

HUMAN CAPITAL AND ECONOMIC GROWTH IN SUB SAHARAN AFRICA COUNTRIES: ARDL AND ECM ANALYSIS

Martha Matashu^{1*}, Melikhaya Skhephe²

^{1,2}Senior Lecturer Faculty of Education North West University

*Email: mmatashu@hotmail.com

Abstract: The long-run relationship between human capital and economic growth in Sub Saharan African (SSA) countries was examined using An ARDL and ECM cointegration analysis approach. The endogenous and human capital theory posits that human capital accumulated acquired from the education system contributes to economic growth in any economy. Despite many years of huge government expenditure in **education**, SSA countries appears to experience little or no economic growth. Studies on the long term effects of human capital on economic growth in SSA countries remain few despite a growing body of research in literature. Using data from 37 SSA countries for the year 2000- 2018 an Autoregressive Distributed Lag ARDL and Error Correction Model (ECM) cointegration the study estimated a Dynamic Fixed Effects model (DFE) to examine the long run relationship between human capital and economic growth. The findings revealed that a cointegration relationship exist between human capital and economic growth. Secondary education had a significant but weak positive effect on economic growth in the short run and a weak negative effect on economic growth in the long run. Primary education however, had an insignificant contribution to economic growth both in the short and long run. Physical capital had significant and strong positive effect on economic growth in the short run whilst in the long run it has an insignificant effect. SSA countries interested in enhancing long run term economic growth through human capital should consider promoting access to secondary school enrolment and improving the quality of primary education. The study provided empirical evidence on the short and long run contribution of human capital to economic growth in SSA countries.

Keywords: Human capital, economic growth, Sub Saharan Africa, ARDL, ECM cointegration

INTRODUCTION

Endogenous economic growth theory proponents like Schultz (1961, 1967) and Becker (1975) together with human capital theorists namely Mankiw, Romer and Weil, (1992) and Lucas (1997) attribute the effect of human capital on determinant of economic growth as mediated by education. Suhendra, Istikomah and Ginanjar (2020) describe human capital as the accumulated knowledge and skills people acquired from the education systems that enhances the abilities of the workforce to improve the productivity and increase economic output within organisation and this in turn leads to economic growth.

Many countries have huge sums of money on education with the intention of building human capital which can lead to economic growth in their economies. Nonetheless, since many years ago there is a continued observed low economic growth trend in Sub Saharan Africa (SSA) despite several years of increasing investment in education. A look at the pattern of economic growth and education indicators by the World Bank Reports since 1970 until 2018 appears to suggest that SSA countries continue to experience low economic growth despite an increase in education. The trend observed for the past half a century raises a question: Are there short run and long run relationships between

human capital and economic growth in SSA countries? An understanding of the long run relationship between human capital and economic growth is essential for supporting human capital driven economic growth policies and strategies in general and in specific in Sub Saharan Africa. The observed education and economic growth trends in SSA countries warrants a study into the long run relationship between human capital and economic growth in countries within the region. Several studies such as Siddiqui and Rehman (2017) and Garza-Rodriguez, Almeida-Velasco and Gonzalez-Morales (2020) found empirical evidence that the impact of human capital on economic growth varies with country and is depended on the underlying education. Cross country studies that examine the long term impact of human capital on economic growth remains very minimal in SSA countries despite the subject drawing attention from many scholars.

If any relationship exist an insight into the short and long run relationships is necessary in light of Engle and Granger (1987)'s cointegration theoretical argument that a residual which is a lagged variable obtained from the cointegrating (long run) relationship called an error correction can be estimated to determine whether the dependent variables will adjust in the short run to its long run relationship. This theoretical argument implies that, the short run effect of human capital on economic growth if any exist, may perhaps operate through channels that have not fully adjusted, however the channels may require relatively a long time to make adjustment to reach achieve their full noticeable changes on economic growth. An educated workforce are believed to being in possession of knowledge, competences and skills that allows them to function optimally, adopt to use of technology and other techniques (Mariana 2015; Marginson 2019).

