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JOURNAL OF EDUCATIONAL REVIEW
VOL. 7 • NO. 3 • JULY-SEPTEMBER 2014

HIGHER EDUCATION AND SUSTAINABLE DEVELOPMENT IN AFRICA: AN EMPIRICAL ANALYSIS

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This paper examines the impact of higher education on sustainable development in Africa. The augmented Solow growth model is adopted as the theoretical framework. The variables involve in this model are investment in physical capital, investment in human capital, population growth, depreciation and growth of technology and growth in national income. The empirical model consists of panel data of selected countries in Africa spanning over the period 1960 to 2010. The growth of national income was used to measure sustainable development and the data were sourced from Africa Development Indicators (ADI) and World Bank's World Development Indicators (WDI). Investment as share of GDP as well as Fixed Capital Formation was used as measure for investment in physical capital and the data was sourced from ADI and Pen World Table. Different measures of higher education participation rates including tertiary education attainment as percentage of total population, tertiary education completion as percentage of total population, tertiary education attainment as percentage of female population and tertiary education completion as percentage of female population were collected. These data was source from ADI, WDI, and Barro-Lee Dataset. Different estimation techniques were used in this paper, this include the Ordinary Least Square, the Fixed Effect and Random Effects estimation techniques. The study showed that all the measures of higher education participation rates had significant impact on sustainable development in all the models. It is therefore recommended that Africa countries should heavily invest in higher education to ensure sustainable development.

Keywords: *Higher Education, Sustainable Development, Africa, Empirical Analysis*

INTRODUCTION

Education for Sustainable Development (ESD) is "a dynamic concept that encompasses a new vision of education that seeks to empower people of all ages to assume responsibility for creating and enjoying a sustainable future" (UNESCO, 2005). It aims to integrate the principles, values and practices of sustainable development into all aspects of education and learning (UNESCO, 2005). Higher education for sustainable development in Africa (HESDA) is therefore the mainstreaming of the principles of ESD in higher institutions of learning in Africa. It is expected that adopting HESDA principles will encourage change in behaviour and mindsets to create a more sustainable future in terms of environmental integrity, economic viability, and a just society for present and future generations (Urama, 2010). Empirical studies find significant correlation between university enrollment rates and growth in national incomes in many countries (Moyer, E.J. 2007). No educational factor correlates as strongly with national incomes as university enrollment rates. Analyses show that attaining full primary education for all which has been the main focus of government policies in many African countries may be a necessary but no sufficient condition for development in most countries globally. For example, Togo and Madagascar have attained over

90% primary school enrollment rates but this has not translated into higher national incomes. The same relationship holds not only between countries but also over time for a single developing country (for details, see Moyer,2007). On the converse, university enrollment rates in sub-Saharan Africa are among the lowest in the world, averaging 5%, compared to > 60% elsewhere and up to 72% in the United States of America. The rate of university enrollment also varies within the region with South Africa attaining up to 15%. Overall, the contributions of higher education in Africa to gross national incomes are significantly low (Moyer, 2007 &Botman *et al.*, 2009).

The importance of human capital has been stressed in the growth and development literature. This suggests that human capital accumulation is a key to the growth and development of any society. Mankiw *et al.* (1992) argued that including human capital in growth model can potentially alter theoretical modeling and/or the empirical analysis of growth. At the theoretical level, it can be shown that sufficient accumulation of human capital will make the returns to all reproducible capital (both physical and human capital) constant instead deceasing return to physical capital assumed under the Solow growth model without human capital. Empirically omission of human capital from growth regression will lead to over estimating the impact of physical capital as well as population (that is, labour). Hence, Mankiw *et al.* (1992) developed an augmented Solow growth model which consists of physical and human capital. Since then, it is common practice in growth studies to include human capital variable.

Broadly speaking human capital accumulation is defined to include investment in education and health. The idea is that an individual who is educated and healthy will be more productive than an individual who is educated but not healthy or healthy but not educated. However, empirical studies so far are restricted to investment in education ignoring investment in health. Even with this narrow focus, there is huge challenge in the measurement of human capital accumulation that is education. To be able to compare our work with previous studies, we also restrict our focus to the impact of education. In addition, we assumed that knowledge acquired at primary and secondary schools in African countries is not sufficient enough to make any significant contribution to the growth and development of the countries. Thus, the paper considers the role of tertiary education in Africa growth and development. This is major deviation from the common empirical strategy in the literature, most of which either use secondary school education or average years of schooling, (see example, Kwabena (2002), Knack (2002), Mankiw *et al.* (1992), Caselli *et al.*, Bond, Hoeffler and Temple (2001), Levine and Renelt (1992), Hoeffler (2002), Morck, Wolfenzon and Yeung (2003) and Gemmell (1996)). In addition, this paper goes beyond the narrow perspective of defining development as synonymous to growth. In the real world experience a country can grow economically without development, though, growth is a major prerequisite to development. Meaning that there can be growth without development but there can not be development without growth. Hence, development is growth plus other things which include improvement in standard of living, reduction in poverty and inequality, as well as structural transformation. Using measure of growth to proxy for development can be misleading. This paper therefore considered a broader measure for development.

