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DIRECTIONS OF INFLUENCE OF HIGHER EDUCATION PARAMETERS ON ECONOMIC GROWTH IN UZBEKISTAN

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ЎЗБЕКИСТОНДА ОЛИЙ ТАЪЛИМ ПАРАМЕТРЛАРИНИНГ ИҚТИСОДИЙ ЎСИШГА ТАЪСИР ЭТИШ ЙЎНАЛИШЛАРИ

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НАПРАВЛЕНИЯ ВЛИЯНИЯ ПАРАМЕТРОВ ВЫСШЕГО ОБРАЗОВАНИЯ НА ЭКОНОМИЧЕСКИЙ РОСТ В УЗБЕКИСТАНЕ

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Abstract. In addition to human resources and capital, continuing education, in particular higher education, has a significant impact on the economic growth of the Republic of Uzbekistan. Accordingly, the article is considered the problems, advantages of higher education and innovative systems, as well as their role in stimulating economic growth in Uzbekistan. According to the results of the study, it was shown that the number of highly qualified personnel in the country is associated with economic growth. The relationship between higher education and economic growth in the Republic of Uzbekistan was determined using regression analysis, which took into account the growth of GDP and the number of graduates as an independent variable, the cost of per graduate and the average year of study established for the training of highly qualified personnel.

Keywords: Uzbekistan, higher education, qualified personnel, quality, economic growth, regression, graduates, development, capital investments.

Аннотация. Ўзбекистон Республикасининг иқтисодий ўсишига инсон ресурслари ва капитал билан бир қаторда узлуқсиз таълим, хусусан, олий таълим ҳам салмоқли таъсир кўрсатмоқда. Шунга мувофиқ, мақолада олий таълим ва инновацион тизимларнинг муаммолари, афзалликлари, шунингдек, уларнинг Ўзбекистонда иқтисодий ўсишни мотивациялашдаги ўрни ва роли ўрганилди. Тадқиқот натижаларига кўра, мамлакатда юқори малакали кадрлар сонининг иқтисодий ўсиш билан боғлиқлиги кўрсатилган. Ўзбекистон Республикасида олий таълим ва иқтисодий ўсиш ўртасидаги муносабатлар регрессион таҳлил ёрдамида аниқланди, бунда мустақил ўзгарувчи сифатида ЯИМ ўсиши ва битирувчилар сони, ҳар бир битирувчи учун харажатлар ва юқори малакали кадрлар тайёрлаш учун белгиланган ўртача ўқиш йили ҳисобга олинди.

Таянч сўзлар: Ўзбекистон, олий таълим, малакали кадрлар, сифат, иқтисодий ўсиш, регрессия, битирувчилар, ривожланиш, капитал қўйилмалар.

Аннотация. На экономический рост Республики Узбекистан, помимо человеческих ресурсов и капитала, оказывает значительное влияние непрерывное образование, в частности высшее образование. Соответственно, в статье рассматривались проблемы, преимущества высшего образования и инновационных систем, а также их роль в стимулировании экономического роста в Узбекистане. По результатам исследования было показано, что количество высококвалифицированных кадров в стране связано с экономическим ростом. Взаимосвязь между высшим образованием и экономическим ростом в Республике Узбекистан была определена с помощью регрессионного анализа, который учитывал рост ВВП и количества выпускников в качестве независимой переменной, затраты на каждого выпускника и средний год обучения, установленный для подготовки высококвалифицированных кадров.

Ключевые слова: Узбекистан, высшее образование, квалифицированные кадры, качество, экономический рост, регрессия, выпускники, развитие, капитальные вложения

1. INTRODUCTION

Analysis of statistical materials [21] on the level of world literacy shows that this indicator, in particular, in Pakistan 57.9%, India 71.2%, Brazil 92.5%, Turkey 95.6%, Singapore 98.1%, in Switzerland and Japan 99, 0%, in Russia 99.7%, Norway and Spain is 100%, and Uzbekistan 98.9%. However, the top three in the ranking of countries in the world in terms of the education index is Germany (with an index of 0.943); Norway (with an index of 0.930) and the UK (with an index of 0.928). And the Republic of Uzbekistan occupies 71st place in this rating. This means that Uzbekistan is among the leading countries in terms of literacy.

Since general secondary education and vocational education in Uzbekistan are compulsory and regularly trained under state supervision, the coverage rate for these important components of lifelong learning is much higher, i.e. 98.9%. If scientific research is carried out in these areas in the Republic of Uzbekistan and opinions are expressed on the model of reforming the education system and the experience of its implementation, then it will be necessary to take into account the fact that about 35% of the population of Uzbekistan are children under 16 and 60% are young people under 30 years old. When analyzing the global education system, Uzbekistan has a

relatively high educational index, relatively high average life expectancy and the country's GDP, in 2022 this indicator averages 0.77. This, in turn, testifies to the high importance of continuous education, especially higher education, in Uzbekistan.

