Long-Run Relationship between Education and Economic Growth: Evidence from Nigeria

Sikiru Jimoh Babalola
Lecturer, Department of Economics
Federal University of Technology
Yola, Adamawa State
Nigeria.

Abstract

The paper empirically evaluates the impact of education on economic growth in Nigeria. To achieve this, time series were used and the unit root properties of the variables were verified using the Augmented Dickey-Fuller and Phillips-Perron techniques. The results suggest that the variables (economic growth and education) are integrated of order one while the Error Correction terms are integrated of order zero, which is a condition for the existence of cointegration on the basis of Engle-Granger Approach. The Johansen cointegration test further confirms the existence of long-run relationship between the two variables of interest. The causality test results indicate uni-directional causality which runs from economic growth to education. The error-correction mechanism gives evidence for the short-run dynamics. Hence the need for quality assurance in education to make it growth enhancing.

Key words: Education; Economic Growth; Causality; Cointegration

JEL Classification Codes: C22; H52; O11; O15

1. Introduction

Education is commonly regarded as the most direct avenue to rescue substantial number of people out of poverty owing to the tendency for employment opportunities especially for higher skilled workers to be created (Babatunde & Adefabi, 2005),which eventually leads to growth. It is perhaps in recognition of this that academic researchers and policy makers have been preoccupied with analysis of the impact of education on economic growth. As a matter of fact, the role of education in any economy is more crucial today than ever before because of the knowledge based globalised economy. Such attention is also rooted in the fact that productivity greatly depends on the quantity and quality of human resource, which itself largely depends on investment in education. In other words, investment in education leads to the formation of human capital, comparable to physical and social capital, and that makes a significant contribution to economic growth (Pradhan, 2009; Dicken et al., 2006; Loening, 2004; Gylfason and Zoega, 2003; Barro, 2001).

Thus, a fundamental way of generating sustainable economic growth has been educational development. The basic importance of education is to enable individuals with knowledge to be better able to apply that knowledge. Therefore, it is noteworthy to mention that returns on investment in education translate to economic growth and of course extend to improvement in the quality of the society because education can affect children's attitudes and assist them to grow up with social values that are more beneficial to themselves and the nation at large (see Pradhan, 2009; Yogish, 2006; Babatunde & Adefabi, 2005). To the best of our knowledge, much has not been done in this area in recent years on Nigeria. More specifically, the relationship between education and economic growth in Nigeria needs to be further investigated not only with a view to confirming the results of previous studies, but also considering the level of educational decadence in Nigeria. The remaining part of the paper is organized as follows: section two covers the theoretical and empirical review; section three describes the method of analysis; section four is where empirical results are presented and discussed, and finally, section five contains the summary and conclusion.

2. Theoretical and Empirical Review

2.1 Theoretical Linkage between Education and Growth

It is very clear in the literature that the interest in economic growth and its causes dates back to the time of Adam Smith and David Ricardo, even though the formalization of growth theories was not until 1950s and 1960s. Generally, growth theory suggests that economic growth depends on the accumulation of economic (including human) assets, and the return on these assets, which in turn depend on technological progress, the efficiency with which assets are being used, and the institutional frameworks of production (Blackden et al., 2007).

Specifically, the theoretical basis for the impact of education on economic growth takes its root in the endogenous growth theory, which emphasizes on the centrality of human capital for innovation and technological progress (Gundlach et al., 2001; World Bank, 2000). The theory emerges out of 'policy ineffectiveness', which characterizes the neo-classical growth theory by giving importance to the production of new technologies and human capital development, thereby focusing on factors within the model rather than relying on external factors. Endogenous growth economists believe that improvements in productivity are linked to a faster pace of innovation and extra investment in human capital (Babatunde & Adefabi, 2005). They emphasize on the need for government and private sector institutions and markets which nurture innovation to actively provide incentives for individuals to become inventive. They also identify the central role of knowledge as a determinant of economic growth. Endogenous growth theory therefore predicts positive externalities and spillover effects from development of a high valued-added knowledge economy to the development and maintenance of a competitive advantage across the globe.