The objectives of this paper therefore are: (i) examine the effect of enrollment into institutions of higher education on growth and development, and (ii) to investigate the impact of higher education attainment on growth and development in Africa. Achieving these two objectives goes a long way to unravel the role of higher education to sustainable development in the Africa continent.

The rest of the paper is arranged in the following order: the next section addresses the issue of methodology and data which is closely followed by the nature and sources of data. The next section addresses the issue of estimation technique while the immediate section after this examines the presentation and discussion of results. Policy implication arising from the findings of this study is the next section while the last section is the concluding remarks.

METHODOLOGY AND DATA ISSUE

To investigate the impact of higher education on growth and development we specify and estimate a number of empirical models. First, we estimate the traditional Solow growth model without human capital and thereafter, estimate augmented Solow growth model with human capital. The second empirical strategy is to run higher education and other control variables on measure of development. Therefore, the estimable equations are specified as follows:

$$lny_{it} = \alpha + \alpha_i + \theta_t + \beta_1 lnsk_{it} + \beta_3 ln(n_{it} + g + \delta) + \varepsilon_{it} \quad (1)$$

$$lny_{it} = \alpha + \alpha_i + \theta_t + \beta_1 lnsk_{it} + \beta_2 lnsh_{it} + \beta_3 ln(n_{it} + g + \delta) + \varepsilon_{it} \quad (2)$$

The equation 2 can further be simplified as:

$$\text{lnyit} = \alpha + \alpha_i + \theta_t + \beta_1 lnsk_{it} + \beta_2 lnTEAT_{it} + \beta_3 ln(n_{it} + g + \delta) + \varepsilon_{it} \quad (3)$$

$$lny_{it} = \alpha + \alpha_i + \theta_t + \beta_1 lnsk_{it} + \beta_2 lnTECT'_{it} + \beta_3 ln(n_{it} + g + \delta) + \varepsilon_{it} \quad (4)$$

$$\text{lnyit} = \alpha + \alpha_i + \theta_t + \beta_1 lnsk_{it} + \beta_2 lnTEAF_{it} + \beta_3 ln(n_{it} + g + \delta) + \varepsilon_{it} \quad (5)$$

$$lny_{it} = \alpha + \alpha_i + \theta_t + \beta_1 lnsk_{it} + \beta_2 lnTECF_{it} + \beta_3 ln(n_{it} + g + \delta) + \varepsilon_{it} \quad (6)$$

Where lny_{it} is log real GDP per capita in country i at time t, sk_{it} is investment in physical capital, sh_{it} is investment in human capital, n_{it} is population growth, g growth rate of technology, δ is rate of depreciation, α_i is time invariant effect unique to each country i, θ_t is time effect common to all countries in period t, and ε_{it} is individual time varying error distributed independently across individuals and independent of all α_i and θ_t. Education attainment is used to measure investment in human capital and four different measures are used to captured it as shown in equations 3 to 6, TEAT stands for tertiary education attainment as percentage of total population, TECT is tertiary education completion as percentage of total population, TEAF is tertiary education attainment as percentage of female population and TECF is tertiary education complete as percentage of female population.

NATURE AND SOURCES OF DATA

Data used for the purpose of empirical analysis in this paper are of two type .The first is quinquennial starting in 1975, 1980, . . . and ending in 2010 for all the variables in the model with school enrollment, while model with school attainment starts in 1965 and ends in 2010. This data set is so arranged to conform with the conventional practice in growth studies. Thus, this data set is used to estimate the growth models specified in equations 1, 3, 4, 5 and 6 above. The data sets consist of thirty seven 37 countries selected based on availability of data.

