International Journal of Advanced Research in Education and Society
e-ISSN: 2682-8138 | Vol. 1, No. 1, 35-43, 2019
http://myjms.mohe.gov.my/index.php/ijares

THE LINK BETWEEN EDUCATION AND ECONOMIC GROWTH IN ALGERIA: AN EMPIRICAL INVESTIGATION

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Accepted: 1 April 2019 | Published: 15 April 2019

Abstract: *This paper examines the link between education and economic growth in Algeria over the period 1990-2016. This period is seen as the transition period where Algeria has conducted structural economic changes. The study employs the co-integration and error-correction models as well as Granger causality test. The main findings of the empirical study revealed the existence of a long-run equilibrium relationship between education and economic growth in Algeria. However, there is no causality between them. It is, therefore, imperative to rethink the quality of the educational outcomes, and to adapt them to the real requirements of the national economy.*

Keywords: Education, Economic growth, Co-integration, Algeria

1. Introduction

Education has long been viewed as the engine of economic growth. Enabling work force with high skills will raise their productivity. Equally empowering people with education will enhance the quality of their lives, socially, politically, culturally and so on. These non-monetary returns to education in addition to the increased productivity will have a positive and sustainable effect on economic growth.

It has been well established in both the augmented neoclassical theory (Mankiw, Romer, Weil 1992) and the endogenous growth theory (Lucas, 1988; Romer 1990) that the human capital –accumulated through education- plays a crucial role in spurring economic growth. This conclusion is strongly supported by a myriad of empirical studies either nationally or internationally.

On the other hand, there is an inter-relationship between education and economic growth; education is both the seed and the flower of economic growth. That means education can positively affect growth, and in turn this latter once increased can rise funding for education sector.

Given the educational levels, researchers usually argue that in developing countries primary and secondary education explain economic growth in contrast to developed education where tertiary education is mainly the most important educational level that impacts growth. This refers chiefly to the technological gap between the two groups. While the developed countries are the main source of innovation and new knowledge, the role of developing countries is basically to imitate and assimilate what comes from abroad.

In attempting to investigate the link between education and economic growth, most studies did not distinguish between the pre and post-transition periods. In our paper, the main objective is to focus mainly on the post-transition period (after 1990) while addressing the relationship between secondary education and growth in Algeria. During this period, the private sector has been developed, and it became an important player in the labour market. To carry out the empirical study, we used co-integration approach and Granger causality test. The main results suggest that there is a long-run relationship between education and growth in Algeria; however, education does not cause economic growth.

The rest of the paper is organised as follows: Section two reviews literature on the link between education and economic growth. Section three presents the empirical evidence. Section four describes the data and methodology. Section five analyses the empirical results and discussion. Section six concludes.

2. Theoretical background

According to Hanushek and Wößman (2010), there are at least three channels through which education can influence economic growth. First, education enables accumulating human capital of working force. Hence productivity will increase, and consequently "transitional growth toward a higher equilibrium level of output" [as in augmented growth theories, cf. Mankiw et al. (1992)]. Second, education promotes innovation which results in creating new technologies. This in turn will spur economic growth [as in the theories of endogenous growth: Luas (1988), Romer (1990)]. Third, the diffusion of knowledge can be facilitated by education. This diffusion can successfully help in implementing new technologies devised by others [cf., Nelson and Phelps (1966), Benhabib and Spiegel (1994)].

Admitting that education affects economic growth based on the above arguments, the question that arises usually is whether the accumulation or the stock of education that impacts growth. Lucas (1988) and Mankiw et al. (1992) among others argue that the accumulation of human capital matters for growth whereas Nelson & Phelps (1966) and Benhabib & Spiegel (1994) –for example- believe that the stock of human capital which effects growth.

Besides, most researchers focus on quantitative measures of education while they run growth regressions. In fact, few studies use proxies for the quality of education to estimate "the effective" effect of education on growth. In this respect, for instance, Hanushek and Kimko (2000) used data from the international student achievement tests to build a measure of educational quality. They found a statistically and economically significant positive effect on education quality on growth between 1960 and 1990. This effect is far larger than the relationship between the quantity of education and economic growth.

