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An Empirical Investigation on Determinants of Human Capital Development in Africa: A Panel Data Analysis

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Abstract: *Africa is regarded as the least developed continent in terms of overall development and specifically in terms of human capital development (HCD) ef- forts. Research on the determinants of HCD in Africa is scanty, as the literature is dominated by country-specific studies as well as group of country studies that primarily focus on the effect of human capital on growth and other economic de- velopment parameters. Therefore, this paper investigates the determinants of hu- man capital development in 33 African countries over a 14-year period from 2000 to 2013. The empirical analysis is predicated on Sen's capability approach that was modified following Binder and Georgiadis (2011) in order to explicitly ac- count for the role of health, infrastructure and institutions as potential drivers of HCD. This is a departure from previous studies that focused primarily on the role of education. In addition to preliminary tests such as line plot, descriptive statistics and correlation analysis carried out, the data is analysed using panel unit root, co- integration and causality techniques. Findings show that all the variables are integrated of order one while HCD and its determinants have a stable long-run equilibrium relationship. Specifically, all the variables significantly influence HCD in the long run, whereas the contemporaneous models suggest that only institutions matter. Utilizing alternative estimators as well as estimation of subsamples, ro- bustness tests reinforce our findings. Therefore, African governments may consider supporting HCD through sustained investment in the education and health sectors. At the same time, short-term gains may be attained through enhanced institutional quality and infrastructure development.*

Keywords: *human capital; Africa; health; education; panel data analysis*

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I. Introduction

Weak human capital development (HCD) efforts in Africa and the obvious disconnection between aggregate growth, health, and education indicators makes it imperative to understand the driving factors of HCD. A regional comparison of life expectancy at birth shows that Africa recorded 59.6 years as at 2013 in contrast to the global average of 71 years. Africa has a need-based shortage of 818,000 healthcare professionals based on the recommended global standard of 1.4 medical doctors and 0.88 nurses per 1,000 people in a country (United Nations Development Programme, 2013). However, despite the World Health Organization's recommenda- tion, medical doctors per 1,000 people in Africa stood at 0.2 (ibid.). In terms of education, Africa records the lowest school enrolment in the world. The gross school enrolment (tertiary) in Africa stood at 8.1%, while North America and the world average was 90.9% and 32%, respectively in 2012. Schultz (1999) notes that most African countries record weak health and education indicators compared to other regions around the world. Thus, improving human capital in Africa has become a major concern for re- searchers and policy makers and this motivates this empirical pursuit.

A dominant strand of literature observed that inadequate investment in education and health hinder inclusive growth and constrains participation of vulnerable groups (see: Asaju *et al.*, 2013; Omojimite, 2011; World Bank, 2010; Ndulu, 2010; Odia & Omofonmwan, 2010; Dae-Bong, 2009; Apple- ton & Teal, 1998); others have focused on different contexts. For instance, Acemoglu *et al.* (2014), Binder and Georgiadis (2011), United Nations Development Programme (2009), De Muro and Tridico, (2005) considered the institutional perspective; while Sapkota (2014), Ludema (2014) and Waema (2002) examined the infrastructure context. While these studies

have underscored the role of human capital towards sustained economic development, they failed to consider the long- and short-run determinants of HCD, which has remained at the forefront of Africa's development agenda. Furthermore, considering the role of health and education towards HCD cannot be downplayed. As pointed out by Schultz (1999), health and education are beneficial and can be viewed as investments in human capital which, lead to a higher standard of living.

In terms of methodology, unlike previous studies such as Acemoglu *et al.* (2014), Maurizio and Giovanni (2016), Pelinescu (2015), Atalay (2015), Maazouz (2013), which ignored the unit root characteristic of the underly- ing panel data series, this study relies on Levin *et al.* (2002) and Im *et al.* (2003) in order to ascertain the order of integration of the underlying series. One limitation of the former is that it relies on the assumption of cross- sectional independence (Baltagi, 2008). Moreover, the null hypothesis that all cross-sections have a unit root is restrictive. Many studies fail to reject the null of no co-integration, even in cases where a long-run relationship is suggested by theory. Therefore, the long-run relationship between HCD and its determinants is examined using the Engle-Granger based panel co- integration tests proposed by Pedroni (1999, 2004) and Kao (1999). While the latter proposes several tests for co-integration that allow for heteroge- neous intercepts and trend coefficients across cross-sections, the former follows a similar approach, but specifies a model with cross-section specif- ic intercepts and homogeneous coefficients.

It is against this background that this paper seeks to give an account of factors that drive HCD in 33 African countries and they are Benin, Botswa- na, Burkina Faso, Burundi, Cameroon, Cape Verde, Congo Rep., Cote d'Ivoire, Djibouti, Egypt, Ethiopia, Gambia, Ghana, Guinea, Kenya, Leso- tho, Malawi, Mali, Mauritius, Morocco, Mozambique, Namibia, Niger, Rwanda, Senegal, Sierra Leone, South Africa, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zambia. These countries were selected basing on data availability. The paper models human capital development as a function of education, health, infrastructure, and institutional indicators in line with the theoretical literature. An understanding of how these variables influence sustained HCD can serve as valuable inputs in national and regional policy formulation and implementation regarding sustained capacity building ef- forts in Africa. Summing up, the motivation for this research is based on three interrelated factors; (i) human capital is regarded as an important driver of inclusive growth; (ii) technical progress plays a vital role in elimi- nating the growth drag that characterizes most African economies; and (iii) HCD promotes equity, redistribution and opportunities for the most vulner- able groups. The outline of the paper is presented as follows: Section 1 is the introduction while Section 2 provides a review of related literature. The focus of Section 3 is on methodology. Section 4 dwells on the empirical analysis and discussion of results, while Section 5 concludes.