Work Bank (2021) describe economic growth as a measures of the gross value added by resident producers within an econom. Engel and Granger (1987) remarked that economic variables are expected to wander and return to equilibrium in the long run. Considering Engel and Granger (1987)'s idea of cointegration and error correction estimation there is a possible assumption that human capital and economic growth might have short term and long run relationship. Resultantly, to examine the long-run and short- run relationship between human capital and economic growth in SSA countries this paper thus used an ARDL cointegration and (ECM) techniques. According to Darrat and Al-Yousif (1999) the coefficient of the ECM term shows the process by which the dependent variable adjust in the short run to long run position.

Patterns of education versus economic growth in Sub Saharan African

There is evidence that primary and secondary education and economic growth patterns for the SSA countries since 1970 to 2019 suggest the existence of an inverse relationship between education and economic growth. The World Bank (2021) analysis of primary school enrolment indicate an increase from 54,17% in 1970 to 98,9% in 2019 compared to world increase from 88,89% to 101,12% respectively. The observed progress towards primary school enrolment might have been contributed by many collaborated efforts in the pursuit of Millennium Development Goals (MDGs) of universal primary Education For All (EFA) that was established in the United Nations Millennium Declaration of 2000. The World Bank (2021) analysis of secondary school enrolment show an increase from 13, 45% in 1970 to 43, 24% in 2018 compared to world ranking of 40,

06% in 1970 to 75, 35% in 2018. Evidently, the increase in secondary education in SSA countries still falls below the expected world ranking. Despite the growing recognition of human capital as driver for economic growth, evidence from World Bank (2021) report surveys since 1970 to 2018 indicate that SSA region continues to have the largest number of developing countries in the world.

The observed trend suggests that perhaps the relationship between education and economic growth might not be linear. Overall this raises scepticism about the long term relationship of education and human capital to stimulate economic growth in SSA countries. There is evidence from studies such as those by Barro and Lee 1992; Kotásková, Procházka and Maitah 2018 that primary and secondary school education as proxies for human capital has significant contribution to economic growth. Building upon those studies human capital and economic growth in this study will be presented by primary and secondary education. Primary and secondary education provides a foundation for the acquisition of knowledge, skills and capabilities which will be escalated to the formation of human capital and economic growth (Abd El-aziz & Ramadan 2021; Siddiqui & Rehman 2017; Liu & Fraumeni 2020). Keiler (2015) elucidates that although primary education play an important role in basic production of goods and services however, workers with secondary education are likely to have advanced knowledge and skills that enable them to use technology. Primary education provides foundational knowledge of the education system that unravels a learner's basic elementary and future intellectual development. Secondary education pursues the completion of primary education deepening the complexity of the cognitive knowledge, skills and competences acquired

by learners thus equipping them for entering into the labour market or furthering their studies (Master Foundation 2020; World Bank 2021). Judging by the view that each stage of education raises productivity differently, it can be presumed that the variations in the impact of human capital on economic growth are explained by differences in education within countries.

LITERATURE REVIEW

According to Mills et al (2006) cross country studies are useful for establishing a general pattern underlying processes or patterns across a different context. Understanding differences and similarities in contexts becomes important in light of growing empirical evidence emanating from varieties of the effects across economies of human capital on economic growth (Hanusheka and Woessmann 2020; Suhendra & Istikomah 2020; Mohamed, Abd El-aziz and Ramadan 2021). Fukao, Makino and Settsu found that human capital explained the economic growth for Chinese economy for the past 130 years since 1885 to 2015. Anoruo and Alike (2015) used panel-dynamic ordinary least square (PDOLS) method to examine the direction of causality between human capital and economic growth in 29 SSA countries. The study used number of years of schooling and returns to education as proxies of human capital. Anoruo and Elike (2015) found evidence of a causal and bidirectional relationship between human capital and economic growth in all countries. Given that their study made use of only one PDOL equation Anoruo and Elike (2015) cautioned that interpretation of their findings should be done cautiously. Evidence from Anetor (2021) suggests that the economic context of the SSA region is different from other regions, suggesting that perhaps well-

established relationship between human capital and economic growth observed in other part of the world might not work well within countries in the SSA region. These findings also inconsistent with Wang, Hua, Tao and Moldovan 2021 whose findings indicate that human capital in SSA has not yet reached certain thresholds that propel economic growth and development.