Beyond this discussion, some economists make the point that the role of education in growth is still subject to controversy. Sheehan (2014), for instance, states four arguments to highlight this view. First, not education as a whole which effects economic growth, but rather certain kinds of education such as higher education in sciences and technology, technical training, and agricultural education. Second, there is the problem of measurement since human capital –unlike physical capital- is intangible and "embodied" in human beings. Third, it is not easy to ascertain the effect of education on growth given the long-term nature of investment in education like the other social investments –such as transportation. Fourth, it is difficult to specify the impact of education on growth since it is indirect; education –as part of research and development (R&D)- effects growth via technical change which is complex in reality.

3. Empirical evidence

There exist a large number of empirical studies that attempted to investigate the contribution of education in developing countries. These studies used different techniques for estimation. Some of them adopted the augmented neoclassical approach while others relied on the endogenous growth theories. The findings as will be shown confirm that there are huge differences in terms the nature of the relation education-growth.

In their paper, Kreishan and Alhawari (2011) investigated the causal impact of education on economic growth in Jordan over the period 1978-2007. They used cointagration and causality tests for this purpose. The main result of their study shows that there is long-run relationship between education and economic growth in Jordan. In Pakistan, Naeem and Jangraiz (2012) used cointegration technique to study the relationship between education and economic growth during 1971-2008. They found that both primary and secondary education contribute to GDP per capita. Moreover, they argued that there is a long-run relationship between education and growth. In Nigeria, Owalabi and Okwu (2010) examined the role of human capital in economic growth during the period 1983-2004. They used OLS technique to estimate the model. Results showed that only secondary and tertiary education enrolment rates exerted statically significant effect on growth in Nigeria over that period. Leoning (2004) investigated the impact of education on economic growth in Gualtimala for the period 1951-2002. By using ECM model, he concluded that better educated labour force has a positive and significant impact on growth. Furthermore, a growth accounting framework showed that education explains about 50% of the output growth.

In the Algerian context, numerous studies attempted to highlight the relationship between education and economic growth. Various techniques have been used for estimation such as cointegration and ARDL. Among the latest studies are the following:

Cherifi (2012), in his paper, investigated the role of human capital in growth in Algeria between 1964 and 2010. He used enrolment rates in secondary education as a proxy for human capital. He applied VAR technique for estimation. The main finding of his study shows that there is a negative effect of education on economic growth. In their study, Moussaoui and Zirar (2015) estimated the effect of government spending on education on economic growth during 1970-2009. They used co-integration approach to study the long-run equilibrium between the both variables. They concluded that rising spending on education reduces growth in Algeria. In another study, Becherair (2014) used ARDL approach to study the relationship between educational levels and economic growth during the period 1971-2011. The results indicated the existence of a stable long-run relationship between primary and tertiary education on one hand, and economic growth on the other one. Hanni and Benmariem (2014) estimated the impact of education on economic growth during 1991-2009. They adopted the model proposed by Mankiw et al. (1992). They used enrolment rates in secondary education as a proxy for human capital. Their main finding is that there exists a significant positive impact of education, lagged three years, on growth. Increasing enrolment in secondary education by 1% will raise growth by 0, 17% after three years. In contrary, there is a negative relationship between the two variables in the short run. Houchine (2015) studied the relationship between graduates from university –as a measure of human capital- and economic growth over 1970-2009. To do so, he used a cointegration model. He revealed that the increase of the number of graduates by 1% will raise economic growth by 0,27% in the long run. Chemingui and Ayadi (2003) listed a set of factors that explain the poor contribution of education in economic growth in Algeria. First, labour institutions and

education system are inefficient. Second, the national economy is not well diversified. Third, the participation of private sector is still weak. Fourth, the labour policy is not efficient.

In fact, the findings of these studies are contradictory. This may refer to many possible factors. One can list at least three main factors: the different measures used for education, the different techniques used for estimation, and the different periods over which the studies estimated the effect of education on growth.

