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EDUCATION AND GROWTH

IS HIGHER EDUCATION A DRIVING FORCE OF ECONOMIC GROWTH IN UZBEKISTAN?

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KEYWORDS: Uzbekistan, higher education, knowledge economy, quality of education, economic growth

ABSTRACT: This article describes how accumulated knowledge is becoming as a driving force of economic growth and social development in Uzbekistan. The article discusses the achievements and challenges of education and its role in fostering of economic growth of Uzbekistan. Education is admitted to be one of the driving forces of the knowledge based economy. In particular, along with the capital and human resources the quantity and quality of education in general, higher education particularly, may have significant effect on economic growth. The research attempted to determine the existence of correlation between quantity/quality of higher education and the economic growth in Uzbekistan. Regression estimation with GDP growth as dependent variable and number and quality of graduates, per graduator costs as well as accumulated average year of schooling as independent variables revealed strong relationship between higher education and economic growth in Uzbekistan.

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Introduction

Formation of knowledge economy is based on four pillars: economic environment, education, and innovation system and information communication technology. Knowledge is becoming as a driving force of economic growth and social development of developing countries, including Uzbekistan. Economic and institutional regime must provide incentives for the efficient use of existing and new knowledge and the flourishing of entrepreneurship. People need education and skills that enable them to create innovations and share the new knowledge, to use it well. Uzbekistan is among the top nations in the literacy rate ranking. This indicates that school attendance is very high, which is not surprising if to take into account that in Uzbekistan secondary education is compulsory and schools are under control and provision of government. Taking about model of reforming educational system in Uzbekistan and experience of its implementation it's important to mention that, about 35% of Uzbekistan population is children under 16 and 60% are youth under 30. Uzbekistan has relatively high index of education and proportionately greater than the indexes of life expectancy and GDP. In world education index with an average of 0.77.For this reason the most attention is paid on education sector, especially higher education, in Uzbekistan. The development of the area is not only the quantity but also the quality

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of education. The Uzbek economy has faced three phases of growth. First phase covers the period, roughly, from 1991 to 1998 during which country recovered from the negative economic and social corollaries of the collapsed Soviet Union and transited to sustainable growth cycle. At the initial stages of development, thus, new state had to address the issues related to elimination of dependency and providing self-sufficiency of food, low labor as well as technological development with obsolescent and worn-out machinery across sectors of production, incomplete structure of production and shaking socio-economic living standards, especially, in rural areas. Uzbekistan has embarked on National Professional Training Program (NPTP) that includes +3 year compulsory vocational education at college or lyceum added to 9 years of secondary school from 1997. After NPTP was adopted, public expenditure on education sector was redistributed and 7.5% of total budget per year was allocated to compulsory vocational education. This research covers second and third phases of economic development and investigates how the implementation of the National Professional Training Program effected on economic growth of a country.

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 1970s. Barro (1999) examined the schooling quality and economic growth while Hanushek and Kimko (2000), Hanushek and Woessmann (2008) studied the relationship between quality of education and economic growth. Hanushek and Kimko (2000), Hanushek and Woessmann (2008) measured the quality of education based on cognitive skills in mathematics and science, whereas Barro (1999) used data on internationally test scores to measure the schooling quality. These researchers found that qualitative education has a strong and robust influence on economic growth. In this empirical research, the main issue is the analysis of the direct correlation between quantity/quality 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.

Eduardo and Laurini (2010) have presented new evidence on the role of cognitive skills in Economic Development. Kozma (2008) 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 is known as *knowledge economy* will bring 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. However, from 1994 to 2000, GDP per capita growth rate turned into 4.39% and Finland became one of the competitive economies in the world. During this period, the unemployment rate declined in half, the trade balance moved from large deficit into trade surplus and Helsinki's stock market rose very well over 200%. This dramatic turn was due to the implementation of investments in technological infrastructure, education and research and development, emphasizing the creation and sharing of new knowledge. Thus, 21st century students are required to have cognitive skills in order to continuously learn and create new knowledge which will cause to economic growth.

