Comparative study of higher education influence on economic growth of G8 and OPEC countries

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ABSTRACT

In this study, based on developed neoclassic growth model, a comparative study about higher education effect on economic growth of two different groups of countries; G8 (first eight developed or industrialized countries) and OPEC (petroleum export countries) has been conducted by econometric and panel data methods. In addition, regression model’s coefficients of 14 countries have been calculated by EViews software during 1990 – 2010. Finally, obtained results of these two groups were compared with each other. Obtained results showed that in OPEC countries, higher education has not a meaningful effect on economic growth, and contrary, in G8 countries higher education have meaningful effect on economic growth.

Key words: high education, gross domestic production, economic growth, OPEC countries, G8 countries

Introduction

Human capital is a significant factor in modern economic growth theories. Economic growth depends not only on human capital, but also on performance of this capital. Improvement of human capital causes that on one hand, labor agent gets skillful and proficient more than before, and on the other hand technology and science development causes capital agent be more efficient and productive. Therefore, performance and efficiency of both production agents rely on education of labor force and development of technical sciences.

Schultz [22] shows that investing in people and their education is an agent that insures human welfare. In addition, analysis of production growth in developed countries has shown that investment in human capital contributes more than two third of production increase in these countries and other one third is due to other agents. [11]

Education as one of most important facet of human capital formation has a significant contribution in achieving economic growth through improvement of labor skills and enhancement of production capacities and therefore has a crucial role in economic boom. Although experiences and past of different countries show that mere education could not meet economic development, and education influence on economic growth is depend on economic policies of those countries. In fact, these policies determine that how and how much educated individuals could apply their taught.

Considering significance and necessity of present study about higher education influence as one of most important human capital indexes on economic growth, one could expect that by discovering relationship between these two variables in two groups of countries, that is, OPEC member countries and G8 developed countries that have completely different economic structure through offering consistent solution for these countries regarding their economic conditions, direct stable (continuous) economic growth so that finally leads to increase of economic welfare.

Previous Research:

Economic growth discussion backed to classic economists, especially, Adam Smith, Ricardo and Malthus. Adam Smith related growth to labor division, specialty and capital accumulation. Malthus emphasizes on labor and land contribution as productive agents and assumes technology development level as a constant agent. Ricardo established his growth economic theory on descending final efficiency law [7].

First economic pattern (model) presented by Harrod – Domar that was completed by Solow in 1950s. They believed that physical capital formation is the most important growth agent. At first, labor force and physical capital were considered and other
Vast studies about influential agents on economic growth show that in addition to labor force, physical capital and technological advancement, there are other agents that affect economic growth. One of these agents that are pointed by new economic growth theories is human capital. Theoretical studies in scope of economic growth have been shown a strong casual effect of human capital especially education as one important forms of human capital on economic growth.

Researchers like Schultz [22], Becher and Mincer, suggested that education affects economic growth through paying labor force.

In this relation, Kuznets argues that a concept of capital that merely incorporates physical and commodity agents is an inexpresseive and defective concept. Therefore, human and physical capitals should be considered together as capital. In Kuznets view, “human capital of an industrialized developed country is not its equipment and industrial facilities, but scientific knowledge and its human capital skills in applying this knowledge”. He believed that investment in education is the main source of human capital formation that leads to empowering labor force and advancement of technical sciences. Thus, human capital is main agent of economic development of the country.

Uzawa [23] showed that how in neoclassic model, one could achieve internal rate in a stable growth. He introduced human capital of labor force and assumed that for its growth, it is necessary to offer services in the form of education and accordingly analyses optimum growth course.

Nordhaws and Shell in their first growth models explain that technology transformation is a result of conscious economic selection. Both of them assume that research motivation is due to its exclusive rent.

After a long period of stagnancy in research about related matter, new researches start with human capital model of Romer and Lucas [20]. Romer and Lucas theorized Arrow and Uzawa beliefs. Lucas introduced human capital agent in his model along physical capital as a production factor and thereafter investing growth in human capital identified as physical investment that is determining factor of society wealth. He argue that, the opportunity cost of human capital devoted to education sector affecting labor productivity and adaptability of labor force with new technologies and thus creating long-term development. Romer presents his model with this assumption that external effects should be considered in production function. In his model, per capita production depends not only on per capita stock but also on whole accessible capital in economy. In new researches, emphasizing on technology or labor force quality has the main contribution in description of economic growth. Purposes of these studies were describing labor force quality or technology concepts and therefore predicate these models of endogenous growth to this category of studies.

