
Determinants of Human Capital Development in Africa

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Abstract:

Purpose: *The study had two main objectives, namely (1) to investigate the determinants of human capital development and (2) to explore if the complementarity between FDI and information and communication technology-enhanced human capital development in Africa, are in line with theoretical predictions.*

Design/Approach/Methodology: *The study used panel data analysis (fixed effects, random effects, pooled ordinary least squares, dynamic generalized methods of moments) with African panel data ranging from 2001 to 2015.*

Findings: *The dynamic GMM method noted that human capital development was positively affected by its own lag in a significant manner. Under all the four econometric estimation methods, FDI had no significant influence on human capital development, yet information and communication technology significantly impacted human capital development across all the methods used. The study also revealed that the complementarity between FDI and information and communication technology significantly influenced human capital development under fixed effects, random effects, and pooled OLS only.*

Practical Implications: *Africa is urged to implement policies to strengthen ICT implementation to help the inflow of FDI improve human capital development. The study implies that African nations must implement policies to develop their financial sectors if they want to enhance human capital development. Therefore, African countries are urged to increase their expenditure in revamping and strengthening their infrastructure if they wish to enhance the development of human capital.*

Originality/Value: *This paper is unique because it is the first of its kind to investigate the impact of the complementarity between FDI and information and communication technology on human capital development and to consider the dynamic features of human capital development data.*

Keywords: *Human capital development, Foreign Direct Investment, Africa, panel data.*

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1. Introduction

Globally, according to the Organization for Economic Cooperation and Development (OECD, 2013), the global economy has shifted towards more knowledge-based development, and any continent which does not address the skills gap is bound not only to be left behind but to fail to make any meaningful progress. Consistent with Shuaibu and Oladayo (2016), Africa is the lowest developed continent for its human capital development index, yet there is scanty empirical research on how that can be enhanced in the African context. However, the economic growth impact of human capital development is a settled matter in economics and finance. Lucas (1988), Riley (2012), and Mankiw *et al.* (1992) are part of the extended body of literature, which unequivocally noted that one of the factors that drive economic growth is human capital. Recent research that has supported the positive influence of human capital development on economic growth has been done by Pelinescu (2015), Adeyemi and Ogunsola (2016), Ogunleye *et al.* (2017), Hakooma and Seshamani (2017), Diebolt and Hippe (2018), among others.

To have a full prognosis of the impact of human capital development on growth can only be achieved if the human capital development determinants are known (Shuaibu and Oladayo, 2016). However, empirical research on the determinants of human capital development is very scanty and has been done by quite a few authors such as Rastogi and Gaikwad (2017), Shuaibu and Oladayo (2016), Tsurai (2018), Attanasio (2015), Behrman and Schneider (1992), Praise and George-Anokwuru (2018), Hasan (2000) and Zulkifli *et al.* (2017). In an African context, what influences human capital development has not been adequately researched; hence it is a story that is yet fully to be told. Two prominent empirical researchers on the determinants of human capital development in Africa as a bloc have been done by Shuaibu and Oladayo (2016) and Oketch (2006). Their studies' methodological weaknesses are that they just focused on a few variables, so they were not broad enough to be a true representative of the whole African continent. They also ignored the fact that human capital development data is dynamic and that the influence of one macro-economic variable on another might not be instantaneous, as argued by Matthew and Johnson (2014). Another African study was done by Praise and George-Anokwuru (2018) focused on a single country, Nigeria, whose results cannot be generalized across the African continent. Therefore, research on the determinants of human capital development in Africa is still young and unexplored. The current study fills in that void.

Although literature (Romer, 1986) says that FDI brings technology to the host country, which enhances human capital development, it is quite clear that no study has been done on the impact of new technology (ICT) brought by foreign direct investment on the development of human capital. It is against this background that the current study investigates the impact of the complementarity between FDI and information and communication technology on human capital development in the African context.

The rest of the paper was then organized as follows: Section 2 discussed the theoretical view of human capital development determinants, section 3 reviewed the empirical literature on the determinants of human capital development whilst section 4 described the research methodological approach, including results and their interpretation. Section 5 concluded the paper, whereas section 6 is the reference list.

