

# **Human Capital and Economic Growth: A Panel Data Analysis with Health and Education for MENA Region**

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## **Abstract**

This article analyzes the relation between economic growth and human capital for the period between 1990 and 2011 in 15 MENA (Middle East and North Africa) countries. The authors rely on The Augmented Solow Model as it is used in Mankiw et. al. (1992). However, the statistical analysis is panel-data for countries. Human capital is represented separately by health and by education. The findings show that in MENA countries, when education quality is improved, the GDP per capita would increase, thus growth can be much effective. It is also noted that both in terms of health and education the public spending for human capital has no significance on GDP per capita. The decision makers of countries may pay attention, if effective growth process takes part in their agenda for development strategies.

**JEL classification numbers:** I15, I25, O40.

**Keywords:** Human Capital, Economic Growth, Panel Data, MENA Region.

## **1 Introduction**

Recent theoretical studies in the field of growth focus on the responsibilities of human capital in the process of economic growth. This made human capital one of the most discussed issues in the field of economics. There are two main components of human capital: education and health. While education enhances the quality of human capital, health improves the efficiency and effectiveness of human capital. Health also has great importance in that it supports the other elements of human capital. Being healthy sets the ground for the improvement of education level.

Cullison (1993)<sup>[1]</sup>, Barro and Sala-i-Martin (1995)<sup>[2]</sup> figured out that there is a positive relation between government expenditures for education, and growth; on the other hand, Levine and Renelt (1992)<sup>[3]</sup> found that there is no strong relation between the

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expenditures for education and economic growth. In Kelly's study (1997)<sup>[4]</sup>, student enrollment rate and education expenditures were set as variables, and it was derived that statistically education does not have a significant effect on economic growth. Grossman (1972)<sup>[5]</sup>, who looks into the effect of health capital on economic growth and productivity, is among the researchers who study the relation between health and economy. Grossman (1972) suggests that the number of days one can work for would go up if people are healthy. Barro (1996)<sup>[6]</sup>, suggests that health is the engine of economy and is an asset that produces capital. To measure the effect of human capital in the field of health, Barro and Lee (1993)<sup>[7]</sup> relied on life expectancy. They used it as the proxy value of health stock. According to the findings of the study, human capital in the area of health affects economic growth positively to a great extent. Rivera and Currais (2003)<sup>[8]</sup>, on the other hand, state that health expenditure is one of many other factors that affect the wellbeing of nations. They also suggest that productivity is positively affected by health expenditure and thus a better economic growth is ensured thanks to higher labor productivity.

This paper aims to empirically analyze the effects of health and education, which constitute the components of human capital, on the economic growth of MENA countries. Panel data analysis is preferred for this analyze in these countries between 1990 and 2011. Focusing on human capital as the driving force behind economic growth especially for developing countries causes overemphasis on education and health related gains. The reason why the economic growth rates per capita are relatively low in MENA countries may be the rapid growth of population and their economic growth being mainly dependent on oil export. In addition, the region lacks dynamic sectors that can compete in the international arena and hosts unregistered labor market. Under the stated circumstances, it is of utmost importance to look for an answer to the question what the relation between human capital and economic growth in the MENA region will be.

The following part of the paper presents the relevant literature accounts. The third part includes the methodological framework employed in the study. The fourth part consists of the data descriptions and the test results. The last part features the conclusion and offers some policy implications.

## **2 Literature Review**

Human capital has two components: education and health. Education provides the quality of labor, while health increases labor's efficiency and performance. There are several empirical studies focusing on the effect of variables related to health and education on economic growth. Some of these studies include education alone while others involve only health; there are also studies that pay attention to both.

In those empirical studies covering the relation between education and growth, the following were used for proxy variable of human capital: the number of students registered for a variety of education levels, schooling rate, literacy rate, the rate of university graduates, and expenditures for education. For the empirical studies about relation between health and growth, following items were selected as variables: population growth rate, average life expectancy, life expectancy at birth, infant death and birth rates, calorie per person, and healthcare expenditures.