2.2 Related Empirical Evidence

The existence of a considerable large volume of micro and macro-empirical evidences on the relationship between education and economic growth makes it impossible to explore all the literature. While the micro-economic evidences focus on impact of education on individuals' incomes and other associated benefits, macro-ones give attention to the growth effects of aggregate investment in education. However, some of these previous relevant studies are reviewed below: At the microeconomic level, Harmon et al. (2001) find that an additional year of schooling increases wages at individual level by around 6.5 per cent across European countries and that this effect can be as high as 9 per cent in EU members with less regulated labour markets where pay scales presumably reflect productivity more closely.

In their study on OECD, Mankiw et al. (1992) find that if human capital investment (as a share of GDP) is increased by a tenth, output per worker will rise by 6 per cent; if investment in human capital is doubled, output per worker will eventually rise by about 50 per cent. Coming to the macroeconomic level, a study by Pradhan (2009) on India using error-correction modelling, establishes a uni-directional causality from economic growth to education. Aghion et al. (2009), provide evidence to support the causal impact of education on economic growth in the United States. Babatunde and Adefabi (2005) and Dauda (2010) find similar evidence in their studies on Nigeria. Other studies whose findings agreed with positive effect of education on economic growth include (Mankiw, Romer &Weil, 1992; Barro, 1991; Landau, 1983).

3. Methodology and Data

3.1 Model Specification

The model specification draws inspiration from the earlier works of Pradhan (2009) and Babatunde and Adefabi(2005). The choice of the existing model is based on the fact that it allows for generation and estimation of all the parameters without resulting into unnecessary data mining.

The growth model for the study takes the form:

$$gdp = f(edu) \qquad (1.0)$$

Where gdp and edu are the gross domestic product and investment in education respectively.

Equation (1.0) is treated as a Cobb-Douglas function with investment in education, edu, as the only explanatory variable. It can therefore be expressed in linear form:

$$\text{loggdp}_t = \beta_0 + \beta_1 \text{logedu}_t + \varepsilon_t \qquad (1.1)$$

$$\beta_0 \text{ and } \beta_1 > 0$$

The variables remain as previously defined with the exception of being in their log form. ε_t is the error term assumed to be normally, identically and independently distributed.

3.2 Stationarity and Cointegration

Stationary test:

It has been argued in the literature that almost all macroeconomic variables have unit roots or random walk (i.e., are non-stationary) over time. In other words, macroeconomic data usually have a stochastic trend that is capable of influencing the statistical behavior of the alternative estimators. Such stochastic trend is removable by differencing. By definition, stationarity means the non-existence of unit root. Using functional definition, if $Y_t = \rho Y_{t-1} + U_t \quad \text{and} \quad -1 \leq \rho \leq 1$, where Y_t is the variable of interest and U_t is a white noise error term, we say variable Y_t has unit root and conclude that it is non-stationary provided $\rho = 1$.

The verification of the unit root status of variables becomes imperative because regression based on non-stationary variables is spurious and could undermine the policy implications (see Engle and Granger, 1987).
A variable that is stationary at level is said to be integrated of order zero (I (o)), while the one that becomes stationary, after differencing is integrated of order 'd' (i.e., I (d)), where 'd' is the number of time a variable undergoes differencing before attaining stationarity. The time series properties (or unit roots) of the variables used in this study were examined using Augmented Dickey – Fuller (ADF) (Dickey and Fuller, 1979 and 1981) and Phillips-Perron(PP) techniques. The lag length will be selected using the Schwartz Bayesian Information Criterion (BIC).
Cointegration test:
In economics, the concept of cointegration denotes existence of long – run or equilibrium relationship between two or more variables. A test for cointegration is conducted as a pre–test to avoid 'spurious regression' situations (Granger,1986). According to Granger's representation theorem, if there is cointegration, at least unidirectional causality exists. In this study, the cointegration approach developed by Johansen (1988) and expanded by Johansen and Juselius (1990) is accordingly adopted.