4. Data and Methodology

In this study, we use annual data time series that cover the period 1990 to 2016. The variables used are obtained from the World Bank database (WDI, 2018). The study model is based on a Cobb Douglas production function: (Naeem & Jangraiz, 2012)

$Y = (A, K, L)$ (1)
If human capital is included in equation (1), it becomes as follows:
$Y = (A, K, L, H)$ (2)
Where (Y) shows real GDP Per Capita, (L) shows labour force, and (H) denotes human capital. This latter is measured by secondary education.

The empirical form of the model becomes:
$\ln Y = \alpha 0 + \alpha 1 \ln K + \alpha 2 \ln L + \alpha 3 \ln SE + \mu i$ (3)
Where:
K is the physical capital measured by the Gross Fixed Capital Formation (GFCF).
L is the labour force participation rates.
SE is the number of students enrolled in secondary education.
μi is the error term.
$\alpha 0, \alpha 1, \alpha 2, \alpha 3$ are the respective parameters.

Thus the model used for estimation is given as follows:
$\ln GDP = \alpha 0 + \alpha 1 \ln GFCF + \alpha 2 \ln L + \alpha 3 \ln SE + \mu i$ (4)

All variables are measured in real terms, and they are all of them expressed in logarithm.

5. Empirical Analysis

As there are several methods used to detect the unit root in time series, and to determine the order of its stationary, it is used here the Philips Perron (PP) test statistic. Table (1) shows the results:

Table 1: The Results of PP Unit Root Tests

Variables	Philips Perron Test statistic		
	Intercept & trend	Intercept	None
LnGDP	-3.110777 (0.1247)	- -	- -
D(LnGDP)	-3.155655 (0.1159)	- -	-2.594115 (0.0118)**.***
LnGFCF	-2.568084 (0.2962)	- -	- -
D(LnGFCF)	-4.885508 (0.0032)*.**.***	- -	- -

LnL	-0.924854 (0.9376)	- -	- -
D(LnL)	-6.683457 (0.0001)*.**.***	- -	- -
LnSE	-1.130106 (0.9040)	- -	3.818465 (0.9998)
D(LnSE)	-4.317880 (0.0113)	-4.020159 (0.0050)*.**.***	- -

Note: *, **, *** represent significance at 1%, 5% and 10% respectively.

The results reveal that all the variables are non-stationary at level, but they are stationary after taking the first difference. The variables Gross Domestic Product per capita (LnGDP), Gross Fixed Capital Formation (LnGFCF), labour force (LnL) and Secondary Education (LnSE) are integrated at the order of one I (1), where there is a mixture of DS and TS types.

After determining the integration order of all time series, we next examine the optimal lag length of VAR model as shown in table (2). All the lag length criteria were determined by one optimal lag length as well.

Table 2: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	118.2023	NA	1.27e-09	-9.136185	-8.941165	-9.082094
1	251.1530	212.7212*	1.12e-13*	-18.49224*	-17.51714*	-18.22179*
2	266.8227	20.05718	1.29e-13	-18.46582	-16.71064	-17.97900
* indicates lag order selected by the criterion						

The results of trace test for the null hypothesis (H0) show that the number of co-integration equations is less than or equal to "r". In addition, time series for the variables are static. It is shown that the probability values of the trace test are greater than the tabulated significant values in two cases.

Thus, the null hypothesis (H0) is rejected and the alternative one (H1) is accepted. This is confirmed by maximum Eigen value test which is carried out by two co-integration equations (table 3). Hence there is at least one co-integration equation which indicates a static linear combination between the two variables. This result also ascertains the existence of a long-run equilibrium relationship between these variables. That means they do not diverge from each other, and they show similar behaviour among them.