One of the studies pointing at the relation between education component of human capital, and growth was conducted by Zhang and Casagrande (1998)<sup>[9]</sup>. They conducted a

study in a cross-section of 69 countries, and concluded that subsidizing education increases the economic growth in both developing and developed countries. Asteriou and Agiomirgianakis (2001)<sup>[10]</sup> set different education levels as variable of human capital for Greece. They found that there is long term positive relation between each variable and growth. In addition, Keller's study (2006)<sup>[11]</sup>, conducted for East Asian countries, the findings reveal that expenditures for primary schools and expenditures per student for this level are influential on economic growth. Hu (2010)<sup>[12]</sup>, drawing on the human capital theory that benefits from Cobb-Douglas production function, analyzed the contribution of investments in human capital to the economic growth in Xinjiang. Hu (2010) found that education positively contributed to economic growth between 1990 and 2009, and underlined that the government should increase its educational investments in order to be able to fully make use of human capital accumulation. Huang and Li (2010)<sup>[13]</sup>, covering the period 1952-2004, examined the relation between China's higher education scale and GDP. Using Unit Root Test, Cointegration Test and Variance Decomposition, they found that there is correlation between GDP and number of students enrolled in higher education institutions. They conclude that economic growth can affect higher education scale, and that the contribution of education to economic growth is constantly increasing.

One of the studies that examine the relation between the health component of human capital and growth is conducted by Barro (1996)<sup>[6]</sup>. In his research that focuses on the relation between economic growth and the health component of human capital used the panel data of eighty countries concerning the years between 1965 and 1990. As the proxy variable of human capital in health field, life expectancy was used in the study. The findings of the study suggest that life expectancy significant variable that affects the economic growth positively. For instance, an increase by 1 per cent in average life expectancy leads to an increase by 4.2 per cent in economic growth. Moreover, Bloom and Sachs (1998)<sup>[14]</sup> studied the relation between health and output. In their study, they used cross-section analysis for the years between 1965 and 1990. According to the results of their study, although birth and mortality rates at infancy negatively affect the output, life expectancy has the opposite effect. According to Heshmati's (2001)<sup>[15]</sup> research in the OECD countries about the relation between GDP and health expenditure per person between the years 1970 and 1992. The impact of health expenditure on economic growth is positive under the extended Solow model. Bhargava et.al. (2001)<sup>[16]</sup> examined the relation between survival rates of adults and economic growth in developed and developing countries between 1965 and 1990. They found that in lower income countries the effect of survival rates of adults is more obvious. Bloom et.al. (2004)<sup>[17]</sup> conduct another research in which they form a panel of countries for every ten years between the years 1960 and 1990. Their findings confirm that once labor experience is taken under control, there is a positive correlation between a good level of health and total output. They regard the effect of average life expectancy on growth regression as real productivity effect and state that life expectancy with an additional one year would lead to a 4 per cent increase in income per person. The data of 53 countries was utilized in the study of Jamison et.al. (2005)<sup>[18]</sup> who used the proxy variable as the rate of survival of males aged between 15 and 60 with a five years of interval scale. The findings of the study indicate that an increase of 1 per cent in the rate of survival leads to an increase of 0.23 per cent in economic growth. They suggest that the reason for the improved health is due to the faster growth between the years 1965 and 1990. Pradhan (2010)<sup>[19]</sup> examined the impact of health expenditure on economic growth in 11 OECD countries between the years 1961 and 2007. Pradhan (2010) benefited from a cointegration test which revealed

that there is a bidirectional causal relation between economic growth and health expenditure. On the other hand, the results of country specific tests indicated that there is a mixed causal relation between them. Cooray (2013) <sup>[20]</sup> analyzed 210 countries to find out the relation between health capital by gender and economic growth. Cooray (2013), found out that in higher and upper – middle income countries, there is a strong and positive relation between health and economic growth, while in lower and middle income countries health acquisitions are only significant through education and health expenditure. Cooray (2013), also highlights the fact that rises in fertility rates lead to a decrease in the effect of health on economic growth.

### 3 Theoretical Framework

The Model is taken from Solow (1956) <sup>[21]</sup>. The extended form that captures human capital variable was presented by Mankiw et.al. (1992) <sup>[22]</sup>, which this paper extensively relies on. We focus on the model's implication for panel-country data.