3.3 Causality Test and Error Correction Mechanism:

Granger Causality test:
Causality is a kind of statistical feedback concept which is widely used in the building of forecasting models. Historically, Granger (1969) and Sim (1972) were the ones who formalized the application of causality in economics. However, Granger's work dominates the literature, and becomes popularly known as Granger causality test. The definition states that in the conditional distribution, lagged values of Y_t add no information to explanation of movements of X_t beyond that provided by lagged values of X_t itself (Green, 2003). In summary, one variable (X_t) is said to granger cause another variable (Y_t) if the lagged values of X_t can predict Y_t and vice-versa.

In this study, the Granger causality test was performed using the following vector autoregressive (VAR) models:
If causality (or causation) runs from edu to gdp, we have:

$$loggdp_t = \sum_{i=1}^{k} \alpha_i \, loggdp_{t-i} + \sum_{j=1}^{k} \beta_j \, logedu_{t-j} + u_{1t} \qquad (2.1)$$

If causality (or causation) runs from gdp to edu, it takes the form:

$$logedu_t = \sum_{i=1}^{k} \gamma_i \, logedu_{t-i} + \sum_{j=1}^{k} \delta_j \, loggdp_{t-j} + u_{2t} \qquad (2.2)$$

It is assumed that the disturbance terms u_{1t} and u_{2t} are uncorrelated.

The decision rule:
From equation (2.1), $logedu_{t-j}$ Granger causes $loggdp_t$ if the coefficient of the lagged values of edu as a group (β_j) is significantly different from zero based on F-test (i.e., statistically significant). Similarly, from equation (2.2), $loggdp_{t-j}$ Granger causes $logedu_t$ if δ_j is statistically significant.

Error Correction Mechanism:
Error correction mechanism was first used by Sargan (1984), later adopted, modified and popularized by Engle and Granger (1987). By definition, error correction mechanism is a means of reconciling the short-run behaviour (or value) of an economic variable with its long-run behaviour (or value). An important theorem in this regard is the Granger Representation Theorem which demonstrates that any set of cointegrated time series has an error correction representation, which reflects the short-run adjustment mechanism.
The error correction models for this study take the form:

$$\Delta loggdp_t = \alpha_0 + \alpha_1 \Delta logedu_t + \alpha_2 ect_{1t-1} + e_{1t} \qquad (2.3)$$

$$\Delta logedu_t = \beta_0 + \beta_1 \Delta loggdp_t + \beta_2 ect_{2t-1} + e_{2t} \qquad (2.4)$$

Where, Δ is the difference operator (i.e., $\Delta \text{loggdp}_t = \text{loggdp}_t - \text{loggdp}_{t-1}$ and $\Delta \text{logedu}_t = \text{logedu}_t - \text{logdpgedu}_{t-1}$), t is time trend, ect is error correction term, e_{1t} and e_{2t} are white noise error terms. The coefficients of the ect (i.e., α_2 and β_2) capture the extent to which the models converge to equilibrium after deviation from their long-run equilibrium positions. For the long-run equilibrium position to be restored after deviation (or disturbance), estimated value of at least one of α_2 and β_2 is expected to be negative and statistically significant.

3.4 Data

The major variables used for this paper are Gross Domestic Product (GDP) and expenditure on education (EDU). The data for both variables are time series covering (1977 - 2008). The data are obtained basically from the Central Bank of Nigeria Statistical Bulletin.

4.0 Empirical Results and Discussion

This section covers the empirical results of the study. The first part is devoted for stationarity and cointegration results, and followed by that of the Granger causality.

Unit Root Test

Table 1 presents the results of the unit root test. The results show that both variables of interest, namely loggdp and logedu attained stationarity after first differencing, I(1), using both the ADF and PP tests for unit root. However, the error correction terms (ect_1 and ect_2) are found to be stationary at level (i.e.,I(0)), which is an indication of necessary condition for the existence of cointegration between economic growth (gdp) and investment in education(edu).