At the initiative of the President of the Republic of Uzbekistan, the country has begun to form in Uzbekistan the foundation of a new Renaissance era in Uzbekistan - the Third Renaissance. Mirziyoyev [8] emphasized about this, "Since ancient times, the issue of upbringing and education has always had an urgent meaning. How do the developed countries of the world achieve high progress and prosperity? Isn't it because of the tremendous focus on science and education? That is why in recent years, in order to comprehensively develop the country, build a new Uzbekistan, radical reforms, as in all other areas, are being carried out in the education system. New horizons in the development of the sphere, undoubtedly, are opened by the recently adopted "Law On Education".

At the moment, our main goal is to form the foundation of a new renaissance - the Third Renaissance - for large-scale democratic reforms in Uzbekistan, including in the education system. Historical lessons show that our land, located at the crossroads of the Great

Silk Road, has long been one of the centers of high civilization and culture. The nation's rich scientific and cultural heritage, unique architectural monuments, ancient inscriptions and rare manuscripts testify to the three-thousand-year history of our country.

The torch of science that burned brightly in Greece in ancient times was rekindled in Central Asia in the 9th-12th centuries. This was the First Renaissance on earth, and scientists whose names and works are known all over the world shook the world with their unique works and great inventions.

Abu Raikhan Beruni, Muhammad Kho-rezmi, Abu Ali ibn Sina, Ahmad Fergani, Mahmud Zamakhshari and dozens of other scientists, with their scientific activities and discoveries of world significance, have made a huge contribution to universal human development. The creation of a great empire by Sakhbikiran Amir Temur in the 15th century, which was later ruled by his worthy descendants, was the beginning of the Second Renaissance in our region. She gave the world outstanding scientists - Mirzo Ulugbek, Kazi-zoda Rumi, Abdurakhman Jami, Giyosiddin Koshi, Ali Kushchi, great poets Lutfi, Alisher Navoi, Sakkoki, Hafiz Khorezmi, Babur and so on.

President of the Republic of Uzbekistan Mirziyoyev Sh.M. [8] noted, "During both Renaissance periods, our people reached great heights of development due to their enormous potential, and this gives us a sense of pride. As the folk wisdom says, "The river of life does not stand on". Today, we have the right to say that we have all the opportunities to create the foundations of a new renaissance in Uzbekistan, relying on the priceless, unprecedented and unique heritage of our people. Conquering the next milestones directly depends on how skillfully we use this unique potential. Today, we have taken upon ourselves the creation of the foundations of the New Renaissance - the Third Renaissance as a strategic task, and we regard it as a national idea. Systems of pre-school education, general secondary education, professional and higher education, scientific and cultural institutions are four interconnected links of the New Renaissance. We consider kindergarten

teachers, school teachers, professors, scientific and creative intellectuals to be the four most important pillars in the formation of the new Renaissance. I am sure that dear parents will support this initiative, and it will certainly become the fifth link, the fifth pillar of the new Renaissance. This serves as the strongest foundation for the development of our spiritual and educational life." In this regard, the purpose of the research is to analyze and critically assess the quality of training of highly educated specialists in Uzbekistan and to determine the relationship between the number of highly qualified personnel and the economic growth indicator.

2. LITERATURE REVIEW

It is obvious that, cognitive skills have a substantial effect on economic growth of any country. Many economists have been interested in learning not only the effect of quantity of education but also the effect of quality of education on economic growth since 1970 s. Barro [2] examined the schooling quality and economic growth while Hanushek and Kimko [4], Hanushek and Woessmann [5] had studied the relationship between quality of education and economic growth. Hanushek, Kimko and Woessmann [4,5] have measured the quality of education based on cognitive skills in mathematics and science whereas Barro [2] uses data on internationally test scores to measure the schooling quality and these researchers have found that, qualitative education has a strong and robust influence on economic growth. In this empirical research, the main issue will be to discuss the direct correlation between quantity of higher education and economic growth in Uzbekistan and to find out whether skilled labor is more important than the quantity of educated workforce in Uzbekistan.

However, Lant Pritchett [15] does not support the ideas of other researchers who consider the positive relationship of massive education to economic growth. No one denies that there is a partial correlation between enrollment ratios and economic growth. However, Pritchett [15] advised not to use this partial correlation in assessing the impact of human capital change. He considers that, there must be another inter-relationship for the partial correlation of enrollment rates and economic growth. Uzbekistan's researchers

from Center for Social Research Yakov Asminkin and Olga Nemirovskaya [1], Tashkent have conducted research on education reforms in Uzbekistan. They provided qualitative analysis of the current situation of national higher education and suggested the ways of deepening the reform.

