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The influence of development level of different generations on innovative development

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Abstract. This paper discusses the influence of development level of generations on innovative development of a country in case of Kazakhstan. Parameters which influence the development level of human capital and innovative development level of a region were determined. Direct influence of human capital on innovative development of a region is proved and the results generalized on national level. Consequently, based on the performed analysis, country's population was divided into three generations. Using official statistics, the influence of the development level of generation on innovative development of the country was proved.

Key words*: developed generation, education, human capital, innovative development, national innovation system.*

JEL codes: *O15, O32.*

1. Introduction

The modern conditions for development of Kazakhstan economy, with rich potential in natural resources which is mainly occupied by oil and gas sector, lead to a transition from raw material to processing orientation, based on innovations. In this regard the Government of Kazakhstan is working on the development of the national innovation system, but there have not been observed a significant progress. According to the KEI index (the level of knowledge application in the economy) Kazakhstan is on par with low income countries such as Kenya and Mongolia, while Kazakhstan's macroeconomic indicators are of a country with an average income. This situation is explained by the fact that in many regions of the country during the implementation and support of innovations not sufficient attention is paid to human capital. There are no

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calculations of the impact of human capital and determination about what kind of generation, what type of people contribute to the innovative development of the country the most.

The aim of the research is to identify the influence of development level of different generations on the level of innovative development of Kazakhstan.

To do this the author has to tackle the following tasks:

- To identify the relationship between human capital and innovative development of the country using multidimensional comparative analysis through the calculation of statistical integral indicators of "human capital" and "level of innovative development of regions";
- To divide the working population of the country in generations based on the main characteristics (age, work experience, education);
- To analyze and to determine the share of each generation in the innovative development of the country based on the statistical data.

The fundamental works and provisions of domestic and foreign scientists in the fields of economic growth, innovative development and regional economy, on the subject of assessing the level of human capital development and management of its formation were used as a theoretical and methodological basis for the study. The works by Isabek (2014) define national economy as an innovational system, which was formed under the pressure of globalization. Human capital is an integral part of the innovational development that can be extrapolated from the works by Kneller (2002) who shows on the US data that inefficiency in production depends upon the level of human capital of the country's workforce. Another important work on this topic belongs to Ustinova (2015), who developed a methodology for estimation of the connection between human capital and innovative development of the region based on the Russian Federation. The result of that work was that the higher the development level of human capital in the region, higher the innovative development level of the region. Contribution of my work is to test the methodology used by Ustinova on the sample of Kazakhstan and to go further and determine the contribution of each generation of human capital to innovative development.

The method of research is based on statistical methods (factorial, regression analysis), the application of the tables approaches to visualize the results of the study.

The findings contribute to the improvement of approaches to study the human capital, its structural components, human capital management, the methods of study the innovation processes in economic systems, contribute to the justification of the relationship of human capital and innovation development of the regions and better equip the toolbox for assessment of that relationship.

