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Higher Education and Economic Growth: A Cross-Country Analysis of Sub-Saharan Africa

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Abstract
This study empirically estimated the effects of education on economic growth in Sub-Saharan Africa using a set of cross-country panel data from 11 countries over the period 2005-2011. The methodological procedure employed in the analysis followed the Breusch-Pagan Lagrangian Multiplier test and Hausman test techniques. Based on the Fixed Effects (FE) model, estimated results reveal that tertiary education has a positive but statistically insignificant effect on economic growth in the region. The computed R-squared indicates that nearly 41.64 percent total variation in economic growth was accounted for by primary, secondary and tertiary education during the period 2005-2011. The F-statistic (=16.44; $p < 0.05$) indicates that the model was statistically significant.
Keywords: education, economic growth, primary, secondary, tertiary and enrolment

I. INTRODUCTION

Higher education widely remains one of the supreme dominant instruments that enhance sustainable economic growth across the globe (World Bank, 2012). According to Gyimah-Brempong, Paddison & Mitiku (2006), the modern growth theory underscores that human investment in higher education is a very effective instrument of stimulating economic growth. Quang (2012) further accentuates that higher education improves individuals' knowledge and productive capabilities that enhance economic growth. Therefore, rising the mean years of schooling of the population is an integral component of the productive development strategy. According to Hanushek & Woessmann (2007), however, although many countries have increased tertiary education opportunities, the approaches used remain ineffective towards producing the expected student achievement outcomes. While some studies show that higher education contributes positively towards economic growth; questions still remain on the magnitude to which higher education significantly influence economic growth. In context of developing countries, some studies regard higher education as the major source of economic growth (Hall & Jones, 1999); while other studies regard primary education as the major driving force of economic growth (Petrakis & Stamatakis, 2002; and McMahon, 2002).

The objective of this study was to analyse the effects of education in promoting the economic well being of countries in the Sub-Saharan African region.

II. LITEREATURE REVIEW

From either the endogenous or expanded neoclassical growth model, higher education is regarded to have a positive impact on the economic growth. According to Azariadis & Drazen (1990) and Rebelo (1991), even the minimum level of education is necessary in order for higher education to have a quantifiable impact on economic growth. Hanushek & Woessmann (2007) uphold that the availability of microeconomic evidence of human productivity-enhancing effects of higher education provides a strong ground to steadily review the effects of higher education on the productivity of countries. Looking at it from the basic level, Artadi & Sala-Martin (2003) stresses that there is positive relationship between primary school enrolment rates and economic in African countries.

Appiah & McMahon (2002) reveal that higher education positively affects income growth through improved health and environment. Furthermore, Agiomirgianaskis, Asteriou & Monasitiriotis (2002) and Voon (2002) report that; holding other factors constant, the higher the level of education, the stronger the growth impact of education. Deriving from Barro (1991), Barro (1999) and Mankiw, Romer & Weil (1992), studies by Hanushek (1995) and Krueger & Lindahl (2001) reveal significant positive relationship between the higher education and economic growth.

However, studies by Benhabib & Spiegel (1994), Barro & Lee (1994), Barro (1999), Barro & Sala-i-Martin (1995), Bils & Klenow (2000) and Pritchett (2001) find no significant relationship between higher education and economic growth. Extending from Hanushek & Woessmann (2007), a possible reason of such findings could be linked to the rationale that ignoring quality differences in education considerably distorts the true picture of the relationship between education and economic growth.

III. ECONOMETRIC METHODOLOGY

This study used cross-country data for fifteen countries during the period 2005-2011. Annual data on GNI per capita (economic) growth, primary enrolment ratio, secondary enrolment ratio and tertiary enrolment ratio were

used in the study. Data on all the variables were obtained from the World Bank's World Development Indicators (World Bank, 2012) online database. The estimation procedure used followed diagnostic evaluation of the Pooled OLS regression, GLS Random Effects (RE) model and Fixed Effects (FE) model using the Breusch-Pagan Lagrangian Multiplier test and Hausman test.

$$\text{Pooled OLS model}: Y_{it} = \alpha + X'_{it}\,\beta(\alpha_i - \alpha + e_{it}) \quad \text{---------- (1)}$$

$$\text{Random Effects(RE) model}: Y_{it} = \alpha + X'_{it}\,\beta + (u_i + \upsilon_{it});\ \upsilon_{it} \sim IID(0, \sigma_v^2) \quad \text{---------- (2)}$$

$$\text{Fixed Effects (FE) model}: Y_{Iit} = \alpha_i + X'_{it}\,\beta + u_i + e_{it} \quad \text{---------- (3)}$$

The Breusch and Pagan Lagrangian Multiplier test was run on the RE model to select between the Pooled OLS and Random Effect models. The LM test was run based on the formulation:

$$LM_u = \frac{nT}{2(T-1)}\left[\frac{\sum(\sum e_{it})^2}{\sum\sum e_{it}^2} - 1\right]^2 = \frac{nT}{n(T-1)}\left[\frac{\sum(T)\bar{e}_i}{\sum\sum e_{it}^2} - 1\right] \sim \chi^2(1) \quad \text{---------- (4)}$$

Following rejection of the hypothesis that Pooled OLS was appropriate, the Hausman test was performed to appropriately select between RE model and FE model based on the specification:

$$H = \left(\hat{\beta}_{FE} - \hat{\beta}_{RE}\right)' \left[\left(V\left(\hat{\beta}_{FE}\right) - V\left(\hat{\beta}_{RE}\right)^{\wedge}(-1)\right)\right]\left(\hat{\beta}_{FE} - \hat{\beta}_{RE}\right) \quad \text{---------- (5)}$$