An article by Dr. Robert B. Kozma [6] provides good understanding of knowledge economy and its contribution to economic growth. He refers that, the creation and sharing knowledge feed into the economy to generate knowledge-driven, virtuous cycle sustainable growth, which reflects the knowledge economy that brings a country sustainable growth for their economy. The researcher illustrates the case of Finland as an excellent example. In the early 1990s, Finnish economy faced a significant recession with an average GDP growth rate of -3.68% from 1990 to 1993. The researchers, Eduardo and Marcio Laurini [3] from Insper Institute of Education and Research and Ibmecc Business School, have presented new evidence on the role of cognitive skills in Economic Development.

The results of the study by A. Maddison [7] showed a direct relationship between the rate of economic growth and the level of education of the population: an increase in budgetary spending on education by 1% leads to an increase in the country's GDP by 0.35%. V. Shchetinin [16] explains that the economy can develop only in conditions of an increase in the level of education of the workers involved in it, who make a significant contribution to social production.

Pogadaeva S.S., Kharitonova N.I. [14], Shakkum M.L. [17] write that in world practice, special attention is paid to the problem of the impact of education on economic growth, since from 70 to 90% of GDP is determined by scientific technical progress and innovative economy. Thus, according to experts, in countries with the most developed economies, on average, 60% of the increase in national income is determined by the increase in knowledge and education of society. Similar studies were carried out by the Organization for Social and Economic Development (OECD) [13], which showed that increasing the "education" of society for 1 academic year provides an increase in the economy of the

OECD countries by 5% in the short term and by 2.5% - in the long term. The influence of education on economic growth was also studied in the EU countries, the results showed [18] that an increase in the level of education increases macroeconomic productivity, in particular: an increase in secondary education by 1 year raises production per capita by 6%; an annual increase in human capital by 1% in higher education provides an increase in the growth rate of GDP per capita by 5.9%.

Nabiev D.X., Ochilov A.O., Raimova M.J., Ostonova M.E., Normurodova Z.E., Ochilov A. [9] argues that for Uzbekistan, investment in to the quality of education can be very useful rather than investing in to the quantitative education. For education quality we have chosen the average final exam scores of students (the first attempt), while number of graduates were chosen as the best representative of education quantity [10]. Ochilov A. Ruziyev Z., Babayeva L., Ganiyeva Sh. [11] determined that the above results suggest that one-unit change in number of educated workforces causes nearly 2 percent increases in economic growth of Uzbekistan. One-unit change in capital investments causes 0.02 percent increase in economic growth.

Competitive highly qualified cadres trained in higher educational institutions have a special place in increasing (exceeding) the country's prosperity and welfare of the people. A.O. Ochilov, E. Ostonov, B.T. Shodiev, T.Sh. Ergashev, F.F.Khakkulov [12] in this regard, the article presents scientific proposals for the modernization of the higher education system, their foundations and information on the expected results.

3. METHODOLOGY

Using the annual statistical data of the Republic of Uzbekistan for 2001-2021, descriptive analysis and statistical tests were conducted in addition to empirical analysis. The results of the empirical analysis showed that the Republic of Uzbekistan has not been able to fully use its potential until now.

For this, comprehensive socio-economic, political, educational and spiritual reforms are required in the country. Currently, technological progress, innovation and concentration of knowledge are reliable factors of production. Thus, investments in scientific research and

development, deepening of knowledge, improvement of innovations open the way to unlimited growth of Uzbekistan's economy. Above all, GDP growth rate or GDP per capita growth is the most reliable indicator of economic growth. In our research work, we have selected variables that are important for creating econometric models. During the study, we studied, discussed and compared many versions of the most important determinants of economic growth, the quantity and quality of education.

One of the research theories was to explain economic growth related to the quality of education through public investment in education. However, investment in education does not directly affect the quality of education – it can improve teaching tools and equipment, motivate teachers, and have many other effects.

The data in the study obtained from the following sources:

✧ GDP per capita (Y/N): World Development Indicators and Human Development Reports

✧ Schooling enrolment ratio, government expenditure on education: World Bank indicators

✧ Student/teacher ratios: UNESCO and World Bank education statistics

✧ Other information: Finance Ministry, Higher and Secondary Special Education Ministry, State Statistical Committee, and Labor and Social Protection Ministry of the Republic of Uzbekistan