II. Literature Review

The assertion by Adam Smith in 1776 that: "increasing division of labour may lead to economic prosperity" gave rise to thoughts on human capital subsequent upon which it evolved into a scientific theory (Fitzsimons, 1999). Schultz (1961) opines that human capital plays a vital role towards national and regional economic growth and development. Several attempts have been made to clarify how human capital contributes to socioeconomic development (Alexander, 1996; Sen, 1999; Grubb & Lazerson, 2004; Balcerzak, 2016); Rastogi (2002) defines human capital as knowledge, competency, attitude and behaviour embedded in an individual; while Romer (1990) refers to human capital as a fundamental source of produc- tivity. According to Rosen (1999), it is an investment that people make to increase their productivity. Frank and Bemanke (2007) define human capi- tal as a set of factors such as education, experience, training, intelligence, energy, work habits, trustworthiness, and initiative that affect the value of a worker's marginal product. Human capital is also defined as investments in education, health, on-the-job-training, and migration that enhance an individual's productivity in the labour market, as well as in non-market activities (Sharpe, 2001). Factors that determine HCD include; time invest- ed in education by students, investment in education by governments (Dae- Bong, 2009, pp.7-8). Others include educational and healthcare reforms, on the job training, vocational learning, part-time and formal education (Didenko, 2007, p. 6). Evidently, even at the conceptual level, a lot of em- phasis has been laid on the role of education, thereby ignoring other poten- tial determinants.

Early theories of human capital opined that investment in education and training develops human capital (Schultz, 1961; Becker, 1964). Another strand of literature predicts that effective healthcare services would im- prove human capital development (Oster *et al.,* 2013). According to the first line of reasoning, skilled labour makes it easy for countries to adopt and implement new technologies, thereby reinforcing returns on education and training (Nelso & Phelps, 1966). For example, Schultz (1998) makes a tangible connection between education and its impact on HCD. People are viewed as a source of economic development even though others attrib- ute development to improvements in technology (Schultz, 1961). The other strand of literature posits that health has an impact on HCD (Oster *et al*., 2013). Grossman's (1972) model that draws from the neoclassical theory of choice lays emphasis on health as a fundamental determinant of HCD. The author identifies social class, work environment, employment status, in- come, housing conditions, pollution, education, diet and lifestyle as major determinants of healthy living. The model opines that individual demand good health for two reasons: first,

for enhanced economic productivity; and second, for activities such as leisure.

HCD from improved investment in health and education enhances eco- nomic growth. Lucas (1988) opines that HCD is an engine of economic growth. Higher productivity of education increases the marginal product of labour. This implies that incentives to promote HCD are high due to its potential growth effect. Solow's (1956) growth model assumed two factors of production – labour and capital. However, the model does not consider HCD as an important component of the labour-induced growth process; and as a separate factor of production like capital and labour (Erich, 1996). Hence, Mankiw *et al.* (1992) present an augmented Solow model by intro- ducing human capital as a separate input based on a standard Cobb-Douglas labour-augmenting production function that accounts for technical progress (Barro & Sala-i-Martin, 1995, pp. 54-55). Although, the model of Mankiw *et al.* (1992) predicts a similar long-run growth experience for countries under the assumption that they draw from homogenous technology, the inclusion of human capital in the model provides a platform to explain dif- ferences in human capital-induced growth across Africa.

In contrast, Amartya Sen's capability approach as described in (Sen 1979; 1999) provides insight to the view that capability to achieve valued functioning is paramount for HCD. The underlying principle behind this approach is that an individual's capability is determined by social context, endowments of the individual as well as opportunities and choices accorded to the individual. The core of this model is its focus on what people can effectively do and/or become- that is, their capabilities (Robeyns, 2005) or functioning. Notably, the approach has gained prominence not only in theo- retical issues of development, but empirical applications as well. For in- stance, in analysing the determinants of human capital using this model, Wigley and Akkoyunlu-Wigley (2006) focus on education, while and Widdows (2008) examined the health dimension. The study by De Muro and Tridico (2008) considered the role of institutions. However, as the global economy becomes more knowledge-driven, HCD becomes an im- portant issue for policy makers in Africa at the national, sub-regional, and regional levels (Organization for Economic Cooperation and Development, 1996).

Improving human capital in Africa has become a major discourse among economists, researchers and policymakers. Some studies emphasize inadequate investment in education and health as major causes of low hu- man capital performance in Africa (Appleton & Teal, 1998; Dae-Bong, 2009; Omojimite, 2011; Asaju *et al.*, 2013; World Bank, 2010; Ndulu, 2010; Odia & Omofonmwan, 2010; Kern, 2009). These studies opine that inadequate investment in education and health are not only contributory factors to Africa's economic difficulties, but also, the poor state of existing infrastructure in these critical sectors have dampened the prospects for sus- tained HCD. For instance the experience of South-East Asia, and Europe where robust HCD strategies have been put in place to propel their econo- mies on a sustained development path. Contrarily, Africa has experienced relatively lower degree of development especially over the last 6 decades due to, amongst other factors, the low education attainment in many Afri- can countries (Guisan, 2005) and weak healthcare systems. Findings from Asaju *et al.* (2013) and World Bank (2010) suggest that human capital plays a positive and significant role towards development, and that large education gaps portend negative consequences.

Similarly, Schultz (1999) examines health and schooling investments in Africa in terms of infant and child mortality, life expectancy, and school enrolment rate, controlling for national income and urbanization from 1960 to 1995. The study conclude that inter-country regressions do not determine the link between human capital investments and regional economic growth. Health and education are not only beneficial, but may be viewed as invest- ments in human capital that leads to improved standard of living in Africa. The rapid socio-economic development is a function of the quality of hu- man capital; however, African countries are still lagging behind in this regard, partly as a result of dearth of planned efforts towards sustained HCD efforts through robust education and training (Awopegba, 2001, pp. 157-167) as well as improved healthcare service delivery.

