Education and economic growth: the case of MENA** countries

Mirnaser Mirbagheri hir[1], Farzad Rahimzadeh[2] and Javad Ghadimpoor[3]

1Department of economics, Payame Noor University, PO BOX 19395-3697 Tehran, I.R of IRAN
E-mail:mirbagheri_hir@yahoo.com
2 Department of economics, Payame Noor University, PO BOX 19395-3697 Tehran, I.R of IRAN
E-mail:rahimzadeh@modares.ac.ir. Tel: +989141535890
3Management and Accounting Department, ParsabadMoghan Branch, Islamic Azad University, Parsabad, Iran
*Corresponding Author: Javad Ghadimpoor

Abstract: Empirical evidences indicate that education is necessary for economic development process in each country. Education can increase labor productivity, people income, life quality, human capital accumulation and led to economic growth. Therefore in this study, we use selected MENA countries data and panel data approach for examine relationship between education and economic growth. First, stationary of variables has been tested, and then cointegration of model variables has been surveyed by pedroni panel cointegration tests. Study results show that in MENA countries, secondary and tertiary educations are important factor to increase production. In contrast, primary education has no statistically significant effect on production level.
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** Middle East and North Africa. Sample countries are Algeria, Egypt, Islamic Republic of Iran, Jordan, Malta, Morocco, Oman, Saudi Arabia, United Arab Emirates, Syrian Arab Republic, Tunisia, Lebanon and Kuwait.

1. Introduction

Education can play key role in economic development process. From the macroeconomic aspects, education and its quality affect on labour productivity, human capital accumulation and led to future economic improvement. Also, in microeconomic aspect, education increase employment opportunities and people income and improve life quality for them. Therefore, Education has an important share in economic policy and economic development map in each country. In other words, Education is universally acknowledged a primary tool to promote economic development. It plays a fundamental part in developing human capital and escalates economic growth by improving skills, increasing competency, and productivity. The education brings benefits for the whole society and the individuals. This importance indicate that policy maker in every economy should be inform about the economic impacts of education and consider it.

economic growth model that presented by Robert Solow, has emphasis on physical capital and labour force as a determinant of economic growth in each country, after him, other economist such as Robert Lucas introduce another type of capital that named "human capital". The human capital theory recognizes people as a type of economic asset and shows that increased investment in health, skills, and knowledge provides future returns to the economy through increases in labor productivity. Education increases workers' average earnings and productivity, and it also reduces the incidence of social problems such as drug abuse, crime, welfare dependency, and lack of access to medical care, all of which can weigh heavily on the economy. This feature of capital can explain a part of growth differences between countries. By assuming that education has major share in human capital formation, we can consider education as necessary input for enhance production level.

Because of education importance, the impact of education on economic growth has been surveyed in several studies. Some study concluded that education has a significant and positive impact on economic growth. Barro (1991) finds a positive relationship between education expenditures and economic growth. Benhabib and Spiegel, (1994) acknowledge the human capital development as a source of economic growth. Gemmell (1996) determine that, both human capital and their growth rates as main determinants of economic growth. In other one, education has an insignificant and no clear impact on economic growth. For instance, De Meulmester and Rochet (1995) concludes that the relationship between education and economic growth is not always positive.

The purpose of this study is to survey importance of education on economic development in MENA countries. Therefore, we use these country's data and panel data approach to examine the education effects on economic growth.

2. Theorical basics

The relationship between economic growth and education has been one of the central treads of economic analysis. Consider Mankiw, Romer, and Weil (1992) human capital augmented Solow model of economic growth.

$$Y(t) = K(t)^{\alpha} H(t)^{\beta} [A(t)L(t)]^{1-\alpha-\beta} \qquad (1-2)$$

Where $\alpha, \beta \in [0,1], \alpha + \beta \in [0,1]$ and t denotes time. This implies that the production function exhibits constant returns to scale in its three factors: physical capital (K), human capital (H), and productivity-augmented labor (AL). All markets (both input and output markets) are assumed to be perfectly competitive. All firms are assumed to be identical. The economy can then be described by a representative agent. Physical capital and human capital are assumed to be accumulating factors and the representative agent saves output to have more capital (either physical or human).