4. ANALYSIS AND MAIN RESULTS

Today, there are 178 higher educational institutions in Uzbekistan, of which 113 are local, 31 are foreign higher educational institutions and their branches. In particular, over the past 4 years, 12 new higher educational institutions, 20 branches and 24 branches of foreign higher educational institutions have been created. Based on the proposals of staff customers, the classification of directions and specialties of higher education includes 342 areas of education and 638 master's degrees. In the 2019/2020 academic year, part-time education was introduced in 59 higher educational institutions, and regime of evening-study – in 10 higher educational institutions. The number of students studying in higher educational institutions of the

country amounted to 880 thousand in the bachelor's degree and 24 thousand in the master's, which has increased 1.6 times over the past 2 years. 52,7% of students study the humanities and pedagogical sciences, 27.1% - production and technology, 4.9% - social sphere, economics and law, 5.6% - agriculture and water management, 4.0% - health and social sphere, 5.7% are trained in specialties in the field of service education. 38.0% of undergraduates study the humanities and pedagogical sciences, 21.8% - production and technology, 15.7% - social sphere, economics and law, 6.7% - agriculture and water management, 12.4% - health and social sphere, 5.4% study in the sphere of service education. The admission parameters for the 2019/2020 academic year were 145700 people and increased by 16% compared to the previous year and by 98% compared to 2016. Since the 2018/2019 academic year, 16 universities of the country have launched joint training programs with foreign universities based on joint educational programs [19].

At the present time, deep economic reforms and modernization processes are being carried out in the branches and sectors of the economy, which requires the introduction of new technologies. For this, it is necessary to increase the number of highly qualified personnel who work in the labor market and contribute to the economic growth of the country. According to the data of the State Statistics Committee of the Republic of Uzbekistan, in January 2023, the labor resources of the republic will amount to 19,456,000 people, which is 55.4% of the permanent population. Of these, the number of people employed in the economy is 14,211.6 thousand, the employment rate is 73.0%; the number of unemployed people is 1503.5 thousand, and the unemployment rate is 9.6% compared to the number of economically active population (15615.9 thousand people).

In recent years, the number of applicants to state and non-state universities has been more than 1 million people, and their number is increasing year after year. Admission of applicants in higher educational institutions is carried out in full-time, part-time, evening and distance learning. The number of HEI graduates and secondary special education establishments has

tendency to increase over time. In the 2021-2022 academic year, the number of graduates of higher educational institutions amounted to 104,000 people, and in the 2022-2023 academic year, 135,000 graduates graduate from state universities in the regions of the republic. Studies show that more than 1 million new jobs are created annually in economic sectors and sectors thanks to the implementation of the State program for ensuring the employment of the population. Higher educational institutions of Uzbekistan conclude long-term triangular contracts (enterprise-university-graduate) with enterprises for employment of new graduates. For instance, in 2000 workers with higher education diploma was accounted for 20% against 31% in 2021. But the current market need for specialists in the structural terms is not match with the market supply [20]. Despite the measures taken to reform the organizational, financial and higher education system in the country, the higher education system in Uzbekistan today meets the modern requirements of the labor market, creative thinking, knowledgeable, talented and competitive highly qualified. cannot provide personnel training [20].

Graduates of higher education institutions in some cases do not have knowledge about successful business development and market economy. The business sector's demand for training is more disproportionate than the ability of public educational institutions to meet them. In such conditions, it is difficult to balance supply and demand in the labor market.

However, although a sufficient number of specialists are being trained in the social spheres: healthcare, education, in some regions there is still a shortage of personnel. There is a shortage of engineering, mining, ICT specialists for industrial enterprises, and qualified and experienced managers for small businesses. From the point of view of the demand of the labor market, the training of educated and qualified personnel and the effective use of their labor in many other branches and fields are creating problematic situations.

Regression Models Identification. We begin our quantitative analysis of the relationship between economic growth and the higher education. The dependent variable is the GDP

per capita growth, in \$1000. The regressors are the share of university graduate workers in the labor force of the economy (SHQW, in percentage), the investment in education sector, (CI in bin\$). For the model specifications, we introduce the following notations of dependent and explanatory variables: GDP per capita, in \$1000; Economic growth rate, EG, percentage; Capital Investment, CI, in billion US dollars; Capital Investment growth rate, CI, percentage; Share of the high qualified workers in the labor force, (HEI graduates), SHQW, in percentage; Total number of labor force, engaged in production, LF, in 1000 workers; Number of annual HEI graduates, DNG, in persons; Annual Growth rate of DNG, percentage.

Aggregated investments into the sectors for 1997-2021 grew by 15.9% and exceeded 26% of national income, on average, during the second and third phases of development. The efficiency of the economy (total factors productivity) grew by 4%, average, during the high growth phase. Respectively, real income of the nation grew by average 6.5% from 2006 to 2018. During 1997-2021 period numbers of qualified workers and HEI graduates grew faster than total labor force, which were accounted for respectively 3.7% and 2.5%. The average years of schooling has increased slowly, at rate of 0.8%. From 2006 to 2013, stable and moderate GDP growth rates of the country had relatively more triggered by the growth rates of labor and capital rather than that of productivity. Specifically, increasing number of highly educated and skilled labor force combined with appropriate labor market policies has contributed to the aggregate output growth during the second phase. Thanks to the improving business spheres, encouraged SMEs, comprehensive trade policies as well as increasing spending on R&D, education and social-welfare, productivity and its contribution to the country's economic growth increased significantly. According to our estimations for 2007-2017 years around 71% of the GDP, growth rates were attributable to the growth of efficiency in the economy.