Significance of human capital, in general, and education specifically in growth theories of 1998 and 1990 in endogenous growth models and developed neoclassic growth model (MRW) has been verified. In developed neoclassic growth model human capital is considered as an additional data. Therefore, those countries that have rapid education rate, they will have more national income and economic growth. In endogenous growth model, education is regarded as a process that will change production technology, facilitate adaptation with foreign technology and facilitate transmission of sources to most dynamic and advanced sects.

Education and national income interact with each other. On one hand, formation of human capital by educational investments leads to specializing individuals and causing more production and increase of national income. On the other hand, increase of national income results in savings accumulation, increase of whole investments and investing in education and human capital. Most of empirical studies confirm that countries with more skillful and educated labor force that have more accessibility to education during time, outperformed in economic growth; in other words, a country could achieve better economic growth performance with increasing efficiency of education sect and encouraging individuals to more educations (Storelsletten and Zilibotti, 2000).

In theoretical view, in primary stages of development, first and second level of education have more significance, but with increase of national income and passing through preliminary stages of growth and development, due to more necessity to high technological and knowledge-based techniques for manufacturing and offering public services and subsequently competition in international markets, level of formal education get more important.

Gemmell investigated the effect of three education levels on economic growth in different countries during 1960-1985. He showed the meaningful effect of primary and secondary education levels on economic growth in developing countries. In this study, third level of education (tertiary education) was efficient for OECD countries, merely.

Barro [1] conducted inter-country evaluations for hundred countries during ten-year periods between 1960-1990 decades. In his evaluation equation, dependent variable was real gross domestic production per capita and descriptive variables were autoregressive gross domestic production, education of men over 25 years-old that are measured at beginning of each periods, rule the law index, exchange rate variable, inflation rate, government consumption/ GDP ratio (except education and defense), democracy index and autoregressive
fertility rate. He used three stages least square method for solving three contemporaneous equations. Based on obtained results, Barro concluded that education years of secondary and higher levels for men with more than 25 years-old had efficient effect on development of countries. According to Barro’s evaluation, each additional education year for men with more than 25 years-old increases development rate approximately by 44%. Barro results about education quality show that this factor is more important than quantity of education that is obtained from average years of secondary and high levels of education. He identified strong effect of secondary and high levels education on economic growth as a result of significant role of technology distribution and assisted contribution of human capital in absorption of modern technologies from advanced countries.

Petrakis and Stamataki found that the influence of education on development depends on development level. Developing countries with low economic income benefit from primary and secondary levels, frequently; in contrast, developed countries with high economic income get more beneficial from third or higher education level.

Sa’adat conducted a research about causal relationship between human capital and economic growth in Iran during 1959 – 2001 through Hsiao’s Granger causality test. According to his results, petroleum and non-petroleum incomes have been caused increase of human capital during mentioned period and human capital leads to economic growth without petroleum.

Another research has been conducted about the effect of higher education on economic growth of African countries. Although, there was no meaningful relation between higher education level and per capita income in African countries by previous studies, in this study impact of excellent human capital on national per capita income of African countries has been evaluated as meaningful and positive relation. [9]

In fact, when results of formal and informal education are effective in creating additional skills and potential abilities of labor force and human capital forms production process, productive capacity of whole economy increases and finally aids economic growth. Many studies like Mankiw [15], Benhabib and Spiegel, Barro and Sala verified essential role of human capital on economic growth.

Unlike these empirical studies that endorse positive effect of human capital on economic growth, there are some empirical studies that suggested meaningless relation between education and economic growth and in some cases negative effect of education on economic development. We can refer to, for example, Lau, Jemison and Louat, Islam [10] and Pritchett [19] studies.

Lau, Jemison and Louat investigated 58 developing countries during 1960 – 1986 in their studies. They used real GDP as dependent variable and Physical capital, labor force and staff’s average years of schooling as descriptive variables in their model. Thereafter, variation percent of real GDP of each country measured for each one-year increment of average years of education. In some mentioned developing countries, annual increment of this average had not meaningful effect on GDP increase. Even in some countries, this effect was negative.