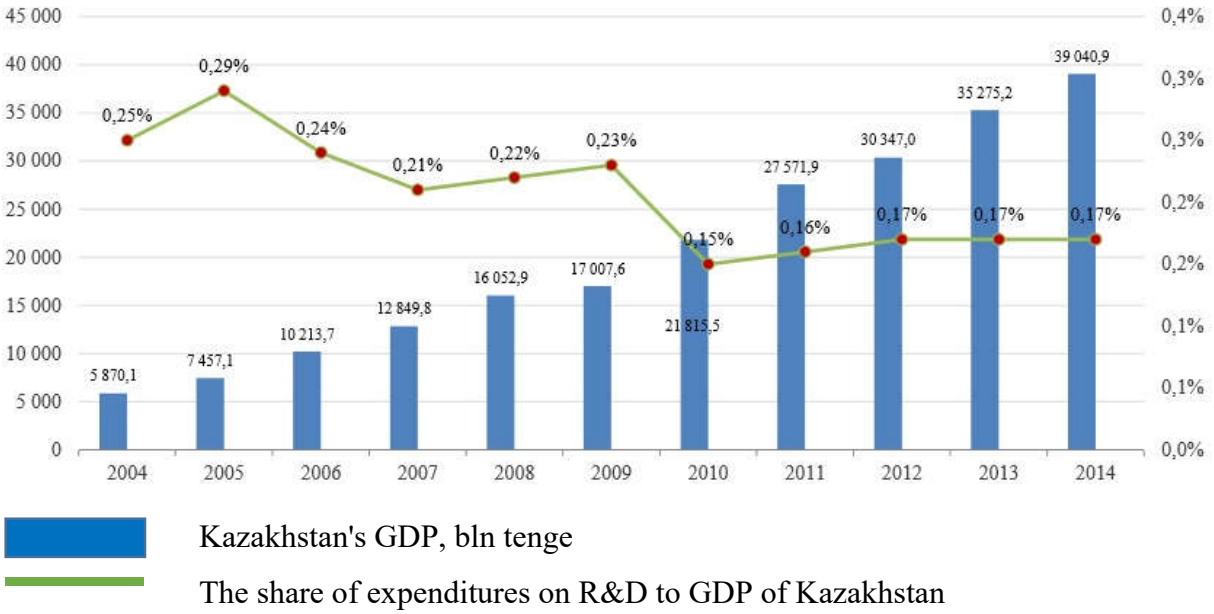
2. Key research findings

Today in a world the influence of innovation on economic growth is increasing. In the world market the products of intellectual activity have more value in comparison with other areas of economic activity. The level of innovation development of the country closely correlates with the level of the overall development of the country as a whole.

There are different factors that affect the level of innovation development. In the case of Kazakhstan, many politicians and scientists have long believed that the main factor for the increase of the level of innovation development - is the money allocated for research and development (R & D).

Only in recent years in the science of country an opinion on the role of human capital in the innovation development of the region have emerged. Research on the formation and development of human capital has begun (Issabekov et al., 2014: 98).

Figure 1. Share of Gross Domestic Expenditures on R&D to GDP of Kazakhstan

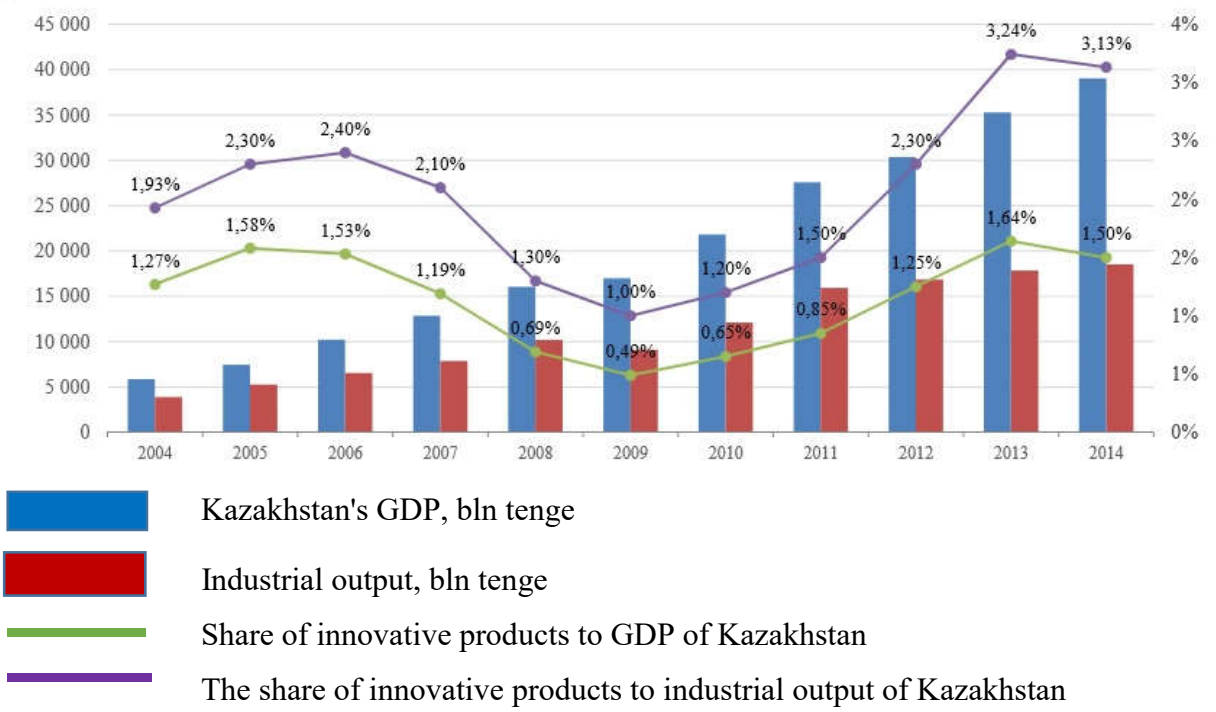


Source: Author's own elaboration based on data from the Committee of Statistics of the Republic of Kazakhstan (2015)

According to Figure 1, the biggest level of expenditures on R&D was recorded in 2005, when it reached 0.25% of Kazakhstan GDP. In the following years the trend was interrupted, and the expenditures started decreasing, which can be explained by the global crisis and unstable economic situation in the country. With temporary increases in 2009 and 2012, in 2014 it fell until 0.17%.

