Education and Economic Growth Nexus: Does Proxy Matter

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ABSTRACT

This study tests whether education-economic growth nexus is sensitive to proxy used for education. Three broad proxies were identified in the literature, expenditure on education which is an input, school enrolment, which is a flow and education attainment which is a stock. While attainment is the most reliable of the three, expenditures on education is the least reliable. However for African countries, expenditure on education is the most available, while education attainment is hardly available. Using annual data for gross enrolment in primary, secondary and tertiary institutions, for Nigeria between 1970—2009 as the first proxy for education, and total capital and recurrent expenditures on education for the same period as an alternative proxy. The study finds that education is not associated with economic growth with both proxies in growth empirics.

Keywords: Enrolments, Expenditures, Attainment, Education, Growth

1.0 INTRODUCTION

The debate on how to measure education stemmed from the arguments on its definition. The skill that is embodied in an individual has different dimensions that involve health, education and lifestyle. In quantitative terms, therefore, human capital involves the measurement of health, education and other social services that contributed to the improvement of individual well-being (Uwatt, 2002). The most common and quantitative measurement of human capital component is education. Human capital is multi-faceted and includes a complex set of human attributes. The stock of human capital held by individuals is hard to measure with precision in a quantitative term. The stock of education received formally in school remains the closest way of measuring the component of human capital stock obtained through schooling.

Several approaches have been used to measure education in the literature on growth empirics, while some researchers used enrolment ratio (Barro, 1997; 1998); Petrakis and Stanelasis (2002), others used the proportion of population that has attained a certain level of education (Barro and Sala-i-Martin, 1995). Some others used expenditures on education (McMahon, 1987) (Appiah and McMahon, 2002).

This paper seeks to use two of the commonest proxies for education: gross enrolment and expenditure to test whether education-economic growth nexus is sensitive to the type of proxy used for education with Nigerian data. What follows this introductory section is a brief review of literature, this is followed by discourse of different measurements of education, their strength and weakness. Section four presents the model. Section five discusses the results while sector six presents the concluding remarks.

2.0 A Brief Review of Literature

Most of the studies on growth-education linkage often seek to explain differences in economic growth rate across countries in term of levels and changes in education and human capital among other variables. What spurs these cross-country studies is the fact that vast differences in growth rates among countries are not easily explainable by traditional neo-classical growth models. Cross countries studies were made popular in the 1990s by Barro (1997) who pioneered the usage of different variables to explain growth differences in a number of countries.

A major problem associated with cross-country studies is the inability to take care of country specific characteristics (Easterly and Levine, 2001). Some studies have also shown that cross-country studies on growth determinants, popularly known as growth regression approach, suffers from the problem of homogeneity in technology level (Eberhardt and Teal, 2009). This means that country specific characteristics are not taken into consideration. As alternative approach is also to use country specific studies with the aim of getting specific country behaviour that may explain education economic growth nexus better.

A comparative analysis of literature on growth empirics for both developing countries and developed countries (OECD) shows that proxy used for estimation of education differs due to availability of data.

Fraise-Seren (2000) proposed a new interpretation for the process of human capital accumulation using factor of the employed population with at least secondary school education as proxy for education human capital for Spain. The study finds

that the higher the country level of education, the more the desire for accumulation of education to augment level of income. Some studies also investigated the distribution of human capital within the economy by using the interaction between distribution of human capital technological progress and economic growth for Portugal. The study finds that the composition of human capital is an important factor in the determinant of the pattern of economic development.

Francis and Doucouliagos (1997) investigated the relationship between human capital formation and economic growth in the United States of America, using data for GDP in private sector only, underlying the importance of the private sector to economic growth in the United States. The study finds that causal relationship exist between economic growth and human capital.

Studies on rates of return on education for developed countries have been more extensive than those of developing countries because of availability of data. Chia (1990) estimates that the investment in first degree in Australia yields a private rate of return of 9.6 percent for male and 12.6 percent for female, while study by Maani (1996) provides similar estimates for New Zealand. This shows that studies for developed countries use more sophisticated proxies for education because of availability of data. Studies for developing countries are constrained by poor data.

Ncabe (1990) uses investment GDP ratio and total enrolment in Zimbabwe schools to test the impact of education on economic growth. The results provided strong support for a long-run relationship between education and economic growth.

Du Ha and Ahmed (2000) investigated the determinants of economic growth in Pakistan using real capital stock, labour force, real export-import tariff collection rate and secondary school enrolment. The study finds that secondary school enrolment impacted positively and significantly on economic growth in Pakistan.

