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Factors Affecting the Distribution of Intellectual Potential and Returns in Kazakhstan

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Abstract

Purpose: This research is aimed to study the level of the intellectual potential distribution, as well as the correlation between economic growth and key indicators of intellectual potential in each region of Kazakhstan. A review of the conceptual framework shows that there is a large body of research evaluating the level of intellectual potential in different ways based on different factors. **Research design, data, and methodology:** The research methodology is divided into two groups the integral index method using the normalization of indicators, weighting, and ranking; the method of correlation analysis. By the proposed methodological approaches, were calculated a set of factors affect the distribution of the intellectual potential. Statistics are taken for indicators of development of the intellectual potential for 2011-2020 from the Bureau of National Statistics. **Results:** Ranking results showed gaps between regions in Kazakhstan by the level of intellectual potential. Correlation analysis results revealed a statistically significant relationship on expenditures on R&D, computer literacy, innovative products, number of PhD students, and cultural and leisure indicators. **Conclusions:** Based on the obtained results of the intellectual potential level development there were given recommendations for the reproduction and regulation of the intellectual potential in the future.

Keywords: Distribution, Intellectual Potential, Science, Education, Innovation, Kazakhstan

JEL Classification Code: O11, O15, P25

1. Introduction

Production effective functioning is impossible under insufficient development and application of intellectual potential. Economic growth of the production is based on a well-thought-out policy in the field of intellectual potential usage and its distribution for the stable development of the intellectual property. The significance of intellectual potential is defined as an important source, which affects the growth of competitiveness of any economy. Emphasizing various interpretations of intellectual potential (e.g., scientific employees, innovative products, scientific developments, etc.) many scientists argue about the relationship between intellectual potential and sustainable economic development (Carayannis, 2004). In the process of this issue studying, many researchers began to consider the intellectual potential as a body of knowledge of scientists or intellectual property workers (Bapna, Langer, Mehra,

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Gopal, & Gupta, 2013; Dasgupta & David, 1994; Helpman, 1993). In addition, the intellectual potential is one of the most important studies in terms of the connection of the resources and reserves of the subject with the driving forces of the intellect, with the sphere of motivational needs and general human abilities (Capello & Lenzi, 2015; Dettori, Marrocu, & Paci, 2012; Jaffe, 2000). Features of the intellectual potential also relate to the results of the innovative sector and the distribution of new knowledge (Cammarano, Caputo, Lamberti, & Michelino, 2017; Zbuchea, Pînzaru, Busu, Stan, & Bârgăoanu, 2019).

Despite the wide complex of the intellectual potential development measures, which are actively applied in many countries, they scarcely ever provide an expected positive effect. This problem is especially urgent in developing countries such as Kazakhstan, Russia, Belarus, Ukraine, where the preservation of intellectual potential comes first. Nevertheless, for efficient management of the intellectual potential and its robust implementation consideration must be given to features of its formation and distribution, a set of components. The main attention should be paid to the factors influencing the spread of the intellectual potential of the population.

Moreover, the intellectual potential development is associated with a highly qualified specialist generation, which has extensive knowledge (Mithas & Lucas, 2010; Slaughter, Ang, & Boh, 2007; Suksod & Cruthaka, 2020). Additionally, the intellectual potential development link with innovative products in combination with knowledge management, resulting in new knowledge distribution (Cammarano et al., 2017; Jankowska, Matysek-Jędrych, & Mroczek-Dąbrowska, 2017). New knowledge develops competitive advantages, which leads to innovative development of the territory (Grandinetti, 2016; Kireyeva, Abilkayir, & Tsoy, 2018; Mankiw, Romer, & Weil, 1992; Schiuma & Lerro, 2008).

Many factors can affect the development of the economy, on the whole, development of the intellectual potential researchers associate with endogenous growth. With the growth of endogenous factors, economic growth can be achieved (Hoon & ShinMah, 2016; Mohanty, Bhanumurthy, & Dastidar, 2018). Further, the intellectual potential characteristics are linked with the development of education and its sufficient funding (Alexiou, 2009; Anyanwu, 2014; Capello & Lenzi, 2015; Riihelaninen, 2013). Many authors argue about different factors having an impact on intellectual potential development, one of them is cultural development in society (Limaj & Bernroider, 2019; Yuwono, 2021), development of an individual mindset, or range of interest results in intellectual development.

The research presented in this article is aimed at filling the gap developed in the field of preservation and distribution of intellectual potential and its impact on the country's development indicators. For this reason, basic indices for calculating the index of the intellectual potential of each region are used as indicators. Based on the use of indicators it can be concluded that balanced support and balanced usage of the factors of the intellectual potential development will lead to economic growth in the future. Such evaluation is necessary for decision-making associated with the viability of financing the accumulation of the intellectual potential and with a certain focus.