However, Lant Pritchett (1996) 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 (1996) claims that, this partial correlation cannot be used in assessing the impact of human capital change. He considers that, there must be another interpretation for the partial correlation of enrollment rates and economic growth. Moreover, Pritchett (1996) argues that, quality of education is impossible to measure across countries as there is no particular reason to believe that physical indicators such as teacher/student ratio or resources expended per student will adequately proxy the quality of education. Furthermore, he considers that, the years of schooling can create cognitive skills but these skills are sufficiently bad as they are devoted to privately remunerative but socially wasteful, or even counter-productive, activities.

Uzbekistan's researchers Yakov Asminkin and Olga Nemirovskaya (2007) 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.

According to our previous research results primary school enrollment ratio has been declining in Uzbekistan since 1989. As for the correlation between GDP growth rate and primary school enrollment, it demonstrates negative relationship between them. The same relationship can be observed in between GDP growth rate and Secondary school enrollment ratio in Uzbekistan. There is a negative relationship which means that, although school enrollment ratios have been declining, the GDP growth rate has been increasing year by year. The same situation can be seen in between GDP growth rate and tertiary school enrollment ratio in Uzbekistan. They are negatively correlated to each other. This phenomenon is different in Uzbekistan compared to other countries. It can be observed that, school enrollment ratios are positively correlated in many countries but not in Uzbekistan.

However, it is worthy to mention that, school enrollment ratios are the measures of quantitative education. In African countries, the literacy rates are so low, very few African people go to school, and thus, an increase in the number of people who go to school can have a positive effect on GDP growth rate of their countries. The quantity of education has a large effect on economic growth in African and other less developed countries. However, we are aware that, the literacy rate in Uzbekistan is almost 100%, more clearly, almost every person is enforced to study at school. For Uzbekistan, investment in to the quality of education can be very useful rather than investing in to the quantitative education (Ochilov, 2012).

Methodology

Using annual data of the Republic of Uzbekistan from 1997 to 2013, descriptive analysis and statistical tests are undertaken in additional to empirical estimations. In accordance with the Constitution of the Republic of Uzbekistan all citizens of the country are entitled to receive education. The state guarantees everyone a free general education and school education is under the supervision of the state. Empirical analysis showed that Uzbekistan has not been able to utilize its full potential leaving significant gap to be filled with recommended policy and institutional reforms. Nowadays compilation of technological development, innovations and knowledge is a credible factor of production. Thus, investments into R&D, deepening knowledge, enhancing innovations would create path for unlimited growth for Uzbekistan's economy. First of all, it is clear that GDP growth rate or GDP per capita growth is the best to represent economic growth. In constructing econometric models however, explanatory variables should be selected carefully. During the research many versions of best representative variables of the economic growth, quantity and quality of education were discussed and compared. One of the

theories was to explain economic growth due to education quality via government investment in education sector. But investment in education has no direct effect on education quality - it may enhance teaching tools and facilities, motivate teachers and have many other effects. Therefore, it was needed to find a variable(s) that provide the best explanation for the changes in education quality. 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.

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

For our analysis we have chosen Mankiw-Romer-Weil model. The reason is that, Solow enhanced this model in order to incorporate education quality. The general form of the production function which incorporates the quantity and the quality of education can be expressed by model as follows:

$$y = A\,k(t)^{\alpha}\,(\theta h(t))^{\beta} \tag{1}$$

Where, *y* - Output per capita, *k (t)* - stock of capital per capita, *h (t)* - stock of human capital per capita

The quantity of education is measured by ***h(t)*** and the quality of education is measured by **θ**. It is assumed that the labor force grows exogenously at a rate ***n*** and ***A (t)*** grows exogenously at a rate *g*. The depreciation rate is denoted by **δ**. According to the MRW model, *g* and δ are assumed to be the same across countries. If we denote investment in physical capital by S_k and gross investment in human capital by S_H, the steady state level of per capita output can be expressed as:

$$y^{*} = \left(\frac{A s_K^{\alpha} (\theta s_H)^{\beta}}{(n+g+\delta)^{\alpha+\beta}} \right)^{\frac{1}{1-\alpha-\beta}} \tag{2}$$