Preliminary analysis concluded that productivity growth has constituted significant portion of economic growth of the country. With increasing labor factor, theory predicts that

increase in the savings rate, or equally investments, leads to permanent increase in growth rates as growth in capital accumulation followed by permanent faster growth of labor never leads to diminishing returns to capital. Permanent increase in labor is obvious by the fact that there is always unemployment in any market economy.

In order to model a time series data with the Box-Jenkins approach the series has to be jointly stationary. In practical terms, the series is stationary it tends to wonder more or less uniformly about some fixed level [19]. In statistical terms, a stationary process assumed in particular state of statistical equilibrium, i.e. $p(x)$ is the same for all t . Because for our research the time series data is using, we conducted the Dickey-Fuller test. We built a regression lines between fractions of the current values of variables (GDP, SHQW, CI) dependent on a fraction of previous values of the series. In all cases, p -values of variables were less than 0.05 or 5%, so we rejected the null hypothesis and proceeded with econometric analysis. Our time series data is jointly stationary and we can conduct regression analysis based on OLS estimations. Our task is not to develop a forecasting model but rather to estimate causal relationships among time series variables, that is, to estimate the dynamic causal effect on Y over time of change in controlled variables. To identify the model, firstly we needed to choose and decide which functional form to use for the research. Firstly, we develop LIN, LOG-LIN, LIN-LOG and LOG-LOG model specifications. In order to see the linear relationship between GDP growth and the share of HEI graduates in the labor force, capital investments in education, the weighted average performance rate of graduates in final exams and average years of schooling of workers in the national economy. Row (1) presents the base specification, in which the repressors are the economic growth and four control variables, the percentage of higher diploma workers in the labor force, investment in education sector, the weighted average schooling of workers and the weighted average marks of graduates in the final exams. As we can see from equation (1), high values of the economic growth rate to be associated with a future increase of all the controlled variables.

This model assumes that there is direct linear relationship between dependent and independent variables i.e. absolute change in one or more explanatory variables will cause absolute change in a dependent variable.

In LOG-LIN model, the logarithms of GDP growth rate are a dependent variable and the explanatory variables are the same as in the above model. This function assumes that absolute change in one or more independent variables will cause relative (percentage) change in dependent variable. Next, by taking the GDP per capita growth rate as the dependent variable and the share of HEI graduates in the labor force, capital investments in education sector, the weighted average performance rate of graduates in final exams and average years of schooling of workers in the national economy as independent variables we will construct LIN-LOG model. Finally, in LOG-LOG model both dependent and independent variables we took in logarithms and regressed. This function assumes that relative change in the independent variable(s) will entail relative change in the dependent variable.

Table 1 summarizes the results of regressions of the economic growth on various sets of repressors. Each row summarizes a separate regression. Each regression has the same dependent variable, economic growth rates. The entries in the first five columns are the estimated regression coefficients, with their standard errors below them in parentheses. The asterisks indicate whether the t -statistics, testing hypothesis that the relevant coefficient is zero, is significant at the 10 (one asterisk), five (two asterisks), or 1% level (three asterisks). The final two columns contain summary statistics for Akaike information criterion (AIC) and Schwarz information criterion (SIC criterion). Regressions that include the economic growth and control variables measuring growth characteristics reported in row (1) through (4).

To choose between these functional forms four different regressions were estimated. To choose the proper model, we have to compare: (1) R^2 , (2) Akaike information criterion (AIC) and (3) Schwarz information criterion (SIC), F , and t -analysis and test coefficients on statistical significance.

$$Y \text{ (GDP per capita)} = \beta_0 + \beta_1 \text{SHQW} + \beta_2 \text{CI} + \beta_3 \text{NZ} + \beta_4 \text{SPER}$$

$$\text{Log}(Y \text{ (GDP per capita)}) = \beta_0 + \beta_1 \text{SHQW} + \beta_2 \text{CI} + \beta_3 \text{NZ} + \beta_4 \text{SPER}$$

$$Y \text{ (GDP per capita)} = \text{Log} \beta_0 + \beta_1 \text{Log}(\text{SHQW}) + \beta_2 \text{Log}(\text{CI}) + \beta_3 \text{Log}(\text{NZ}) + \beta_4 \text{Log}(\text{SPER})$$

$$\text{Log}(Y \text{ (GDP per capita)}) = \text{Log} \beta_0 + \beta_1 \text{Log}(\text{SHQW}) + \beta_2 \text{Log}(\text{CI}) + \beta_3 \text{Log}(\text{NZ}) + \beta_4 \text{Log}(\text{SPER})$$

The values of intercept and slope coefficients are shown in table 1.