Table 3: Johansen Cointegration Test for education-growth relationship

Hypothesis		Trace	Critical	Prob	Hypothesis		Max-Eigen	Critical	Prob
H_0	H_1	Statistic	Value 5 %		H_0	H_1	Statistic	Value 5 %	
r = 0	**r = 1**	57.65844	40.17493	0.0004	**r = 0**	**r ≥ 1**	29.14933	24.15921	0.0097
r = 1	**r = 2**	28.50911	24.27596	0.0138	**r ≤ 1**	**r ≥ 2**	18.73454	17.79730	0.0360
r = 2	r = 3	9.774564	12.32090	0.1288	r ≤ 2	r ≥ 3	9.606376	11.22480	0.0950
r = 3	r = 4	0.168188	4.129906	0.7343	r ≤ 3	r ≥ 4	0.168188	4.129906	0.7343

Since there is a long-run equilibrium relationship between variables, the error correction model can be estimated. This involves estimating short-term and long-term parameters of different variables. The estimated model based on error correction is formulated in the following equation:

D(LNGDPC) = C(1)*(LNGDPC(-1) - 2.01630386887*LNL(-1) - 4.32326455689*LNSE(-1) + 0.202968552986*@TREND(90) + 85.8565650771) + C(2)*(LNGFCF(-1) + 3.22802942698*LNL

(-1) + 1.07176917017*LNSE(-1) - 0.186274421781*@TREND(90) - 89.5633497866) + C(3)*D(LNGDPC(-1)) + C(4)*D(LNGFCF(-1)) + C(5)*D(LNL(-1)) + C(6)*D(LNSE(-1)) + C(7)

The results of the estimation show that estimated lagged error correction term is negative and significant, ECT=C(1)= -0.097139 is the speed of adjustment towards equilibrium. It is the speed of adjustment of any equilibrium towards long run equilibrium state, suggesting that approximately 9.71% of disequilibrium in previous year is corrected in the current year.

Table 4: Vectors Error Correction Model Estimation

Variables	Coefficient	Std. Error	t-Statistic	Prob
C(1)	-0.097139	0.029007	-3.348799	0.0036
C(2)	-0.239508	0.067774	-3.533922	0.0024
C(3)	0.032592	0.217460	0.149874	0.8825
C(4)	-0.064978	0.091436	-0.710640	0.4864
C(5)	0.193049	0.338250	0.570729	0.5752
C(6)	0.020057	0.124445	0.161169	0.8738
C(7)	0.010987	0.010160	1.081425	0.2938

R-squared	0.582356	Mean dependent var	0.013759
Adjusted R-squared	0.443141	S.D. dependent var	0.021232
S.E. of regression	0.015844	Akaike info criterion	-5.220567
Sum squared resid	0.004519	Schwarz criterion	-4.879282
Log likelihood	72.25709	Hannan-Quinn criter.	-5.125909
F-statistic	4.183145	Durbin-Watson stat	2.176357
Prob(F-statistic)	0.008313		

The above result means that it takes approximately one year for any deviation from the long run relationship between education and growth economic to be corrected after a change in education.

The other variables such as C(2), C(3), C(4), C(5), C(6) and C(7) they are all short run coefficients whether these variables jointly can influence GDP or not. After having used Wald statistic, p-value of the Chi-Square value is equal to 0.0000 (less than 5%). Therefore, we reject the null hypothesis and accept the alternative one. That means the variables Gross fixed capital formation, labour and secondary education can jointly influence the dependent variable (real GDP per capita).

Table 5: Wald Test-Coefficient Restrictions for all variables

Wald Test: Equation: Untitled			
Test Statistic	Value	df	Probability
F-statistic	7.298634	(6, 18)	0.0005
Chi-square	43.79181	6	0.0000
Null Hypothesis: C(2)=C(3)=C(4)=C(5)=C(6)=C(7)=0			

However, secondary education represented in (C6) cannot alone influence the dependent variable in the short-run, so the decision on this model is consistent with Table (6).

Table 6: Wald Test-Coefficient Restrictions for secondary education and economic growth

Wald Test: Equation:Untitled			
Test Statistic	Value	df	Probability
t-statistic	0.161169	18	0.8738
F-statistic	0.025976	(6, 18)	0.8738
Chi-square	0.025976	6	0.8720
Null Hypothesis: C(6)=0			

Time series often contain autocorrelation errors; therefore, we use the following test to detect the risk of autocorrelation. The Breusch–Godfrey serial correlation LM test is used to test for autocorrelation in errors in the regression model. The Breusch-Godfrey test provides the following results:

Table 7: Breusch-Godfrey Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	2.479649	Prob. F(2,16)	0.1153
Obs*R-squared	5.915391	Prob. Chi-Square (2)	0.0519

Either considering the probability associated with Fisher's statistic (F-statistic) which equals 0.1153 or that of Chi-Square which is more than 5%, it is concluded, therefore, that there is no autocorrelation of residuals in the model.