2. Literature Review

2.1 A Theoretical View of the Determinants of Human Capital Development

The majority of theoretical literature on human capital development determinants argues that the different variables (FDI, information and communication technology, financial development, economic growth, and government consumption) have a positive impact on human capital development whilst variables such as trade openness, population growth, and infrastructural development were found to have a mixed effect on human capital development (Table 1).

Table 1. *Theoretical determinants of human capital development- Theory intuition and expected sign(s)*

Variable	Theory intuition	Expected sign
FDI	FDI brings technical know-how, labor, technology, and human capital development to the host country (Lucas. 1988; Romer. 1986). Another argument is that FDI flow into the host country as a package that encompasses technical know-how, advancement in human capital development, capital, knowledge of the international markets, organizational skills, and managerial skills (Kumar and Pradhan. 2002).	+
ICT	According to De Grip and Sauermann (2013), information and communication technology empowers individuals with technical know-how, facilitates learning, education, skills acquirement, and human capital development in general.	+
FIN	According to Kargbo et al. (2016), financial development facilitates the efficient and effective use of financial products towards enhancing human capital development. The same author argued that when a financial sector is developed, it is likely that more credit is be availed towards education and skills development, thus generally boosting the level of human capital development in the country.	+
OPEN	A study done by Binder and Georgiadis (2011) argued that trade openness's positive effect on human capital development was more than physical capital, government consumption, and economic growth's influence on human capital development. The same study noted that trade openness enables the exchange of skills programs to be implemented with easy not only between countries or regions but across the globe, thus facilitating human capital development.	+/-

POP	According to Rosenzweig (1990), rapid population growth at the national level diverts some resources towards food procurement, which could have been used towards implementing quality education and skills enhancement programs (human capital development). Indirectly, high population growth creates a market that attracts FDI, which then flows alongside human capital development skills, technology, and managerial expertise (Jorgenson. 1963).	+/-
GROWTH	High levels of economic growth produce higher income per capita and wealth, which gives a country more capacity to generate revenue that can be directed towards the implementation of human capital development enhancement programs (Shuaibu and Oladayo. 2016).	+
INFR	Sapkota (2014) argued that infrastructure development not only spur economic growth, societal development, the standard of living, but it allows society to get a good education, skills development, and overall enhancement of human capital development. In a study of 91 developing groups of countries, Sapkota (2014) produced results which that show noted that electricity, water sanitation, and road infrastructure had a significant positive impact on human capital development.	+/-
GCONS	The higher the level of government final consumption directed towards human capital development, the better the outcome is expected in education quality, skills development, and health (Oluwatobi and Ogunrinola. 2011).	+

Source: Author' compilations.

2.2 An Empirical View of the Determinants of Human Capital Development

The empirical literature on human capital development determinants is quite scant, but their results vary, mixed, and divergent (refer to Table 2). It is clear from the few empirical studies on the determinants of human capital development that there is no single agreeable list of factors that determine human capital development; hence the subject matter is still far from being over. It is against this backdrop that the current study empirically tests the determinants of human capital development to contribute to the subject matter's discourse (Son and Noja, 2013).

Table 2. *The determinants of human capital development – An empirical focus*

Author	Country/Countries of study	Period	Methodology	Results
Rastogi and Gaikwad (2017)	BRICS (Brazil, Russia, India, China, South Africa)	2005-2015	Fixed effects model	Foreign direct investment and gross domestic product were found to have a significant positive effect on human capital development in BRICS nations.
Shuaibu and Oladayo (2016)	Africa	2000-2013	Panel data analysis	Infrastructural development, health and health were found to be significant positive determinants of human capital development in the African continent.

Tsauroi (2018)	Emerging markets	1994-2014	Panel data analysis	Trade openness, financial development, infrastructural development, FDI and economic growth enhanced human capital development in emerging markets.
Attanasio (2015)	Developing countries	2000-2015	Panel data analysis	Economic growth enhanced human capital development.
Behrman and Schneider (1992)	India		Multiple regression analysis	Economic growth, trade openness and FDI are related to human capital development
Oketch (2006)	47 African countries	1960-1995	Two stage least squares	Per capita growth enhanced human capital development in African countries.
Praise and George-Anokwuru (2018)	Nigeria	1985-2015	Three stage least squares and descriptive statistics	Economic growth and health component of human capital development were found to have a bi-directional relationship. Government expenditure on health had a positive reduced mortality rate. Education expenditure and economic growth were found to have had a feedback effect, although expenditure on education was found to have had not enough positive influence on the education sector.
Hasan (2000)	Developing economies	Over various time lags	Panel data analysis	State of income distribution, military expenditure, rate of economic growth and per capita income were the major determinants of human capital development.
Zulkifli et al (2017)	Malaysia	1982-2014	Time series data analysis	Education level was to have had a significant positive impact on human capital development whilst unemployment and FDI had an insignificant influence on human capital development in Malaysia's case.