The document is structured as follows. In section 3, we present and describe the dataset and indicate the research methods used. In section 4, we present and discuss the test results. Section 5 concludes the paper with a summary of the key findings of the study.

2. Literature Review

2.1. Intellectual Potential and Influence of Human Resources

The sources of intellectual potential are diverse; they can be innovation components and public associations. Yet the main role in the development and distribution of intellectual potential is attributed to human potential. This is the most important factor, which can shape and influence the distribution of intellectual potential. Challenges of the current world order oblige societies to create an innovative and creative society. The core of such a society must be highly intelligent people with a precise understanding of modern, innovative processes. Despite many studies of intellectual potential in the scientific community, there appear problems in determining the factors that stimulate the development of intellectual potential.

Intellect is an integral component of development, but intellect has a major feature it is necessary not only to develop it but also to be involved in its distribution. Distribution supposes continuous movement towards increasing the capabilities of the intellect (Drucker, 1993). This structure of behavior is built on the independent variables as specific behavior, approval perception, and perceived behavioral control (Ajzen, 1991). The intellectual potential is a particular substance, consisting of knowledge, information, intellectual property, and experience (Dasgupta & David, 1994; Davenport & Bibby, 1999; Helpman, 1993). Helpman (1993) evaluated the components of intellectual potential concerning market, organizational and human capital. Conversely, Armitage and Conner (2001) studied empirical research before 1997 and discovered that about 39 and 27% of differences in the attempt and behavior were triggered by the theory of planned behavior.

Other researchers described the intellectual potential based on the human capital analysis and efficacy of its

application (Jaffe, 2000; Lynch & Black, 1995). For example, Black and Lynch (1996) in their work analyzed the return on investment in human capital at the firm level. While this strand of research analyzes factors whereby employer-provided training has more or less effect (Lynch & Black, 1995).

Human resources and their analysis are among the most important topics for research in terms of return on investment (Bapna et al., 2013; Zygmunt, 2019). Eventually, the most important factors, which influence the formation and distribution of the intellectual potential, are the system of higher education and scientific organizations, which are influenced by the level of science state funding. In addition, human capital has a direct positive impact on intellectual potential.

The problems of low level of financing of scientific research are especially urgent in developing counties, where a major part of government expenditures is accounted for education resulting in the loss of highly educated professionals (Gerasimov, Sharafutdinov, Kolmakov, Erzinkyan, Adamenko, & Vasilyeva, 2019; Libanova, 2019; Mishchuk & Grishnova, 2015). Accordingly, such policy of developing countries creates major issues for human resources development. In their works, Russian scientists analyze the link between higher education and the rates of regional economic development from 2012 to 2015 (Agasisti, Egorov, Zinchenko, & Leshukov, 2020). The indicators of effectiveness are calculated at the institutional level using a two-step semi-parametric analysis of data coverage. Derived results prove the positive impact of higher educational institutions on the economic growth of the region.

In present studies of human capital, attention was given to the return from investments in training by raising wages (Mithas & Lucas, 2010; Slaughter et al., 2007). Highly qualified employees ensure higher financial performance of investments compared with the employees of much lower qualification quality (Suksod & Cruthaka, 2020).

Based on the results of the research provided by Jankowska and others explain how national innovative systems can transform the contribution of innovations to innovative products in different countries (Jankowska et al., 2017). Next, in another work, there is considered the impact of the combination of innovative practices on knowledge management strategy and type of innovative product (Cammarano et al., 2017). Innovative opportunities depend on knowledge and intellectual capital; therefore, it is important to share knowledge, which leads to the distribution of new knowledge (Zbuchea et al., 2019).

Based on the analysis of the literature review, it can be concluded that many scientific works investigate the intellectual potential. Nevertheless, there are no detailed studies, which consider not only investment and innovative factors, but cultural, scientific, educational components as well, which would provide reliable data for analysis in developing countries. The intellectual system is important, where the leading role is played by the processes of knowledge generation, application, and distribution.

2.2. Intellectual Potential and Economic Growth

Human capital is directly involved in the production process, bringing returns to stimulate economic growth. Thus, economic development increasingly determines a person's intellectual potential, acting as the sum of his innate abilities, general and special education, acquired professional experience, creative activity, moral, psychological, and physical health. The economic growth is represented by the totality of the product that was released in a calendar year in all economic sectors of the country (GDP/GDP per capita).