Bidirici *et al.* (2005) analyse the relationship between human capital, growth, and brain drain in 77 countries using panel data for the period 1990 to 2001. They observed that migration increases growth in developed coun- tries, but generally slows down growth in less developed countries. The result also shows that education index, adult literacy rate, schooling rate, education investments, *per capita* income, growth rate, and average life expectancy are positively and significantly related to human capital in ma- jority of the countries considered. However, Erich (1996) suggest that em- pirical research should take into account other important determinants of human capital such as quality of education, workforce experience and health status of the population. This limitation constitutes a part of the val- ue addition of this paper.

Some studies have shown the interaction between institutions (set of social rules that structure social interactions) and human capital develop- ment (see, Acemoglu *et al.*, 2014; Binder & Georgiadis, 2011; United Na- tions Development Programme, 2009; De Muro & Tridico, 2005). For example, using two-stage least square regression, Acemoglu *et al*. (2014) examine the relationship between institutions and quality of human capital for long-run economic development. Their result revealed that both human capital and institutional variables were statistically significant. Binder and Georgiadis (2011) apply dynamic panel model for 87 countries between 1970 and 2005 to analyse the effect of macroeconomic policies (investment in physical capital, government consumption and trade openness) on the development of human capital measured by the Human Development

Index (HDI). The findings suggest that policies that seek to increase trade open- ness spur HDI more than of the effectiveness of Gross Domestic Product (GDP). The key insights from this study reveal the importance of strong institutions for the improvement of HDI. In line with Sen's capability ap- proach, De Muro and Tridico (2005) note that institutions play an important role towards HCD. For example, institutions have a vital role in promoting direct and indirect capabilities of people, because good institutional policies create development opportunities.

The role of infrastructure cannot be downplayed in view of the fact that it provides ample opportunity to partake in various economic activities, constitutes an important component of societal development, and contrib- utes immensely to the living standard (OECD, 2006). Sapkota (2014) as- sesses the impact of several infrastructure variables (access to electricity, access to clean water sources, and road density) on HDI and its three com- ponent indices such as education, health and income, using panel data from 1995 to 2010 covering 91 developing countries. The dynamic panel esti- mates using General Methods of Moments (GMM) reveal that the three infrastructure variables have significant positive impacts on HDI. However, access to electricity and water has a positive and significant effect on edu- cation and health indexes only. Sapkota (2014) observes that to achieve the post-2015 development strategies (Sustainable Development Goals-SDGs), it is important to address the infrastructure challenges. The findings under- score the importance of infrastructure in the human development process.

Another attempt to clarify the importance of infrastructure on HCD was by Waema (2002, p. 7), who revealed that Information and Communication Technology (ICT) is the key to transforming traditional economies into information and knowledge-based economies in Africa. For instance, Sin- gapore, India, and Malaysia, perceive ICTs as the engine for promoting sustained development and growth, as well as gaining global competitive advantage. The author argues that ICT increases productivity, improves infrastructure development, minimizes production cost, and creates high value-added industries. Waema (2002) supports the idea that infrastructure services improve human capital with focus on ICT, electricity, access to clean water and road density, in addition, our study uses the internet as the measure of infrastructure, because the internet is driving large changes in the global economy (Ludema, 2014), and we argue forcefully that it will continue to drive HCD towards higher productivity in the future if African nations key into it. Acemoglu *et al.* (2014) use rule of law index to measure the quality of institutions, while De Muro and Tridico (2005) recognize the importance of institutions towards HCD, however, our study uses regulatory quality to reflect the competence of policy-makers to channel policies towards improved HCD in Africa.

Finally, in terms of education and health, our measurement is not based on aggregate expenditure on these sectors, but the share of health and edu- cation spending on aggregate public absorption. Unlike the previous studies that examine individual impacts of the determinants of human capital, we consider, simultaneously, several structural and institutional factors that may influence HCD in Africa. This is with a view to informing regional policy formulation and implementation with respect to the identified drivers and constraints. In sum, the literature survey highlights several important issues in empirical research on the impact of education, health, institutions and infrastructure on HCD.

III. Theoretical Framework

Human development finds its theoretical underpinnings in Sen's capabili- ties approach (Sen, 1979; 1999) which holds "a person's capability to have various functioning vectors and to enjoy the corresponding well-being achievements" to be the best indicator of welfare. This perspective shifted the analysis of development to the vector of attributes such as income, education, health, as well as vector of possible opportunities available to indi- viduals: a starving or uneducated person would have fewer choices than a healthy, educated person. This implies that education may not be the sole driver of economic transformation. The quantity and quality of investment (domestic and foreign) together with the choice of technology and overall policy environment constitute important determinants of economic perfor- mance.

The capability approach attaches relevance to the role of institutions for human development (Sen, 1999). De Muro and Tridico (2008) observe that the links between institution and human development are complex because human development is a multidimensional concept. Institutional and devel- opment policies come together to make development less uneven, and to create equal development opportunities for all, in order to improve the standard of living.

Therefore, the algebraic model can be specified as:

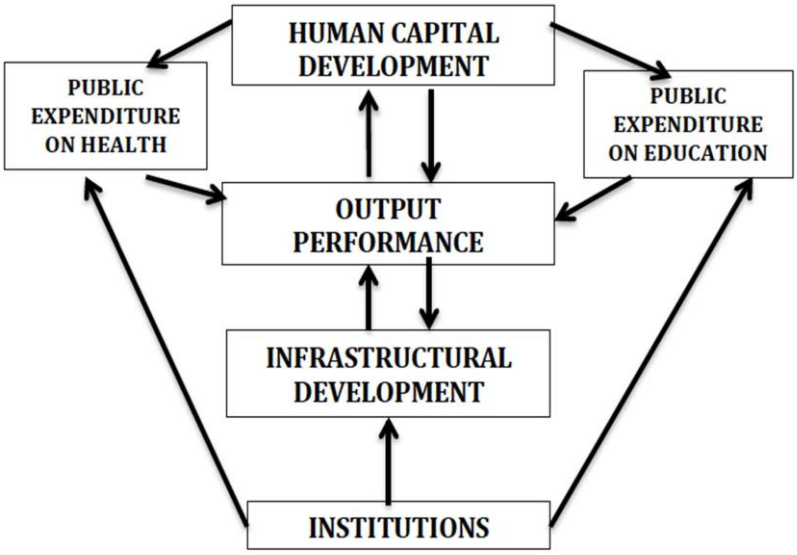
$$HD = f(Z) \qquad (1)$$

where: HD is human development, Z is a vector of exogenous capability shifters.