Following MRW model, when an economy moves from initial level of output per capita to a steady state level, the speed of convergence along a transitional path can be expressed as:

$$ln(y(t)/y(0)) = (1-e^{-\lambda t})ln(y^{*}) + (1-e^{-\lambda t})ln(y(0)) \tag{3}$$

Where ***y**** is the steady state level of output per capita ***y(0)*** is initial level of output per capita and λ can be defined as a speed of convergence of an economy which is equal to λ ***= (1-*** α ***-*** β ***)(n + g +*** δ ***)***

If we combine the equation **(3)** with the logarithms of the equation **(2)**, we take the following approximation:

$$ln(y(t)/y(0)) = a_0 + a_1 ln(s_k/(n+g+\delta)) + a_2 ln(s_H/(n+g+\delta)) + \\ + a_3 ln\, y(0) + a_4 ln\theta + \mu \quad (4)$$

According to equation **(4)**, the growth rate of output per capita depends on the accumulation of physical capital, human capital and education quality. Moreover, in order to examine the differential effects of education quantity on quality, an interaction term, $\theta \ln s_H$ will be added to equation (4) of the model.

$$ln(y(t)/y(0)) = a_0 + a_1 ln(s_k/(n+g+\delta)) + a_2 ln(s_H/(n+g+\delta)) + \\ + a_3 ln\, y(0) + a_4 ln\theta + a_5 \theta ln\, s_H + \mu \quad (5)$$

The model comes up with these two main equations **(4)** and **(5)** and these equations are used in empirical analysis.

Data analysis and overview of the higher education system in Uzbekistan

Regression models identification

As the primary objective of the research was to find out the existence of direct relationship between economic growth and higher education quantity and quality, chosen variables for the estimation are to suit the requirements of the theory. The following dependent and explanatory variables were introduced:

GDP per capita (Real GDP divided by number of total population), in $1000;

Economic growth rate, EG, %;

Capital Investment, CI, in billion US dollars;

Capital Investment growth rate, CI, %;

Number of high qualified workers, (HEI graduates), HQW, in 1000 persons;

HQW annual growth rate, HQW, %;

Average year of workers' schooling, we call this as "educational zence" of workers NZ, in years;

Annual growth rate of average of workers' schooling, NZ, %;

Total number of labor force, engaged in production, LF, in 1000 workers;

Labor force growth rate, LF, %;

Number of HEI graduates, DNG, in persons;

Annual Growth rate of DNG, %;

Costs per student, COSTS, in 1000 sums;

Average student performance rate, SPER, %;

Aggregated investments into the sectors for 1997-2013 grew by 15,2% and exceeded 23% of national income, on average, during the second and third phases of development.(Figure 1) 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 2012.During 1997-2013 period numbers of qualified workers and HEI graduates grew faster than total labor force which were accounted for respectively 3.3% and 2.1%. 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 were 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 2006-2013 years around 70% of the GDP growth rates were attributable to the growth of efficiency in the economy. (Table 4)

Preliminary analysis concluded that productivity growth has constituted significant portion of economic growth of the country. Thus, there is wide scope of policy implications needed to be considered for potential growth opportunities of the economy. It would be plausible to shed some light on them as they are the fundaments of the second generation endogenous growth theories.

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 supported by the fact that there is always unemployment in any market economy.

The following graphs show the correlation between GDP growth rate and education (more specifically school enrollment ratios in primary, secondary and tertiary education). Generally, there should be causation works such as higher GDP per capita results in better education which means higher GDP because human capital is an important cause of economic growth. Moreover, the better educated people are the better educated their children will be and so on; this chain of education has long-lasting benefits for economic growth.

To identify the model, firstly we needed to choose and decide which functional form was appropriate for the research. Firstly, linear, LOG-LIN, LIN-LOG and LOG-LOG models have been used. Linear model was used to see the relationship between GDP growth and number of labor force, capital investments and average years of schooling of workers in the national economy. 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 were taken as a dependent variable and the explanatory variables 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, LIN-LOG model has been used by taking the GDP growth rate as a dependent variable and the logarithms of number of labor force, capital investments and average years of schooling of workers in the national economy. This functional form assumes that absolute change in regressed is caused by relative (percentage) change in one or more dependent variables.