In the main document of the European Commission (2010), there was admitted uneven development, including knowledge distribution as a tool of economic cohesion. EU country's experience shows that the competitive advantages of modern economies are determined by the ability to create and distribute knowledge, for effective application of the intellectual capital for the innovative development of the territory. The majority of scientists from the field of regional development adhere to this position (Grandinetti, 2016; He, Tao, Meng, Chen, Yan, & Vasa, 2021; Kireyeva et al., 2018; Mankiw et al., 1992; Schiuma & Lerro, 2008; Yessentay, Kireyeva, Khalitova, & Abilkayir, 2020). Namely, knowledge and the system of its continuous changes are the basis of progress, the source of economic growth, and the competitive ability of the country. For example, Mankiw made a great advance in the development of the endogenous growth model. Particularly, research in this field confirms the existence of a relationship between education development and economic growth (Mankiw et al., 1992). They confirmed a positive correlation between human capital, economic growth, gross domestic product (GDP per capita), domestic innovation, competitiveness, and sustainable technological development. Notably, human capital becomes the source of the rapid reproduction of new ideas. Again, Schiuma and Lerro (2008) imparted particular importance to the intellectual potential, as a strategic resource and source of transfer of innovations in the region. Cross-country studies show a negative and non-linear relationship between years of schooling and economic growth (De Gregorio & Lee, 2002). Later, Földvári and Van Leeuwen, using the most popular functional forms, found that the impact of inequality in school education on income inequality is very low, even insignificant in an economic sense (Földvári & Van Leeuwen, 2011).

Research in the field of endogenous growth was

constantly conducted and filled the gap. Thus, Hoon and ShinMah (2016) illustrated the impact correlation of economic growth in Korea by the theory of endogenous growth. Among other things, the study's influence of expenditures on R&D on economic growth is based on adding control variables to the growth equation. Grandinetti focused on the concept of absorptive capacity, to fill this theoretical gap (Grandinetti, 2016). He studied two topics, how the opportunities are developed at the start of a new venture and knowledge distribution processes. At the same time, in several regions, the opportunities for innovation distribution are limited based on objective reasons. Additionally, development a disparity of regions by geographic and technological features of the placement of infrastructure facilities (Mohanty et al., 2018).

Alexiou claimed that education is the most important step during the process of economic growth discovered that education is of crucial importance in building human capital and economic growth as GDP (Alexiou, 2009). Riihelaninen (2013) analyzed the correlation between government expenditures on education in European Union and found a temporary positive effect of education spending on economic growth. Other scientists constantly use various methodological approaches for the evaluation of differences in economic indicators of European nations using the information on the use of human capital (Capello & Lenzi, 2015; Dettori et al., 2012). Several late studies are underlying the importance of cultural potential, which is the engine of the growth of sustainable development, determining the intellectual capital of any state (Limaj & Bernroider, 2019; Yuwono, 2021). Culture in the modern economy contributes to the formation of budget profitability by improving the quality of human potential, creating new jobs, reduces social tension, which affects the dynamics of GDP growth. Therefore, in these studies, the level of visits to tourist places visits cultural and leisure facilities was used as the main variable.

Some scientific research analyzed the correlation between education and economic growth and found that education increases labor productivity per capita. Anyanwu (2014) highlighted factors that contributed to the economic growth of Africa and learned from the experience of China. The author used five non-overlapping averages from 53 African countries between 1996 and 2010, where real GDP was the dependent variable. The results showed that domestic investment, education, public administration effectiveness, and an urban population have a positive influence on African economic growth.

Despite the variety of existing approaches in the economic literature to the study of the research processes of the intellectual potential and factors that influenced the process of return and distribution, the approaches used in these studies are not universal. The assessment of the level of development of the intellectual potential in many developing countries, such as Kazakhstan is conducted rarely. Few works study the level of intellectual potential distribution and returns. Moreover, there are practically no scientific works, which study the dependence of economic growth and intellectual capital in the context of regions. This study will try to fill this gap.

3. Research Methods and Materials

Most of the works of foreign researchers and international organizations are focused on the development of the methodology of the intellectual potential evaluation of the regions (World Bank, RDP, UN, WIPO). Some of the methods of evaluation are aimed at studying the intellectual potential distribution issues at the macro level; others are directed at the micro level. Some scientists used correlation analysis to identify the relationship between intellectual potential and development indicators (Bilan, Mishchuk, Roshchyk, & Kmecova, 2020; Cho, 2020). In the scientific literature, the most popular method is the index method, which can cover qualitative and quantitative indicators when evaluating (Bryhinets, 2021). Yeh-Yun Lin, and Edvinsson (2008) applied the index method of national intellectual capital evaluation. The authors used the indicators of human capital, market capital, technological capital, and financial capital in the assessment.