Otu and Adenuga (2006) used growth rate of GDP, capital expenditure on education to test for the impact of education on economic growth in Nigeria. The study finds that education impact positively on economic growth.

Enrolments ratio involves the number of students who enrolled at certain levels of education (Barro and Lee, 1996). It is divided into two categories: gross enrolment and net enrolment. Gross enrolment figures show enrolment for students of all ages at a given level of schooling—primary, secondary or tertiary. Net enrolment figures show the proportion of students of a customary age-group that enrolls in each level of schooling. The basic difference between gross and net enrolment is that in the first, enrolments are taken irrespective of whether the candidates fall in

What the above has shown is that due to poor availability of data, poor countries tend to use two basic proxies: expenditure on education and enrolments, while developed countries do choose from variety of proxies for education.

3.0 Difference Measurements of Education

The following section briefly explains different measurements of education, their strength and weakness:

a. Education Expenditure

This involves both capital and recurrent expenditure on education for a particular period normally a year. It is usually derived from budgetary figures. It may be used as capital or recurrent expenditures. While the first involves what is used for infrastructural development and other expenditure that may have a life-span that is beyond a fixed period, the second involves those expenditures that are spent on personnel costs, consumables and other current inputs. In most countries, despite the fact that other levels of government spend enormously on education, expenditures on education by the central government are only used as a measure of public expenditure on education. This may be due partially to the availability of data, and partially because central governments dominate governance in most developing countries. Other variants of this type of measurement are education expenditure/GDP ratio, ratio of education expenditure to total expenditure, ratio of education expenditure to defence expenditure and education expenditure per capita.

Some of the problems associated with this type of measurements are: (i) expenditures not adjusted either for inflation or currency rate differentials (in case of cross-country studies) may overstate or understate the effects of education expenditure on economic growth; (ii) expenditure, like enrolment ,is not addition to stock of human capital but input (Solow, 2003); (iii) expenditures, in some countries especially in sub-Saharan African, are notorious for not reaching their targets, this may not be a good indicator of human capital stock.

b. Education Enrolments

or outside the customary age-group for the level of schooling while in the second, age-group is considered.

The problem with gross enrolment figure is that it may be overstated because of repeaters, while the problem with net enrolment figures is that they create errors when students start school at ages either earlier or later than the customary ones. The standard UNESCO categories for school enrolments are: no schooling; primary schooling; some secondary schooling; complete secondary schooling and tertiary

schooling. One of the problems with enrolment is that it is, like expenditures, an input into the production of addition human capital, and not addition to human capital itself. Also, it does not show the rate of change of the utilisation of education human capital.

c.   Educational Attainments

This deals with the proportions of the population who have successfully completed or attempted a given level of schooling—tertiary, secondary, or primary. It shows the population's attainment of skill, and knowledge associated with a particular level of education. Barro and Lee (1996) used a perpetual inventory method, with the

According to Barro and Lee (1996) educational attainment provides a reasonable proxy for the stock of schooling capital for a broad group of countries. However, these data have a number of shortcomings. First, the measure of educational attainment does not take account of skills and experience gained by individuals after their formal education. Second, the measures do not take to account

education is reflected in the performance of students and graduates. Students' scores in

.

Hanushek and Kim (1995) constructed a cross-section data set of international test scores in the subjects of science and mathematics for 39 countries. Barro and Lee (1996) have complied test scores on the examinations in science, mathematics and readings that have been conducted in various years for up to 58 countries by the International Association for the Evaluation of Educational Achievement (IEA) and the International Assessment of Education Progress (IAEP). These studies cover primary or secondary students of the same age, such as age 9, 13 and pupils in the last years of secondary education. Since the tests are carefully designed to ensure international comparability, the test scores would capture the cross-country variation in cognitive skill of the students and therefore measure differences in the quality of future labour force.

Hanushek and Kim (1995) and Barro (2002) find that test scores are positively related to growth rates of real per capita GDP in cross-country regression. One shortcoming of these data however, is that the observation applies to different years and is most abundant for OECD countries. The sample size is also smaller than those of average years of schooling.

e.   International Adult Literacy Test

Knowledge can be gained or lost after the completion of formal education. Ideally, test of cognitive ability would be administered to adults as well to students. Recently, the International Adult Literacy Survey (IALS) has, for the first-time, provided a direct comparison of certain work related skills in the adult population of various countries. The

census/survey observations on attainment as benchmark stock and new school enrolment as flows added to stock with appropriate time lag to measure education attainment for a large number of countries.