Cointegration Test

Having established the time series properties of the data, the test for presence of long-run relationship between the variables using the Johansen and Juselius(1992) trace statistic for cointegration was conducted. The results are reported in Table 2 and confirm the presence of a single cointegrating vector at five percent level of significance.Estimating the long-run relationship, the results are contained in equation (1.1)* which show positive relationship between education and economic growth. Precisely, 1% increase in investment in education raises the level of GDP by 107.1%.

$$\text{loggdp} = 1.6874 + 1.0710\text{logedu} \qquad (1.1)^*$$
$$(0.1660)\quad (0.0419)$$
$$R^2 = 95.60\%$$

The standard errors are in the parentheses and both the constant and the behavioural parameter are statistically significant at 1%.

Granger Causality Test

The results of Pairwise Granger Causality between economic growth (gdp) and investment in education (edu) are contained in Table3. The results reveal the existence of a unidirectional causality which runs from economic growth (gdp) to investment in education (edu), while the reverse does not hold. These results are in consonance with similar study by Pradhan (2009) on Indian economy.

Error Correction Models

It is established in the literature that cointegration is a necessary condition for an error- correction model to hold (see Engle and Granger, 1987 and 1991). The results of the error-correction model as contained in (2.4)* reveal evidence for the model to be error-correcting in the long-run after short-run disturbance. This is captured by the statistical significance of negatively signed error-correction term. However, the estimates for equation (2.3) could not meet the a priori expectation both in sign and statistical significance and therefore not reported. It should be noted that the reported results suffice as earlier indicated.

$$\Delta\text{logedu}_t = 0.0532 + 0.2694\Delta\text{loggdp}_t - 0.4552\text{ect}_{2t-1} \qquad (2.4)^*$$

5. Conclusion

The paper seeks to analyze, empirically, the relationship between investment in education and economic growth in Nigeria using annual data over the period 1977 to 2008. The unit root properties of the data were examined using both the ADF and PP techniques after which the cointegration and causality tests were conducted.

The error correction models were also estimated in order to examine the short –run dynamics. The major findings include the following:

- The series of both variables of interest, namely, education and economic growth were found to be integrated of order one using both the ADF and PP tests for unit root.
- The existence of long-run relationship between education and economic growth as confirmed by the Johansen cointegration test results.
- The presence of a uni-directional causality which runs from economic growth to education and not vice-versa.
- The error correction estimates gave evidence of convergence to equilibrium path after short-run disturbance.

The paper is therefore a contribution to fill the gap between the developed and developing countries in the existing literature.

Finally, the paper recommends:

- The enhancement of productivity in order to boost growth (GDP).
- The need to focus on quality assurance in education in order to make it growth enhancing.

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Appendix

Table 1: Results of Unit Root Test

Variable	Augumented Dickey-Fuller Test(ADF)			Philips-Perron Test(PP)		
	ADF Statistic	Probability	Order of Integration	PP Statistic	Probability	Order of Integration
loggdp	-4.285488	0.0117**	I(1)	-4.217079	0.0136**	I(1)
logedu	-5.600401	0.0006*	I(1)	-5.766139	0.0004*	I(1)
ect_1	-3.090716	0.0398**	I(0)	-2.725663	0.0312**	I(0)
ect_2	-2.852240	0.0649***	I(0)	-2.826695	0.0678***	I(0)

Source: Author's computation from the computer output.
(*)(**)(***) are 0.01, 0.05 and 0.1 levels of significance respectively.

Table 2: Results of Johansen Cointegration Test

Eigen value	H_0	Trace Statistic	0.05 Critical Value	0.01 Critical Value
0.387	$r \leq 0$	12.239*	9.24	12.97

Note: r denotes the number of cointegrating vectors.
* Indicates rejection of null hypothesis (H_0) at 0.05(5%) critical value.
Source: Author's computation from Johansen Cointegration test results.

Table 3: Pairwise Granger Causality Test

Lags: 2

Null Hypothesis(H_0):	Observation	F-Statistic	Probability
edu does not Granger Cause gdp	30	0.66658	0.52235
gdp does not Granger Cause edu	30	5.02389	0.01466*

* Indicates rejection of null hypothesis (H_0) at 0.05(5%) critical value
Source: Author's extract from the computer output.