Table 1. Comparison of Economic Growth Functional Specifications

Model types	Parameters					R^2	AIC	SIC
	β_0	β_1	β_2	β_3	β_4			
LIN	-10886** (2070)	154.52*** (25.81)	49.809** (13.82)	223.3* (135.9)	112.2*** (42.8)	0.98	12.7	13.08
LOG-LIN	3.621*** (0.576)	0.0462*** (0.0072)	0.0056*** (0.0038)	0.082* (0.037)	0.034** (0.01)	0.98	3.58	3.34
LIN-LOG	-51570* (9856)	2949.2*** (487.6)	320.2* (67.56)	2850* (1502.9)	8989** (2916)	0.98	12.7	12.96
LOG-LOG	-8.750* (2.751)	0.901*** (0.1361)	0.0510* (0.0188)	0.911* (0.41)	2.750** (0.81)	0.98	3.64	3.40

Notes: Robust standard errors reported in parenthesis. *, **, *** Significant at the 10%, 5% and 1% levels respectively. F-statistics respectively are 172,184,187 and 200.

We know that R^2 is one of the measures of goodness of fit of a regression model and it always lies between zero and one. R^2 explains how well independent variables fit to a dependent variable. The more it is close to 1, the more the dependent variable is explained by the independent variables used and vice versa (Gujarati, 2004). Moreover, when comparing two or more models, the model with the lowest values of AIC and SIC are preferred¹. Table 1 above summarizes the comparison of four models:

As we see from the results, the independent variables better explain the dependent variable as R^2 is the highest in the LIN-LIN and LOG-LOG models. As for AIC and SIC, the lowest values of them are in these models. Among these, the logarithm model satisfies all above-mentioned conditions and that we will use for further analysis. According to this regression, an additional percentage of the graduate workers'

share in the labor force, investment, average schooling and weighted average graduate marks increases the economic growth respectively by 0.901, 0.051, 0.911 and 2.750 percentages. However, there is another issue to consider. As we know education, quantity measured in graduates will have effect on economic growth after some years of graduation. In other words, the quantity of educated workforce puts effort only after this workforce enters the labor market. So, one should be careful with estimating correlation between education quantity and economic growth in current stage.

To identify the quantitative influence of higher education further number of annually graduates as explanatory variable (DNG) included to the model. Different types of the specifications between economic growth and number of annually graduates and capital investment were regressed:

$$Y \text{ (GDP per capita)} = \alpha_0 + \alpha_1 \text{DNG} + \alpha_2 \text{CI}$$

$$\text{Log}(Y \text{ (GDP per capita)}) = \alpha_0 + \alpha_1 \text{DNG} + \alpha_2 \text{CI}$$

$$Y \text{ (GDP per capita)} = \text{Log} \alpha_0 + \alpha_1 \text{Log}(\text{DNG}) + \alpha_2 \text{Log}(\text{CI})$$

$$\text{Log}(Y \text{ (GDP per capita)}) = \text{Log} \alpha_0 + \alpha_1 \text{Log}(\text{DNG}) + \alpha_2 \text{Log}(\text{CI})$$

The values of intercept and slope coefficients we presented in Table 2.

Therefore, the estimation and statistical testing returned the following results:

$$Y \text{ (GDP per capita)} = 1000.55 + 0.031324DNG + 95.25628CI$$

Table 2. Higher Education Quantity Models Characteristics

Types of models	Parameters			R ²	AIG	SIG
	α_0	α_1	α_2			
LIN	1000** (207.5)	0.031*** (0.004)	95.25** (23.09)	0.9250	14.11	14.26
LOG-LIN	7.36*** (0.061)	1.03E-05 (1.25E-06)	0.02*** (0.0068)	0.9231	2.128	1.981
LIN-LOG	-16815. (2697)	1772.3** (256.5)	541.9* (149.9)	0.8943	14.45	14.60
LOG-LOG	1.6167* (0.773)	0.575*** (0.073)	0.11*** (0.043)	0.8993	1.857	1.710

Notes: Robust standard errors reported in parenthesis. *, **, *** Significant at the 10%, 5% and 1% levels respectively.

In the Figure 1, the following info showed: GDP growth, capital investment, the number of highly qualified personnel in production, labor

force, number of graduates, education censorship and higher education efficiency rates.