Exploring several applied methods allows for the conclusion that there is no standard method for uniform indicators acceptable for assessing the intellectual potential in the region. These methods are comprehensive enough, as they mostly cover scientific and educational aspects and do not consider innovative and cultural indicators of the intellectual potential distribution in a region. A methodology should be proposed, which consists of the set of indicators, aimed at the identification of regions where the distribution of the intellectual potential occurs best. This way, based on the literature review developed by the authors a comprehensive factors system was developed, which covers scientific, intellectual, innovative, and cultural indicators, and particular variables showing the level of the intellectual potential development in the regions are identified. Hereby, for evaluation of the level of the intellectual potential distribution of the region, there were used 10 indicators were grouped into key blocks.

In this work, research methods were used by the set aims:

Aim 1: Revealing regional differences in the intellectual potential - an index method was applied by ranking.

Aim 2: To assess the influence of factors on the formation of the intellectual potential of the regions of Kazakhstan on the above indicators - correlation analysis was applied.

By these aims, the research methodology is divided into two groups:

1. In this research the intellectual potential distribution of the region was identified through the calculation of the integral index of the intellectual potential, with the help of normalization of indicators, weighting, and ranking. By the proposed methodological approach, intermediate scientific, educational, innovative, cultural pastime indicators were calculated using the arithmetic mean. Then, a normalized estimate was used to normalize the data ($I_{normalized}$) - indicator characterizing the distance of values from the average value for the general population. It is calculated for each value by the formula (1):

$$I_{normalaized} = \frac{a_i - F_i}{\sigma} \quad (1)$$

$I_{normalized}$ is the value of indicators derived from the identified factors;

a_i is the value of indicators within the factor calculated for each region;

F_i is the arithmetic value of each indicator calculated for each region;

σ – standard deviation.

Further, to derive the indicator of each block, the average value of the normalized data by region is calculated.

These values were found for all groups of indicators: scientific, educational, innovative, and cultural pastime.

The vulnerability of the regions was found according to the formula (2):

$$I_{IntelPot} = \frac{Sien_{m_i} + Edu_{m_i} + IN_{m_i} + Cul_{m_i}}{4} \quad (2)$$

$I_{IntelPot}$ is the integral index of intellectual potential;
$Scie_{mi}$ is the scientific potential index;
Edu_{mi} is the educational potential index;
IN_{mi} is the innovation potential index;
Cul_{mi} is the cultural pastime index.

After calculations according to the above formulas, the level of distribution of the intellectual potential of the regions will be determined according to the following scale (Table 1).

Table 1: Scale for quantifying the degree of the index of intellectual development in the region

Base score range	Type of vulnerability
[≥ 0 – 0,9]	Low-level index of intellectual development
[≥ 1 - 1,4]	Medium level index of intellectual development
[≥ 1,5 – 2,0]	High-level index of intellectual development

Next, regions were ranked according to the values of aggregated indicators by "sorting in descending order". For the minimum-maximum normalized data based on weighting and ranking, indicators below 0.9 can be assumed that the region has a low level of distribution of intellectual potential. Further, for all cases above 1, it can be assumed that the level of the distribution index of intellectual potential is average. If the indicators are higher than 1.5 then it is expected that the index of the intellectual potential distribution is high.

2. One of the main indicators affecting the economic development of the region is the gross regional product (GRP), which is widely used in the system of national accounts, and expresses in market prices the total value of goods and services belonging to this territory. The significance and dynamics of this indicator in a particular region determine the development of regional economic potential. At the same time, it is important to know which factors influence GRP and through which indicators it is possible to influence its value and achieve a positive result.

One of the ways to solve this problem is to conduct a correlation analysis aimed at studying the forms of communication that establish quantitative relationships between the selected variables. For the correlation calculation of data features with exponential distribution, the Pearson algorithm has advantages over other algorithms in terms of accuracy and efficiency. Let X and Y be two variables (for example, in the prediction of high-risk students, X is the GRP of the regions and Y is the indicator of the intelligent capacity of the population). The correlation between X and Y is represented by C. The value of C and the degree of correlation are generally defined as shown in table 2.

