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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. LITERATURE 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-Martín (2003) stresses that there is positive relationship between primary school enrolment rates and economic in African countries.


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

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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.

\[ Y_{it} = \alpha + X_{it}' \beta (\alpha_i - \alpha + e_{it}) \]  \hspace{1cm} (1)

Random Effects (RE) model: \[ Y_{it} = \alpha + X_{it}' \beta + u_i + v_{it}; v_{it} \sim IID(0, \sigma^2_i) \]  \hspace{1cm} (2)

Fixed Effects (FE) model: \[ Y_{it} = \alpha_i + X_{it}' \beta + u_i + e_{it} \]  \hspace{1cm} (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:

\[ LM_u = \frac{nT}{2(T-1)} \left( \frac{\sum \left( \sum e_{it}^2 \right)^2}{n(T-1)} - 1 \right) = \frac{nT}{n(T-1)} \left[ \sum (T)e_i - \sum e_i^2 - 1 \right] - \chi^2(1) \]  \hspace{1cm} (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:

\[ H = \left( \hat{\beta}_{FE} - \hat{\beta}_{RE} \right)^T \left[ V \left( \hat{\beta}_{FE} - \hat{\beta}_{RE} \right)^T \left( -1 \right) \right] \left( \hat{\beta}_{FE} - \hat{\beta}_{RE} \right) \]  \hspace{1cm} (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:

\[ Economi \_ growth_{it} = \alpha + \beta_1(Primary\_edu_{it}) + \beta_2(Secondary\_edu_{it}) + \beta_3(Tertiary\_edu) + u_{it} \]  \hspace{1cm} (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

<table>
<thead>
<tr>
<th>Economic growth</th>
<th>Coeff.</th>
<th>Std. Err.</th>
<th>z</th>
<th>P &gt;</th>
<th>z</th>
<th>95% Conf. Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary enrolment ratio</td>
<td>.000527</td>
<td>.0005465</td>
<td>0.76</td>
<td>0.434</td>
<td>-.0006432</td>
<td>.0014991</td>
</tr>
<tr>
<td>Secondary enrolment ratio</td>
<td>.0008425</td>
<td>.0005161</td>
<td>1.86</td>
<td>0.068</td>
<td>-.000007</td>
<td>.001953</td>
</tr>
<tr>
<td>Tertiary enrolment ratio</td>
<td>.000262</td>
<td>.0004773</td>
<td>0.54</td>
<td>0.598</td>
<td>-.0006835</td>
<td>.0011875</td>
</tr>
<tr>
<td>_cons</td>
<td>.378987</td>
<td>.0631989</td>
<td>5.78</td>
<td>0.000</td>
<td>.2350193</td>
<td>.4827546</td>
</tr>
<tr>
<td>sigma_u</td>
<td>.11617118</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sigma_e</td>
<td>.0084721</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>rho</td>
<td>.99674356</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Var</th>
<th>sd = sqrt(Var)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GNI per capita growth</td>
<td>.0253879</td>
</tr>
<tr>
<td>e</td>
<td>.0000701</td>
</tr>
<tr>
<td>u</td>
<td>.0132644</td>
</tr>
<tr>
<td>Test: Var (u) = 0</td>
<td>Chibar2(01) = 45.50</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Economic_growth</th>
<th>Coeff.</th>
<th>Std. Err.</th>
<th>t</th>
<th>P &gt;</th>
<th>95% Conf. Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary enrolment ratio</td>
<td>.0007848</td>
<td>.0005022</td>
<td>1.46</td>
<td>0.187</td>
<td>-.0003597 to .0017292</td>
</tr>
<tr>
<td>Secondary enrolment ratio</td>
<td>.0005703</td>
<td>.0004791</td>
<td>1.37</td>
<td>0.255</td>
<td>-.0004361 to .0015567</td>
</tr>
<tr>
<td>Tertiary enrolment ratio</td>
<td>.0004699</td>
<td>.000432</td>
<td>1.31</td>
<td>0.279</td>
<td>-.0004184 to .0013782</td>
</tr>
</tbody>
</table>

\[ \text{corr}(u_i, Xb) = 0.5728 \]

\[ \text{obs per group: min} = 1 \]
\[ \text{avg} = 3.0 \]
\[ \text{max} = 7 \]

\[ F (2, 64) = 16.44 \]
\[ \text{Prob} > F = 0.0033 \]

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

Table 4: Hausman test results

<table>
<thead>
<tr>
<th>(b) Coefficients</th>
<th>(B) Coefficients</th>
<th>(b-B) Difference</th>
<th>sqrt(diag(V_b – V_B))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary enrolment ratio</td>
<td>.0006848</td>
<td>.000428</td>
<td>.0002568</td>
</tr>
<tr>
<td>Secondary enrolment ratio</td>
<td>.0005603</td>
<td>.0009415</td>
<td>-.0003812</td>
</tr>
<tr>
<td>Tertiary enrolment ratio</td>
<td>.0004799</td>
<td>.000252</td>
<td>.0002279</td>
</tr>
</tbody>
</table>

\[ \text{chi2}(3) = 9.33 \]
\[ \text{Prob} > \text{chi2} = 0.0251 \]

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.

REFERENCES


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