A G D I   Working Paper

WP/18/054

How Enhancing Information and Communication Technology has affected Inequality in Africa for Sustainable Development: An Empirical Investigation [1]

Forthcoming: Sustainable Development

Simplice A. Asongu
Department of Economics, University of South Africa,
Pretoria, South Africa.
E-mail: asongusimplice@yahoo.com

Nicholas M. Odhiambo
Department of Economics, University of South Africa,
Pretoria, South Africa.
E-mail: odhianm@unisa.ac.za

[1] This working paper also appears in the Development Bank of Nigeria Working Paper Series.

2018 African Governance and Development Institute WP/18/054

Research Department

How Enhancing Information and Communication Technology has affected Inequality in Africa for Sustainable Development: An Empirical Investigation

Simplice A. Asongu & Nicholas M. Odhiambo

September 2018

Abstract

This study examines if enhancing ICT reduces inequality in 48 countries in Africa for the period 2004-2014. Three inequality indictors are used, namely, the: Gini coefficient, Atkinson index and Palma ratio. The adopted ICT indicators include: mobile phone penetration, internet penetration and fixed broadband subscriptions. The empirical evidence is based on the Generalised Method of Moments. Enhancing internet penetration and fixed broadband subscriptions have a net effect on reducing the Gini coefficient and the Atkinson index, whereas increasing mobile phone penetration and internet penetration reduces the Palma ratio. Policy implications are discussed in the light of challenges to Sustainable Development Goals.

JEL Classification: G20; I10; I32; O40; O55

Keywords: ICT; Inclusive development; Africa; Sustainable development

1. Introduction

Three factors motivate the positioning of this study which assesses how enhancing information and communication technology (ICT) affects inequality in Africa, notably: the growing policy syndrome of inequality in the light of challenges to Sustainable Development Goals (SDGs)[2]; the importance of ICT in contemporary development outcomes and gaps in the literature.

First, in the light of SDGs, bringing the level of extreme poverty to a threshold below three per cent of the global population by 2030 is reachable for other regions in the world but very challenging for Africa. Some studies have suggested that the objective can be achieved if growth rates attained during the period 2000 to 2010 are maintained until the year 2030 (Ravallion, 2013). Another stream of literature posits that progress in poverty alleviation at the global level will decline in the coming years (Chandy *et al.*, 2013; Yoshida *et al.*, 2014). The situation of Africa is quite distinct because despite experiencing more than two decades of growth resurgence, the continent was considerably off-course from achieving the Millennium Development Goals (MDGs) extreme poverty target (Tchamyou, 2018a, 2018b).

Two perspectives are apparent from the above insights. On the one hand, the fact that the number of people living in extreme poverty have been increasing despite two decades of growth resurgence is an indication that the fruits of economic prosperity have not been trickling down to the poor factions of the population on the continent (Asongu & Kodila-Tedika, 2017; Asongu & le Roux, 2018). On the other hand, even if the growth rates are maintained as argued in Ravallion (2013), the extreme poverty target for 2030 is still not very likely to be achieved unless inequality is reduced. The need to address inequality in order to eradicate extreme poverty by 2030 is consistent with Bicaba *et al.* (2017): "*This paper examines its feasibility for Sub-Saharan Africa (SSA), the world's poorest but growing region. It finds that under plausible assumptions extreme poverty will not be eradicated in SSA by 2030, but it can be reduced to low levels through high growth and income redistribution towards the poor segments of the society*" (p. 93). This assertion on Sub-Saharan Africa is

[2] Consistent with Fosu (2013), policy syndromes are features that are not favourable to economic development. These include: "administered redistribution", "state breakdown", "state controls", and "suboptimal inter temporal resource allocation". With respect to Asongu (2017), in the light of challenges to 21st century development, a knowledge economy gap between two countries represents a policy syndrome. Asongu and Nwachukwu (2017) and Tchamyou *et al.* (2018) understand the concept of policy syndrome as growth that is not inclusive. The conception and definition of policy syndrome in this study is inequality.

.

relevant to North African countries (Ncube *et al.*, 2014). The relationships between economic growth, inequality and poverty build on the perspective that the response of poverty to growth is a decreasing function of inequality, such that reducing inequality is crucial to extreme poverty alleviation (Fosu, 2015). In this study, we consider the relevance of ICT in reducing inequality because of the growing importance of information technology in development outcomes in the continent (Asongu, 2013; Penard *et al.*, 2012; Afutu-Kotey *et al.*, 2017; Asongu & Boateng, 2018; Efobi *et al.*, 2018; Gosavi, 2018; Humbani & Wiese, 2018; Asongu & Odhiambo, 2018a).

Second, in the light of the high potential for ICT penetration in Africa, compared to other regions of the world where ICT penetration has reached saturation levels, there has been a growing strand of literature on the importance of information technology in improving macroeconomic and human developments (Abor *et al.*, 2018; Tchamyou, 2017; Minkoua Nzie *et al.*, 2018; Isszhaku *et al.*, 2018; Asongu & Nwachukwu, 2018a; Gosavi, 2018). Unfortunately, to the best of our knowledge, empirical studies focusing on the nexus between ICT and inequality are sparse.

Third, the recent inequality literature has focused on, *inter alia* the: nexus between foreign investment and income inequality (Kaulihowa & Adjasi, 2018); relationships between consumption, income and the wealth of the poorest factions in Sub-Saharan Africa (De Magalhães & Santaeulàlia-Llopis, 2018); nexus between corruption and inequality (Sulemana & Kpienbaareh, 2018); gender inequality (Bayraktar & Fofack, 2018; Mannah-Blankson, 2018; Elu, 2018); reinvention of foreign aid for inclusive development (Jones & Tarp, 2015; Page & Söderbom, 2015; Asongu, 2016) and relationships between information sharing, education, finance and inequality (Tchamyou, 2018a, 2018b; Meniago & Asongu, 2018).