Table 2: Definition of the values and relevance of C

A base score of the values of C	Relevance
[0.8 < C ≤ 1.0]	This indicates that X and Y are extremely related
[0.6 < C ≤ 0.7]	This indicates that X and Y are strongly related
[0.4 < C ≤ 0.6]	This indicates that X and Y are moderately related
[0.2 < C ≤ 0.4]	This indicates that X and Y are weakly related
[0.0 ≤ C ≤ 0.2]	This indicates that X and Y are very weakly related or not related

Further, let X obey the exponential distribution that was found according to the formula (3):

$$\int(x \mid \mu) = \begin{cases} \frac{1}{\mu}\theta^{-\frac{x}{\mu}}, x > 0 \\ 0, x \le 0 \end{cases} \quad (3)$$

According to the index distribution, the mathematical expectation value of X can be obtained: E(X) = μ; Square difference of X: E(X) =μ_2.

In the data set, set the proportion of positive samples and negative samples to p_t and, respectively, and the mathematical expectation of positive samples and negative samples on X to be μ and μ_n, respectively, then the Pearson correlation C of X and Y is shown in equation (4):

$$C = \frac{\sqrt{p_t p_n}(\mu_t - \mu_n)}{\sqrt{2\mu_t^2 p_t + 2\mu_n^2 p_n - (\mu_t p_t + \mu_n p_n)^2}} \quad (4)$$

The limitation of the current research was the lack of some of the indicators for the calculation of national statistics for the period 2011-2020. Therefore, the study used statistical data from the official website of the Bureau of National Statistics of the Republic of Kazakhstan (some data are given in Supplemental Materials).

4. Results and Discussion

4.1. Results of evaluating the level of intellectual potential distribution

By applying the suggested methodology, there has been evaluated the level of the intellectual potential distribution of the regions of Kazakhstan. The main goal of the evaluation was to receive representative data from the perspective of intellectual potential evaluation as the key factor of innovative development. The suggested methodology of evaluation allows to identify the direction of the state change, i.e., acknowledge positive and negative development trends. Through the use of order scale for quantifying the degree of an index of intellectual development the rank (place) of the region among other regions is determined: the higher the value, the higher the rank.

Table 3 presents the ranking results according to the value of the intellectual development index for 2011 and 2020.

Ranking of the regions by the level of the intellectual potential distribution has allowed the divide the regions into three groups.

Firstly, obtained data for 2011 and 2020 differs significantly. The first place is taken by Almaty city demonstrating high values of most indicators in all factors under consideration, in particular, the value of internal costs on research and development and the value of innovative products. In comparison, in 2020, the situation has changed and the group of regions with a high level of distribution of the intellectual potential included 3 regions: Almaty city (2,480), Turkestan region (2,110), and Shymkent city (1,970).

Secondly, there has been identified that 14 regions of Kazakhstan in 2011 had low values for the level of intellectual potential development. The main reasons for the low level of intellectual potential distribution are the lack of means necessary for the development of intellectual structures, production area, the number of qualified specialists, low level of creative and critical thinking culture of a considerable part of the population. In 2020, the situation has changed significantly. Thus, positive trends in the distribution of the intellectual potential and the group of regions with an average value included Nur-Sultan c., Mangistau, West Kazakhstan, Zhambyl, East Kazakhstan, Pavlodar, Almaty, Kyzylorda, Atyrau, North Kazakhstan, and Aktobe regions. Positive dynamic in the considered regions is conditioned by the simultaneous growth of the indicators, which characterize the potential of scientific research and developments.

Table 3: Ranking according to a value of the intellectual development index in 2011 and 2020

Region	Vulnerability, 2011	Rank	Vulnerability, 2020	Rank
Akmolinskaya	0,514	13	0,946	15
Aktobe	0,440	16	1,025	14
Almaty	0,998	4	1,240	10
Atyrau	0,551	12	1,090	12
West Kazakhstan	0,666	9	1,361	6
Zhambylskaya	0,656	10	1,355	7
Karaganda	0,399	17	0,740	17
Kostanay	0,753	7	0,942	16
Kyzylorda	0,483	15	1,150	11
Mangystau	0,792	6	1,435	5
Pavlodar	1,126	3	1,310	9
North Kazakhstan	0,592	11	1,080	13
Turkestan	0,848	5	2,110	2
East Kazakhstan	0,495	14	1,345	8
Nur-Sultan city	1,154	2	1,450	4
Almaty city	1,730	1	2,480	1
Shymkent city	0,704	8	1,970	3

Source: Organized by authors

Thirdly, it has been identified, that Karaganda, Akmolinskaya, and Kostanay regions show low rates of intellectual potential. Overall, the insufficient level of intellectual potential in the regions of the last group is deteriorating by the extremely low benefit from the implementation of innovations. In current regions, the result of the innovative activity is significantly lagging from the average level across the country. Provided calculation demonstrates gaps between regions of Kazakhstan in the level of intellectual activity.