And finally in LOG-LOG model both dependent and independent variables were taken to logarithms and regressed. This function assumes that relative change in dependent variable(s) will entail relative change in the dependent variable.

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

Y (GDP per capita) = β_0 + β_1 LF + β_2 CI + β_3 NZ

Log(Y (GDP per capita)) = β_0 + β_1 LF + β_2 CI + β_3 NZ

Y (GDP per capita)=Log β_0 + β_1 Log(LF)+ β_2 Log(CI)+ β_3 Log(NZ)

Log(Y (GDP per capita)) =Log β_0 + β_1 Log (LF)+ β_2 Log(CI)+ β_3 Log(NZ)

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

We know that R^2 is one of the measures of goodness of fit of a regression model and it always lies between 0 and 1. 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[1]. Moreover, when comparing two or more models, the model with the lowest values of AIC and SIC are preferred[2].

As we see from the results, the independent variables better explains the dependent variable as R^2 is the highest in LIN model. As for AIC and SIC, the lowest values of them are also in LIN model. Among these the linear model satisfies all above mentioned conditions and that was used for further analysis. So, the research uses the following regression model:

Log(Y (GDP per capita)) = --1.1371 +2.1553Log (LF) + 0.02450Log (CI) --0.2957Log (NZ)

The regression is run on annual data for 1997-2013 for Uzbekistan obtained from above mentioned sources.

[1, 4] Gujarati, 2004, Basic Econometrics, 4th ed., the McGraw-Hill, USA. Pages 536-537

However, there is another issue to be considered. 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.

In order to handle the "time lag" of increased education quantity effect, we decided to estimate only *current* effect. Current effect will study how change in education quantity of current workforce impacts on economic growth. Population with completed secondary education already can be counted as labor force - thus, enrolment in tertiary schools (HEIs, re-qualification programs, trainings) is expected to have immediate effect on current economic growth of Uzbekistan. This model tests how the quantity of existing educated workforce is correlated to economic wellbeing of the nation.

To take into account the effect of education quality, the average years of schooling of workers was added to regression model as an explanatory variable. The slope coefficient of these repressors is expected to explain the relationship between current quality of education and economic growth of Uzbekistan.

First, it gives estimation results for current effect of education quantity on economic growth and it provides detailed interpretation of possible reasons for the type of relationship revealed between the variables. First of all, it is worthy to see how the quantity of educated current labor force effects economic growth and to what extent. As we know, educated workers and specialists are the main contributors to the overall output in the economy. Thus, level of education quantity in tertiary schools is expected to have direct effect on economic growth.

The intercept and slope coefficients (except average years of schooling) are statistically significant. The above results suggest that one unit change in number of educated workforce causes nearly 2 percent increases in economic growth of Uzbekistan. One unit change in capital investments causes 0.02 percent increase in economic growth. Unfortunately the average years of schooling had negatively affected on economic growth. It is interesting to observe negative relationship between these two variables. The estimation suggests that increased number of schooling entails fall in GDP growth of Uzbekistan. There may be three different explanations to this situation:

1) The more existing employees are trained and re-educated - the more efficient they become. As we know, one high quality specialist can replace many unskilled workers. Thus, increase in average years of schooling might have been causing *structural unemployment* i.e. unemployment due to lack of skill and experience. Increasing number of highly qualified workforce even more resists the employment of lesser skilled labor. However, there are many spheres that very low skilled employees are needed rather than certified professionals. This argument relaxes the severity of negative impact of increased years of schooling on overall economic wellbeing of the nation.
2) Tertiary centers in Uzbekistan are targeted to educate and re-educate existing workers. Organizations send their employees to HEIs to enhance their qualification. This done by freeing them from all work they are actually responsible to do. In most cases, re-educational periods are on a vacation basis. Consequently, when there is more labor force enrolled in tertiary schools, there are fewer actually working employees in the economy. This is the situation when tertiary

education is temporarily "steals" labor force from the economy causing in actual output.