#### 3.1 The Solow Model

The model used in this paper originated from Solow (1956) <sup>[21]</sup>. As argued in Mankiw et.al. (1992) <sup>[22]</sup> as well, technological progress, saving and population growth are taken as exogenous variables. Two inputs are considered first: capital and labour. A Cobb-Douglas production function is assumed, so production amount at time  $t$  is given by the following equation (1).

$$Y(t) = K(t)^\alpha (A(t)L(t))^{1-\alpha} \quad 0 < \alpha < 1 \quad (1)$$

where  $Y$  is output,  $K$  capital,  $L$  labor, and  $A$  the level of technology. It is assumed that  $L$  and  $A$  grow exogenously at rates  $n$  and  $g$ .

$$L(t) = L(0)e^{nt} \quad (2)$$

$$A(t) = A(0)e^{gt} \quad (3)$$

Equation 2 and 3 show that effective units of labor,  $A(t)L(t)$ , grows at rate  $n+g$ . One of the model's assumptions is a constant fraction of output,  $s$  is invested.  $k$  is defined as the stock of capital per effective unit of labor,  $k = K/AL$ , and  $y$  is defined as the level of output per effective unit of labor,  $y = Y/AL$ , the change of  $k$  against time is given by

$$\begin{aligned} \dot{k}_t &= sy(t) - (n + g + \delta)k(t) \\ &= sk(t)^\alpha - (n + g + \delta)k(t) \end{aligned} \quad (4)$$

where  $\delta$  is the depreciation rate. According to equation (4)  $k$  converges to a steady-state value  $k^*$  defined by

$$k^* = [s / (n + g + \delta)]^{1/(1-\alpha)} \quad (5)$$

Solow model focuses on the impact of saving and population growth on real income. Equation (5) shows that the steady-state capital-labour ratio is directly proportional to the rate of saving, while inversely proportional to the rate of population growth on the other hand. When it is substituted for equation (5) into the production function and take the logs, the steady-state income can be found as follows;

$$\ln \left[ \frac{Y(t)}{L(t)} \right] = \ln A(0) + gt + \frac{\alpha}{1-\alpha} \ln(s) - \frac{\alpha}{1-\alpha} \ln(n + g + \delta) \quad (6)$$

As the model assumes that factors are paid their marginal products, it predicts the signs as well as the magnitudes of the coefficients on saving and population growth. As capital's share in income ( $\alpha$ ) is approximately 1/3, the model implies an elasticity of income per capita with respect to the saving rate of approximately 0.5 and an elasticity with respect to  $n + g + \delta$  of approximately -0.5.

From equation 6 it is expected to see whether real income is lower in countries with higher values of  $n + g + \delta$  and higher saving rates. It is assumed that  $g$  and  $\delta$  are constant across countries.  $g$  refers to the advancement of knowledge, which is not country – specific. Another assumption stresses that depreciation rates are not varying greatly across countries because all the countries proximate and hold similar economic features.

### 3.2. Solow Model with the Addition of Human Capital Accumulation

This section continues to deal with the Solow Growth Model (1956),<sup>[21]</sup> with addition human-capital accumulation. By following Mankiw et.al. (1992)<sup>[22]</sup>, and continuing from equation (6), equation (7) is the form of production function with human capital stock. Both the theoretical model and empirical analysis can be potentially changed by including human capital in analysis of economic growth.

$$Y(t) = K(t)^\alpha H(t)^\beta (A(t)L(t))^{1-\alpha-\beta} \quad (7)$$

where  $H$  is the stock of human capital, and variables are reserve their previous definitions. Assume that  $s_k$  be the fraction of income invested in physical capital and  $s_h$  the fraction invested in human capital. The change of economy can be determined by equation (8) and (9) as:

$$\dot{k}_t = s_k y(t) - (n + g + \delta)k(t) \quad (8)$$

$$\dot{h}_t = s_h y(t) - (n + g + \delta)h(t) \quad (9)$$

where  $y = Y/AL$ ,  $k = K/AL$ , and  $h = H/AL$ . It is assumed that both the same production function applies to human capital, physical capital, and consumption.

Depreciation rate of human capital is equal to physical capital.

Another assumption suggests that  $\alpha + \beta < 1$ , meaning that there are decreasing returns to all capital. The economy converges to a steady state as implied in equations (8) and (9) with the following formulas:

$$k^* = \left( \frac{s_k^{1-\beta} s_h^\beta}{n+g+\delta} \right)^{1/(1-\alpha-\beta)} \quad h^* = \left( \frac{s_k^\alpha s_h^{1-\alpha}}{n+g+\delta} \right)^{1/(1-\alpha-\beta)} \quad (10)$$

When equation (10) is changed with production function and logs are taken, the following equation for income per capita can be found.

$$\ln \left[ \frac{Y(t)}{L(t)} \right] = \ln A(0) + gt - \frac{\alpha + \beta}{1 - \alpha - \beta} \ln(n + g + \delta) + \frac{\alpha}{1 - \alpha - \beta} \ln(s_k) + \frac{\beta}{1 - \alpha - \beta} \ln(s_h) \quad (11)$$

Equation (11) and equation (6) are similar, while equation (11) shows how income per capita depends on population growth as well as accumulation of physical and human capital.