Siddiqui and Rehman (2017) used Empirical Bayesian methodology to examine the effect of human capital on economic growth in East and South Asian countries. From their findings primary and secondary education has a significant effect on economic growth in the East Asia whilst in South Asia only primary education had effect on the larger part of the region yet secondary education has insignificant effect except in Pakistan where it had a weak significant effect on economic growth. Siddiqui and Rehman (2017) argued the possibility that countries in the East Asia region have already experienced full and adequate access and completion to primary and secondary education preparing them to transition to tertiary school than those in South Asia. These findings are inconsistent with those of Maneejuk and Yamaka (2021) who in a comparative study of ASEAN-5 countries namely, Thailand, Indonesia, Malaysia, Singapore, and the Philippines, confirmed that both secondary and higher education enrolment rates have a significant contribution to economic growth in those at individual and regional levels.

Khan and Khan (2015) using a Granger Causality Test on data set for the period of 1971 to 2012 found a causal relationship between human capital and economic growth in Pakistan. The same study found no bidirectional relationship between secondary school enrolment, at different levels and economic growth suggesting that a

causative relationship did not exist between human capital and economic growth. Findings in Awel (2013) showed the presence of a bidirectional causality running from relationship human capital to from output per worker and conversely from output per worker to human capital in Sweden. Yusoff (2011) found that an increase in school enrolments contributed to economic growth in Malaysia during 2001 to 2006.

The scope of individual country specific studies are useful for understanding country specific contexts of the specific country however, their scope does not extend to identify factors that are common to all systems thereby broadening an understanding of a national problem in comparison to the experiences of the other countries. Kotásková et al (2018) using the Granger Causality Method and the Cointegration examined the effect of enrolment rates and average years of schooling as well as gender to examine effect of human capital on economic growth in India. Their study found that secondary school enrolment has significant impact on economic growth whilst primary school enrolment had an indirect effect at probability of 95%. Afzal et al (2010) using an ARDL found that an inverse relationship existed between school education and economic growth in the short run, whilst it has significant long term effect in the future in Egypt. Mills, van de Bunt and de Bruijn (2006) explain the comparative studies not only uncover differences between entities but discover universal patterns, differences that explain specificities and reveal unique attributes of specific entity that might be impossible to detect using than using other research methods.

The literature discussed in this review reflected a number of contextual and methodological imitations. With regards the context elements most of the ideas raised in

the previous studies were based on contexts that different from the SSA, thereby limiting the relevance of the findings to countries in the region. Regarding the methodological aspects although useful in highlighting correlational, cause and effect relationship between economic growth and human capital correlational based studies suffers from the limitation of the long run relationship between the variables. Darrat and Al-Yousif (1999) explain that correlations-based analysis are useful for establishing whether significant or insignificant, positive or negative relationship exist between variables however, they are of limited use because they ignore the cointegration (long-run) relationship between variables. As evidence by literature review little studies have been done to establish the long term relationship between human capital and economic growth in SSA. Darrat and Al-Yousif, (1999) cautions that the standard linear regression are biased by virtue of their emphasis of the short term and correlations raising the risk of failing to reveal the true and complete long run relationship between variables. Heeding the advice from Darrat and Al-Yousif (1999); Engel and Granger (1987) as well as Mills et al (2006) this paper unlike other previous studies it address the methodological gap by employing an ADRL and ECM to examine the long term impact of human capital on in SSA countries.

METHODOLOGY, DATA AND MODEL SPECIFICATION

The study examined data set for 37 SSA countries from 2000- 2018, higher income countries were excluded based on the data freely available at the World Bank Indicators (WDI) website used in this study. The selected countries appear suitable to test for long term relationship between human capital

and economic growth given an observed trend of increase in education and continued low growth observed for many years. A human capital augmented Cobb-Douglas (1923) production function where economic growth is considered as a function of physical capital and human capital as proposed by Neeliah and Seetanaah 2016; Schultz 1961; 1967; Becker 1975; Lucas 1997; Romer 1989; Mankiw et al 1992) in used in this study. Human capital is proxied by primary and secondary school enrolment, economic growth is represented by GDP and physical capital proxies of Gross capital formation as proposed by (Barro and Lee 1992; Romer1989) as well as Maneejuk and Yamaka (2021) amongst other scholars. The World Bank (2021) defines gross capital formation as was previously considered as gross domestic investment and it includes factors such as additions to the fixed assets which include land improvements plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools and other infrastructure. The study hold the assumption that economic growth is a function of human capital and physical capital is specified in the following model.