Figures for both attainments and enrolments at different levels of education were collected from census/survey information compiled by UNESCO and other sources. The census/survey figures report the distribution of education attainment on the population stratified by age or by sex, in for most cases, six categories: no formal education; incomplete primary; complete primary; first cycle of secondary; second cycle of secondary and tertiary.

differences in the quality of schooling across countries, especially for cross-country studies.

d.   International Test Scores by Students

An alternative measure of education stock, which is considered to reflect variations of educational quality across countries, is score in internationally comparable test of educational attainment. Conceptually, the quality of internationally comparable test is considered a good indicator of schooling quality study considered the multi-faceted nature of literacy and made effort to measure directly the skill of adult population. Literacy was measured in three domains—prose literacy, document literacy and quantitative literacy. The literacy skills were evaluated in each country through detailed interviews with a sample. Results were registered on a scale of 0 to 500 in each of the three domains.

One of the shortcomings of the study is that it covers only 12 OECD countries. Seven countries participated in the first survey—Canada, Germany, The Netherlands, Poland, Sweden, Switzerland (French speaking and German speaking) separately, and the United State. Five additional countries participated later—Australia, Belgium, Ireland, New Zealand and United Kingdom. Sweden was the best performing country in all domains, while Poland was the worst performing country in all domains. The scores among the three domains are highly correlated with coefficient of over 0.93. Studies based on the IALS data show that these measures of literacy have a

significant relation with gross earning of individual within a country independently from effect of education.

f.   Estimates of the Market Value of Human Capital

Another approach to measuring the stock of human capital is to assess differences in labour market outcomes such as earnings or employment of educated workers that are attributable to the individual's schooling. There have been attempts to measure the human capital stocks in terms of its market values. A labour-income based measure is derived by weighing

different segments of the workforce by the ratio of earning at different levels of education.

Gallop and Sorgenson (1980); Jorgenson, Gallop and Frautiment (1987); and Mulligan and Sala-i-Martin (1995) used this method to estimate the human capital stock of the United States. This measure, however, is not widely applicable to international comparison due to the limited availability of detailed wage data for most countries. A shortcoming of this approach, however, is that it may be difficult to use for most countries, especially less developing countries of Africa, Asia, or Latin America.

g. Rate of Return to Schooling

Collins and Busworth (1996) and Pritchett (2001) employed the usage of estimated rates of return rather than duration of schooling as weights in the construction of aggregate human capital. Since the estimated rates of return measure productivity of education at each level this measure is conceptually better than average years of schooling. A measure of average years of schooling assumes unrealistically that a year of education adds a constant quality of human capital whether undertaken by a primary pupil or a college student. One problem with the measure aggregated by rate of return, however, is that the available estimates of returns to schooling are not always accurate. For instance, the estimates may overstate return because of the likely positive correlation between schooling and unmeasured characteristics such as ability.

An important advantage of this type of measure, however, is that it measures what education is used for as a proxy for human capital and not input or flow as the case of expenditures and enrolment. However, in a situation where the divergence between private and public return to education is large and biased towards private return, it may create the problem of wrong correlation with growth.

3.1 Model

The link between education and economic growth can be described using Cobb-Douglas model

$$y_t = A, F(K, L, H) \qquad \dots 1$$

where: Y = aggregate real output
K = capital stock
L = labour force
A = efficiency of factor production
H = Human capital

Expressed in growth form, using natural logarithms to produce a linear equation in level, eqn. 1 becomes:

$$\ln y_t = \ln A_t + \alpha \ln k_t + \beta \ln L_t + \gamma \ln H_t \qquad \dots 2$$

The extended Solow model above facilitates simple regression based estimates of how educational capital ought to contribute to growth promotion.

The error-correction model of *eqn.* 2 may be written as follows:

$$\Delta \ln y_t = \gamma_1 \Delta \ln k_t + \gamma_2 \cdot \Delta \ln h_t \dots - \gamma_3 (\ln y_{t-1} - \alpha \cdot \ln k_{t-1} - \beta \ln h_{t-1} - \ln A) + u_t \dots 3$$

It is obviously difficult to estimate *eqn.* 3 using ordinary least squares since the variables in parenthesis cannot be formed without the knowledge of α and β. However, its re-parameterised form can be estimated :

$$\Delta \ln y_t = \ln A + \gamma_1 \cdot \Delta \ln k_t + \gamma_2 \Delta \ln h_t \dots$$
$$+ \gamma_3 \cdot \ln y_{t-1} + \gamma_4 \ln k_{t-1} + \gamma_5 \ln h_{t-1} + \gamma_6 + u_t \qquad \dots 4$$

The required elasticities α and β can be calculated from the estimates of the parameter γ_3. This coefficient contains additional information because it can be interpreted as a measure of the speed of adjustment in which the system moves towards equilibrium on the average.