Source: Author compilations.

3. Methodology

The study used panel data from African countries spanning over a fifteen-year period, ranging from 2001 to 2015. These African nations are Burundi, Kenya, Rwanda, Algeria, Morocco, Tunisia, Ghana, Nigeria, Senegal, Cameroon, Democratic Republic of Congo, Gabon, Namibia, South Africa, and Mozambique. The sampling procedure to select these African countries used is the stratified judgmental sampling approach to ensure that each African region is equally represented in the sample. The reputable and international databases from which the data was extracted include International Financial Statistics, World Development Indicators, African Development Bank, the International Monetary Fund, and the United Nations Development Programme.

Pre-estimation diagnostics:

Correlation analysis, descriptive statistics and trend analysis are discussed under this sub-section.

Table 3. Correlation analysis

	HCD	FDI	ICT	FIN	OPEN	POP	GROWTH	INFR	GCONS
HCD	1.00								
FDI	-0.02	1.00							
ICT	0.79***	-0.02	1.00						
FIN	0.65***	-0.01	0.66***	1.00					
OPEN	0.26***	0.48***	0.26***	0.31***	1.00				
POP	-0.41***	0.13*	-0.41***	-0.75***	-0.27***	1.00			
GROWTH	0.51***	-0.06	0.51***	0.37***	0.37***	-0.35***	1.00		
INFR	0.51***	-0.12*	0.51***	0.76***	0.39***	-0.86***	0.54***	1.00	
GCONS	0.22***	0.19***	0.22***	0.44***	0.27***	-0.28***	0.18***	0.34***	1.00

Note: ***/**/* denotes statistical significance at the 1%/5%/10% levels, respectively.

Source: Author compilation from E-Views.

HCD, FDI, ICT, FIN, OPEN, POP, GROWTH, INFR, and GCONS respectively stand for human capital development, foreign direct investment, information and communication technology, financial development, and trade openness, population growth, economic growth, infrastructural development, and government consumption.

As seen in Table 3, FDI and human capital development were negatively, but insignificantly related whilst population growth and human capital development were positively but significantly correlated. Other variables, such as information and communication technology, financial development, trade openness, economic growth, infrastructural development, and government consumption, were significant about human capital development, in line with the literature (Table 1). A multicollinearity problem existed in the data set, as seen by a correlation of 86% (population growth and infrastructural development), in line with Stead (1996).

Table 4. Descriptive statistics

	HCD	FDI	ICT	FIN	OPEN	POP	GROWTH	INFR	GCONS
Mean	10.8	3.62	10.8	39.4	68.5	2.32	2277	3.50	15.97
Median	5.77	2.22	5.77	31.1	65.9	2.61	1309	1.49	16.2
Maximum	57.1	41.8	57.1	117.4	125.5	3.71	10716	12.45	31.57
Minimum	0.01	0.01	0.01	2.86	0.76	0.76	112.9	0.01	3.8
Standard deviation	13.5	5.24	13.5	25.9	21.5	0.76	2347	3.84	4.95
Skewness	1.82	4.51	1.83	1.13	0.20	-0.54	1.40	0.91	0.21

Kurtosis	5.59	28.2	5.61	3.83	2.58	1.94	4.47	2.36	3.36
Jarque-Bera	187.2	6711	188.8	54.5	3.1	21.2	94.1	35.02	2.79
Probability	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.25
Observations	225	225	225	225	225	225	225	225	225

Note: ***/**/* denotes statistical significance at the 1%/5%/10% levels, respectively.

Source: Author compilation from E-Views.

Economic growth is the only variable whose data is characterized by abnormal values, as seen by the standard deviation, which exceeded 100. The probability of the Jarque-Bera is equal to zero for variables such as human capital development, foreign direct investment, information and communication technology, financial development, population growth, infrastructural development, and economic growth. This means that only data sets for government consumption and trade openness do not follow a normal distribution.