$$GDP_{it} = f(\text{physcap}, \text{senrolpri}, \text{senrolsec}) \dots \dots \dots (1)$$

Where: GDP_{it} is the gross domestic product per capital, physcap = physical capital, senrol = school enrolment primary and senrol represent school enrolment secondary

To establish whether a long run relationship between human capital and economic growth exist an ARDL and error correction model cointegration analysis techniques were specified and estimated. This follows the diagnostic tests which showed the presence of mixed stationary level of $I(0)$ and $I(1)$, therefore techniques such as the Eangle –

Granger and Johansen technique could not be used. The error correction models can be specified as in (Durak and Eroğlu 2019). The ARDL (p, q) where p represent the lag of the dependent variable and q of the independent variable. As such the model can be specified as follows:

$$Y_{it} = \sum_{j=1}^p \lambda_{ij} Y_{i,t-1} + \sum_{j=0}^q \delta_{ij} X_{i,t-j} + \mu_i + \varepsilon_t \quad (2)$$

Where $i=1, 2, \dots, N$ is the number of countries, $t=1, 2$ presenting time in years... μ_i = constant effects, j is the number of lags, X_{it} independent variables vector (kx1), $Y_{i,t-1}$ dependent the lagged value of the variable, (kx1) coefficients vector and λ_{ij} represent the coefficient of the dependent variable.

To estimate the speed of rate adjustment to equilibrium with human capital and economic growth changes with if there is any long term relations an error correction question was derived from equation 2 and is expressed as follows:

$$\Delta Y_{it} = \mu_i + \phi_1 (Y_{i,t-1} + \theta'_i X_{i,t}) + \sum_{j=1}^{p-1} \lambda_{ij}^* \Delta y_{i,t-1} + \sum_{j=0}^{q-1} \delta_{ij}^* \Delta X_{i,t-j} + \varepsilon_t \dots (3)$$

ϕ_1 = the long-term or equilibrium relationship between Y_{it} and X_{it} . λ_{ij}^* Shows the previous-term coefficients of the dependent values in the model and δ_{ij}^* is the short-term coefficients of the lagged independent variables. The error correction coefficient ϕ_1 is the measurement value of the convergence rate of Y_{it} to the long-term equilibrium value following the change in the independent variable (X_{it}). If value of ϕ_1 is

negative and statistically significant this shows the existence of a cointegration relationship between Y_{it} and X_{it} . If the value of ϕ_1 is negative it indicates that there is long term relationship between human capital and economic growth. Given that this study seek to examine the long run relationship between human capital and economic growth, the ARDL and error correction model specified in equation (1), (2) and (3) will be used to estimate the long term relationship and short term dynamics between these variables.

Data analysis

Descriptive statistics

The mean, mode and standard deviation of economic growth, physical capital, primary and secondary school enrolment were determined as well as the correlation between them was determined and presented in Table 1. The findings in Table 1 show that, overall mean score of economic growth for SSA countries is 4.52 and standard deviation 4, 36. These small differences between mean and standard deviation indicates there are low variations in economic growth. Primary and secondary school enrollment have a mean of 100 and 40 with standard deviation of 23.14 and 22.18 respectively. The high differences between mean and standard deviation show that there are major variations in primary and secondary school enrollment. The correlations show that only school enrolment has a significant but negative relationship with economic growth.