As education becomes more broadly based, low-income people are better able to seek out economic opportunities. Psacharopoulos(1992) by study of the relation between schooling, income inequality and poverty in 18 countries of Latin America in the 1980s found that one quarter of the variation in workers' incomes was accounted for by variations in schooling attainment. It concludes that clearly education is the variable with the strongest impact on income equality. Bourguignon (1995) investigate the determinants of income distribution in 36 countries found secondary enrollment rates to be significant.

We can receive to steady-state level of output by mathematical ways. It show that, the rate of human capital accumulation can affect the steady-state level of output per effective worker and higher level of human capital accumulation lead to higher level of output per effective worker. From an empirical perspective, the addition of human capital to the model allows for another dimension to be invoked in explaining differences in output levels across countries. Therefore, Countries who invest in education are predicted to have higher income levels than those who don't, for any given investment rate in physical capital.

3. Literature review

Since the work of Mankiw, Romer and Weil (1992) and Barro (1991), there has developed a large literature on relation between education and economic growth. Some authors conclude that the education quantity has positive effects on economic growth (Hanushek, 1995, Temple, 2001, Krueger and Lindahl, 2001, Gemmel, 1996, Benhabib and Spiegel, 1992). Education quantity is measured by schooling enrolment ratios (Mankiw, Romer and Weil 1992, Barro 1991, Levine and Renelt 1992), the average years of schooling (Hanushek and Woessmann 2007, Krueger and Lindhal 2001), adult literacy rate (Durlauf and Johnson 1995, Romer 1990) and education spending (Baladacci et al.). Baladacci et al. (2008) find a positive association between education spending and economic growth. Ozturk (2001) concluded that Education in every sense is one of the fundamental factors of development and No country can achieve sustainable economic development without substantial investment in human capital. Cooray (2009) examine the effect of the quantity and quality of education on economic growth. This study finds that education quantity when measured by enrolment ratios, unambiguously influences economic growth. There are however, studies that find a weak relationship between education quantity and growth. Devarajan et al. (1996) observe a negative insignificant relation between public spending on education and economic growth. Bils and Klenow (2000) and Prichett (2001) finds no relation at all between schooling and economic growth.

Also, the relationship between schooling quality and economic growth is examined in the work of Barro (1999), Hanushek and Kimko (2000), Hanushek and Kim (1995), Hanushek and W oessmann (2007). The studies of Hanushek and Kimko, Hanushek and Kim and Hanushek and Woessmann develop a measure of labour force quality based on cognitive skills in mathematics and science and find that this has a strong and robust influence on economic growth. Barro (1999) using data on student scores on internationally comparable examinations to measure schooling quality finds a positive relation between schooling quality and economic growth.

4. Model specification

We Consider Mankiw, Romer, and Weil (1992) human capital augmented Solow model of economic growth.

$$Y(t) = K(t)^{\alpha} H(t)^{\beta} [A(t)L(t)]^{1-\alpha-\beta} \qquad (1-4)$$

Where $Y(t)$ is the level of output, $K(t)$ physical capital, $H(t)$ human capital and $A(t)$ the level of technology. Taking the natural logarithm of equation (4-1), equation (4-2) is obtained.

$$LnY(t) = \alpha LnK(t) + \beta LnH(t) + (1-\alpha-\beta)Ln[L(t)A(t)] \qquad (2-4)$$

By Adding a random component to the equation (4-2) with this assumption that $\varphi = (1-\alpha-\beta)LnA(t)$, equation (4-3) is obtained.

$$LnY(t) = \varphi + \alpha LnK(t) + \beta LnH(t) + (1-\alpha-\beta)LnL(t) + U(t) \qquad (3-4)$$

Since, this equation to be estimated by cross- country data, the estimated equation is as follows.

$$Ln(Y)_{i,t} = \varphi_i + \alpha Ln(K)_{i,t} + \beta Ln(H)_{i,t} + (1-\alpha-\beta)(L)_{i,t} + U_{i,t} \qquad (4-4)$$

Where i Index denote the number of country ($i = 1-14$) and t is the data set period ($t = 1990-2011$). $U_{i,t}$ is error term that include the country effects (μ_i), time effects (λ_t) and disturbance term of the equation ($\varepsilon_{i,t}$). That is $U_{i,t} = \varepsilon_{i,t} + \lambda_t + \mu_i$.

1.4. Data

In this article, 13 countries from MENA considered for 1990 - 2011 period. In the estimated model, variables are defined as below:

$LnY(t)$: Natural logarithm of each country's GDP (constant 2000 US$)

$LnK(t)$: Natural Logarithm of gross capital formation.