Islam evaluated a regression of inter-country data for Solow model that human capital was added to this model. He use 1960 -1985 data and divide them into five subsets in order to using five dataset for each country. Islam used average years of primary, secondary and tertiary schooling for more than 25 years-old persons as human capital index. His evaluation results showed that human capital variable has not meaningful coefficient for description of economic growth.

In response to this inconsistency between theoretical discussion and empirical results and describing its reasons, many researches have been conducted. Some researchers excluding labor force quality variable in these study because they identified it as origin of this inconsistency [4]. Other researchers argue that influence channel of education on economic growth is weak and they believe that, in fact, human capital development stem from economic growth. On the other hand, Lopez, Thomas and Wang, 1998 believe that education variable is not adequate for explaining economic growth of countries and therefore introduce education distribution into their pattern.

For investigating claim of those researchers that believe in meaningless of education effect and even negative effect of it on economic growth, one could use casual method for verifying or rejecting relation between human capital and economic growth. Cheng and Hsu were first researchers that studied causal relation of human capital and economic growth. They concluded that in Japan, increase of human capital had been the cause of economic growth and economic growth caused development of human capital. In their study, human capital index was considered as the ratio of educated individuals to labor force.

A paper with title of “human capital formation and economic growth” was published in America by In and Doucouiagos in 1996 that ratio of registration in educational institutions to labor force has been used as human capital index. This study verified conclusion of Cheng and Hsu and showed that a mutual relationship exist between human capital and economic growth.

Zara’enejad studied Granger casual relation between higher education expenditure and real gross domestic production in Iran. He used three method for examining this hypothesis that higher education expenditures is cause (Granger) of economic growth; standard Granger casual, Hsiao’s Granger causality
and ARDL method. Studied period was 1974 – 2004. Results showed that in Iran’s economy no variable is cause of other variables. This conclusion was confirmed by all three-mentioned method.

In sum, from the World Bank point of view, there is an evident and obvious relation between education and economic policies. Based on a study in 1965 – 1987, rate of economic growth of those countries that have more economic stability, high level of education and more free market economy had been more than of other countries. Growing of human physical capital along with modifying market in an exogenous economic structure, accelerate rate of economic growth. Otherwise, education had no meaningful effect on economic growth. In fact, education could not help overregulated Economies with limited freedom for productivity of physical capital, but in market-based economy (like G8 countries), education will help economic growth and final productivity of physical capital, significantly.

Hypotheses:

In this study, based on developed neoclassic growth model, a comparative study about high education effect on economic growth of two different groups of countries; G8 (first eight developed or industrialized countries) and OPEC (petroleum export countries) has been conducted by econometric and panel data methods. In addition, regression model’s coefficients of 14 countries have been calculated by views software during 1990 – 2010. Finally, obtained results of these two groups were compared with each other. we test the following hypothesis:

H1: there is a meaningful difference between the influence of high education on economic growth in OPEC and G8 countries

Research Method:

In this study, panel data has been used for evaluating the pattern during 1992 – 2010. Based on model of advanced neoclassic growth, a comparative study was conducted about the effect of higher education on economic growth in two groups of countries with different economic structures i.e. OPEC member countries and G8 group countries; The obtained results of these two groups compared with each other.

Organization of petroleum export countries (OPEC) is an international cartel that is formed by Algeria, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates, Ecuador, Angola and Venezuela. According to data of mentioned parameters, due to lack of required data in some of these countries, in this study Iran, United Arab Emirates, Kuwait, Libya, Saudi Arabia and Venezuela were included as OPEC member countries.

G8 group countries consist of eight industrial and developed countries that dominate over 65 % of world economy. Leaders of G8 countries gather annually. G8 countries consist of: United States of America, Japan, Germany, France, Great Britain, Italy, Canada and Russia.

In this study, World Development Indicator (WDI) data was used for variables such as GDP, labor force (L), physical capital (K) and total factor productivity (TFP) and Barro and Lee data was used for higher education variable (H).