Table 1. Descriptive statistics and correlation

Variable	gdp	Phycap	senrolpr	senrosec
Mean	4.512	6.23e+09	100.0695	40.502
Std. Dev.	4.363	1.35e+10	23.142	22.178
Min	-20.599	6974332	32.356	6.19735

Max	33.629	8.25e+10	149.3075	109.444
Obs	703	676	564	448
Correlation				
Gdp	1.000			
Phycap	0.004	1.000		
senrolpr	0.032	-0.0370	1.0000	
senrosec	-0.152*	0.295*	0.266*	1.0000

Where $[GDP]_{(it)}$ is the gross domestic product per capital, phycap represents physiscal capital, senrol school enrolment primary and senrosec represent school enrolment secondary

***, **, * represents significant level at 1%, 5%, 10% respectively

Within and Between Variations in human capital and economic growth in SSA countries

The variation between dependent variable and the regressor in the panel data was estimated and presented in Table 2. The findings show that, the overall variation of economic growth is estimated at 4.51, within variations 4.04 and between of 1.66. This indicate that time variation within countries has contributed the largest portion to the observed overall mean and there is low fixed variation between countries overtime. It can be concluded that countries within the Sub

Saharan Africa region did not experience notable changes in economic growth within their economies during the seventeen years period under investigation. The findings show that countries suffer from high between country and cross country differentials in terms of primary and secondary school enrollment. This suggest that despite the overall high school enrollment, other countries in the region have low enrollment both in primary and secondary education. The overall mean of secondary enrollment on average is 40.72%.

Table 2. Overall Within and Between Variations in Panel Data

Variable		Mean	Std. Dev.	Min	Max	Observations
gdp	Overall	4.518	4.362526	-20.599	33.629	N = 703
	Between		1.656269	.799	8.970	n = 37
	Within		4.044594	-22.041	31.455	T = 19
phycap	Overall	6.23e+09	1.35e+10	6974332	8.25e+10	N = 676
	Between		1.25e+10	7.92e+07	5.48e+10	n = 36
	Within		5.38e+09	-3.11e+10	3.45e+10	T-bar = 18.778
senrolpr	Overall	101.283	22.29183	32.356	149.308	N = 684
	Between		20.10611	56.428	139.065	n = 36
	Within		10.16482	49.924	132.748	T = 19

senrosec	Overall	40.721	19.679	6.1974	109.441	N = 703
	Between		18.574	12.946	93.711	n = 37
	Within		7.150	21.290	67.830	T = 19

Findings of first Generational Unit Root Test and Stationary analysis test

Establishing the long term relationship between human capital and economic growth required several diagnostic tests to be conducted first determine the fitness and accuracy of model specified in equation 1, 2 and 3 to estimate the proposed relationship. As such, a test for first generation unit roots were applied using the IM Persaran and Shin, Breitung Levin, Lin, Chu test and ADF Fisher Unit root test and the results are presented in Table 3. All the four models tested the null hypothesis that, economic growth, secondary school enrollment, primary school enrollment and physical capital all have a unit root (non

stationary), whilst the alternative hypothesis postulated that the variables do not have a unit root (stationary). The results show that some variables are stationary at level I (0), and some of them are stationary in the first difference I (1). The mixed stationary reflects the possibility of the presence of the problem of cross sectional dependence. Resultantly, second generation unit root tests were conducted to test for cross sectional dependence using Pesaran's Cross-sectional Augmented Dickey Fuller (CADF) and CIPS test respectively that were employed to examine whether there is correlation between units.

Table 3. First Generational Unit Root Test Unit root test

Level	1 st Differences							
	IM Persaran and Shin	Breitung	Levin, Lin, Chu	ADF Fisher – Unit Root test	Im Persaran and Shin	Britung	Levin, Lin, Chu	ADF Fisher –Unit Root test
GDP	-9.862**	-	-	--	-15.574***	-11.903***	-17.979***	-31.853***
Phycap	-	2.444***	-	0.509	-11.229***	-7.809***	-9.326***	-18.044***
Senrolpr	2.520**	4	-	-2.054*	-	-7.393***	-8.550***	-18.409***
Senrosec	4.063***	3.323	3.742**	-2.952***	10.864**	-9.215***	-4.796***	-22.472***
	-	3.200	0.375	-2.952***	-12.354***	-9.215***	-4.796***	-22.472***