The value of the intellectual development index varies from 2,480 – in a region, a region that is highly active in the implementation of innovations, to 0,946 (the minimum value). Related to a weak trend of leveling of the intellectual potential distribution level there is clear isolation of Almaty city in 2011 and 2020. From the map, it can be seen that the rest of the regions are not as prominent as the city of Almaty. In 2020, we can also notice the allocation of Shymkent c., an improvement in the index by 5 positions (+5) and Turkestan (+3) regions. Crucial aggravation in this group of regions has demonstrated Karaganda (0), Akmola (-3), areas that are visible from the collation map. The rest of the eastern and western regions, including Nur-Sultan city (-2), Mangistau (+1), West Kazakhstan (+3), Zhambyl (+3), East Kazakhstan (+6), Pavlodar (-9), Almaty (-6), Kyzylorda (+4), Atyrau (0), North Kazakhstan (-2), Aktobe (+2) regions show an improving trend compared to 2011, which are indicated with a blue color in the map, and they correspond to the distribution scale.

When we see the leading group – the first group in 2020 included three regions Almaty city, Turkestan region, and Shymkent city. The values for this group of regions are approximately twice outrank corresponding Kazakhstan average value. This can be explained by the fact that for the last 10 years the field of education, science, innovation, and culture have undergone significant reforms, had a positive impact on the development of the intellectual potential in the regions of Kazakhstan.

In our view, this is associated with different conditions for the intellectual potential components distribution in the regions. Additionally, all parameters of the intellectual potential distribution and the quality of the intellectual policy are mostly identified based on the resources, priorities, and management skills of the regions. Consequently, it can be concluded that government has great stimulating power for intellectual potential development because a weakening of the intellectual potential components stimulation in the future will result in diverse differentiation of intellectual potential development. As noted previously, the diverse development of the regions for the intellectual potential development provides differentiation between them, though in the result the ultimate index of the intellectual potential becomes an average, smoothed evaluation, to some extent balancing different components of intellectual development, at the same time hiding them.

4.2. Results of the correlation of the relationship between economic growth and key indicators of intellectual potential

Correlation analysis was conducted to identify the level of distribution of the intellectual potential factors and their impact on economic growth in regions of Kazakhstan. The analysis predicts that there exists a correlation between economic growth (GRP) and key indicators of intellectual potential. According to the results of the analysis of available data, there was mostly a confirmed existence of positive correlation. Interestingly, certain indicators in some regions show the random distribution and negative correlation between variables (Table 4).

Table 4: Descriptive statistics of selected variables and correlation results

Region	Rdexp	Academic staff	PhD students	Univer grad	College grad	School grad	Innov act	Innov prod	Digit literacy	Library visitors	Theater visitors	Museum visitors
Akmolinskaya	0.8903* (0.0002)	-0.6873* (0.0195)	0.8908* (0.0002)	-0.7051* (0.0154)	-0.8826* (0.0003)	-0.6364* (0.0353)	0.5949 (0.0535)	0.6787* (0.0217)	-0.8481* (0.0010)	0.6972* (0.0171)	0.7261* (0.0114)	0.8486* (0.0010)
Aktobe	0.9354* (0.0000)	-0.7600* (0.0066)	0.9690* (0.0000)	-0.3807 (0.2481)	-0.8831* (0.0003)	-0.5259 (0.0966)	-0.2542 (0.4507)	0.8885* (0.0003)	-0.7455* (0.0085)	0.9168* (0.0001)	0.7221* (0.0121)	0.7310* (0.0106)
Almaty	0.7661* (0.0060)	0.7137* (0.0136)	0.9225* (0.0001)	-0.6611* (0.0268)	-0.7784* (0.0048)	-0.5868 (0.0577)	-0.4369 (0.1791)	0.7795* (0.0047)	-0.1005 (0.7686)	0.9114* (0.0001)	0.8476* (0.0010)	0.8517* (0.0009)
Atyrau	0.8732* (0.0004)	0.2886 (0.3893)	-	-0.5572 (0.0750)	-0.7264* (0.0113)	-0.3726 (0.2591)	0.1208 (0.7236)	0.3789 (0.2504)	-0.7228* (0.0120)	0.8978* (0.0002)	0.9619* (0.0000)	0.8242* (0.0018)
West Kazakhstan	0.4445 (0.1708)	0.0056 (0.9869)	0.8211* (0.0019)	0.7226* (0.0120)	-0.8058* (0.0027)	-0.7354* (0.0099)	0.7386* (0.0094)	0.5289 (0.1160)	0.1494 (0.6611)	0.9044* (0.0001)	0.8462* (0.0010)	0.8955* (0.0002)
Zhambylskaya	-0.2486 (0.4610)	-0.7176* (0.0129)	0.8852* (0.0003)	-0.4674 (0.1471)	-0.8761* (0.0004)	-0.7021* (0.0160)	-0.4690 (0.1456)	0.9675* (0.0000)	-0.1256 (0.7129)	0.1215 (0.7218)	0.8670* (0.0005)	0.4499 (0.1650)
Karaganda	0.6705* (0.0239)	-0.5585 (0.0742)	0.9714* (0.0000)	-0.7083* (0.0147)	-0.8933* (0.0002)	-0.6391* (0.0343)	0.2756 (0.4120)	0.8278* (0.0017)	-0.2947 (0.3790)	-0.7093* (0.0145)	0.8535* (0.0008)	0.7656* (0.0060)
Kostanay	0.6812* (0.0210)	-0.6359* (0.0355)	0.9169* (0.0001)	-0.6994* (0.0166)	-0.8322* (0.0015)	-0.6225* (0.0408)	0.0877 (0.7976)	0.9522* (0.0000)	-0.6578* (0.0278)	-0.8051* (0.0028)	0.7858* (0.0041)	0.7230* (0.0119)