Studies on growth are divided between using per worker values or per capita values of variables. For example Mankiw, Romer and Weil (1992) use per worker values while Islam (1995), Caselli, Esquivel and Lefort (1996) use per capita values. However, Hoeffler (2002) argued that the choice of per worker or per capita is not sensitive to result. Meanwhile, she used per capita values for the sake of robustness. In this paper we also use per capita values. Thus, real GDP per capita which is obtained from Africa Development Indicators (ADI) is used for y. Investment as share of real GDP per capita is used for sk_{it} as proxy for investment in physical capital and is obtained from Pen World Table. Population growth is calculated using data on population aged 16 to 65 obtained from ADI. We use this age bracket because they constitute the working population (not everyone in the economy contributes to output). Following Mankiw, Romer and Weil (1992), Islam (1995), Caselli, Esquivel and Lefort (1996) and Hoeffler (2002), technological progress and depreciation rate are assumed to be constant across countries and that they sum to 0.05. Therefore, the sum of population growth and 0.05 gives values for $(n + g + \delta)$. Finally,higher education is used as proxy for human capital which is measured in two broad ways – (i) tertiary educational attainment and (ii) tertiary education completed. The data is sourced from Barro and Lee education data set available from 1950 to 2010 for many countries of the world. This measurement also have two dimension which we consider in this paper, higher education attainment/completed as percentage of total population and as percentage of female population.

ESTIMATION TECHNIQUES

This study employs different estimation methods including the OLS, fixed effect and random effect estimators. The OLS estimator is consistent only when the orthogonal assumption holds. However, a number of reasons have been adduced for the possible violation of orthogonality assumption in the growth regression. First, the regression disturbance term may include some unobserved country effects that may be correlated with the regressors employed. Second, some of the regressors may be correlated with shocks that affect income per capita. Also, there is possibility of simultaneity

biases resulting from the endogeneity of some growth determinants. To overcome these econometric problems, we employ the fixed effects (FE) and random effects (RE). In this study, we report and compare results obtained from these estimators and we also conduct some diagnostic tests such as hausman test to complement the estimation techniques.

PRESENTATION AND DISCUSSION OF RESULTS

The regression results are presented in tables 1 to 3, table 1 presents pooled/OLS results, table 2 presents Fixed effect results and table 3 presents Random effect results. In each of the tables results for model 1 to 5 are presented. Model 1 is result of the baseline model with only two explanatory variables (physical capital and population growth which stands for labour). In model 2 we controlled for tertiary education attainment as percentage of total population, tertiary education completed as percentage of total population, tertiary education attainment/completed as percentage of female population are controlled for in models 3, 4 and 5 respectively.

In table 1 all the variables in model1 are significant, physical capital has positive impact on economic performance while population growth has negative impact. These signs are in conformity with theory and previous empirical studies. However, when measure of tertiary education is introduced in model 2 population growth came out insignificant while physical capital and education have significant positive effect. Education is significant and positive in all the models. There is remarkable improvement in the results after introducing education, for example the R square increase and the root mean square decrease.

In Table 2 all variables in model 1 are not significant but when education is introduced in models 2 to 5, physical capital became significant but population is not significant through out. Education is significant and positive in all the results. Similarly, in the table 3 which contains the Random effect results, education is equally significant all through. The introduction of education led to increase the R squares, (that is the within, between and overall R squares).

A number oflessons can be drawn from these results: first, if people has access to higher education physical capital becomes more useful and effective. Second, population growth will not have negative impact on the economic as predicted by theory. Third, tertiary education for both male and

Table 1
OLS Results, Dependent Variable is log of Real GDP Per capital

Variables	*Model 1*	*Model 2*	*Model 3*	*Model 4*	*Model 5*
Physical Capital	0.5140*	0.3871*	0.3983*	0.4022*	0.4047*
	(0.0645)	(0.0586)	(0.0592)	(0.0575)	(0.0571)
Population growth	-0.1626*	-0.0798	-0.0978***	-0.0801	-0.1010**
	(0.0568)	(0.0551)	(0.0556)	(0.0514)	(0.0523)
Tertiary education attainment, total		0.2092*			
		(0.0300)			
Tertiary education completion, total		0.2092*			
		(0.0300)			
Tertiary education attainment, female			0.3648*		
			(0.0523)		
Tertiary education completion, female				0.1900*	
				(0.0236)	
Tertiary education completeion, female					0.3325*
					(0.0421)
Constant	6.1733*	5.8293*	5.9145*	5.9101*	5.9963*
	(0.2056)	(0.1810)	(0.1857)	(0.1736)	(0.1768)
R^2	0.1400	0.4233	0.3672	0.4119	0.3686
F. Statistic	34.58*	59.90*	59.04*	62.44*	61.67*
Root MS	0.9415	0.772	0.8087	0.7796	0.8078
No. Observation	369	369	369	369	369

Source: computed by authors, *significant at 1%, **significant at 5%, ***significant at 10%, robust standard error in parenthesis.