Another way to explain the function of human capital in determining income in this model is combination of equation (11) with the equation devised for steady-state level of human capital as provided in equation (10) produces an equation for income as a function of the rate of investment in physical capital, the rate of population growth, the level of human capital.

$$\ln \left[ \frac{Y(t)}{L(t)} \right] = \ln A(0) + gt + \frac{\alpha}{1 - \alpha} \ln(s_k) - \frac{\alpha}{1 - \alpha} \ln(n + g + \delta) + \frac{\beta}{1 - \alpha} \ln(h^*) \quad (12)$$

There can be made a relation between equation (6) and equation (12). They are almost identical. So it can be expected that human capital is positively correlated with the saving rate and negatively correlated with the population growth.

Equation (11) can be called the reduced form of augmented model. Both equation (11) and equation (12) can be chosen to predict the regression. So the available data will be helpful to choose the appropriate equation form.

## 4 Data

The human capital variable is analyzed in two different aspects. Thus the model is implemented for the two forms of human capital data. One of them is for health and the other of them is education. This approach may narrow our focus, but it offers an opportunity to compare the health and education contribution to growth.

We use annual data which covers the period 1990-2011. Our available data is for 15 MENA countries. These countries are; Algeria, Bahrain, Djibouti, Egypt Arab Republic, Iran, Jordan, Malta, Morocco, Oman, Syrian Arab Republic, Tunisia, United Arab Emirates, Kuwait, Lebanon and Israel. World Bank notes that there are 21 countries in MENA region. The only reason for selecting 15 of them for the study is their availability of access to information. The data used in the study has been compiled from the statistics of World Bank, IMF, OECD and UNESCO as published on their official websites. Also, statistics of the related states that have been published on their official websites have been used as a source of data related to certain years.

We use three different proxies for the rate of human capital accumulation ( $s_h$ ). The proxies for health are life expectancy at birth total years, fertility rate total (births for woman), health expenditure public (% of GDP). The proxies for education are primary completion rate total (% of relevant age group), pupil teacher ratio primary and public spending on education total (% of GDP). The dependent variable in the model is derived from Gross Domestic Product (GDP) per capita Purchasing Power Parity (PPP). Data are in constant 2005 international dollars. The dependent variable is obtained from multiplying GDP per capita and labour force/population. And after multiplication the log is taken. We take  $n$  as the average rate of growth the working-age population, where working age is defined as 15 and older who meet the International Labour Organization definition of the economically active population. We measure  $s$  as the average share of investment in real GDP, and  $Y/L$  as real GDP in 2005 divided by working-age population in that year.

## 5 Empirical Results

To run fixed/random effects we set Stata 10 to handle panel data. When we use the command “xtset countrynumber year” in this case ‘countrynumber’ represents the entities or panels (i) and ‘year’ represents the time variable (t). After execution we get the note ‘strongly balanced’ which refers to the fact that all countries have the data for each years. For our explanatory variables we have some missing data; however we can still run the model. To get our dependent variable “X15” we multiply GDP per capita, PPP with labor force / population and then we take the natural logarithm of this multiplication. This approach is taken from Knowles and Owen (1995) <sup>[23]</sup> in which their dependent variable log difference GDP per working age person. Before we run our complete model, we graph our dependent variable by country. Figure-1 shows dependent variable across years by country. Figure-2 shows related dependent variable of these countries by year in one graph.