Equation (1) shows Sen's theory of development as an expansion of ca- pabilities. This is the starting point for the human development approach: the idea that the purpose of development is to improve human lives by ex-

panding the range of things that a person can be and do, such as to be healthy and well nourished, to be knowledgeable, and to participate in community life. Therefore, the focus of development is on removing the obstacles to what a person can do in life such as illiteracy, ill health, lack of access to resources or lack of civil and political freedoms (Sen, 2003).

Figure 1. Potential Drivers of Human Capital Development



Source: own work.

Figure 1 shows that educational attainment has an impact on welfare through the improved capacity of labour on aggregate output. The availability of an educated and healthy labour force provides ample opportunity for shifting the production possibility frontier of African economies. The inclu- sion of public spending on education has been widely pursued in empirical works (Pelinescu, 2015; Atalay, 2015; Maazouz, 2013). The flow path of directional impact is illustrated in Figure 1. Public expenditure on educa- tion and health are expected to exert a positive impact on human capital through economic performance in African countries. Institutions also play an important role on HCD through its impact on fiscal policy discipline as well as efficient channelling of resources towards infrastructure development.

Better institutional quality play a vital role in promoting capabilities of people as well as output productivity. This is because good institutions create equitable development opportunities (De Muro & Tridico, 2005; Balcerzak, 2009; Balcerza & Pietrzak, 2016). Infrastructure can impact human development directly through the provision of important services such as portable drinking water and electricity; and indirectly through en- hancing economic growth, granting access to new income-earning opportu- nities for the most vulnerable groups and strengthening governance (Sapko- ta, 2014).

The Model, Estimation Methods and Data

The model adapted for this study is predicated on Sen's capability frame- work and specified following the exposition of Binder and Georgiadis (2011). However, our model differs from the aforementioned in that we account for the role of health, infrastructure and institutions as major driv- ers of human capital development.[1] The model is specified as follows;

$$HCD_{it} = \alpha_0 + \beta_1 PEE_{1it} + \beta_2 PEH_{2it} + \beta_3 GRWT_{3it} + \quad (1)$$

$$+\beta_4 INST_{4it} + \beta_5 INFRA_{5it} + \mu$$

where the subscript *i* represents the selected African countries and *t* denotes the time frame considered. We rely on human development index as a proxy for HCD. The HDI is a summary measure of human development and it measures a country's attainment of the three dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living.

A stable macroeconomic environment as represented by economic growth is expected to exert a positive influence on HCD since sustained increase in national income translates to improvement in *per capita* income. This in turn provides ample opportunity for training and capacity building. Following Bidirici *et al.* (2005), a positive relationship between economic performance and HCD is expected.

PEE and PEH denote public expenditure on education and health, re- spectively and these are important input parameters for sustained HCD. They capture the impact of domestic absorption in the health and education sectors on HCD. *Apriori*, we expect a positive relationship between educa- tion and health expenditure on HCD (see Baah-Bonteng, 2013). In terms of measurement, public expenditure on education and health as share of total expenditure are used.

INST means institutions and this is captured by regulatory quality. It captures the ability of government to formulate and implement effective policies and regulations. This variable plays a vital role towards HCD be- cause strong institutions provide a favourable environment for the pursuit of HCD programmes. Therefore, better institutional quality should improve HCD in Africa. More so, in the capability approach, institutions are particu- larly relevant as mediators between economic growth and human develop- ment (see, Georgis & Georgiadis, 2011; De Muro & Tredico, 2008).

INFRA means infrastructure and this is captured by access to internet. Internet users (per 100 people) are defined as individuals who have used the internet from any location in the last 12 months via computer, mobile devices, personal digital assistant, etc. This variable is expected to be a positive function of HCD (Sapkota, 2014). As pointed out by Rotham *et al.* (2014), infrastructure provides the foundations for modern day econom- ic activities and therefore, constitutes a major sector of the economy given its contribution towards raising welfare.

This study makes use of panel causality test. Hurlin and Venet (2001), note that the heterogeneity between countries is an important consideration when conducting analysis with panel data.[2] The test equation for each i and for all t is:

$$y_{it} = \sum_{k=1}^{p} \rho^{(k)} y_{i,t-k} + \sum_{k=1}^{p} \theta_i^{(k)} X_{i,t-k} + \mu_{i,t} \quad (2)$$

where it is assumed that the autoregressive coefficients $\rho^{(k)}$ and the vector of regression coefficients slopes $\theta_i^{(k)}$ are constant for all k in $[1,p]$. The autoregressive coefficients are identical for all units while the regression coefficients' slope can vary across individuals. The purpose of this test is to establish the causal link between these variables.

Next, we conduct panel unit root test by utilizing the Levin-Lin-Chu (LLC) test (See Levin, Lin and Chu, 2002) panel unit root. The test is based on the following ADF-type specification given as;

$$\Delta y_{it} = \alpha y_{it-1} + \sum_{j=1}^{pi} \beta_{ij} \Delta y_{it-j} + X'_{it}\delta + \mu_{it} \quad (3)$$

where μ, i and t are as earlier defined. We assume a common $\alpha = \rho - 1$ (where ρ is the autoregressive coefficient), but allow for the difference term, p_i, to vary across coefficients. The notation X_{it} represents the exoge- nous variables in the model, including fixed effects and individual trend. It is assumed that the persistence of the model's parameters are common across cross-sections so that $\rho_i = \rho$ for all i. Under the null hypothesis for the LLC approach, there is a unit root (H_0: $\alpha = 0$) and an alternative that there is no unit root (H_1: $\alpha = 0$).