Incorporating the error-correction term into *eqn.* 4 gives:

$$\Delta \ln y_t = \ln A + \gamma_1 \cdot \Delta \ln k_t + \gamma_2 \cdot \Delta \ln h_t + \gamma_3 \cdot EC_{t-1} + u_t \qquad \dots 5$$

Eqn. 5 becomes the equation to be estimated. Incorporating the required variables gives:

$$ry = a_0 + a_1 inv + a_2 sse + a_3 lbf + a_4 pse + a_5 tee + u_t \qquad \dots 6$$

where: ry = real gross domestic product
inv = investment
sse = gross secondary school enrolment
lbf = labour force

pse = primary school enrolment
tee = gross tertiary enrolment
u_t = error term

Another version of *eqn.* 6 is estimated using an alternative variable for education total government expenditure on education. This gives *eqn.* 7 as follows:

$$ry = b_0 + b_1 inv + b_2 lbf + b_3 edue + u_t \qquad ...7$$

where:
edue = total government expenditure (capital and recurrent) on education

Notes on Variables

Real gross product (GDP) measures growth. Pritchett (2001) has shown it is conceptually better than per capita income, which theoretically measures economic welfare. Gross fixed capital formation is used as proxy for capital stock because of considerable difficult associated with the process of estimating capital stock with the use of perpetual inventory method. Gross enrolments at the three levels of education: primary, secondary and tertiary and total government expenditures were used as alternative proxy for education. Labour force is considered as the proportion of the population in working age group. The period of the analysis covers from 1970—2009,

4.0 RESULTS

The estimates of *eqns* 6 and 7 using cointegration and error correction model are presented below in three stages: the unit root test, cointegration test and the error correction model.

Table 1: **Unit Root Test**

Variable	PP* With constant & trend	With constant (no trend)	d^*
Logy	-1.8670	-2.8736	I (1)
Δlogy	-8.4234	-8.3104	I (0)
Loginv	0.2111	-1.3742	I(1)
Δloginv	-3.9857	-4.0105	I(0)
Loglbf	0.9143	-19.054	I(1)
Δloglbf	-42.441	-40.064	I(0)
Logsse	-2.2776	-3.3283	I(1)
Δlogsse	-7.5944	-7.6289	I(0)
Logpse	-1.8912	-2.1623	I(1)
Logpse	-4.3866	-4.4543	I(0)
Logtee	-2.8059	-1.8513	I(2)
Δlogtee	-2.8597	-3.3127	I(l)
Logedue	-1.8806	-2.7211	I(1)
Δlogedue	-5.1789	-5.2627	I(0)
Logbmp	-3.3746	-4.0266	I(1)
Δlogbmp	-8.7072	-8.5851	I(0)
ggdp	-4.0209	-4.0336	I(1)
Δggdp	-9.4708	-9.7947	I(0)
Rpe	-10.796	-9.7877	I(1)
Δrpe	-7.0873	-7.0236	I(0)
Im/inv	-1.4286	-1.6464	I (1)
Δ (lm/inv)	-6.5150	-6.5000	I(0)
Critical values: *Level* 1% level 5% level *1st Difference* 1% level 5% level	-3.6171 -2.9422 -3.6228 -2.9446	-4.2242 -3.5348 -4.2324 -3.5386	

Notes: PP and d denote Philips -Peron test and decision about the order of integration of variables respectively.

The Philips-Peron unit root test was conducted for the variables in the model. Conventionally, the null hypothesis is that there is a unit root in each variable. Naturally the null hypothesis of the unit root should be accepted if the PP statistics are less than negative than critical value. A test of unit root using the first difference of each variable shows that all the variables were stationary at first difference except gross tertiary enrolment which was stationary at second difference. All these tsts were done on the lag values of the variables.

Cointegration Test

The cointegration test was conducted for the 2 models in the study. The rule of the thumb is that absolute value of the Augmented Dickey Fuller should be greater than the critical value at either 1 percent or 5 percent level of significance.