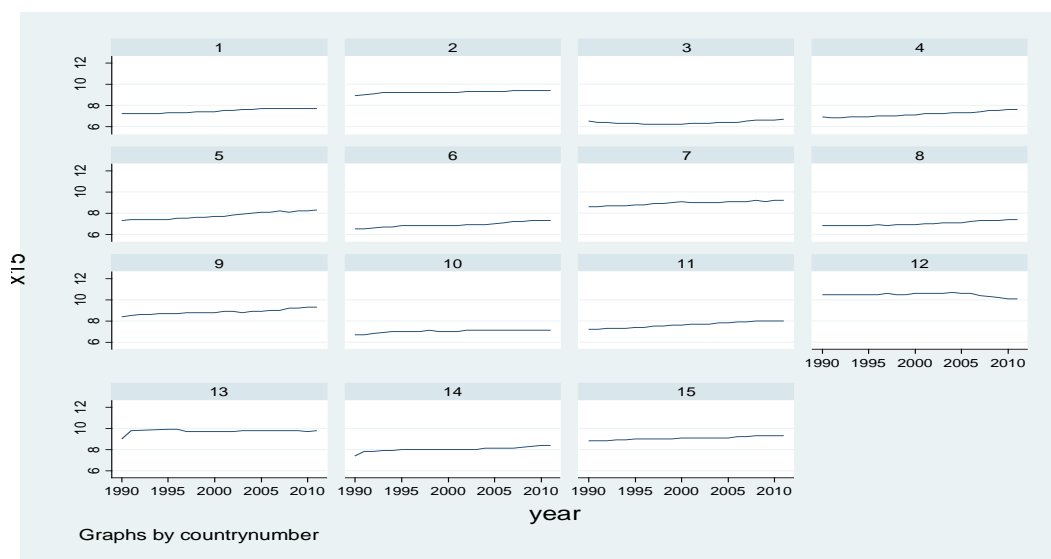


Figure 1: The Change of Dependent Variable Across Years by Country

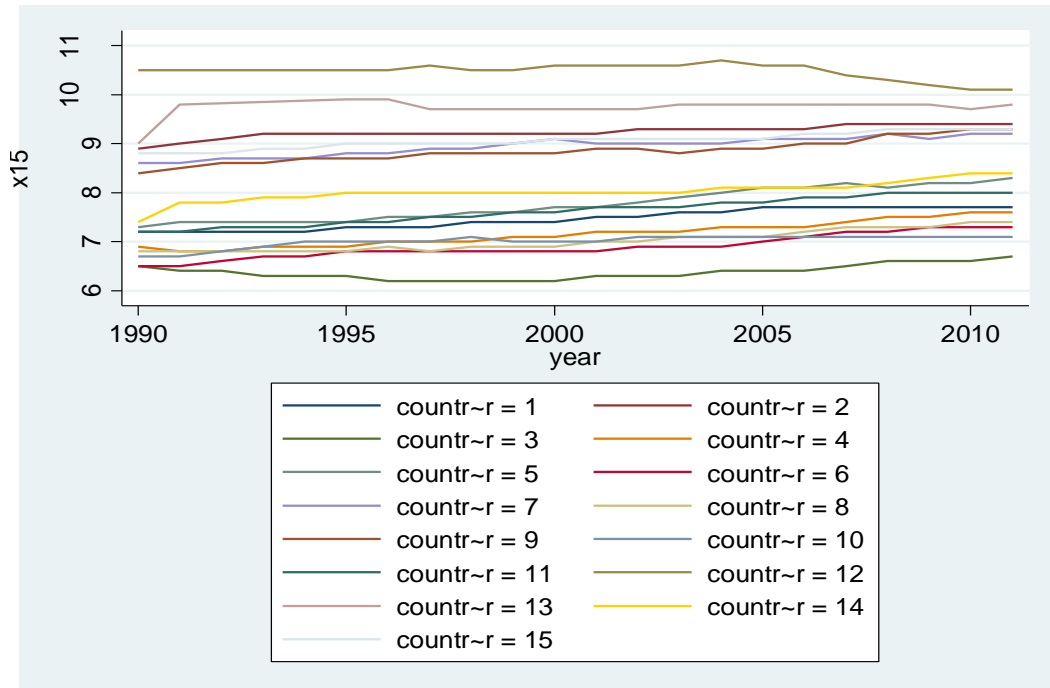


Figure 2: The Change of Dependent Variable Across Years by Country Overlaying One Graph

Table-1 presents fixed-effects and random-effects regressions of the log of income per capita on the log of investment rate, the log of  $n+g+\delta$ , and the log of the three variables are life expectancy at birth total years (X3), fertility rate total (births per woman) (X4), health expenditure public (% of GDP) (X5) respectively. The “ $(n+g+\delta)$  %” variable is coded as X15 and X16 is the log of X15. The human capital measure enters significantly in X3 and X4. But it is not significant for the X5 variable. These three variables explain almost 45 percent of the panel data-country variation in income per capita in 15 MENA countries.



