	0,04	11,72
Atyrau	0,89	671,84	0,06	58,26
West Kazakhstan	2,57	624,49	0,03	22,53
Zhambyl	7,07	208,55	0,05	11,80
Karaganda	2,70	778,68	0,07	21,61
Kostanay	3,58	464,82	0,04	23,74
Kyzylorda	5,66	163,44	0,02	15,56
Mangistau	1,52	882,91	0,26	33,32
Pavlodar	2,60	633,24	0,01	28,30
North Kazakhstan	4,67	121,74	0,02	22,21
Turkestan	4,80	92,06	0,02	6,18
East Kazakhstan	3,66	1208,32	0,15	21,45
Astana city	3,88	2272,51	0,21	82,16
Almaty city	2,36	4103,23	0,22	52,93
Shymkent	4,55	655,35	0,05	17,06

Table 3. Output Parameters

Regions	**Number of patents**	**Number of scientific articles**	**The number of created and used new technologies and equipment objects**
Akmola	7	19	166
Aktobe	2	48	107
Almaty	11	12	68
Atyrau	9	22	124
West Kazakhstan	3	5	10
Zhambyl	9	12	134
Karaganda	46	217	64
Kostanay	7	14	331
Kyzylorda	3	17	179
Mangistau	5	19	0
Pavlodar	41	33	96
North Kazakhstan	3	6	0
Turkestan	7	23	92
East Kazakhstan	27	97	172
Astana city	91	1001	2813
Almaty city	306	916	1018
Shymkent	12	92	0

Table 4. Indicator of efficiency

Regions	Indicator of efficiency
Akmola	0.24226
Aktobe	0.32230
Almaty	0.41988
Atyrau	0.23809
West Kazakhstan	0.06534
Zhambyl	0.64954
Karaganda	0.93687
Kostanay	0.61849
Kyzylorda	0.88477
Mangistau	0.08246
Pavlodar	1
North Kazakhstan	0.32576
Turkestan	1
East Kazakhstan	0.32681
Astana city	1
Almaty city	1
Shymkent	0.41162

As a result of applying the DEA CCR approach, the most effective indicator of the functioning of the education system was shown by such regions as Pavlodar region, Turkestan region, Astana and Almaty, due to higher output indicators, the number of patents, the number of scientific articles and the number of new technologies and objects created and used . In addition, performance indicators close to 1 were shown by the Karaganda (0.94) and Kyzylorda (0.88) regions. Nevertheless, low efficiency is observed in the North Kazakhstan region (0.33), which is due to higher input data compared to other regions in terms of the share of educational expenses in GRP, the number of personal computers per 1000 workers, but the output parameters of the region are not comparable with the input indicators. As a result, based on the application of the DEA CCR approach, the effectiveness of the functioning of the education system of the regions of Kazakhstan was assessed, which shows an uneven distribution of education spending resources, the number of specialist researchers and the provision of personal computers.

5. Conclusions

The proposed methodology for assessing the effectiveness of the use of intellectual potential at the regional level based on the DEA CCR allows us to identify the strengths and weaknesses of the emerging high-tech economy across the country and allows us to assess the effectiveness of the use of intellectual potential in its regions in order to identify weaknesses and points for future growth.

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