3) Employees taking higher education are motivated by possible higher level of wages because of their higher qualification. Thus, upon completion of tertiary education they require higher salaries. Increased number of highly qualified and expensive workforce puts pressure on employers and drives wage rates up. Organizations may react to these changes by cutting on production in order to minimize costs.

The interesting situation is that secondary and primary school enrolment rates also negatively affected the economic growth of Uzbekistan. There may be different reasons for this: Large number of secondary education students will lead to increased popularity of tertiary education. Commonly, people tend to continue their education after secondary school as they value higher education than the secondary or secondary-specialized. As a result, these secondary school obtainers continue to obtain further education instead of entering workforce and contribute to the economic growth.

To identify the quantitative influence of higher education further number of annually graduates as explanatory variable ***(DNG)*** was entered into model. Different types of the relationships between economic growth and number of annually graduates and capital investment were regressed.

Y (GDP per capita) = $\alpha_0 + \alpha_1$ DNG + α_2 CI

Log(Y (GDP per capita)) = $\alpha_0 + \alpha_1$ DNG + α_2 CI

Y (GDP per capita) = Log $\alpha_0 + \alpha_1$ Log (DNG) + α_2 Log (CI)

Log(Y (GDP per capita)) = Log $\alpha_0 + \alpha_1$ Log (DNG) + α_2 Log (CI)

The values of intercept and slope coefficients are shown in table 2.

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

Y (GDP per capita) = 1000.55+0.031324DNG + 95.25628CI

All coefficients are statistically significant. The results 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. It was assumed that the unemployed rate in a country is constant and annual graduates of universities join the workforce without time lags. The migration of the workforce is not considered because mainly unskilled workers migrate outside of the country. Negative relationship between tertiary education and economic growth in Uzbekistan is explained in the previous article (Shodiev and Ochilov, 2014).

The higher education quality models

Nowadays the universities seek three major contradictory aims: to increase access to higher education, reduce total costs and constantly increase quality of graduates. One of the main objectives of the research was to empirically estimate possible impact of expenditures on education and access on the quality of education in Uzbekistan. For that purpose to the used model was added a new variable - average student's performance rate at the exam as a measurement of education quality. The slope

coefficient of the new variable is assumed to represent the effect of quality level of education delivered on outcome economic wellbeing.

Furthermore, the model is appropriate for time-series data for Uzbekistan. The difference of this model from other models is that, most models that learn the quality of education on economic growth use test scores from mathematics and science of countries. However, such data is not available for Uzbekistan and many other countries. Thus, instead of test scores, the model can use other variable as a proxy of qualitative education. In our case average score of students' performance during exam was used as a proxy variable.

From four different types of models linear and logarithm linear models were chosen for economic analysis.

$$Y\ (SPER) = \gamma_0 + \gamma_1 NS + \gamma_2\ COSTS$$

$$Log(Y\ (SPER)) = \gamma_0 + \gamma_1 NS + \gamma_2\ COSTS$$

$$Y\ (SPER) = Log\ \gamma_0 + \gamma_1 Log(NS) + \gamma_2\ Log\ (COSTS)$$

$$Y\ Log\ ((SPER)) = Log\ \gamma_0 + \gamma_1 Log(NS) + \gamma_2\ Log\ (COSTS)$$

The values of intercept and slope coefficients are shown in table 3.

It is worthy to point out the extent of education quality effect on GDP growth of Uzbekistan. Estimation results above showed that the average years of schooling taken as proxy variable of education quality had very small effect on changes in economic prosperity of Uzbekistan. This may be the result of using generalized data. For the regression overall only higher education indicators were taken. In our case this estimated coefficient would be more representative. But in any case, it would not be surprising that education quality is only one of many factors of economic growth.

According to the linear model one unit increase of both variables (number of students and costs per student) positively effect on quality measured in students' performance.

We assumed that quality of higher education is measured in aggregated formal current, mid-term and final assessments , which was introduced at all HEI since 2005.For this average total scores in exams was taken as dependent variable in our model. The slope coefficients are significant and one percent increase of student' access and costs corresponds respectively to 0.127 and 0.01314 percent increase of higher education quality. It is important to point out that during the investigated period the number of graduates has increase higher then level of the workforce.