Table 1: Estimation of the Augmented Solow Model with Panel Data for Health

Dependent variable: Natural log of GDP per working people in 1990-2011						
Unrestricted Regression	Fixed-effects regression			Random-effects regression		GLS
Sample: Health	X3	X4	X5	X3	X4	X5
Observations/Groups	321/15			321/15		
Constant	-7.04* (1.25)	8.67* (0.15)	7.43* (0.18)	-7.36* (1.29)	8.70* (0.24)	7.46* (0.33)
ln(I/GDP)	0.04 (0.04)	0.07*** (0.03)	0.17* (0.04)	0.03 (0.04)	0.06*** (0.03)	0.17* (0.04)
ln(n+g+ $\delta$ )	0.06** (0.06)	-0.04 (0.03)	0.01 (0.04)	0.06*** (0.03)	-0.04 (0.03)	0.02 (0.04)
ln(Health)	3.48* (0.29)	-0.66* (0.15)	0.06 (0.06)	3.56* (0.30)	-0.66* (0.04)	0.07 (0.06)
R-sq within	0.33	0.44	0.04	0.33	0.44	0.04
R-sq between	0.37	0.16	0.03	0.37	0.16	0.02
R-sq overall	0.34	0.14	0.00	0.34	0.14	0.00
F-statistics	51.64	79.95	4.94			
Wald				156.94	225.82	14.41
Restricted Regression	X3- X16	X4- X16	X5- X16	X3- X16	X4- X16	X5- X16
Constant	8.11* (0.09)	7.64* (0.04)	7.93* (0.06)	8.12* (0.28)	7.65* (0.18)	7.95* (0.26)
ln(I/GDP) - ln(n+g+ $\delta$ )	0.04 (0.04)	-0.12* (0.02)	0.05 (0.03)	0.04 (0.04)	-0.13* (0.03)	0.05 (0.03)
ln(Health) - ln(n+g+ $\delta$ )	-0.05 (0.04)	-0.28* (0.02)	-0.05 (0.03)	-0.05 (0.04)	-0.29* (0.03)	-0.05 (0.03)
R-sq within	0.04	0.26	0.04	0.04	0.26	0.04
R-sq between	0.27	0.18	0.13	0.27	0.19	0.13
R-sq overall	0.06	0.11	0.04	0.06	0.11	0.04
F-statistics	7.23	56.95	7.55			
Wald				13.70	107.15	14.23
The restriction values						
implied $\alpha$	0.04	-0.15	0.05	0.04	-0.17	0.05
implied $\beta$	-0.05	-0.45	-0.05	-0.05	-0.48	-0.05

Note: \*, \*\* and \*\*\* indicates 1%, 5% and 10% significance level.

The results in Table-1 displays that if life expectancy at birth is taken as human capital, it positively affects the income per capita for both fixed and random effects regressions. But on the other hand, if fertility rate is considered it negatively affects the income per capita. In addition, public health expenditure has no significance on these countries. The bottom of Table-1 shows that, for all three variables, the restriction is not rejected. The final lines of the Table-1 give the values of implied  $\alpha$  and  $\beta$  for the restricted regression. Here the only significant variable is X4 for both fixed and random-effects. And the values of implied  $\alpha$  and  $\beta$  for X4 is -0.15 and -0.45 respectively.

Table-2 presents the same regression in Table-1, but this time for education component of human capital represented with three variables. These three variables are primary completion rate total (% of relevant age group) (X6), pupil teacher ratio primary (X7), public spending on education total (% of GDP) (X8), respectively. The human capital measure for education enters significantly in X6 and X7 for both fixed and random-effects. However, it is not significant for X8 variable. These three variables explain more than 60 percent of the panel data-country variation in income per capita.

The results in Table-2 display that if primary completion rate is taken as human capital for education, it positively affects the income per capita for both fixed and random-effects regressions. But on the other hand, if primary pupil teacher ratio is considered, it negatively affects the income per capita, which is already expected. In addition, it is found that public spending on education has no significance on these countries.