Table 5. Mean trend analysis (2001-2015)

	HCD	FDI	ICT	FIN	OPEN	POP	GROWTH	INFR	GCONS
Burundi	1.01	0.61	1.01	23.85	39.78	3.11	202.53	0.32	22.72
Kenya	7.15	1.02	6.85	38.94	55.20	2.71	840.67	0.87	15.38
Rwanda	5.21	1.91	5.23	17.36	40.27	2.47	459.06	0.30	15.91
Algeria	12.60	1.22	12.60	66.08	66.52	1.64	3 868.86	7.78	16.09
Morocco	31.52	2.46	31.42	103.12	72.94	1.25	2 452.16	7.17	18.35
Tunisia	25.45	3.22	25.31	59.69	96.70	1.00	3 606.16	11.14	17.37
Ghana	8.09	5.51	8.09	30.20	86.62	2.51	1 021.85	1.23	13.96
Nigeria	9.43	2.61	9.43	23.85	53.22	2.62	1 593.54	0.61	8.01
Senegal	8.10	2.24	8.10	31.90	70.90	2.77	877.58	2.30	14.35
Cameroon	5.30	1.64	5.30	17.17	52.91	2.68	1 192.77	2.09	11.50
Democratic Republic of Congo	1.00	5.58	1.00	7.93	63.97	3.21	305.05	0.03	9.24
Gabon	14.10	3.33	14.10	18.92	84.75	3.00	7 645.37	2.01	14.38
Namibia	8.55	6.40	8.55	48.55	100.45	1.63	4 090.17	6.94	23.15
South Africa	21.10	1.77	21.10	70.28	59.30	1.27	5 569.67	9.31	19.44
Mozambique	3.75	14.77	3.75	33.61	84.08	2.92	436.87	0.36	19.69
Overall mean	10.82	3.62	10.80	39.43	68.51	2.32	2 277.49	3.50	15.97

Source: Author's calculations based on the World Development Database.

According to Table 5, Algeria, Morocco, Tunisia, Gabon, and South Africa had their mean human capital development above the overall mean human capital development value of 11 per 100 people whilst Burundi, Kenya, Rwanda, Ghana, Nigeria, Senegal, Cameroon, Democratic Republic of Congo, Namibia and Mozambique were characterized by lower than the overall mean human capital development value. However, Burundi, Rwanda, Morocco, Tunisia, Cameroon, Democratic Republic of Congo, South Africa, and Mozambique are outliers since their mean human capital development deviated from the overall mean value of 11 per 100 people.

Burundi, Kenya, Algeria, Cameroon, Namibia, and Mozambique are outliers when it comes to FDI whilst Burundi, Kenya, Rwanda, Morocco, Tunisia, Cameroon, Democratic Republic of Congo, Gabon, South Africa, and Mozambique are also outliers with regards to information and communication technology as their mean values are too far away from the overall mean values. Applying the same reasoning, Burundi, Rwanda, Algeria, Morocco, Tunisia, Nigeria, Cameroon, Democratic Republic of Congo, Gabon, and South Africa are outliers with regards to financial development whilst Burundi, Rwanda, Tunisia, Ghana, Gabon, Namibia, and Mozambique are also outliers because their mean trade openness deviated too much from the overall mean trade openness of 68.51% of GDP.

Morocco, Tunisia, Democratic Republic of Congo, Burundi, Algeria, Namibia, and South Africa are outliers for annual population growth because they recorded mean values that were far away from the overall mean annual population growth of 2.32%. The following countries are outliers about economic growth data sets. Namely, Burundi, Kenya, Rwanda, Algeria, Tunisia, Ghana, Senegal, Cameroon, Democratic Republic of Congo, Gabon, Namibia, South Africa, and Mozambique are outliers whilst Burundi, Kenya, Rwanda, Algeria, Morocco, Tunisia, Nigeria, Democratic Republic of Congo, Namibia, South Africa, and Mozambique are outliers when it comes to infrastructural development, given the application of the similar reasoning. Burundi, Nigeria, Namibia, South Africa, Mozambique, and the Democratic Republic of Congo are also arguably outliers when it comes to government consumption final expenditure data sets. Consistent with Aye and Edoja (2017), all the data was then transformed into natural logarithms to address these econometric issues identified under the pre-estimation diagnostics.