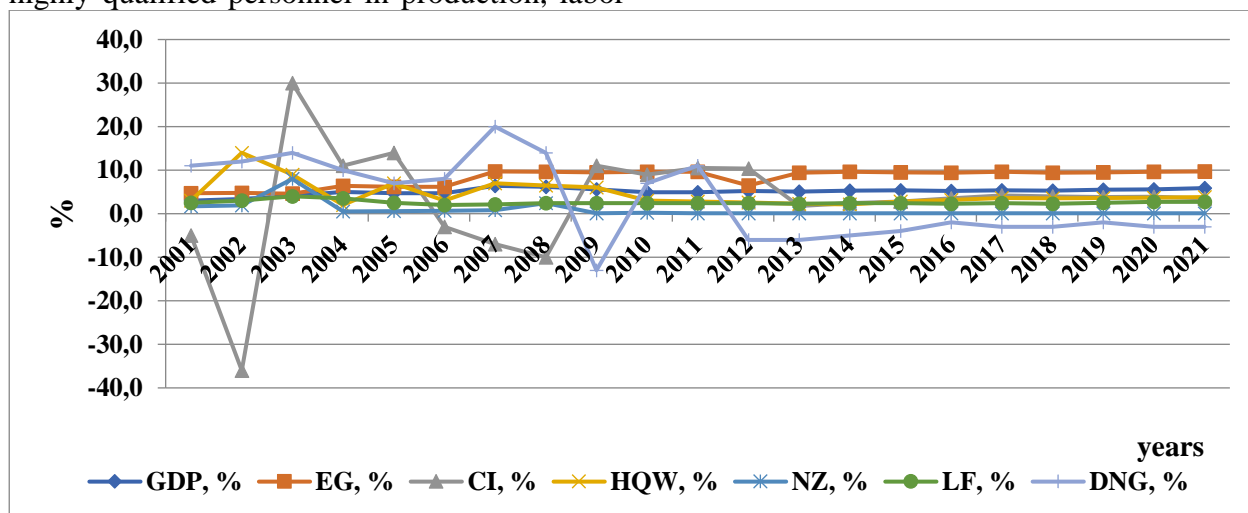


Figure 1. GDP growth, capital investment, the number of highly qualified personnel in production, labor force, number of graduates, education censorship and higher education efficiency rates.

All coefficients of the models are statistically significant. For the further analysis, we have selected the best-fitted specifications: the LIN-LIN and LOG-LOG models. The results in the linear specification suggest that one-unit change in a number of graduate’s and capital investments causes respectively around 31 dollar and 95-dollar increase of per capita output. In the LOG-LOG model, one percent change of the number of graduates, other factors held constant, increases the economic growth by 0.57 percent and one percent change of the investment - by 0.11 percent. We assume that the unemployment rate in a country is constant and annual graduates of universities join the workforce without time

lags, because all graduates in three months find the job places. The migration of the workforce we do not consider because mainly unskilled workers migrate outside of the country.

5. CONCLUSION

Based on the analysis of the studied literature, the evaluation of the results of the scientific researches and the comparison of variables, we emphasize that the amount of education is an important factor of economic growth. More importantly, both the quantity and quality of education are positively related to economic growth, suggesting the importance of focusing on quality rather than quantity of education.

Extensive research has established a direct relationship between economic growth and the quality and quantity of higher education. Although the correlation is weak, the number and level of educated workers has a significant impact on economic growth. In particular, the quality of education is a very important factor in long-term sustainable economic expansion. The hypothesis of a direct relationship between the amount of education and economic growth

is confirmed by the evaluation results. The relationship is positive, but not very strong. This suggests that the goal of increasing the number of educated workers may be an ineffective way to support economic growth or even lead to a decrease in real output. Since the developed model is general, more research is needed to find specific solutions for various variables of higher education quality that affect economic growth.