Region	Rdexp	Academic staff	PhD students	Univer grad	College grad	School grad	Innov act	Innov prod	Digit literacy	Library visitors	Theater visitors	Museum visitors
Kyzylorda	0.3559 (0.2828)	-0.5639 (0.0708)	0.8229* (0.0064)	-0.3485 (0.2935)	-0.5622 (0.0718)	-0.4839 (0.1316)	-0.5529 (0.0777)	0.7698* (0.0092)	-0.0070 (0.9836)	0.8223* (0.0019)	0.6615* (0.0266)	0.7254* (0.0115)
Mangystau	0.9087* (0.0001)	-0.0421 (0.9022)	0.8317* (0.0204)	-0.8375* (0.0013)	-0.5878 (0.0572)	0.4181 (0.2006)	0.6060* (0.0481)	0.4035 (0.2185)	0.2076 (0.5401)	0.9212* (0.0001)	0.9178* (0.0001)	0.8877* (0.0003)
Pavlodar	0.6884* (0.0192)	-0.6009 (0.0506)	0.8221* (0.0019)	-0.7395* (0.0093)	-0.9002* (0.0002)	-0.7430* (0.0088)	0.2891 (0.3886)	0.3456 (0.2978)	-0.6032* (0.0495)	0.7859* (0.0041)	0.8874* (0.0003)	0.4628 (0.1517)
North Kazakhstan	0.5974 (0.0523)	-0.4468 (0.1682)	0.8910* (0.0071)	-0.6090* (0.0467)	-0.8424* (0.0011)	-0.8163* (0.0022)	0.4708 (0.1438)	0.6136* (0.0447)	-0.7042* (0.0156)	0.9182* (0.0001)	0.0718 (0.8339)	0.4847 (0.1308)
East Kazakhstan	0.6690* (0.0244)	0.7534* (0.0074)	0.9521* (0.0000)	-0.7601* (0.0066)	-0.8586* (0.0007)	-0.7810* (0.0045)	-0.6628* (0.0262)	0.6764* (0.0223)	-0.7967* (0.0033)	0.8188* (0.0021)	0.9089* (0.0001)	0.8078* (0.0026)
Nursultan city	0.9108* (0.0001)	-0.6850* (0.0200)	0.9532* (0.0000)	0.7050* (0.0154)	-0.7815* (0.0045)	0.8907* (0.0002)	0.1268 (0.7103)	0.6315* (0.0371)	-0.8451* (0.0011)	0.9797* (0.0000)	0.3564 (0.2819)	0.7480* (0.0081)
Almaty city	0.5648 (0.0702)	0.3477 (0.2947)	0.9195* (0.0001)	-0.9489* (0.0000)	-0.7649* (0.0061)	0.0228 (0.9470)	-0.0463 (0.9410)	0.8253* (0.0018)	0.3578 (0.2800)	0.9205* (0.0001)	0.8032* (0.0029)	0.8850* (0.0003)

Source: Organized by authors

R&D and GRP costs strongly correlate in Aktobe (0.9354), Mangistau oblasts (0.9087), and Nur-Sultan (0.9108). In Aktobe region, indicators of R&D expenditures, an increase in the number of doctoral students in universities, an increase in the volume of innovative products and an increase in the number of visitors to cultural and leisure activities will favorably affect the development of the intellectual potential in the region, what leads to an increase in GRP. In general, most regions of Kazakhstan have a positive relationship between these indicators.