Panel unit root tests: It is evident in Table 5 that the data for all the variables is integrated of order 1, in line with Odhiambo (2009).

Table 5. Panel unit root tests –Individual Intercept

	Level				First difference			
	LLC	IPS	ADF	PP	LLC	IPS	ADF	PP
HCD	-1.53*	1.52	24.93	74.57	-15.52***	-6.59***	65.36***	102.27***
FDI	-11.35***	-4.93***	77.11***	95.45***	-10.23***	-7.89***	117.43***	218.69***
ICT	-1.65**	1.34	25.95	76.76***	-9.25***	-5.16***	72.52***	101.59***
FIN	-1.71**	1.34	22.87	25.12	-6.18***	-4.69***	75.45***	121.55***
OPE N	-2.50***	-0.75	34.90	34.84	-6.90***	-5.24***	83.90***	133.75***
POP	-10.52***	-6.14***	107.01***	59.37***	-6.81***	-3.34***	71.32***	58.37***
GRO WT H	-7.90***	-4.27***	74.42***	79.18***	-3.08***	-2.52***	48.61**	69.28***
INF R	-0.65	0.42	29.02	25.37	-3.55***	-3.17***	58.21***	106.70***
GCO NS	-0.10	1.56	17.75	16.79	-3.53***	-3.88***	64.74***	146.11***

Note: LLC, IPS, ADF and PP stands for Levin, Lin and Chu (2002); Im, Pesaran and Shin (2013); ADF Fisher Chi Square and PP Fisher Chi Square tests respectively. *, ** and *** denote 1%, 5% and 10% levels of significance, respectively.

Source: Author's compilation from E-Views.

Panel co-integration tests: Kao (1999) approach also shows that the variables under study are co-integrated thus paving way for main data analysis using fixed effects, random effects, pooled OLS and the dynamic GMM method.

Table 6. Kao Residual Co-integration Test - Individual intercept

	T-statistic	Probability
Augmented Dickey-Fuller (ADF)	-9.5875***	0.00001

Source: Author's compilation from E-Views.

Considering both theoretical and empirical literature (see preceding sections) in this study, the author came up with the general model description in the form of equation 1 below.

$$\text{HCD} = f(\text{FDI}, \text{ICT}, \text{FIN}, \text{OPEN}, \text{POP}, \text{GROWTH}, \text{INFR}, \text{GCONS}) \quad (1)$$

Table 7. Abbreviation, variables used, including measures

Abbreviation	Variables used	Proxy used
HCD	Human capital development	Internet users per 100 people
GROWTH	Economic growth	GDP per capita
FDI	Foreign direct investment	Net FDI (% of GDP)
POP	Population growth	Population growth (% annual)
INFR	Infrastructural development	Fixed telephone subscriptions
FIN	Financial development	Domestic credit provided by the financial sector (% of GDP)
GCONS	Government consumption	Government final consumption expenditure (% of GDP)
OPEN	Trade openness	Exports +Imports (% of GDP)
ICT	Information and Communication Technology	Individuals using internet (% of population)

Source: Author's compilations.

Below is the econometric estimation procedure derived from equation 1:

$$\text{HCD}_{it} = \beta_0 + \beta_1\text{FDI}_{it} + \beta_2\text{ICT}_{it} + \beta_3\text{FIN}_{it} + \beta_4\text{OPEN}_{it} + \beta_5\text{POP}_{it} + \beta_6\text{GROWTH}_{it} + \beta_7\text{INFR}_{it} + \beta_8\text{GCONS}_{it} + \epsilon \quad (2)$$

Table 8 serves the purpose of describing the econometric terminology included in equation 2.

Table 8. Description of econometric meaning of the equation 2 terms

HCD _{it}	Human capital development in country i at time t
FDI _{it}	Foreign direct investment in country i at time t
ICT _{it}	Information and communication technology in country i at time t
FIN _{it}	Financial development in country i at time t
OPEN _{it}	Trade openness in country i at time t
POP _{it}	Population growth in country i at time t
GROWTH _{it}	Economic growth in country i at time t
INFR _{it}	Infrastructural development in country i at time t
GCONS _{it}	Government final consumption expenditure in country i at time t
β ₀	Intercept term
β ₁ to β ₈	Co-efficient of the independent variables
i	country
t	time
ε	Error term

Source: Author's compilations.

$$HCD_{it} = \beta_0 + \beta_1 FDI_{it} + \beta_2 ICT_{it} + \beta_3 (FDI_{it} \cdot ICT_{it}) + \beta_4 FIN_{it} + \beta_5 OPEN_{it} + \beta_6 POP_{it} + \beta_7 GROWTH_{it} + \beta_8 INFR_{it} + \beta_9 GCONS_{it} + \epsilon \tag{3}$$

Equation 3 incorporates the complementarity of FDI and information and communication technology's influence on human capital development.