$LnL(t)$: Natural Logarithm of labor force

$LnH(t)$: Natural Logarithm of education variable that measured by Primary enrollment (%gross), secondary enrollment (%gross), tertiary enrollment (%gross), Education expenditure (US $) and Education expenditure (%GDP).

All variables data collected from World Bank online database (2012).[1]

2.4. Model estimation

First, we should ensure model variable's stationary by conversional unit root tests. The most widely utilized panel unit root tests are the Im, Pesaran and Shin(IPS) W –test (1997), Levin, Lin and Chu(LLC) t-test (1992) and Fisher type unit root test developed by Maddala and Wu (1999) (Fisher-ADF). In this section, we use Maddala and Wu (MW, 1999) Panel Unit Root Test or The Fisher-ADF test. The Fisher-ADF panel data unit root test is a much more flexible test and is applicable even to unbalanced panels and it is valid for individual ADF tests with different lag lengths. The Fisher-ADF test statistic λ , which has a chi-square distribution with 2N degrees of freedom under the null hypothesis, is expressed as

$$\lambda = -2\sum_{i=1}^{N} \log(\pi_i) \qquad (5-4)$$

Where π_i refers to the probability values from individual ADF unit root tests for each country in the panel. The results of unit root test can summarized as follow in Table1.

[1] - http://data.worldbank.org/data-catalog/world-development-indicators

Table 1: Results of variables stationary based on Fisher-ADF test

situation	variable	level	First difference
Individual intercept and trend	Primary enrollment(%gross)	Non Station	Station
Individual intercept and trend	secondary enrollment(%gross)	Non Station	Station
Individual intercept and trend	Tertiary enrollment(%gross)	Non Station	Station
Individual intercept and trend	Gross domestic product	Non Station	Station
Individual intercept and trend	Gross capital formation	Non Station	Station
Individual intercept and trend	Labor force	Station	-
Individual intercept and trend	Education expenditure(US $)	Non Station	Station
Individual intercept and trend	Education expenditure(%GDP)	Station	-

Table 1 results show that GDP, gross capital formation, Primary enrollment (%gross), secondary enrollment (%gross), tertiary enrollment (%gross) and Education expenditure (US $) have not stationary property in variable level. These variables are stationary by getting first differences. In other words mentioned variables have a unit root. Labor force and Education expenditure (%GDP) are stationary. Hence, the model variables should be sure to cointegrated. If the model variables cointegrated, there is a long-run relationship between the dependent variable and independent variables in the model.

So, to ensure cointegraion of variables, Pedroni panel cointegration test (1997, 1999) is used. Pedroni (1997, 1999) developed a number of statistics based on the residuals of the Engle and Granger (1987) cointegration regression. The tests proposed in Pedroni (1997, 1999) allow for heterogeneity among individual members of the panel, including heterogeneity in both the long-run cointegrating vectors and in the dynamics. Assuming a panel of N industries each with m regressors (X_m) and T observations, the long run model is written as:

$$Y_{it} = \alpha_i + \lambda_i t + \beta_{1i} X_{1,it} + \beta_{2i} X_{2,it} + \ldots + \beta_{mi} X_{m,it} + \varepsilon_{it} \quad t = 1,\ldots,T \quad i = 1,\ldots,N \qquad (6-4)$$

Equation (6-4) implies that all coefficients, and, hence, the cointegrating vector, vary across countries. thus allow full heterogeneity across individual members of the panel. In these tests, the null hypothesis is for each member of the panel the variables involved are not cointegrated, and the alternative that for each member of the panel exists a single cointegrating vector. Pedroni (1997, 1999) also developed seven panel cointegration statistics. Four of these statistics, called panel cointegration statistics, are *within-dimension* based statistics. The other three statistics, called Group mean panel cointegration statistics, are *between-dimension* panel statistics. Following Pedroni (1995, 1997), the heterogeneous panel and heterogeneous group mean panel of rho (ρ), parametric (ADF) and non-parametric (PP) statistics are calculated as follows.