At the same time correlation analysis, showed that R&D costs and computer literacy, the release of innovative products does not have a strong impact on multifactor productivity in Zhambyl, West Kazakhstan, and Kyzylorda regions. However, in other regions, the impact of R&D costs, indicators, computer literacy, the release of innovative products have a strong correlation with the intellectual potential in addition to GRP. increase in the number of visitors to cultural and leisure activities strongly affect GRP in given regions.

Correlation between such indicators as several professors and teaching staff and GRP also has different impact levels. For instance, in the East Kazakhstan and Almaty regions, there is a strong positive relationship (0.7534 and 0.7137), in the Aktobe and Zhambyl regions, on the contrary, there is a strong negative relationship (-0.7600 and –0.7176). The study confirms that in regions where factors are poorly distributed, the return on GRP is also weak.

The number of PhD students and GRP have strong positive relationships in all regions of Kazakhstan. Thus, the strongest positive significance is recoded in Karaganda (0.9714) and Kostanay (0.9169) regions. The results confirm that the number of doctorate students has a positive impact on the distribution of regional intellectual potential, thus the impact of these factors on GRP is strong is surprising that the number of graduating students, the number of college graduates, and the number of school graduates mostly have negative relationships between the variables. As it was noted earlier, similar results of the study have been confirmed in other works (De Gregorio & Lee, 2002; Földvári & Van Leeuwen, 2011). The strongest negative relationships between the number of graduating students and GRP were in Almaty (-0.9489) and Mangistau regions (-0.8375). The strongest negative correlation coefficients for the number of college graduates and GRP were found in Pavlodar (-0.9002) and Karaganda (-0.8933) regions. The strongest negative relationships between the number of school graduates and GRP were shown in West Kazakhstan (-0.7354) and North Kazakhstan (-0.8163).

The last group of indicators of intellectual potential as several visits to cultural and leisure activities shows a positive correlation between variables in all regions. The most positive correlation is between the number of visitors to libraries and GRP in Nur-Sultan (0.9797) and Almaty (0.9205). The influence of the number of theater visitors on GRP is positive and statistically significant in Atyrau (0.9619) and East Kazakhstan (0.9089). Namely, the study proves once again that the cultural development of the population has a positive effect on intellectual potential, thereby contributing to a good return on GRP.

5. Conclusions

Based on the theoretical review, it was revealed that many scientific papers explore intellectual potential. Most researchers claim that the main role in the development of intellectual potential belongs to education and science. In this research we try to fill the gap in the scientific literature, stating that educational, scientific, innovation, and cultural development, namely comprehensive development of the population will lead to the increase of the intellectual potential overall. In this article, we use two methods and available static data from a sample of regions of Kazakhstan for empirical analysis of determinants based on key variables of intellectual potential. Obtained results of the

research are reliable, as evidenced by the values of the normalized ranking data and the correlation coefficients.

Firstly, conducted calculations on ranking show gap between regions of Kazakhstan in terms of the level of development of the intellectual activity. The value of the intellectual development index ranges from 2.478 for a region that is highly active in implementing innovations to 0.934 (the minimum value). In contrast to a weak tendency to flatten, the intellectual potential distribution level there is clear isolation of three areas of Almaty city, Turkestan region, and Shymkent city. They are distinguished by the highest intensity of the intellectual potential distribution. The value for the given group of regions is approximate twice the corresponding average Kazakhstan value. This can be explained by the fact that over the past 10 years in the field of education, science, innovation, and culture there have been huge reforms, which also positively influenced the development of the intellectual potential in the regions of Kazakhstan.

Secondly, obtained results, undoubtedly, reflect the presence of the correlation between economic growth and key factors of intellectual potential. It can be acknowledged that an increase in R&D costs and the volume of innovative products, has a strong positive impact on the economic growth of the region. Besides, the last group of indicators of cultural potential also shows a positive correlation between the indicators. The influence of the number of museum visitors on GRP is positive and statistically significant in twelve regions of Kazakhstan. The study confirms that cultural potential is of great importance in the development of intellectual potential, which gives a positive return on GRP and, accordingly, on the economic growth of the country as a whole.

Accordingly, considering the dynamics and results of the impact of the intellectual potential on economic growth, there are two recommendations for the reproduction and regulation of the intellectual potential in the future: (1) the state should mainly support those forms of education that create professional skills and scientific potential of the country, which are necessary and which have a positive effect on the intellectual potential of each region, i.e., stimulating research and development and supporting PhD students; (2) support for cultural values, which is of fundamental importance and forms the basis of the intellectual potential of the region, therefore, the progress of multifactorial production in intellectual activity is also determined by the level of knowledge acquisition and the development of cultural mentality in society.

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