Conclusion

Changes of transitional period had their negative impact on the popularity and availability of education. However, the government managed to keep control over education system and prevented degradation of schools and educational institutions. As a result, although the quantity of educated labor force decreased, the quality of education kept at and even was brought above initial level. Assessment of data and

comparison of variables pointed out that education quantity is not among important determinants of economic growth. Interesting finding was that quantity of education is negatively related to the economic growth, what indicates the importance of considering the quality of education rather than its quantity.

In the wide scope, research revealed direct relationship between economic growth and higher education quality and quantity. Although the correlation is weak, number and level of educated workforce is found to have significant influence on economic growth. Especially, education quality is found to be a very critical factor of steady economic expansion in very long-run. The hypothesis of direct relationship between education quantity and economic growth is accepted from the estimation results. The relationship is found to be positive and not very strong. This suggests that targeting to increase the number of educated workforce may be inefficient way of supporting economic growth or even cause fall in actual output.

Efforts are to be made to improve the quality of education by supporting research and development, experience exchange and modernization in educational institutions. The research provided reliable study of education as a qualitative and quantitative factor of economic growth. Aiming to transform the learning process we must also help teachers expand their own skills and experience. Many teachers lack the training, confidence and classroom resources to meet these challenges without support and instruction.

Statistical properties of the estimated models were highly satisfactory and possible econometric problems e.g. autocorrelations of variables and serial correlation in error terms were corrected for without significant threats to the credibility of the conclusions. This entails changing the way education is organized — making content more relevant to contemporary life and global challenges, introducing innovative and participatory teaching and learning styles. We must rethink the purpose of education and prepare students for life, not passing exams alone. To facilitate this process and to develop a quality system for an organization, the use of the regression model for the description of quality approaches was recommended and demonstrated.

Since the model is very generic, more research is necessary — especially to find specific solutions for different proxy variables of quality. Additionally, research has been initiated to analyze the differences and adaptation requirements for different proxy education quality to include lagged explanatory variables.

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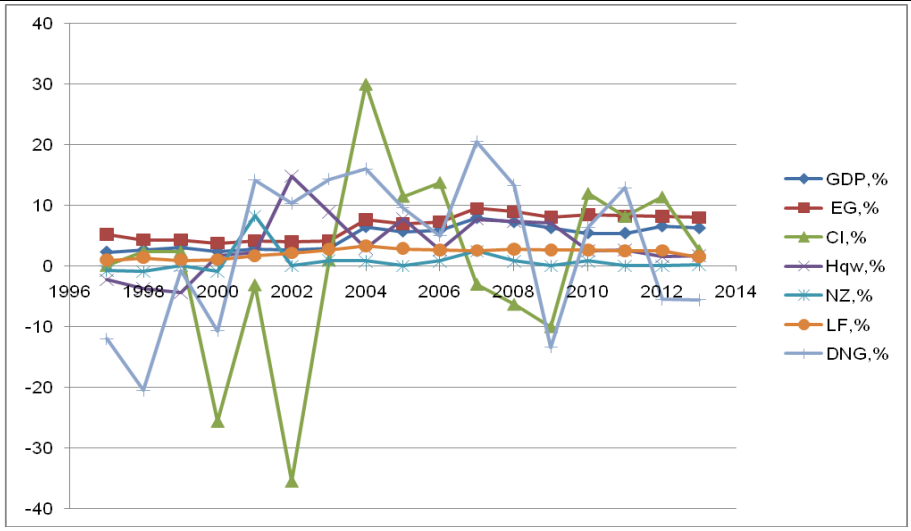
Appendix

FIGURE 1. ECONOMIC GROWTH, CAPITAL INVESTMENT, LABOR FORCE AND HIGHER EDUCATION DYNAMICS



Source: The Statistical Committee of the Republic of Uzbekistan, Annual reports from 1996 to 2013.