For the co-integration test, the residual-based technique proposed by Pedroni (2004, 1999) and Kao (1999) who extended the Engle-Granger framework to tests involving panel data is used. Under the null hypothesis of no co- integration, the residual of equation (1), μ_{it}, will be I(1). The pro- cedure requires that the residuals obtained from estimating equation (1) using OLS are extracted and tested for stationarity (that is, whether the residuals are I(1)) based on the following equation:

$$\mu_{it} = \rho_i \mu_{it-1} + \epsilon_t \quad (4)$$

The next step is to obtain the co-integrating equation from estimating Equation (1) using mean-group estimator

proposed by Pesaran and Smith (1995) and pooled mean-group estimator of Pesaran, Shin, and Smith (1997) to obtain the long run and short run estimates.[3] Assume an auto- regressive distributed lag dynamic specification of the form:

$$y_{it} = \sum^{p} \quad \text{j=1} \quad \lambda_{ij} y_{i,t-\text{j}} \; \text{╪} \sum^{q} \quad \eth'_{ij} \text{X}_{i,t-\text{j}} + \mu_i + \epsilon_{it} \qquad (5)$$

where X_{it} is a vector of explanatory variables; $\eth_{ij}$ are the *kx1* coefficient vectors; λ_{ij} are scalars; and μ_i is the group-specific effects. If the variables in equation (1) are, for example, I(1) and co-integrated, then the error term is an I(0) process for all i. An important feature of co-integrated variables is their responsiveness to any deviation from long-run equilibrium and this implies an error correction model in which the short-run dynamics of the variables in the system are influenced by the deviation from equilibrium (Blackburne & Frank, 2007, p. 198). Therefore, the error correction model is specified as follows:

$$\Delta y_{it} = \dddot{\gamma}_i (y_{i,t-1} - \varphi_i' \text{X}_{it}) + \sum_{\text{j=1}}^{p-1} \lambda^*_{ij} \Delta y_{i,t-1} + \qquad (5)$$

$$+ \sum_{\text{j=0}}^{q-1} \eth'^*_{ij} \boldsymbol{\Delta} \text{X}_{i,t-\text{j}} + \mu_i + \epsilon_{it}$$

The parameter γ_i is the error-correcting speed of adjustment term. If $\gamma_i = 0$, then there would be no evidence for a long run relationship. This parameter is expected to be significantly negative under the prior assumption that the variables show a return to long run equilibrium. The vector φ'_i contains the long run relationship of the variables.

The source of data for this paper is the World Bank's world develop- ment indicators online, and it covers the period 2000–2013. We considered a balanced panel of 33 African countries and the data on the variables of interest were readily available and complete for the selected countries. Ta- bles 1 and 2 in the appendix show the descriptive statistics as well as corre- lation analysis of variables used in estimation. These preliminary tests were carried out to understand the behavioural pattern of the data used in estima- tions. Although the line plot does not show any glaring co-movement be- tween the variables, infrastructure and institutions are the only variables considered that have about 62% positive correlation with HCD (proxied by human development index). The 9% negative correlation between growth
and HCD may be explained by the fact that growth in Africa has not been inclusive. Descriptive analysis show that average growth in Africa is 4.2% with a significant standard deviation of 3.2%. This suggests the existence of substantial disparities in the growth pattern of African countries.

Empirical Analysis and Discussion of Results

The existence of at least one causal link running from the determinants to HCD suggests that there is a long-run and contemporaneous relationship between the variables. Therefore, as a precursor to the dynamics of the model, we conduct Granger causality test within a multivariate panel data framework. Table 1 shows that there is a bidirectional link between *per capita* growth and HCD. However, a unicausal link showing that human capital caused all the other variables without any reverse causation is ap- parent except for public expenditure on health (PEH), which Granger caused HCD. This may be attributed to the fact that the health component of the HCD has a relatively short gestation period. In other words, its im- pact is instantaneous compared to that of education which, takes a relative- ly longer term. The implication of this finding is that for at least one mem- ber of the panel, there is bi-directional causality, and this suggests that there is a long- and short-run relationship between the variables.

Table 1. Panel Causality Test Results

H_0	N	F-Stat.	P-Value
HCD does not Granger Cause GRWT	396	12.724	0.000
GRWT does not Granger Cause HDI	396	6.670	0.001
INST does not Granger Cause HDI	396	0.087	0.917

HDI does not Granger Cause INST	396	2.569	0.078
INFRA does not Granger Cause HDI	396	0.109	0.897
HDI does not Granger Cause INFRA	396	9.402	0.000
PEE does not Granger Cause HDI	396	1.329	0.266
HDI does not Granger Cause PEE	396	4.024	0.019
PEH does not Granger Cause HDI	396	3.833	0.023
HDI does not Granger Cause PEH	396	1.412	0.245

Source: computed by the Author using Stata 13.

The results also indicate that economic growth in Africa provides ample opportunity for HCD and vice versa. In addition, findings suggest that HCD leads to improvement in institutional quality, meaning that better HCD outcomes enlightens people on the need for enhanced governance and more accountability. We also observe that as human capital becomes more de- veloped, the provision of infrastructure improves. This may be partly explained by the causal impact running from public spending on education to human development.

Next, we conducted panel unit root tests for all variables and the results are presented in Table 2. The results show that except for HDI, INFRA and PEH, at least either the LLC or IPS statistic reveal that the variables are stationary or do not contain unit root at levels. Specifically, the IPS test shows that all the series are integrated of order one and therefore, motivates the need for panel co-integration test to be conducted. This is done in order to ascertain the long run relationship between HCD and its potential deter- minants.