On the other hand, we used a White Heteroskedasticity test (this test is used to check if the error variances are no longer on the first diagonal), so the variance of the error is then linked to the values of the explanatory variables.

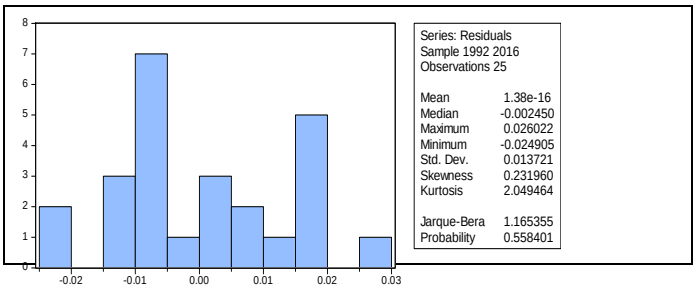
Table 8: White Heteroskedasticity Test

Heteroskedasticity Test: White			
F-statistic	1.444149	Prob. F(6,18)	0.2525
Obs*R-squared	8.123879	Prob. Chi-Square(6)	0.2292
Scaled explained SS	2.209866	Prob. Chi-Square(6)	0.8994

The White Heteroskedasticity Test in this study is shown in Table (8). All probability values of Fisher's statistic (F-statistic) and Chi-Square are more than 5%. One can conclude that there is no heteroskedasticity in the model.

Also, it is necessary to check the normality of the errors. According to the decision rules of the test, we can say that the errors are normally distributed, because the probability associated with Jarque-Bera is equal to 0.558401 (more than 5%). It means equally that the series are stationary.

Figure 5: Normality Test for Errors



Besides, in order to investigate the causality between the variables, we used the causality test initiated by GRANGER (1969). Table (9) provides the results of the short-run Granger causality test based on the probability of Fischer statistic that tests jointly the significance of the coefficients of the explanatory variables in their first differences.

Table 9: Results of Granger Causality Test

Null Hypothesis:	Obs	F-Statistic	Prob.
D(LNSE) does not Granger Cause D(LNGDPC)	25	0.56935	0.4585
D(LNGDPC) does not Granger Cause D(LNSE)		0.65016	0.4287

Based on the results mentioned in the table (9), there is no causal link between secondary education and economic growth in Algeria in both directions.

6. Conclusion

In summing up, evidence strongly suggests that in many developing countries the role of education in economic growth is central (the experience of the South East Asian economies is a good example). Theoretically speaking, the views on the mechanisms by which education affects growth are indeed different, but they ultimately acknowledge such effect.

This paper attempted to investigate the relationship between secondary education and economic growth over the transition period (after 1990) using Johansen co-integration test. It tended equally to test the causality between them using Granger causality test. After having checked the stationary of the variables under study, the co-integration test results showed the existence of a long-run equilibrium relationship between secondary education and economic growth. Nevertheless, causality test suggested neither education causes growth nor growth causes education in Algeria. These results are consistent with the results found in many studies on the link between secondary education and growth in Algeria (see, for instance, those studies mentioned in the empirical evidence of this paper).

In light of these findings, one can advance that the quantity of education alone is not enough to have an impact on growth. Instead, the quality of education is the effective driver of economic growth: "knowledge rather than just time in school is what counts for economic growth" as suggested by Hanushek and Wößman (2010). Unfortunately, the ranking of the Algerian education system is at the bottom in the international education quality evaluation reports such as that of PISA (2015). Therefore, it is imperative for policy makers to focus much more on enhancing the quality of education and link the skills acquired in secondary schools with the real requirements of the national economy.

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