1. Panel *v*-Statistic

$$Z_v = \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^{2} \right)^{-1} \qquad (7-4)$$

2. Panel ρ -Statistic

$$Z_\rho = \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^{2} \right)^{-1} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i} \left(\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i \right) \qquad (8-4)$$

3. Panel non-parametric (PP) *t*-Statistic

$$Z_{pp} = \left(\sigma^2 \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^{2} \right)^{-1/2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \left(\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i \right) \qquad (9-4)$$

4. Panel parametric (ADF) *t*-Statistic

$$Z_t = \left(\hat{S}^{*2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^{*2} \right)^{-1/2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1_{i,t-1}}^{*} \Delta \hat{e}_{i,t}^{*} \qquad (10-4)$$

5. Group ρ -Statistic

$$\tilde{Z}_\rho = \sum_{i=1}^{N} \left(\sum_{t=1}^{T} \hat{e}_{i,t-1}^{2} \right)^{-1} \sum_{t=1}^{T} \left(\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i \right) \qquad (11-4)$$

6. Group non-parametric (PP) *t*-Statistic

$$\tilde{Z}_{pp} = \sum_{i=1}^{N} \left(\hat{\sigma}^2 \sum_{t=1}^{T} \hat{e}_{i,t-1}^{2} \right)^{-1/2} \sum_{t=1}^{T} \left(\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i \right) \qquad (12-4)$$

7. Group parametric (ADF) *t*-Statistic

$$\tilde{Z}_t = \sum_{i=1}^{N} \left(\sum_{t=1}^{T} \hat{S}_i^{-2} \hat{e}_{i,t-1}^{*2} \right)^{-1/2} \sum_{t=1}^{T} \hat{e}_{i,t-1}^{*} \Delta \hat{e}_{i,t}^{*} \qquad (13-4)$$

where $\hat{\sigma}^2$ is the pooled long-run variance for the non-parametric model given as $1/N \sum_{i=1}^{N} \hat{L}_{11i}^{-2} \hat{\sigma}_i^2$; $\hat{\lambda}_i = 1/2\left(\hat{\sigma}_i^2 - \hat{S}_i^2\right)$, where $\hat{L}_i$ is used to adjust for autocorrelation in panel parametric model, $\hat{\sigma}_i^2$ and $\hat{S}_i^2$ are the log-run and contemporaneous variances for individual *I,* and $\hat{S}^2$ are obtained from individual ADF-test of $e_{i,t} = \rho_i e_{i,t-1} + v_{i,t}$; S^{*2} is the individual contemporaneous variance from the parametric model, $\hat{e}_{i,t}$ the estimated residual from the parametric cointegration, while $\hat{e}_{i,t}^{*}$ the estimated residual from the parametric model and $\hat{L}_{11i}$ the estimated log-run covariance matrix for $\Delta\hat{e}_{i,t}$, and L_i is the *i*th component of the lower-triangular Cholesky decomposition of matrix Ω_i for $\Delta\hat{e}_{i,t}$ with the appropriate lag length determined by the Newey-West method.

The small sample size and power properties of all the seven statistics are examined in Pedroni (1997). In terms of power, Pedroni showed that the group-ADF statistic generally performs best, followed by the panel-ADF statistic. While the panel-variance and the group-rho statistic do poorly.

In this section, seven models have been estimated with panel data. Cao Panel cointegration test results of these models are presented in Table 2.

Table 2: Cointegration of model variables

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Panel	*Group*	*Panel*	*Group*	*Panel*	*Group*	*Panel*	*Group*	*Panel*	*Group*
Variance ratio	3.32*	-	6.7*	-	-0.09	-	-2.3*	-	1.8	-
Rho statistic	6.55*	8.08*	6.35*	7.76*	6.41*	7.75*	6.39*	7.77*	5.89*	7.08*
PP statistic	-9.26*	-9.94*	-5.55*	-8.66*	0.07	-6.99*	1.38	-6.72*	1.63	-7.19*
ADF statistic	-3.59*	-3.7*	-0.99	-2.94*	-0.43	-4.18*	-0.38	-3.1*	1.51	-3.03*

A * indicates the rejection of the null hypothesis of no cointegration at least on the 0.05 level of significance.

Results from Table 2 indicate the null of no cointegration is rejected by all seven statistics in model 1. In model 2, null hypothesis is rejected by six statistics. In model 3, 4 and 5, null of no cointegration is rejected by four, five and four statistics, respectively. On the basis of these results, the long-run relationship between model variables strongly supports.