Poverty, lack of human capital development investment ensures that people remain in poverty and finding it difficult, if not impossible, to get jobs and get out of poverty in the future. It also follows that increased human capital development today improves health, education, and skill levels for the future generation. It is against this reasoning that the current study assumes that human capital development is affected by its own lag, a theoretical view that has so far been ignored by all empirical studies on human capital development determinants. Econometric model 4 introduces the lag of human capital development, an equation that was then estimated using Arrelano and Bond's (1991) dynamic GMM method.

$$HCD_{it} = \beta_0 + \beta_1 HCAPLAG_{it} + \beta_2 FDI_{it} + \beta_3 ICT_{it} + \beta_4 (FDI_{it} \cdot ICT_{it}) + \beta_5 FIN_{it} + \beta_6 OPEN_{it} + \beta_7 POP_{it} + \beta_8 GROWTH_{it} + \beta_9 INFR_{it} + \beta_{10} GCONS_{it} + \epsilon \tag{4}$$

Table 9. Panel data analysis results for Africa

	Fixed effects	Random effects	Pooled OLS
FDI	0.0003	0.0011	0.0014
ICT	0.9999***	0.9213***	0.9012**
INTERACTION TERM	0.0003***	0.0001**	0.0127***
FIN	0.0120	0.0114**	0.0114**
OPEN	-0.0025	0.0041	0.0041
POP	-0.0033	0.0048	0.0048
GROWTH	0.0031	0.0036	0.0036

INFR	-0.0065*	-0.0039*	0.0039*
GCONS	0.0130	0.0085	0.0085
Number of countries	15	15	15
Number of observations	225	225	225
Adjusted R-squared	0.9124	0.6782	0.6913
F-statistic	342.14	173.92	129
Prob (F-statistic)	0.00	0.00	0.00

Note: ***, ** and * denote 1%, 5% and 10% levels of significance, respectively.

Source: Author's compilation from E-Views.

Table 10. Dynamic GMM results

	Co-efficient	Standard Error	t-Statistic
HCAPLAG	0.0162***	0.0058	2.7690
FDI	0.0008	0.0013	0.6052
ICT	0.9832***	0.0061	160.0675
INTERACTION TERM	0.0005	0.0063	0.0790
FIN	0.0107**	0.0053	2.0234
OPEN	0.0032	0.0032	0.5072
POP	0.0038	0.0064	0.5928
GROWTH	0.0026	0.0029	0.8769
INFR	-0.0036*	0.0021	-1.7144
GCONS	0.0111*	0.0061	1.8203
Adjusted R-squared	0.8542		
J-statistic	2.644		
Prob (J-statistic)	0.00		

Note: ***, ** and * denote 1%, 5% and 10% levels of significance, respectively.

Source: Author's compilation from E-Views.

The lag of human capital development was found to have had a significant positive effect on human capital development under the dynamic GMM approach, in line with Azher's (1995) argument. Under the fixed effects, random effects pooled OLS, and dynamic GMM method, FDI was found to have had a non-significant positive effect on human capital development. The results are according to Romer (1986), whose study says that FDI brings to the host country training of labor, technology, managerial experience, and technical know-how. However, ICT was observed to have a significant positive impact on human capital development across all the four econometric estimation methods, a finding which resonates with De Grip and Sauermann (2013), whose study argued that information and communication technology empowers individuals with not only education but skills and technical know-how to enhance productivity.

Since Lucas (1988) noted that FDI brings along with it improved technology that enhanced human capital development in the host country and De Grip and Sauermann (2013) says that information and communication technology also improves human capital development through revitalizing education, helping in the

delivery of knowledge and technical expertise, it therefore theoretically follows that interaction between FDI and ICT enhances the development of human capital in the hosting country. The theoretical underpinning is in line with the study's findings, which saw all the three econometric estimation methods (fixed effects, random effects, pooled OLS), producing a significant positive relationship running from the interaction term towards human capital development. Under the dynamic GMM, the interaction between FDI and ICT had a non-significant positive effect on human capital development, supporting theoretical underpinnings on the subject matter.