Model 1:   Cointegration test results: OLS Regression of logy on INPT, *log*inv, *log*lbf, *log*pse, *log*sse.

	Critical values	
	1% level	5% level
ADF	-3.6228	-2.9446
4.8583		

Model 2:   Cointegration test result: OLS regression log y on INPT, *log*inv, *log*lbf, *log*due

	Critical values	
	1% level	5% level
ADF	-3.6228	-2.9446
4.0853		

The cointegration test for the 2 models shows that all the equations are cointegrated, that is they have a long-run relationship with the dependent variable in each of the models. The cointegration regression equations are shown below.

Model 1:

Logy=10.9300+0.2144loginv–0.6287loglbf–0.2011logpse–0.0271logsse
        (8.42)   (6.81)   (1.71)   (2.27)   (0.32)
R-square = 0.76; R-bar-square = 0.73; DW = 1.87

Model 2:

Log y = 11.7321 + 0.2087loginv – 0.9309loglbf – 0.0202logedue
        (18.38)   (4.73)   (3.51)   (0.76)
R-square = 0.71; R-bar-square = 0.68; DW = 1.71

Model 1 shows that both gross secondary and primary enrolments have a long-run relationship with economic growth when they are included in a package. The coefficient of investment is positive while others were negative.

Model 2 also indicates that economic growth has a long-run relationship with education human capital proxy by total expenditures on education, investment is positive while labour enters with positive coefficient.

The Error Correction Model

After establishing that the variables in each of the models were cointegrated, the next step is to specify the error correction model. This is done with the auto-regression distributed lag (ARDL) techniques with the highest order of lags of 3. Best fitting Parsimonious equation was selected using the criteria of maximum R-bar squared.

Table 2: Summary of OLS Results

Nigeria: Error Correction Model (dependent variable: DLogY)		
Ordinary Least Square Regressions		
Variables/Model	*1*	*2*
Constant	-0.0491(-.0640)	-0.0625(-0.766)
DLOGINV	0.3691(4.815)	0.4361(4.663)
DLOGLBF	-2.0474(-0.712)	-0.5192(-0.167)
DLOGEDUE(-1)		-0.0382(-1.013)
DLOGEDUE(-3)		0.0416(1.276)
DLOGEDUE(-4)		-0.0280(-0.834)
DLOGPSE	-02455(-1.470)	
DLOGSSE	-0.0414(-0.333)	
DLOGSSE(-3)	-0.3775(-3.654)	
ECM(-1)	-0 9090(-5.558)	-0.9919(-5.316)
R-squared	0.71	0.62
Adj. R-squared	0.65	0.53
S.E	0.09	0.1
D.W	2.3	1.8

Note: t-values are in parenthesis

The result of ECM for the first model, with gross enrolments as proxy for education shows that investment in correctly signed and significant. The coefficient of labour force is not appropriately signed, it is negative. This may be due to the fact that high level of unemployment exists in Nigeria (Chete and Adeoye, 2002) and the fact that 60 percent of the Nigerian working population are in agricultural sector with low productivity and obsolete technology. Both coefficient of primary and secondary enrolment are negative, that is, they are both negatively related to economic growth. This is consistent with Ayara (2002) which finds that education does not impact positively on economic growth in Nigeria.

The result of the second model with alternative proxy for education, total expenditure on education, shows that the ECM equation is correctly signed and significant at 1 percent. The adjusted R^2 is 0.62 which mean that 62 percent systematic variation in the dependent variable is explained by the independent variables. Investment is appropriately signed and significant while labour force has a negative relationship with growth for the same reason as model 1. The coefficient of education, now proxy by total expenditure is negative, like the first model, which means changes in proxy for education does not affect the relationship between economic growth and education. The DW statistic of 1.86 shows the absence of serial correlation, overall F-statistic of 7.11 shows that the model is significant.

5.0

CONCLUDING REMARKS

The struggle to get the right proxy for education has been one of the biggest challenges for empirically evaluating the education economic growth nexus for most poor countries especially in sub-Saharan Africa. Studies for developed countries has shown that proxies like education attainments, rate of return to education and international test scores may reflect the stock of human capital than other proxies like school enrolment and expenditure, while the first is a flow the second is an input. African countries however usually have data for only enrolment and expenditure. This study tests whether using this alternative proxy with Nigeria data may affect the relationship between education and economic growth. It does not, both model return negative coefficient meaning education does not impact positively on economic growth.

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