Table 2
Fixed Effect Results, Dependent Variable is Log of Real GDP Per capital

Variables	*Model 1*	*Model 2*	*Model 3*	*Model 4*	*Model 5*
Physical Capital	0.0745	0.3060*	0.2905*	0.3149*	0.3026*
	(0.1074)	(0.0972)	(0.0983)	(0.1003)	(0.1011)
Population growth	-0.0400	-0.0183	-0.0189	-0.0155	-0.0177
	(0.0432)	(0.0380)	(0.0385)	(0.0389)	(0.0393)
Tertiary education attainment, total		0.1679*			
		(0.0166)			
Tertiary education completion, total			0.3070*		
			(0.0327)		
Tertiary education attainment, female				0.1500*	
				(0.0168)	
Tertiary education completion, female					0.2825*
					(0.0332)
Constant	6.8516*	5.9453*	6.0138*	6.0074*	6.0554*
	(0.2363)	(0.2267)	(0.2284)	(0.2327)	(0.2339)
R^2	0.0032	0.2334	0.2128	0.1968	0.1825
	0.3243	0.5909	0.4942	0.5936	0.5147
	0.1312	0.4201	0.3614	0.4083	0.3621
F. Statistic	0.52	33.39*	29.82*	26.86*	24.48*
No. Observation	369	369	369	369	369

Source: computed by authors, *significant at 1%, **significant at 5%, ***significant at 10%, robust standard error in parenthesis.

Table 3
Random Effect Results, Dependent Variable is log of Real GDP Per capital

Variables	*Model 1*	*Model 2*	*Model 3*	*Model 4*	*Model 5*
Physical Capital	0.2336**	0.3637*	0.3473*	0.3771*	0.3609*
	(0.0929)	(0.0778)	(0.0813)	(0.079)	(0.0817)
Population growth	-0.0723***	-0.0356	-0.0366	-0.0336	-0.0371
	(0.0422)	(0.0367)	(0.0373)	(0.0376)	(0.0380)
Tertiary education attainment, total		0.1787*			
		(0.0154)			
Tertiary education completion, total			0.3234*		
			(0.0307)		
Tertiary education attainment, female				0.1637*	
				(0.0153)	
Tertiary education completion, female					0.2998*
					(0.0303)
Constant	6.5757*	5.8335*	5.9157*	5.8923*	5.9603*
	(0.2357)	(0.2030)	(0.2126)	(0.2050)	(0.2121)
R2	0.0028	0.2229	0.2132	0.1963	0.1819
	0.3120	0.5887	0.4958	0.5932	0.5184
	0.1400	0.4210	0.3641	0.4095	0.365
Chi2	7.60**	147.57*	121.96*	129.51*	110.22*
Hausman	12.13	10.36**	6.21	8.63**	6.36***
No. Observation	369	369	369	369	369

Source: computed by authors, *significant at 1%, **significant at 5%, ***significant at 10%, robust standard error in parenthesis.

female is important for sustainable growth and development in Africa. Forth, growth regressions without measures of education are biased and inconsistent. This means for any country to make any reasonable progress, investment in tertiary education is paramount.

POLICY IMPLICATIONS

The revelation from the empirical results discussion above has relevant policy implications. There is need for more investment in tertiary education in Africa so as to achieve sustainable growth and development in the continent. Beyond just investing in higher education, there is need to put in place policies that will ensure more people have access to higher education. After getting people enrolled in tertiary schools, they should be encouraged to complete so as to acquire the requisite knowledge in order to contribute reasonably to growth and development process. Gender disparity in the access to higher education should be eradicated if possible or minimized to lowest possible level.

CONCLUSION

This paper examines the impact of education on economic growth of Africa. Though, this is not the first the impact of education is empirically studied, this is different from previous studies because it considers the impact of tertiary education. Tertiary education attainment and completion as percentage of total population and as percentage of female population are used in the empirical analysis of the paper. A traditional neoclassical growth model with only physical capital and labour is taken as the baseline model which is compared with models with measure of higher education. The results show that models with measures of education performance better than model without education. The central conclusion in this paper is that tertiary or higher education is important in explaining growth development of Africa. Therefore, governments and policymakers in Africa need not only to investment in higher education but also to make policies that will encourage people to enroll and complete higher education.

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