Table 2. Panel Unit Root Test Results

	Level		**FirstDifference**	
	LLC	**IPS**	**LLC**	**IPS**
GRWT	-4.309*	-4.445*	-18.398*	-14.855*
HDI	2.118	1.191	5.30E+13	-3.486*
INST	-5.399*	-2.258**	-13.030*	-8.942*
INFRA	6.519	11.081	-9.618*	-4.314*
PEE	-2.912*	0.553	-9.087*	-7.730*
PEH	-0.428	1.382	-10.103*	-7.976*

Notes: The null that there is a unit root assumes a common unit root process for Im, Pesaran and Shin (IPS) test and assumes individual unit root process for the Levin, Lin and Chu (LLC) technique. Proba- bility values are in parenthesis. * and ** indicate 5% and 1% significance level.

Source: computed by the Author using Stata 13.

The results of the Pedroni panel co-integration test are presented in Ta- ble 3. From the test result, the PP and ADF statistic for the within and be- tween dimension suggest that we reject the null hypothesis of no co-integration. Since the test statistic show evidence of a long run relationship, we conclude that HCD and its determinants- GRWT, INST, INFRA, PEE and PEH are co-integrated. It is pertinent to note that despite this finding, HCD is a long-term phenomenon, and its full impact becomes more evident over a relatively long period of time; particularly the education component. This may be explained by the fact that the education system in Africa pre- scribes at least 10-15 years of primary, secondary and tertiary education.

Table 3. Panel Cointegration Test

Pedroni Residual Cointegration Test				**Kao Residual Cointegration Test**	
Within Dimension		Between Dimension		t-stat.	Value
Panel rho-Stat.	3.23	Group rho-Stat.	5.84	ADF	-2.50*
Panel PP-Stat.	-19.85*	Group PP-Stat.	-24.88*	*Residual variance*	13.11
Panel ADF-Stat.	-5.70*	Group ADF-Stat.	-3.13*	*HAC variance*	4.25

Notes: (*) denotes significance at 5%. HAC means heteroscedasticity and autocorrelation consistent.

Source: computed by the Author using Stata 13.

Having established the existence of a long-run relationship between the variables, we apply heterogeneous panel estimation methods to obtain the long-run coefficients. The result for the pooled mean group and mean group estimation is presented in Table 4. For the full sample, the pooled mean group result shows that the estimation output conforms to *apriori* expectation except for the coefficient of public expenditure on education (PEE) as a share of total expenditure, which carried an unexpected negative sign. This may be attributed to the relatively short time frame (13 years) used and the impact of education spending on human capital development may take a longer period to materialize and the schooling period (primary to tertiary) in most African countries requires at least 15 years. This is in line with the findings by Ranis (2004). Observably, all the long-run coefficients (excluding PEE) are correctly signed and statistically significant.

Another empirical contribution of this paper is the estimation of a short- run model. Although the co-integration analyses reveal long run relation- ship and estimates, a more insightful result can be obtained from the dy- namic adjustment model. This estimation provides both the speed of ad- justment to the long-run equilibrium in the presence of an abrupt shock or disturbance as well as short-run estimated coefficients of the determinants of HCD in Africa. Table 4 reveals the estimates of the error correction model. The results of the parsimonious model reveal that the coefficient of the error correction term (ECT) is negative and statistically significant for the PMG estimator, but insignificant for the MG estimator. This lends cre- dence to our earlier finding of the existence of a long-run relationship be- tween HCD and its determinants in Africa.

Table 4: Long-Run Estimates (Dependent Variable: HCD)

Variable	Pooled Mean Group		Mean Group	
	Coefficient	Z-Stat	Coefficient	Z-Stat
PEE	-0.014* (0.005)	-2.82	0.004 (0.027)	0.14
PEH	0.023** (0.009)	2.51	0.036 (0.025)	1.40
GRWT	0.023** (0.009)	2.59	0.004 (0.003)	0.94
INST	0.406* (0.134)	3.03	0.473 (0.479)	0.99
INFRA	0.056* (0.018)	3.18	0.063 (0.052)	1.21

Notes: Standard errors are in parenthesis while * and ** denote significance at the 1% and 5% level.

Source: computed by the Author using Stata 13.

Notably, in addition to the significant coefficient of the ECT in the PMG estimation, the institutional quality measure was statistically signifi- cant in both models as well. This suggests that HCD responds by approxi- mately 0.03 index points to improvements in institutional quality in the short-run PMG estimation. The coefficient of the error correction term of about -0.11 implies that about 11% of the adjustment towards equilibrium takes place in the first year. Therefore, we conclude that the speed of ad- justment of HCD is quite slow in responding to transitory shocks.

Table 4: Contemporaneous Model (Dependent Variable: HCD)

Variable	Pooled Mean Group		Mean Group	
	Coefficient	Z-Stat	Coefficient	Z-Stat
const	0.009(0.003)	3.28	0.201(0.0598)	3.35
D(PEE)	0.001(0.0002)	0.15	0.001(0.000)	0.54
D(PEH)	0.001(0.0005)	0.68	0.001(0.001)	1.4
D(GRWT)	-0.002(0.0005)	-0.5	-0.001(0.0004)	-0.92
D(INST)	0.025*(0.005)	1.13	0.018**(0.010)	-1.74
D(INFRA)	0.001(0.0022)	0.74	-0.002(0.004)	-0.51
ECT	-0.109*(0.005)	-1.81	-0.299*(0.126)	-2.37

Notes: Standard errors are in parenthesis while * and ** denote significance at the 1% and 5% level.

Source: computed by the Author using Stata 13.

To conclude, the Hausman test (with sigmamore option in STATA) is used to test for the difference in the pooled mean and mean group estima- tors. The sigmamore option forces the variance–covariance matrix from the efficient model to be used in calculating the test statistic (Blackburne & Frank, 2007). The calculated Hausman statistic and distributed Chi-Square are 1.23 and 5, respectively. Thus, we conclude that the ECT of the PMG, the efficient estimator under the null hypothesis, is more robust (See: Table 5). It is pertinent to note that the PMG estimator assumes that the long-run elasticities are equal across all panels. Pooling this cross-country data yields efficient and consistent estimates if there are restrictions imposed. In our model, the assumption of slope homogeneity does not hold given that the true model is heterogeneous. This may explain the inconsistency of the contemporaneous MG estimator.