***, **, * represents significant level at 1%, 5%, 10% respectively

Second Generation Unit Root Test Results and Cross-Sectional Dependence Test

Prior testing for Pesaran's CADF and CIPS a Pesaran (2004) a CD test was used to test for cross-section dependence in all the panels. The result of the CD test for (1) is 4.105 ($p = 0000$), this indicates that the test strongly cannot reject the null hypothesis that there is no cross-sectional independence in the panel. The results of the second generation root which are stronger than the first generation roots test take into account the cross-sectional dependence across all countries series and all the variables for the whole panel are stationary at level 1(0) and the other part at level (1). The Pesaran's CADF test at both level (0) and 1 (1) are examined at the null

hypothesis (H0) that assumes there is a unit root, whilst H1 that assumes at least one of the series is stationary. The results could not reject the null hypothesis indicating that there is a presence of unit root. The critical values of tables of Pesaran (2007) and the t-test obtained from the second generation test are given in Table 4. Unlike in the null hypothesis that there is non stationary, this test examines whether at least one if the series is stationary as alternative hypothesis. If the $CADF_{Calculated} < CADF_{critical}$, the null hypothesis cannot be rejected and the series are said to have a unit root. Table 4 shows that most of the Calculated values of each of the variables is greater that the critical values of Table (b) of Pesaran (2007) and given in table 4 and therefore contains no unit root.

Table 4. Pesaran's test of cross sectional independence

CADF test result in fixed model of level and first differenced cross sectional dependency								
Variables	Tests	Levels (0)			1 st Differences 1(1)			
		Critical values			Critical values			
	Pesaran's CADF	0.001	0.005	0.010	Pesaran's CADF	0.001	0.005	0.010
GDP	-4.113***	-2.760	-	-2.540	-	-2.760	-	-
Phycap	-2.770**	-2.760	-	-2.540	5.794***	-2.760	2.620	2.540
Senrolpr	-2.780**	-2.760	-	-2.540	3.801***	-2.760	2.620	2.540
Senrosec	-3.327***	-2.760	-	-2.540	4.248***	-2.760	2.620	2.540
			2.620		5.364***		2.620	2.540

***, **, * represents significant level at 1%, 5%, 10% respectively

The Findings of Cross-Sectional Dependence

Test (CIPS)

In the second generations CIPS test, the null hypothesis there is "unit root" while alternative hypothesis "least one of the series is stationary" is tested. When the variables in the table are examined, it can be concluded that a very large part of the data calculated for

each of the variables is generally higher than the critical values. This leads to the rejection of the null hypothesis and accepting of the alternative hypothesis suggesting there at least one of the variables is stationary. The observed mixed stationary makes it impossible to test for cointegration using techniques such as Johansen, vector error correction methods and Engel and Granger.

Table 5. Cross-Sectional Dependence Test (CIPS)

Variables	Tests Levels Critical Values				1 st Differences Critical Values			
	Pesaran CIPS	0.001	0.005	0.010	Pesaran CIPS	0.001	0.005	0.010
GDP	-3.940	-2.03	-2.11	-2.25	-5.329	-2.03	-2.11	-2.25
Phycap	-2.710	-2.03	-2.11	-2.25	-3.903	-2.03	-2.11	-2.25
Senrolpr	2.740	-2.03	-2.11	-2.25	-4.001	-2.03	-2.11	-2.25
Senrosec	-3.271	-2.03	-2.11	-2.25	-4.915	-2.03	-2.11	-2.25

***, **, * represents significant level at 1%, 5%, 10% respectively

Results for Panel Cointegration Analysis

Westerlund (2007) Cointegration Test

Westernlund 2007 error correction cointegration and Panel ARDL cointegrated analysis were applied because the first generation unit root tests showed mixed stationary whilst second generation unit root CADF showed non stationary whilst CIPS shows stationary. The mixed stationary thus indicates that the Westernlund 2007 error correction cointegration analysis and ADRL panel cointegration analysis should be used. Therefore, the Westernlund 2007 error correction cointegration analysis was used to examine whether there is cointegration between the variables. To account for the presence of cross sectional dependences a Westernlund (2007) uses four test statistics to test the existence of cointegration. For Both group statistics that is, (Gt and Ga) as well as (Pa and Pt) the null hypothesis is “there is no cointegration for cross-sectional units” and the alternative hypothesis is that “there is no cointegration in some units but there are cointegration in some units”. The results for