Introducing theoretical principles of used model:

It is assumed in this pattern that (Y) product with a combination of physical capital (K) and expert labor force (H) based on Cobb-Douglas Production Function with constant efficiency with respect to scale grows as following relation (Ebrahimi, 2003):

$$Y = K^\alpha (AH)^{1-\alpha}$$

Where:

(A) is labor-intensive technology that grows with constant rate $\lambda$. It is assumed that workers pass (u) hours of their time for training and learning required skills. Production function of expert labor force is as follows:

$$\frac{d\log H}{du} = \Psi H = e^{\psi u} L$$

Where;

$\Psi$ is constant and here we have $\Psi > 0$.

By increasing number of unskilled labor force (L) and number of work hours (u), expert labor force increases. Above equation shows that a little increment of (u) increases (H) value as much as $\Psi$ percentage.

As Solow model in per capita condition, accumulation of capital is like as following.

$$k(t) = s \cdot y(t) - (n + g + \delta)k(t)$$

In this relation

$$k(t) = \frac{K(t)}{A(t)H(t)}$$

and

$$y(t) = \frac{Y(t)}{A(t)H(t)}$$

Thus, adding human capital does not change main characteristics of pattern. By relying on this pattern, one could deduce that some countries are rich due to high investment rates in physical capital. In addition, consume most of their time for acquiring and accumulating skill and knowledge. These countries have low population rate and high level of technologies [20].

In this study, for evaluation of physical capital variable, regulation (adjustment) of physical capital has been used that is like following:

$$K_t = (1 - \delta)K_{t-1} + I_t$$
Where,

$K_t$ is physical capital; $(I)$ gross investment and $(δ)$ depreciation rate that with regarding Romer model it was considered 4 percent for all countries (Romer, 2001) because depreciation statistical rate is not available for these countries. As could be observed, for using abovementioned equation, initial value of physical capital is required. For obtaining value of physical capital, Prepetual Inventory Method (PIM) has been used. Based on mentioned method, the initial value of physical capital $(K_{t-1})$ could be obtained from following equation:

$$K_{t-1} = \frac{I_t}{r+δ}$$

(5)

Where,

$(r)$ is average rate of annual investment growth.

In addition, in this study total factor productivity variable has been computed from Divisia method according to following equation in each year and for all countries.

$$TFP = \frac{GDP}{k^{α} L^{(1-α)}}$$

(6)

Where,

GDP is gross domestic production, $(K)$ physical capital, $(L)$ recruited labor force, $(α)$ capital contribution in production and $1 - α$ is labor force contribution in production. Romer argues that capital contribution in production for mentioned countries is about $1/3$ [20] and this value could be used as an approximate for capital production’s extension of capital. It should be mentioned that providing complete competition and constant efficiency (performance) with respect to scale and lack of external consequences, production extension of capital is equal to capital contribution of production and also results of TFP computation obtained from Solow residue and Divisia methods are same.

Model evaluation and results analysis:

Pooled Least Square method based on fixed effects has been evaluated and its results for six countries (OPEC member) are as following:

$$\log (GDP) = 0.007132 + 2.24E-09 (L) + 0.264046 \log(K) + 0.088008 \log(H) + 0.004472 (TFP)$$

(0.89) \hspace{1cm} (3.17) \hspace{1cm} (18.8) \hspace{1cm} (0.93) \hspace{1cm} (19.6)

$R^2 = 0.86 \hspace{1cm} \overline{R^2} = 0.84 \hspace{1cm} F = 51.3 \hspace{1cm} D-W = 1.76$

Coefficient of whole labor force variable $(L)$ is positive and equal to $1.61E-08$. This coefficient states that one percent increase of whole labor force increases economic growth by $1.61E-08$ %.

Coefficient of physical capital logarithm $\log (K)$ is positive and equal to 0.32, in which indorses role and significance of physical capital on economic growth in these countries. According to above results, one percent increase of physical capital is equivalent to 0.32% of economic growth.

Coefficient of higher education logarithm $\log (H)$ is negative but is meaningful, statistically, and is equal to $-0.03$. We consider average years of tertiary schooling as higher education index.

Coefficient of total factor productivity variable $(TFP)$ is positive and meaningful and is equal to 0.004. In other words, one percent increase of total factor productivity increases economic growth by 0.004 %.