References

1. Asminkin, Ya., Nemirovskaya, O., 2007. "Toward compulsory vocational education in Uzbekistan: A decade on," // Technical and Vocational Skills Development. No.38. – pp. 41-42. Available from: https://unesco.unesco.org/fileadmin/user_upload/docs/NN38Jan2007.pdf
2. Barro, R., 1999. "Human Capital and Growth in Cross Country Regressions" // Swedish Economic Policy Review. Vol.6. – pp. 237-277. Available from: <https://www.government.se/contentassets/8e643e6e816841cf8b619be7d4dd3baa/robert-j.-barro-human-capital-and-growth-in-cross-country-regression>
3. Eduardo & Laurini, M, 2010. New evidence on the role of cognitive skills in Economic Development. // [Online] Available from: <https://ideas.repec.org/p/ibr/dpaper/2010-01.html> [Accessed 15 January 2023].
4. Hanushek, A, E & Kimko, D, D., 2000. Schooling, Labor-Force Quality, and the Growth of Nations // [online] Available from: <https://www.aeaweb.org/articles?id=10.1257/aer.90.5.1184> [Accessed 15 January 2023].
5. Hanushek, E. and Woessmann, L. (2008) The Role of Cognitive Skills in Economic Development // Journal of Economic Literature, 46, 607-668. <https://doi.org/10.1257/jel.46.3.607> [online] Available from: <https://www.scirp.org/%28S%28351jmbntvnsjt1aadkpozje%29%29/reference/referencespapers.aspx?referenceid=2657277> [Accessed 15 January, 2023].
6. Kozma, B, R., 2008. ICT, Education Reform, and Economic Growth: A Conceptual Framework // [Online] Available from: <https://www.intel.com/content/dam/www/public/us/en/documents/brochures/kozma-wp1-conceptual-framework.pdf> [Accessed 20 January 2023].
7. Maddison A. Dynamic Forces in Capitalist Development // Oxford: Oxford University Press, 1991. - p. 37-43. Available from: <https://www.amazon.com/Dynamic-Forces-Capitalist-Development-Comparative/dp/0198283989>
8. Mirziyoyev Sh.M. Speech by the President of the Republic of Uzbekistan Shavkat Mirziyoyev at the solemn meeting dedicated to the Day of teachers and mentors // 09/30/2020. Available from: <http://uza.uz/ru/posts/vystuplenie-prezidenta-respubliki-uzbekistan-shavkata-mirziye - 30.09.2020>
9. Nabiev D.X., Ochilov A.O., Raimova M.J., Ostonova M.E., Normurodova Z.E. Features of the impact of higher education on the economic growth of the Republic of Uzbekistan // Central European Management Journal. Poland, ISSN: 2336-2693 E- ISSN: 2336-4890. DOI: 10.5281/zenodo.7306300. Vol.30. Iss.3 (2022). pp. 953-965. Available from: https://journals.kozminski.cems-j.com/index.php/pl_cemj/pdf/Dilmurod%20Khamidullaevich%20Nabiev,.pdf
10. Ochilov A. et al. Is higher education a driving force of economic growth in Uzbekistan? // Perspectives of Innovations, Economics and Business, PIEB. – 2014. – T. 14. – №. 4. – C. 160-174. Available from: https://econpapers.repec.org/article/pdcjrpieb/v_3a14_3ay_3a2014_3ai_3a4_3ap_3a160-174.htm
11. Ochilov A. Ruziyev Z., Babayeva L., Ganiyeva Sh. Highly qualified personnel as a factor in increasing economic growth in Uzbekistan // International Journal of Psychosocial Rehabilitation. Vol. 24, Issue 09, 2020. – pp. 3867-3880. Available from: <http://arm.sies.uz/?wpdmpro=highly-qualified-personnel-as-a-factor-in-increasing-economic-growth-in-uzbekistan-akram-ochilovzafar-ruziyev-lola-babayeva-sharifa-ganiyeva>
12. Ochilov A.O., Ostonov E., Shodiev B.T., Ergashev T.Sh., Khakkulov F.F. Modern Approaches To Management Of Training Of Highly Qualified Personnel In New Uzbekistan Higher Education System // Journal of Positive School Psychology. Turkey, ISSN: 2717-7564. 2022. Vol.6., №10. pp. 2432-2442. Available from: <https://scholar.google.com/citations?user=c2EkIiwRYqMC&hl=ru>
13. Pawlowski, J. M., 2007. The Quality Adaptation Model: Adaptation and Adoption of the Quality Standard ISO/IEC 19796-1 for Learning, Education, and Training // Educational Technology & Society, 10 (2), 3-16 Available from: https://www.researchgate.net/publication/220374665_The_Quality_Adaptation_Model_Adaptation_and_Adoption_of_the_Quality_Standard_ISOIEC_19796-1_for_Learning_Education_and_Training
14. Pogadaeva SS, Kharitonova NI Regional aspects of sustainable development on the example of the Kemerovo region [Electronic resource] // Economy of Russia: theory and modernity: materials of 2 Chayanovskih readings. - Moscow, 2002. - Available from: <http://bookbk.net/book/34-kognomika-karpenko-mp/7-14kognitivnyj-chelovek-yekonomika-i-obrazovanie.html>

15. Pritchett, L, 1996. Where Has All the Education Gone? // The world bank economic review, Vol.15, No.3. pp. 367-391. [Online] Available from: <https://www.jstor.org/stable/3990107> [Accessed 20 January 2023].
16. Shchetinin V. Human capital and the ambiguity of its interpretation // World Economy and International Relations. - 2001. - No. 12. - pp.42-49.
17. Shakkum ML High technologies in the military-industrial complex are not yet available, but ... // Patriot, - June 27. 2002. - p.3.
18. Sianesi, B. and Van Reenen, J. (2003) The Returns to Education: Macroeconomics // Journal of Economic Surveys, 17, 157-200. <https://ideas.repec.org/a/bla/jecsur/v17y2003i2p157-200.html>
19. Stock J.H and Watson M.W.,2011, Introduction to Econometrics // Third edition. Addison-Wesley. pp.517-520
20. UNDP, 2022. National Human Development Report 2020-2021. Education in Uzbekistan: Matching Supply and Demand // [Online] Available from: <https://hdr.undp.org/towards-hdr-2022>
21. <https://ru.wikipedia.org>, 2020