the Westerlund (2007) Cointegration Test both the Gt and Ga as well as for Pt and Pa for physical capital, primary and secondary school enrolment, rejects the null hypothesis that there is no cointegration between human capital and economic growth. The test statistic obtained from Gt are -4.217 (p-value=0,000) Ga at -9.782 (p-value=0,000) and similarly Pt -21.443 and Pa -8.892 both at (p-value=0,000). Furthermore, according to the value of the Robust P-value, for all statistics "there is no cointegration" hypothesis was rejected. All the test statistics are statistically significant at the 1 percent level of significance level. These results indicate that there is cointegration suggesting that a long term relationship between human capital and economic growth exists but temporary, therefore, error correction function corrects these deviations in the long term relationship. Test for the long and short term relationships a pooled average group, average group, and dynamic constant effects estimators expressed as PMG, MG and DFE were estimated using the panel ARDL cointegration model

Table 6. Panel Cointegration Analysis Westerlund (2007) Cointegration Test

	Test	Value	Z value	P value	Robust-P value
Model 1 GDP to phycap, senrolpr, senrosec	Gt	-4.217	-10.278	0.000	0.000
	Ga	-9.782	4.229	1.000	0.000
	Pt	-21.44	-7.300	0.000	0.000
	Pa	-8.892	2.544	0.995	0.040

Panel ARDL Estimation of 38 Sub-Saharan African countries

Table 7 represents the results of the PMG, MG and DFE was estimated to answer the question whether a long term relationship exists between human capital and economic growth. The study examined the contribution of each of the variables to the GDP in the short run and long run through the PMG, MG and DFE models. The results in table 7 show that the error-correction term in all the equations of the ARDL are significant at 1 percent. The findings show that the significant error correction coefficient (\emptyset) with a negative sign was obtained from all the three estimators, this indicates that in case of deviations from equilibrium, it will converge to the equilibrium again. The PMG estimator show that approximately 86% of imbalances in a period will improve in the next period and approach long term balance. The PMG estimator show that physical capital has a positive and statistically significant effect on economic in the short run yet a positive but insignificant effect on the long term under all the models. Accordingly, a 1% increase in the physical capital will increase GDP by approximately 4.2% in the short run whilst it has an insignificant effect on economic growth in the long term.

Secondary school enrolment was found to have negative and insignificant effect on economic growth both in the short run and long run. Primary school enrolment

has a positive but insignificant effect on economic growth both in the short run and long run. The proceeding findings suggest that Hausman test should be conducted to examine the homogeneity of long term coefficient and establish the most appropriate indicator. It starts with testing the hypothesis that PMG estimator is more effective estimator than MG estimator. The null hypothesis was rejected suggesting that MG was more effective. The anticipation that MG estimator is ineffective for small sample population and short time series, invoked the conducting Hausman test between DFE and MPG estimator and the hypothesis that MG is more effective was rejected indicating that DFE estimator is a more effective than MG.

Therefore using DFE estimator as the most fit model, consistent Westerlund (2007) Cointegration Test the ECM indicate the presence of long term relationship between all variables across all countries. The results show that 77% of the imbalances in one period will improve in the next period towards the long-term equilibrium. This means that speed of imbalances in the short term approaching to equilibrium in the following period is high at 77 percent adjustment level. Regarding secondary education the results show that it has positive and significant effect on economic growth at 10% in the short run and has a significant but negative effect on long term economic growth. The results show that a 1% increase in secondary enrolment increase economic

growth by approximately 0,1% whilst in the a 1% increase in secondary school enrolment decrease economic growth by -0,1 in long run. The inverse relationship between indicate that increase in education results in a decrease in economic growth in the long run. Physical capital has positive and significant at

1% effect on economic growth in the short run, however, in the long run it has insignificant and low positive effect on economic growth. Primary school enrolment has an insignificant and low positive effect on economic growth both in the short run and long run.