In this model, evaluation method has been based on fixed effects. Selection of evaluation method was based on results of obtained tests in EViews software, because after performing F-Lyimr test (Chaw) it was determined that its model is panel data. In next stage, it was determined by using Hausman test that this model is fixed effects model.

In addition, this model has been estimated for G8 countries: Its equation is as follow:

$$\log (GDP) = 0.000127 + 1.61E-08 (L) + 0.328937 \log(K) - 0.033129 \log(H) + 0.005524 (TFP)$$

(0.31) \hspace{1cm} (21.9) \hspace{1cm} (88.08) \hspace{1cm} (-2.1) \hspace{1cm} (49.6)

$R^2 = 0.98 \hspace{1cm} \overline{R^2} = 0.98 \hspace{1cm} F = 745.2 \hspace{1cm} D-W = 1.92$

In this model all variables are meaningful from statistical point of view.

Coefficient of whole labor force variable $(L)$ is positive and equal to 1.61E-08. This coefficient states that one percent increase of whole labor force increases economic growth by 1.61E-08 %.

Coefficient of physical capital logarithm $\log (K)$ is positive and equal to 0.32, in which show that physical capital with respect to other variables has most effect on economic growth of G8 countries. According to above result, one percent increase of physical capital is equivalent to 0.32% of economic growth.

Coefficient of higher education logarithm $\log (H)$ is negative but is meaningful, statistically, and is equal to $-0.03$. We consider average years of tertiary schooling as higher education index. By 1 % increase of average years of tertiary schooling, economic growth decreases by 0.03 %.

Coefficient of total factor productivity variable $(TFP)$ is positive and meaningful and is equal to 0.005. In other words, one percent increase of total
factor productivity increases economic growth by 0.005%.

In addition, in this model evaluation method was based on fixed effects. Selection of evaluation method was based on results of obtained tests in Eviews software, because after performing F-Lymr test (Chaw) it was determined that its model is panel data. In next stage, it was determined by using Hausman test that this model is fixed effects model.

As observed, obtained results are consistent with theoretical background and show that higher education has different influence on economic growth of G8 and OPEC countries. In six OPEC countries no meaningful effect of higher years of higher education on economic growth was found, in contrast, in G8 countries effect of higher education on economic growth was meaningful.

Discussion and Conclusion:

Vast studies about education effect on economic growth in few past decades represent this idea that human capital accumulation through formal education does not increases economic growth in all countries. Although, influence of education and human capital on economic growth and development of advanced, democratic and industrial countries is evident, there were doubts and uncertainty about the effect of investments in education system especially in higher education level in developing countries like OPEC countries.

In G8 countries production agents function in best form and economic growth most of the time is positive and they have a dynamic economy, the effect of higher education on economic growth is stronger. However, in those countries that their economy is depend on export of raw materials and have not dynamic economy and considerable production, effect of higher education on economy is negligible. With this purpose, the effect of higher education on economic growth of two groups of countries with different economic structure and policy, that is, G8 industrial and OPEC member countries has been estimated and compared with each other by using combinational data of 1990-2010 decades. Based on predicted model, the effect of all studied variables such as labor force, physical capital, total factor productivity and higher education on economic development in G8 countries was meaningful. The effect of higher education on economic development in G8 countries was negative and meaningful. It means, economic growth will decrease with increase of average years of higher education in G8 countries because academic educated labor force with more years of higher education will enter to the market posterior. There is required infrastructure for more production by them, therefore the average years of high education increased, economic growth will decline. While prediction of this model for six OPEC countries shows no meaningful effect of education agent on economic growth because there is not required infrastructure for increasing economic growth by educated and skillful experts. As observed, results show that higher education has different influence on economic development of G8 and OPEC countries and finally this hypothesis confirmed statistically. In advanced and industrial economy of G8 countries that is based upon increase of production, export, international exchanges and privatization, government intervention has been reached to minimum level. Higher education system in these countries has more freedom and independence in comparison with raw material exporter countries and offer more favorable outcomes with higher quality to manufacturing and economic sector. Therefore, countries like OPEC group that are exporter of raw materials should pay special attention to this subject; of course, therefore serious endeavor should be carry out in order to higher education system reach freedom, independence and its deserved and worth full position in development of these countries.

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