Despite that, as is it shown in the Figure 2, the volume of an innovative products is growing. It reached 3.13% with respect to GDP and 1.50% with respect to Industrial output in 2014. Such high indicators in Kazakhstan were seen only in 2013 before. This trend contradicts the opinion of many scientists and politicians that amount of expenditures strongly contributes to the development of innovations.

Figure 2. Share of Innovative Products to GDP and to Industrial Output of Kazakhstan



Source: Author's own elaboration based on data from the Committee of Statistics of the Republic of Kazakhstan

On this basis, we can consider another theory about the connection between the level of innovative development of the region and the level of human capital development.

Innovative development is accompanied by changes in the organization of production, efficient use of resources, the use of scientific results and technical progress that leads to improved performance (social, economic and environmental aspects). Analysis of foreign works showed the presence of studies that have shown a significant impact of human capital on production output (Romer et al., 1990: 251) based on the model used obtained a statistically significant positive relationship between human capital and economic growth. At the same time, a number of studies do not support this relationship between human capital and economic growth. The scientific literature in this area found nonlinearity (Kalaytzidakis et al., 2001: 54) and an indirect impact of human capital on economic growth in their study obtained a

significant negative coefficient on "human capital". There are few theoretical studies that explain the impact of human capital on the spread of technology.

Existing empirical studies give different results. A group of works can be selected in which it is concluded about the positive impact of human capital on the spread of technology (Kneller, 2002: 76), in other works the effect of human capital is characterized as ambiguous (Hu, 2000: 1258). The main research problem is related to the development of methods to assess the impact of capital investments in technology by developing countries to achieve such growth rates, which are comparable to those of developed economies, and that reduces the projected period of time to overcome the backlog of leaders in technology. In the event that such mechanism for the spread of existing technologies exists, it will be one of the arguments for innovative development.

The author conducted the analysis of human capital and its relationship to the level of innovation development of various regions. To calculate the integral indicators of "human capital" and the "level of innovative development of the region" a multidimensional comparative analysis was used. For the information base - the data of the Committee on Statistics of the Republic of Kazakhstan about the level of education, income, number of researchers and etc. for all regions of Kazakhstan in 2014.

Among the parameters for the calculation of the integral index of "human capital" the following were chosen:

- The proportion of workers with secondary and higher education in total employment;
- Number of employees engaged in research and development per 100 thousand of people;
- Life expectancy at birth;
- Coefficient of funds (measures the gap between people with highest and lowest 10% income levels);
- The proportion of the population with incomes below the subsistence minimum.

The development level of human capital is closely correlated with the education, which depends on the income level. For this reason, the last two parametres were included in the evaluation methodology.

Table 1. Methodology to evaluate the relationship between development level of human capital and innovative development of the region

№	Phase	Procedure
Determining the level of human capital development		
1	Identification of parameters for the calculation of the integral index of "human capital"	Definition of statistical indicators characterizing the human capital
2	Definition of standardized coefficients for each unit of observation (territory)	$StK_i = \frac{x_i}{x_{kz}}$ where: Xi – an input value of the parameter for i-region; Xkz – an average value of the parameter in the Republic; $St\mathcal{K}_i$ - standardized ratio.
3	Definition of the integral index of "human capital" for each region	$STK = \sqrt{\frac{\sum_{j=1}^{m} (StK_i)^2}{m}}$ where: STK - an integral index; m – number of parameters, considered in calculation.
4	Definition of the intervals and regions boundaries that fall into each group	The distribution of regions into groups according to the value of the integral indicator: 1. High 2. Above Average 3. Average 4. Below Average 5. Low
Determining the level of innovation development of the regions		
5	Identification of parameters for the calculation of the integral index "level of innovative development of the region"	
6	Determination of standardized coefficients for each unit of observation (region). Calculation method is similar to item 2	
7	Determination of the integral indicator "level of innovative development of the region" for each region. Calculation method is similar to item 3	
8	Determination of the interval and region boundaries that fall into each group	
Formation of the "level of human capital - level of innovative development of the region" matrix		
9	Distribution of regions in the cells of the matrix	
10	Interpretation of the results	

Source: Author's own elaboration based on: Ustinova et al., 2015: 59

The values of all parametres mentioned above are provided on the regular basis by the Committee of Statistics of the Republic of Kazakhstan, and therefore represent the most liable data.