TABLE 1. COMPARISON OF ECONOMIC GROWTH FUNCTIONAL FORMS

TYPES OF MODELS	PARAMETERS				R^2	AIC	SIC
	β_0	β_1	β_2	β_3			
LIN	-2328.5** (717.78)	0.6979*** (0.0697)	27.4790** (11.663)	-143.89* (111.29)	0.992	11.88	12.08
LOG-LIN	6.11314*** (0.1292)	0.00021*** (0.0000.26)	0.00065*** (0.0021)	-0.0191 (0.0200)	0.997	-5.357	-5.161
LIN-LOG	-8737.6* (4499.4)	7160.61*** (928.35)	209.910* (80.203)	-1772.2 (1782.3)	0.987	12.42	12.62
LOG-LOG	-1.1371* (0.7978)	2.1553*** (0.1646)	0.02450* (0.0142)	-0.2957 (0.3160)	0.995	-.8454	-.6493

Source: The regression results of the data of The Statistical Committee of the Republic of Uzbekistan, Annual reports from 1996 to 2013.
Notes: Robust standard errors reported in parenthesis. *, **, *** - significant at the 10%, 5% and 1% levels respectively.

TABLE 2. HIGHER EDUCATION QUANTITY MODELS CHARACTERISTICS

Types of models	Parameters			R^2	AIG	SIG
	α_0	α_1	α_2			
LIN	1000* (20)	0.031** (0.04)	95.25* (23.09)	0.925	14.11	14.26
LOG-LIN	7.36*** (0.06)	1.03E-05 1.25E-0)	0.02*** (0.006)	0.923	-2.128	-1.981
LIN-LOG	-16815. (2697)	1772.3** (256)	541.9* (149)	0.894	14.45	14.60
LOG-LOG	1.61* (0.7)	0.575*** (0.07)	0.11*** (0.043)	0.8993	-1.857	-1.710

Source: The regression results of the data of The Statistical Committee of the Republic of Uzbekistan, Annual reports from 1996 to 2013

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

TABLE 3. COMPARISON OF THE EDUCATION QUALITY FUNCTIONAL FORMS

Types of models	Parameters			R^2	AIC	SIC
	γ_0	γ_1	γ_2			
LIN	60.80*** (0.96)	0.038*** (0.03)	0.0009** (0.00028)	0.8930	2.361	2.50
LOG-LIN	4.116*** (0.01)	0.0005** (5.45E-05)	1.33E-05** (4.19E-06)	0.8878	-6.083	-.936
LIN-LOG	15.76** (4.45)	8.941*** (0.70)	0.9456** (0.2676)	0.9220	2.044	2.19
LOG-LOG	3.474*** (0.06)	0.127*** (0.01)	0.01314*** (0.0039)	0.9180	-6.397	-.250

Source: The regression results of the data of The Statistical Committee of the Republic of Uzbekistan, Annual reports from 1996 to 2013

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

TABLE 4. THE RESULTS OF DESCRIPTIVE ANALYSIS OF THE USED DATA

	EG,%	DNG	Costsper stud	CI,$ Bil	GDP per capita	HQW	LF	NS	NZ	Stud. perfor,%	TFP,%
Mean	6.38	55129	881.0	4.04	3158	2002	10116	247	11.9	71.3	2.26
Median	7.00	52758	736.0	3.10	2876	1982	9910	258	11.9	71.6	2.1
Maximum	9.50	82918	2317	12.0	5000	2979	12411	298	12.5	73.0	4.0
Minimum	4.00	35350	445	2.00	2423	1553	8885	166	10.9		1.10
Std. Dev.	2.25	19528	563	2.98	778	491	1114	42	0.42	1.25	0.84
Skewness	0.12	0.294	1.811	2.24	1.16	0.69	0.74	0.2	0.53	0.98	0.47
Kurtosis	1.28	1.39	5.09	6.29	3.35	2.30	2.44	1.8	3.28	4.24	2.23
Jarque-Bera	2.13	2.07	12.4	21.9	3.93	1.69	1.78	1.1	0.82	3.86	1.05
Probability	0.34	0.35	0.002	0.001	0.14	0.42	0.411	0.5	0.66	0.15	0.59
Obser.	17	17	17	17	17	17	17	17	17	17	17

Source: The Statistical Committee of the Republic of Uzbekistan, Annual reports from 1996 to 2013.