Table 2: Estimation of the Augmented Solow Model with Panel Data for Education

Dependent variable: Natural log of GDP per working people in 1990-2011						
Unrestricted Regression	Fixed-effects regression			Random-effects regression		GLS
Sample: Education	X6	X7	X8	X6	X7	X8
Observations/Groups	321/15			321/15		
Constant	4.53* (0.36)	10.22* (0.28)	7.46* (0.19)	4.50* (0.44)	10.36* (0.34)	7.50* (0.33)
ln(I/GDP)	0.07*** (0.05)	0.05 (0.04)	0.18* (0.05)	0.07 (0.05)	0.04 (0.04)	0.17* (0.05)
ln(n+g+ $\delta$ )	-0.01 (0.04)	-0.07*** (0.03)	0.01 (0.04)	-0.00 (0.04)	-0.06 (0.04)	0.02 (0.04)
ln(Education)	0.75* (0.08)	-0.71* (0.06)	0.03 (0.05)	0.77* (0.08)	-0.74* (0.06)	0.02 (0.05)
R-sq within	0.24	0.32	0.04	0.24	0.32	0.04
R-sq between	0.19	0.61	0.02	0.20	0.62	0.15
R-sq overall	0.18	0.51	0.06	0.19	0.51	0.04
F-statistics	31.97	48.50	4.69			
Wald				96.86	147.40	13.38
Restricted Regression	X6- X16	X7- X16	X8- X16	X6- X16	X7- X16	X8- X16

	7.85*	8.18*	7.97*	7.86*	8.21*	7.98*
Constant	(0.09)	(0.33)	(0.04)	(0.28)	(0.17)	(0.25)
	0.14*	-0.10*	0.05***	0.14*	-0.11*	0.05
ln(I/GDP) - ln(n+g+ $\delta$ )	(0.04)	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)
ln(Education)	- 0.08***	-0.24*	-0.05	0.08***	-0.25*	-0.05
ln(n+g+ $\delta$ )	(0.04)	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)
R-sq within	0.05	0.19	0.05	0.05	0.19	0.05
R-sq between	0.05	0.47	0.02	0.05	0.50	0.01
R-sq overall	0.01	0.25	0.00	0.09	0.27	0.00
F-statistics	8.31	35.39	7.55			
Wald				16.00	68.58	14.52
The restriction values						
implied $\alpha$	0.11	-0.15	0.05	-0.11	-0.17	0.05
implied $\beta$	0.07	-0.36	-0.05	0.07	-0.39	-0.05

Note: \*, \*\* and \*\*\* indicates 1%, 5% and 10% significance level.

The bottom of Table-2 shows that for all three variables, the restriction is not rejected. The last lines of the Table-2 give the values of implied  $\alpha$  and  $\beta$  for the restricted regression. Here the significant variable is X6 and X7 for both fixed and random-effects. It is seen that the significance level of X7 is more than X6. The values of implied  $\alpha$  and  $\beta$  for X7 is -0.15 and -0.36 respectively.

## 6 Conclusion

In this article, the relation between economic growth and human capital is analyzed for the period between 1990 and 2011 in terms of 15 MENA countries. Human capital is represented separately by the concepts of health and education. According to the definitions of World Bank; there are 21 MENA; but the available data allows examination of 15. The preferred statistical method in this study is the panel-data estimation for countries. Fixed and random-effect results are obtained and displayed for comparison.

To predict the economic model used in this paper, taken directly from Augmented Solow Model, three different proxies for both health and education are used. While the proxies for health are life expectancy at birth, fertility rate and public health expenditure, the proxies for education are primary completion rate, pupil teacher ratio and public education expenditure. The prediction of GDP per capita can be improved if the data on human capital is available.

An analysis of the health variable for human capital reveals that the statistically significant proxies are life expectancy at birth and fertility rate. The importance of health in growth is shown by this finding. Analysis of education variable suggests that the significant proxies are primary completion rate and pupil-teacher ratio. This finding shows that if the quality of education is improved the GDP per capita would increase, thus growth can be much more effective. It is also noted that, both in terms of health and

education the public spending for human capital has no significance on GDP per capita in MENA countries. This finding might have a political aspect if it is considered in detail by decision makers of those countries.

It can be said that the results in Table-1 and Table-2 do not support Augmented Solow Model since the data used in this paper for human capital consists of proxies different than original Solow Model. In addition, the countries that are analysed are different from original Solow Model in terms of their geographical structures. However the restricted regressions have some meaning. While the restricted regression for health is significant for only fertility rate, it is significant for both primary completion rate and pupil -teacher ratio for education. And, the level of significance for primary completion rate is less than pupil-teacher ratio. In addition, while the implied  $\alpha$  and  $\beta$  in the proxy of fertility rate for health is -0.15 and -0.45 it is -0.15 and -0.36 respectively for education.

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