Table 5: Hausman Test

	MG	PMG	Difference	Std Error.
PEE	0.0038	-0.0141	0.0179	0.2287
PEH	0.0356	0.0225	0.0131	0.216
GRWT	0.0041	0.0233	0.0192	0.0358
INST	0.473	0.4059	0.0671	4.0686
INFRA	0.0627	0.0558	0.007	0.4408

Notes: Hausman Stat = 1.23 and it is distributed Chi Square (5).

Source: computed by the Author using Stata 13.

Robustness Checks

We considered sub-regional groups (north, central, east, west and southern Africa) and employed other estimators to check the robustness of our re- sults. First, we examine the existence of co-integration as well as the long- and short-run determinants of HCD across the 5 sub-regions (See table A3 in appendix). The results are supportive of our earlier findings that there exists a long-run relationship between HCD and the variables considered. However, the short-run estimates differed across the subsamples. Secondly, we assess the sensitivity of our results to the estimation technique em- ployed; employing fixed and random effects model. The results are pre- sented in Table A4 in the appendix. The results are similar to those from Table 3 and 4. The coefficients on all the determinants of HCD are expectedly positive and statistically significant except for public expenditure on education which, was found to be negative.

IV. Conclusions

This paper empirically investigates the determinants of HCD for 33 African countries using heterogeneous panel estimations. The specification draws from Sen's human capital development framework and this is because it provides more insightful information on the link between human capital and its determinants. We find the existence of a long-run relationship be- tween HCD, public expenditures on health and education, infrastructure, institutions and economic growth. Specifically, using pooled mean group estimator, we observe that in the long run, public expenditure on health, infrastructural expansion, better institutions and economic growth signifi- cantly influence HCD efforts. Contrarily, the mean group estimator re- vealed no relationship. However, its contemporaneous counterpart suggests that institutional developments have a positive impact on HCD. These find- ings concur to the robustness checks carried out.

An important policy implication from the empirical findings is that poli- cies that seek to improve HCD in Africa should be pursued with expected long-term outcomes rather than contemporaneous expectations. Two rea- sons are discernible. The first is the fact that improving institutional policy, infrastructure expansion and sustained growth as well as spending on healthcare services drive HCD in Africa over the long term. Second, insti- tutional quality is the only variable that significantly affects HCD in the short run and, therefore, the pursuit of good governance with a view to strengthening institutions may be used to boost HCD in Africa. This can be pursued through skills acquisition programmes and vocational training that enhance employability and earning prospects. The findings also provide impetus for promoting and sustaining economic growth as a means of en- hancing HCD since this makes resources available for pursuing capacity building programmes and development of human wellbeing for increased productivity. This suggest that policy options considered and measures taken to promote HCD efforts should be carried out with a view to sustain- ing domestic economy particularly the education and health sectors in the region.

Our findings also suggest that African countries should seek to improve institutions, promote good governance, increased output and provide ade- quate infrastructure in order to support sustained HCD efforts. In the absence of these considerations, the continent will face enormous challenges in developing its human capital base thereby dampening its prospects for improvement in the United Nations human development index. Furthermore, in order for Africa to sustainably enhance productivity of labour, the need to pursue rural education and health programmes following the expe- riences of Asia and Latin America. These regions have surpassed the basic skill level required for agrarian productivity and shifted to manufactures and services.

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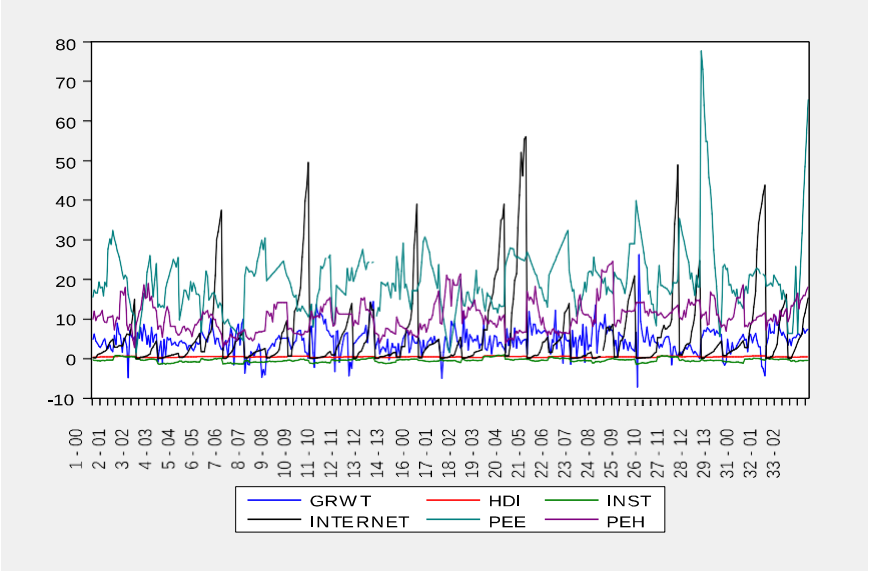
Appendix

FigureA1. Line Plot of Variables used in Estimation



Source: charted by the Authors using Stata 13.

Table A1. Descriptive Statistics for African Countries, 2011-2024

Variable	N	Mean	Max	Min	SD
GRWT	456	4.48	26.27	-7.14	3.16
HDI	456	0.45	0.74	0.23	0.12
INST	456	-0.40	0.90	-1.38	0.48
INFRA	456	6.30	56.00	0.02	10.02
PEE	456	19.77	77.67	1.55	8.72
PEH	456	10.59	24.53	2.82	3.82

Source: computed by the Authors using Stata 13.