Table 7. PMG, MG and DFE Test Results for all countries

Dependent variable GDP	PMG		MG		DFE	
	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Long Term Coefficient						
phycap	0.292	0.187	-0.1184	0.663	0.761	0.408
senrolpr	0.009	0.0098	0.084	0.121	0.035	0.028
senrosec	-0.016	0.0171	0.177	0.758	-0.080*	0.039
Error	-0.856***	0.0487	-1.056***	0.0456	-0.775***	0.599
Correction (Φ)						
Δ _phycap (1)	4.162***	0.791	4.012***	1.1993	2.869***	0.599
Δ _senrolpr (1)	.085	.0538	0.0324	0.082	0.057	0.033
Δ _senrosec (1)	-0.150	0.167	-0.217	0.376	0.086*	0.041
C (Constant)	-1.984	0.238	-15.557	35.232	-9.708	5.874
Number of observations	630		630		630	
Number of countries	35		35		35	
Hausman Test	0.91				4.03	
p-value	0.823				0.258	

Note: ***, **, * indicate the significance level of 1%, 5% and 10%, respectively. The table reports results for pooled mean group (PMG), mean group (MG) and dynamic constant effects (DFE) estimators. The dependent variable is GDP. The first panel (LR) shows long-term effects, while the second panel shows both equilibrium velocity (Φ) and short-term effects (SR). Hausman:

a = PMG is a more effective estimator than MG under the null hypothesis.

b = PMG is a more efficient estimator than DFE under the null hypothesis.

Discussion of Results

An examination of the ARDL and error correction cointegration was done to examine the long run relationship between human capital and economic growth using dataset from 37 SSA countries for the period of 18 years from the year 2000-2018. The results of the study revealed that physical capital and secondary school has significant but weak

effect on economic growth both in the short run and long run. Primary school enrolment has no effect on economic growth in the short run and long run. These results are inconsistent with findings previous studies such as Maneejuk and Yamaka (2021) conducted in AESAN countries where both primary and secondary education had significant and positive effect on economic growth. The weak effect of secondary

education on economic growth might reflect that secondary school enrolment has not yet reached a threshold where it can make a strong contribution to economic growth. The observed trends might be attributed to the fact that the overall enrolment in secondary school in SSA is still lower than the world average, the current increase rate is similar to the world average in 1970 reported by World Bank (2021). The inverse relationship between primary education and economic growth is inconsistent with the theoretical perspectives of endogenous economic growth. Additionally findings contradicts the commonly held development policy views that expansion of education through increased access promote economic growth United Nations Educational Scientific and Cultural Organization (UNESCO), World Bank, United Nations Children's Fund (UNICEF) and many others. These findings might be explained from the Sustainable Development Goals Report (2020) which observed that in low-income countries, the primary completion rate is 34 per cent for children from the poorest 20 per cent of households compared to 79 per cent for children from the richest 20 per cent of household. This may lead one to believe that whilst there is a higher enrolment in primary school, few children might be completing that level of education in SSA countries. Physical capital was observed to have strong and positive on economic growth in the short run and insignificant effect on economic growth in the long run. These results are in contrast to the endogenous economic growth assumptions which assumes that an increase in physical capital lead to an increase in economic growth. These findings suggesting that studies that ignore investigating long term relationship might be misleading due to model misspecification Considering the negative coefficient of secondary school

enrollment in SSA countries, it can be assumed that secondary education has not yet adjusted adequately to reach a threshold that enable the workforce to maximize the benefits of physical capital. The same applies, that primary education has insight contribution to economic growth despite noticeable increase in primary enrollment over the years.

CONCLUSION AND RECOMMENDATION

The study examined the long run relationship between human capital and economic growth. The evidence found in this study compels the conclusion that secondary education has significant but weak effect on economic growth both in the short run and long term in SSA countries whilst primary education has an insignificant contribution. Drawing from the proceeding conclusion it is thus recommended that primary and secondary education should be improved in order to enable it to optimise its utilisation of physical capital both in the short run and long run. Since an increase in education in SSA countries has not yielded the desired economic growth it is necessary to prioritise increasing enrolment in secondary schools in order improve human capital formation for economic growth. The practical implication for human capital driven economic growth strategies suggest the need for an urgency need for increased efforts towards identifying and addressing time invariant factors within countries that hinder enrolment in secondary schools should be undertaken. This study recommends that educational reforms which align national educational objectives with human capital and economic growth needs of countries should be instituted to strengthen human capital development through improved education and in turn promote

economic growth. Overall, SSA countries should improving access to secondary education and quality of primary education in order to enhance the contribution of human capital to long term economic growth.

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