Final Models can be estimated in form of Pooled data or Panel data. The Leamer F test used to detect it. The null hypothesis of this test supposes that model should be estimated as Pooled data. Results of this test presented in table 3. If panel data approach accepted, in the second step, should be determine which method is suitable (fixed effects or random effects) for estimate the Panel data. In this stage, the Housman test (1980) used. Housman test examine the null hypothesis that random effects is suitable for model estimation. If the null hypothesis rejected, fixed effects methods are used. The results of this test show in the table 3, too. It should be noted that due to the model's logarithmic form, we can say that the coefficient of each variable, is elasticity of them. That is, if these variables change 1 percent, the dependent variable of model will change equal to this variable's coefficient. We use several proxies as education variable. These proxies include Primary enrollment (PRIM), secondary enrollment (SEC), tertiary enrollment (TER), Education expenditure in term of US $ (EDU) and Education expenditure as percent of GDP (EDUGDP).

Table 3: result of model estimation (dependent variable: GDP)

variables	Model 1	Model 2	Model 3	Model4	Model 5
c	9 (10.3)*	6.33 (6.25)*	6.04 (6.77)*	7.6 (6.7)*	10.49 (10.95)*
Ln(K)	0.128 (4.32)*	0.288 (11.07)*	0.31 (8.25)*	0.22 (6)*	0.26 (6.73)*
Ln(L)	0.46 (10.74)*	0.75 (12.86)*	0.74 (14.04)*	0.678 (11.66)*	0.466 (9.28)*
Ln(EDU)	0.254 (11.89)*	-	-	-	-
Ln(EDUGDP)	-	0.075 (1.25)	-	-	-
Ln(PRIM)	-	-	0.002 (0.029)	-	-
Ln(SEC)	-	-	-	0.35 (8.22) *	-
Ln(TER)		-	-	-	0.27 (11.5)*
R^2	0.88	0.82	0.84	0.856	0.92
Leamer F test	224.19 (0.00)**	239.94 (0.00)**	214 (0.00)**	215.17 (0.00)**	202 (0.00)**
Housman test	0 (1.00)***	0 (1.00)***	0 (1.00)***	0 (1.00)***	0 (1.00)***

Note: figures in parentheses are t-statistics of each coefficient.

A * indicates the rejection of the null hypothesis on the 0.01 level of significance.
A ** indicates the rejection of the null hypothesis of leamer F test on the 0.01 level of significance.
A *** indicates that we can't reject the null hypothesis of hausman test on the 0.01 level of significance.

In all models, the leamer F test reject null hypothesis .therefore these models can be estimated as the panel data. Also, Housman Test results show that we can't reject null hypothesis and we should estimate all models as random effects. Model estimation results show that capital stock and labor force have positive and statistically significant impacts on production level and have expected signs.

The models results show that capital stock coefficient is estimated "0.128 to 0.31". Since the models are in logarithmic form, so we conclude that if capital stock change 1 percent and all other conditions remain constant, production levels will change "0.128 to 0.31" percent .Also, the estimated coefficient of the labor force is 0.46 to 0.75. This indicate that the elasticity of labor in these countries, is between 0.46-0.75 and by changing labor force 1 percent, production levels will change 0.46 to 0.75 percent, if other conditions remain constant.

The estimation results indicate that, if we measure education variable by secondary enrollment (SEC), tertiary enrollment (TER) and Education expenditure in term of US $(EDU), education has positive and statistically significant effect on output level in MENA selected country. In contrast, education proxies such Education expenditure as percent of GDP (EDUGDP) and Primary enrollment (PRIM) has no significant effects on production. Therefore, we can conclude that, in MENA countries, secondary and tertiary educations are important factor for increase production in these countries.

5. Summary and Concluding Remarks

In this study, the relationship between education and economic growth examined. First, data stationary property tested by Fisher-ADF panel data unit root test. Then, using Pedroni panel cointegration test, existence of cointegration between model variables surveyed. Results of this test indicate that existence of long-run relationship between model variables strongly supported. Also, Leamer F test and hausman test suggest that model should be estimated by panel data approach and as random effects.

Model estimation results show that education variable has positive and statistically significant effects on production level, if it measured by secondary enrollment (SEC), tertiary enrollment (TER) and Education expenditure in term of US $(EDU). In contrast, if education variable measured by Education expenditure as percent of GDP (EDUGDP) and Primary enrollment (PRIM), it has no significant effects on production. Therefore, we can strongly conclude that in MENA countries, secondary and tertiary educations, in contrast Primary enrollment, are important factor to increase production level.

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