Selection of parametres for calculating the integral indicator was mainly driven by the goals and objectives of the study. In addition, the structure of human capital was taken into account, the fundamental components of which are the health capital and professional capital (abilities, skills, knowledge, professional experience and length of service, etc.); it was also taken into account that for the formation of human capital investments, significant portion of which are personal investments of the population (in this regard, one must also consider the parameters associated with the magnitude of income and the level of differentiation), are needed. During the construction of the integral index the substantive interpretation of each parameter was taken into account. For each structural component of the integral indicator the best value was chosen and it was compared with those in the regions of Kazakhstan. These standardized coefficients were squared; the square root of the sum of six squared indicators was taken. The calculated value is the integral index, with values ranging from 0 to 1. These boundaries can be divided into five levels of human capital development: high, above average, average, below average, poor.

According to the analysis it was determined that Akmola, Almaty and South Kazakhstan regions have high levels of human capital.

Table 2. Grouping of regions by levels of human capital development

№	Level	Territories
1	High	Akmola, Almaty, South Kazakhstan
2	Above Average	Aktobe, Karaganda
3	Average	East Kazakhstan, Zhambyl, West Kazakhstan, Atyrau
4	Below Average	Mangystau, Kyzylorda, Pavlodar
5	Low	Kostanay, North Kazakhstan

Source: Author's own elaboration based on the results of analysis

This is due to the fact that these areas are characterized by high involvement of the population in educational and research processes. Aktobe and Karaganda regions have above average levels of human capital development. Low position is taken by Kostanay region.

Based on the analysis it was determined that most of the regions of Kazakhstan belong to the group with an average level of human capital development, respectively the management of these regions is required to adopt the measures aimed at finding reserves and intensification of the formation and use of human capital. Based on the values of certain parameters that are part of the integral index of "human capital", the regions with low levels of human capital development is mainly due to small proportion of workers with a high level of education, a

small number of personnel engaged in research and development. However, in the regions with a high level of human capital we observe the reverse situation. A small proportion of workers with high level of education serve as the criterion for classifying a region as the group with an average level of human capital development.

During the second phase, an assessment of the innovation development level of Kazakhstan's regions on the basis of the multidimensional comparative analysis method using statistical data about the innovative activity of organizations, the usage of advanced production technologies, the share of the costs on research and development to GDP, the value of innovative products in the total volume of products shipped. The parametres were chosen based on the methodology for estimation of the connection between human capital and innovative development of the regions developed by Ustinova. The values of all parametres mentioned above are provided on the regular basis by the Committee of Statistics of the Republic of Kazakhstan.

Table 3. Grouping of regions by levels of innovation development

№	Level	Territories
1	High	Akmola, Almaty
2	Above Average	Aktobe, Karaganda, South Kazakhstan
3	Average	East Kazakhstan, Zhambyl, West Kazakhstan
4	Below Average	Mangystau, Kyzylorda, Pavlodar, Atyrau
5	Low	Kostanay, North Kazakhstan

Source: Author’s own elaboration based on the results of analysis

As the results of the analysis have shown, the areas with a high level of innovative development include the territory of Almaty and Akmola regions. Leading positions occupied by these regions is not accidental: a significant portion of the expenditures on research and development was accompanied by high volume production of innovative products. In addition, activities that were aimed at creating an environment for the production and spread of innovations in these regions were carried out. Kostanai, Mangystau and North Kazakhstan regions were placed in the group of regions with low and below-average innovative development level. These are all consequences of a low usage of advanced production technologies, a small proportion of the expenditures on research and development and, as a result small amounts of innovative products released. Domestic experts explain this by the weak economic activity in these areas, partly due to climatic and geographical conditions, and low population density.

Based on the results of the analysis, it was determined that the majority of regions of Kazakhstan are characterized by an average level of innovation development. This may be one of the obstacles to respond to changing factors of internal and external environment.

At the third phase the "level of human capital – level of innovative development of the region" matrix was constructed. The advantages of using a matrix approach include flexibility and adaptability with respect to the data used (applicability in territorial aspect, in dynamics), the possibility of taking into account the properties of the object, the implementation of quantitative comparative evaluation of observation units, grouping objects in the matrix according to the relationship between them (the identification of linkages between groups) the possibility of positioning, development of the development strategies of the studied object, the determining of a combination of factors ensuring innovative development of specific areas. Depending on the innovation development level and the development level of human capital all regions were divided into several groups. As it turned out, the majority of regions and cities with a high level of human capital and are also characterized by the high level of innovations (Almaty region, Akmola region). Regions with the "above average" level of human capital have "average" or "above average" level of innovative development; regions with a "low" level of human capital have "average" or "below average" levels of innovative development.