Table A2. Correlation Matrix for African Countries, 2011-2024

	GRWT	HDI	INST	INFRA	PEE	PEH
GRWT	1.00	-0.09	0.04	-0.11	0.05	0.24
HDI	-0.09	1.00	0.62	0.62	-0.02	-0.25
INST	0.04	0.62	1.00	0.41	0.04	0.01
INFRA	-0.11	0.62	0.41	1.00	-0.01	-0.12
PEE	0.05	-0.02	0.04	-0.01	1.00	0.09
PEH	0.24	-0.25	0.01	-0.12	0.09	1.00

Source: computed by the Authors using Stata 13.

Table A3. Long- and Short-Run Estimates of Regional Sub-Samples

	Pooled Mean Group Estimates				
LONG-RUN	**West Africa**	**East Africa**	**South Africa**	**North Africa**	**Central Africa**
PEE	0.002* (0.001)	0.280 (5.632)	-0.008 (0.001)	0.004 (0.003)	0.001 (0.008)
	0.011*	0.098	0.041*	0.018	0.008

PEH	(0.001)	(1.890)	(0.010)	(0.0158)	(0.006)
	-0.003*	-0.005	0.007**	0.124**	0.004
GRWT	(0.001)	(0.140)	(0.002)	(0.913)	(0.002)
	0.048*	-0.571	-0.13*7	0.0734	-0.143
INST	(0.0125)	(11.99)	(0.0321)	(0.0301)	(0.119)
	-0.001*	0.168	-0.001	0.027*	0.005*
INFRA	(0.004)	(3.296)	(0.001)	(0.0197)	(0.002)

Table A3 continued

		Pooled Mean	**Group Estimates**		
SHORT-RUN	**West Africa**	**East Africa**	**South Africa**	**North Africa**	**Central Africa**
0.0417		0.0243	-0.004	0.0019	-0.0006
constant	(0.029)	(0.018)	(0.009)	(0.002)	(0.024)
-0.0004		0.011*	-0.0004	0.014	0.007
PEE(-1)	(0.003)	(0.006)	(0.001)	(0.003)	(0.006)
0.0008		-0.001	0.001	0.0021*	0.003
PEH(-1)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
0.0007		-0.004	0.001	0.0104	-0.001
GRWT(-1)	(0.001)	(0.003)	(0.001)	(0.0012)	(0.001)
-0.0101		0.010	0.0004	0.0003	0.0061
INST(-1)	(0.001)	(0.010)	(0.001)	(0.070)	(0.041)
-0.0016		0.0072	0.0015	0.00107	0.0066
INFRA(-1)	(0.003)	(0.009)	(0.001)	(0.001)	(0.001)
-0.064		0.002	-0.007	0.007	0.011
ect	(0.053)	(0.002)	(0.035)	(0.003)	(0.095)
		Mean Group Estimates			
LONG-RUN	**West Africa**	**East Africa**	**South Africa**	**North Africa**	**Central Africa**
	0.004	-0.087	0.010	-0.002	0.202
PEE	(0.003)	(0.089)	(0.012)	(0.001)	(0.201)
	0.003	0.106	0.008	-0.002	0.090
PEH	(0.008)	(0.115)	(0.009)	(0.003)	(0.095)
	-0.005	0.014	0.014*	0.006	0.0274
GRWT	(0.005)	(0.015)	(0.002)	(0.003)	(0.020)
	0.002	2.235	0.166	-0.0231	-0.840
INST	(0.062)	(2.194)	(0.159)	(0.044)	(0.825)
	0.003	0.246	0.008**	0.001	0.066
INFRA	(0.006)	(0.245)	(0.005)	(0.002)	(0.062)
SHORT-RUN	**West Africa**	**East Africa**	**South Africa**	**North Africa**	**Central Africa**
	0.0624	0.186	0.202	0.398	0.145
constant	(0.065)	(0.085)	(0.154)	(0.207)	(0.141)
	-0.0002	0.0003	-0.001	0.0025**	0.023
PEE(-1)	(0.004)	(0.002)	(0.001)	(0.002)	(0.003)
	0.002**	-0.0017	0.0002	-0.00086	0.002
PEH(-1)	(0.001)	(0.001)	(0.805)	(0.001)	(0.001)
	0.0003	-0.0302	0.0004	0.0004	0.0004
GRWT(-1)	(0.002)	(0.023)	(0.001)	(0.002)	(0.001)
	-0.0004	0.0180	-0.038	-0.007	-0.0106
INST(-1)	(0.009)	(0.012)	(0.026)	(0.019)	(0.015)
	-0.0083	0.1864	-0.0062	-0.0036	0.0044
INFRA(-1)	(0.005)	(0.085)	(0.005)	(0.207)	(0.005)
	-0.005	-0.199	-0.430	-0.611**	-0.218
ect	(0.157)	(0.106)	(0.330)	(0.328)	(0.361)

Notes: Standard errors are in parenthesis while * and ** denote significance at the 1% and 5% level.

Source: computed by the Authors using Stata 13.

Table A4. Fixed and Random Effect Estimation

Variable	**Fixed Effect**	**Random Effect**
C	0.421315 (0.006)*	0.428394 (0.013)*
PEE	-0.010273 (0.002)**	-0.000288 (0.002)**
PEH	0.002696 (0.005)*	0.002447 (0.005)*
INST	0.020889 (0.007)**	0.01988 (0.004)*
GRWT	0.001041 (0.004)**	0.031809 (0.007)*
INTERNET	0.00197 (0.001)*	0.002026 (0.001)*
R-Square	0.97	0.36
Adj. R-Square	0.96	0.36
F-statistic	320.96	51.16
Prob(F-statistic)	0.00	0.00

Notes: Standard errors are in parenthesis while * and ** denote significance at the 1% and 5% level.

Source: computed by the Authors using Stata 13.