Results of the Hausman test was used to select the suitable model between RE and FE at 5% level of significance. Differences across panels were measured by interclass correlation; which approaches 1 if the respective individual effects dominate the idiosyncratic error. The econometric estimation method used was a single equation model formulated as:

$$Economi\_growth_{it} = \alpha + \beta_1(\text{Pr}imary\,edu_{it}) + \beta_2(Secondary edu_{it}) + \beta_3(Tertiary\,edu) + u_{it} \quad \text{- (6)}$$

IV. RESULTS & DISCUSSION

Breusch and Pagan Lagrangian Multiplier (LM) Test

The Breusch and Pagan LM test was applied on the RE model estimates to test whether Pooled OLS regression was the appropriate model to apply for analysis.

Table 1: Generalised Least Squares Random Effects model results

R-squared: within = 0.4603 between = 0.6495 overall = 0.5141 corr(u_i,x) = 0 (assumed)			obs per group: min = 1 : avg = 3.0 : max = 7 Wald chi2(3) = 17.55 Prob > chi2 = 0.0005			
Economic_growth	Coeff.	Std. Err.	z	P > | z |	95% Conf. Interval	
Primary enrolment ratio	.000527	.0005465	0.76	0.434	-.0006432	.0014991
Secondary enrolment ratio	.0008425	.0005161	1.86	0.068	-.00007	.001953
Tertiary enrolment ratio	.000262	.0004773	0.54	0.598	-.0006835	.0011875
_cons	.378987	.0631989	5.78	0.000	.2350193	.4827546
sigma_u	.11617118					
sigma_e	.0084721					
rho	.99674356					

The Breusch and Pagan Lagrangian Multiplier test for random effects results (Table 2) rejected the null hypothesis that the Pooled OLS model was appropriate.

Table 2: Breusch and Pagan Lagrangian Multiplier test for Random Effects results

	Var	sd = sqrt(Var)
GNI per capita growth	.0253879	.1593359
e	.0000701	.0083721
u	.0132644	.1151712
Test: Var (u) = 0	Chibar2(01) = 45.50	Prob > chibar2 = 0.0000

The FE model was further run (Table 3) to appropriately select between the RE and FE.

Table 3: Fixed Effects results

R-squared: within = 0.4720 between = 0.6019 overall = 0.4164 corr(u_i, Xb) = 0.5728			obs per group: min = 1 : avg = 3.0 : max = 7 F (2, 64) = 16.44 Prob > F = 0.0033			
Economic_growth	Coeff.	Std. Err.	t	P > | t |	95% Conf. Interval	
Primary enrolment ratio	.0007848	.0005022	1.46	0.187	-.0003597	.0017292
Secondary enrolment ratio	.0005703	.0004791	1.37	0.255	-.0004361	.0015567
Tertiary enrolment ratio	.0004699	.000432	1.31	0.279	-.0004184	.0013782
_cons	.3184014	.0460767	6.73	0.000	.2125796	.4042233
sigma_u	.15797371					
sigma_e	.0083721					
rho	.99739921					
F test that all u_i = 0:	F (11, 21) = 541.73			Prob > F = 0.0000		

The Hausman test (Table 4) was applied to select the appropriate model between RE and FE.

Table 4: Hausman test results

	Coefficients			
	(b) FE1	(B) RE1	(b-B) Difference	sqrt(diag(V_b – V_B)
Primary enrolment	.0006848	.000428	.0002568	.000155
Secondary enrolment	.0005603	.0009415	-.0003812	.0001655
Tertiary enrolment	.0004799	.000252	.0002279	.0001044
Test H0: difference in coefficients not systematic				
chi2(3) = 9.33			Prob > chi2 = 0.0251	

Following the results from the Hausman test, the null hypothesis that the Random Effects model was appropriate was rejected; indicating that the differences between the FE model and the RE model were systematic. Therefore, the coefficients of the FE model were efficient. Based on results of the FE model, education; as measured by primary, secondary and tertiary enrolment ratios revealed positive but insignificant effects on economic growth in Sub-Saharan Africa during the period 2005-2011. Although statistically insignificant, but primary education; in relative terms, had the highest positive influence on economic growth; followed by secondary education; and higher education had the least effect on economic growth. Overall, the R-squared statistic indicates that nearly 41.64 percent total variation in economic growth was accounted for by education in the region. The interclass correlation shows that nearly 99.74 percent of the variance was due to differences across panels.

V. CONCLUDING REMARKS AND RECOMMENDATIONS

The results of this study are in conformity to the findings by Barro & Lee (1994), Benhabib & Spiegel (1994), Barro & Sala-i-Martin (1995), Caselli et al., (1996), Barro (1999), Bils & Klenow (2000) and Pritchett (2001) who report a statistically insignificant positive relationship between education and economic growth. Following Hanushek & Woessmann (2007), ignoring quality differences in higher education possibly distorts the true underlying picture of the association between education and economic growth. This view conforms to UNESCO (2011) which indicates that although secondary and tertiary enrolments increased in Sub-Saharan Africa, most youth enter the labour market with no training, hence many cannot be absorbed for formal employment. In light of this background, future research on the effect of higher education on economic growth should focus on education quality rather than quantity.

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