Fixed effects show that financial development had an insignificant positive influence on human capital development whilst pooled OLS, random effect, and the dynamic GMM shows that the financial sector had a significant positive effect on human capital development. The findings are in line with Kargbo *et al.* (2016), whose study argues that financial sector development ensures the availing of financial products such as education loans and other related financial products, which improves the development of human capital.

Random-effects pooled OLS and the dynamic GMM approaches show that trade openness had an insignificant positive impact on human capital development, a finding which resonates with Binder and Georgiadis (2011), whose study noted that trade openness makes it easier to boost human capital development programs through the implementation of international skills exchange programs between countries. In contradiction to literature, trade openness was found to have had a non-significant negative effect on human capital development under the fixed effects model.

According to the fixed effects model, population growth was observed to have had an insignificant negative effect on human capital development, in line with Rosenzweig (1990), whose study noted that rapid population growth diverts some resources towards food procurement which could have been used towards implementing human capital development initiatives. Random-effects pooled OLS, and the dynamic GMM observed that population growth had a non-significant positive influence on human capital development, a finding which supports Jorgenson's (1963) market size hypothesis, which says high population growth increases the market size in the host country, which then attracts FDI and technical know-how that flows alongside foreign investment. Under the fixed effects, random effects pooled OLS and the dynamic GMM; economic growth was found to have had a non-significant positive effect on human capital development, a finding which generally agrees with Shuaibu and Oladayo (2016), whose study says that high economic growth enables a country to generate more revenue and resources that can be directed towards enhancing human capital development initiatives.

In line with Sapkota (2014), whose study noted that infrastructure development not only spurs economic growth, societal development, the standard of living but also allow the society to get a good education, skills development, and overall

enhancement of human capital development, pooled OLS produced results which show that infrastructural development had a significant positive effect on human capital development. In contradiction with literature, fixed effects, random effects, and the dynamic GMM models noted that infrastructural development had a significant negative effect on human capital development in Africa, a finding which could mean that resources which could have been directed towards enhancing human capital development efforts could have been channeled to develop infrastructure.

General government expenditure was found to have had an insignificant positive impact on human capital development under the fixed effects, random effects, and pooled OLS. A significant positive relationship running from government expenditure towards human capital development was detected under the dynamic GMM. The finding generally resonates with Oluwatobi and Ogunrinola (2011), whose study argues that better education quality, skills development, and health is realized if government expenditure is directed towards implementing human capital development programs.

4. Conclusion

The study had two main objectives, namely (1) to investigate the determinants of human capital development and (2) to explore if the complementarity between FDI and information and communication technology-enhanced human capital development in Africa, are in line with theoretical predictions. The study used panel data analysis (fixed effects, random effects, pooled OLS, dynamic GMM) with African panel data ranging from 2001 to 2015. This paper is unique because it is the first of its kind to (1) investigate the impact of the complementarity between FDI and information and communication technology on human capital development and consider the dynamic features of human capital development data.

The dynamic GMM method noted that human capital development was positively affected by its own lag significantly. Under all the four econometric estimation methods, FDI had no significant influence on human capital development, yet information and communication technology significantly impacted human capital development across all the methods used. The study also revealed that the complementarity between FDI and information and communication technology significantly influenced human capital development under fixed effects, random effects, and pooled OLS only. Therefore, Africa is urged to implement policies aimed at strengthening ICT implementation to help the inflow of FDI improve human capital development. Random-effects pooled OLS and the dynamic GMM methods produced results which show that financial development had a significant positive influence on human capital development. The study implies that African nations must implement policies to develop their financial sectors if they want to enhance human capital development. Fixed effects, random effects, and the dynamic GMM methods show a significant negative relationship running from infrastructural development towards human capital development, a finding which is in

contradiction to the literature on the subject matter. The fixed effects approach also noted that government consumption expenditure had a significant positive impact on human capital development, yet the pooled OLS noted that infrastructural development had a significant positive influence on human capital development. Therefore, African countries are urged to increase their expenditure in revamping and strengthening their infrastructure if they wish to enhance the development of human capital.

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