According to Isabek (2014) the innovative development consists of human capital, technology and physical capital. Therefore, in my work I assume that human capital causes innovative development.

Consequently, the overall level of human capital in various regions affects the innovative development. Especially strongly this dependence is highlighted in the "polar" groups and less obvious it is in the regions with an average level of human capital development.

After establishing the apparent effect of human capital on the innovative development, the author made an analysis of the impact of development levels of generations on the innovative development of the country.

It should be noted that there were turning points in the history of Kazakhstan, which completely changed the system. For example, after the collapse of the Soviet Union, Kazakhstan has gained access to the world system of education and part of the population received their education and training abroad. Considering the Soviet school system and Western higher education system, we can say that this generation has a good foundation. These people are now 30-44 years old, they have already worked in the various structures of the country.

Another generation was only born during the collapse of the USSR and until their maturing all borders has been opened. Their school and university education corresponds to

Western standards; they have a different view of the state, business and science. However, they are 20-29 years old and do not have enough practical experience.

And the oldest generation can include those people, who were born, grew up, got their education and experience in the Soviet period. Different training periods, work, different systems cause the difference between these three generations. Brief description for each generation is shown in the table below.

Table 4. Grouping human capital according to generations

№	Generation	Age	Characteristics
I	Young generation	20-29	Educated in the new integrated system, open to innovations, little experience
II	Generation of independence	30-44	The first generation to have access to the western and the Soviet system of educations, has sufficient experience
III	Generation of the Soviet Union	45-60	The Soviet Union approach to education and work, not sufficiently flexible to changes, has great experience.

Source: Author's own elaboration based on the results of analysis

The above mentioned analysis was done as follows:

- Depending on the level of education, experience and outlook (depends in which system a person has spent years of studying and work) the population of Kazakhstan was divided into three generations.
- Age frames from 20 to 29, 30 to 44 and from 45 to 60 years were grouped specifically so because the statistics show that such groups of people almost identical in quantity of people. This is due to the demographic situation in the country and life expectancy.
- For the three selected groups their share in the two parameters was determined, which were used in the calculation of the integral index of "human capital". The remaining four parameters are common; therefore, they cannot be divided into age groups.

Table 5. Grouping human capital according to generations

Parametr	I generation	II generation	III generation
Number of personnel, engaged by research and development estimated at 1000 people	6%	53%	38%
The proportion of employees with higher education in the total amount of the employed	44%	45%	11%

Source: Author's own elaboration based on the results of analysis

The table above clearly shows the importance of each generation in the innovative development of the country. According to the data of Statistics Committee of the Republic of Kazakhstan, the share of II generation in the Number of personnel, engaged in research and development per 1000 people, estimated at 53%, and The proportion of employees with higher education in the total amount of the employees is 45%. This proportion is relatively high when comparing with the shares of other generations. Along with this, the conclusion is that the generation of people who are 30 to 45 years old who have a good western education, coupled with the remnants of the Soviet system of education, who have 10-25 years of experience, they are the main driving force of our science and innovation.

3. Conclusion

The results of the analysis on the Republic of Kazakhstan show a direct link between the development level of generations and innovative development of the country. The obtained result makes it possible to offer the following activities:

- Conduct a monitoring of personnel potential in the innovation sphere; monitoring aimed at identifying the factors that facilitate and impede to the creation and spreading of innovations, in order to obtain the necessary and objective information about the innovative potential of the regions and innovative activity of the population;
- Develop the concept of human capital training for the innovative economy and design a mechanism for its implementation.

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Wpływ poziomu rozwoju różnych pokoleń na rozwój innowacyjny

Streszczenie

W niniejszym artykule omówiono wpływ poziomu rozwoju pokoleń na rozwój innowacyjny na przykładzie Kazachstanu. Określono parametry oddziałujące na poziom rozwoju kapitału ludzkiego oraz rozwój innowacyjny regionu. Dowiedziono, że kapitał ludzki bezpośrednio wpływa na rozwój innowacyjny regionu, a następnie uogólniono ten wniosek na skalę krajową. Konsekwentnie, na podstawie przeprowadzonej analizy, podzielono populacje kraju na trzy pokolenia. Wykorzystując oficjalne dane statystyczne, udowodniono, że poziom rozwoju pokoleń oddziałuje na rozwój innowacyjny kraju.

Słowa kluczowe: rozwinięte pokolenie, edukacja, kapitał ludzki, rozwój innowacyjny, krajowy system innowacji.