Employing Ordinary Least Squares, Asongu (2015) has established a negative relationship between mobile phone penetration and inequality with cross-sectional data which consists of 2003-2009 average growth rates. The corresponding findings are exploratory, from which causality and solid policy inferences cannot be established. The present research departs from the underlying study by: (i) using a panel data structure with an updated sample; (ii) employing three income inequality indicators and (ii) adopting an estimation technique that is robust to the control for endogeneity. In essence, this research is based on a panel of 48 countries in Africa for the period 2004-2014 and the empirical evidence is based on the

Generalised Method of Moments (GMM). The advantages of the GMM approach over the OLS technique are discussed in the methodology section.

Tchamyou (2018a) and Meniago and Asongu (2018) are also studies in the literature that are closest to this research. Tchamyou (2018a) has examined the role of financial access in moderating the impact of lifelong learning and education in African countries. The author concludes that: (i) primary school enrolment interacts with all financial channels (depth, efficiency, activity and size) to reduce income inequality and (ii) lifelong learning exerts net negative impacts on income inequality through financial depth and efficiency mechanisms. Meniago and Asongu (2018) have extended Tchamyou (2018a) by revisiting the finance-inequality nexus in a panel of African countries in the light of the Kuznets hypothesis to: (i) conclude that, with the exception of the financial stability mechanism, financial activity (or credit access) and financial allocation efficiency reduce income inequality and (ii) confirm the Kuznets hypothesis on the nexus between income levels and income inequality.

The present study is similar to the underlying two studies in the sense that three inequality indicators are used, namely: the Gini coefficient, the Atkinson index and the Palma ratio. This research also departs from the underlying two studies by considering ICT as a mechanism by which income inequality can be reduced in Africa. The ICT indicators employed include: mobile phone penetration, internet penetration and fixed broadband subscriptions. It is relevant to note that the underlying studies have used education, finance and income levels as channels for reducing income inequality. The research question this study seeks to answer is the following: how does enhancing ICT affect income inequality in Africa?

The theoretical connection between ICT and inequality can be understood from neoclassical models of knowledge creation and diffusion (Kwan & Chiu, 2015). Consistent with the attendant literature, neoclassical growth models maintain that technology can be an important source of economic and human development in poor countries (Abramowitz, 1986; Bernard & Jones, 1996; Asongu *et al.*, 2018a). According to the theoretical underpinning, information technology enhances socio-economic development and the wellbeing of citizens (Muthinja & Chipeta, 2018; Bongomin *et al.*, 2018; Uduji & Okolo-Obasi, 2018a, 2018b; Asongu *et al.*, 2019a, 2019b). Arguments provided to support the importance of ICT in inclusive human development include: (i) it offers enabling conditions to avoid physically moving from one place to another by allowing users to perform activities from a distance (Ureta, 2008; Efobi *et al.*, 2018; Shaikh & Karjaluoto, 2015); (ii) ICT enhances access to relevant and timely information which is crucial in development activities, essentially because it increases users' cheap access to inputs of development, expands their capabilities and limits existing barriers (Smith *et al.*, 2011) and (iii) the highlighted positive development externalities are more rewarding to the poor than to the rich factions of the population in Africa (Asongu, 2015). In summary, the engaged literature is broadly consistent with the position that the underlying benefits are more relevant in poor households than in rich households. Hence, the soundness of the research question motivating this study.

The relationship between inequality and sustainable development is based on the fact that for inclusive development to be sustainable, it must be sustained and for sustained development to be sustainable, it should be inclusive (Amavilah *et al.*, 2017). The positioning of the study also departs from the contemporary sustainable development literature which has focused on *inter alia*: the relationship between environmental degradation and inclusive human development (Asongu & Odhiambo, 2018b), linkages between economic progress and environmental sustainability in the light of conflicts (Fisher & Rucki, 2017); connections between beliefs that are normative and attitudes of individuals towards environmental welfare (Wang & Lin, 2017); the comparative importance of environmental sustainability (Asongu, 2018) and the relevance for planning in sustainable development outcomes (Saifulina & Carballo-Penela, 2017).

The rest of the study is structured as follows. Section 2 discusses the data and methodology, while the empirical results and discussion are covered in section 3. The study concludes in section 4 with implications and future research directions.

2. Data and methodology

2.1 Data

The study focuses on an unbalanced panel of forty-eight countries in Africa with annual data for the period 2004-2014[3]. The periodicity and scope of the study are motivated by data availability constraints at the time of the study. Consistent with Tchamyou (2018a, 2018b), the data is obtained from four main sources:(i) World Development Indicators (WDI) of the

[3]The 48 countries include: "Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Congo Democratic Republic, Congo Republic, Côte d'Ivoire, Djibouti, Egypt, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome & Principe, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda and Zambia".

World Bank for the ICT indicators and some of the control variables; (ii) World Governance Indicators (WGI) of the World Bank for some of the control variables; (iii) the Financial Development and Structure Database (FDSD) of the World Bank for some control variables; (iv) the Global Consumption and Income Project (GCIP) for the inequality variables.

Three inequality variables are adopted by the study. These include: (i) the Gini coefficient which denotes the distribution of income across the population. Unfortunately, as argued by Naceur and Zhang (2016), this indicator cannot capture welfare in low income groups or in tails of the inequality distribution. Hence, in order to enhance robustness of the estimations, the study complements the Gini coefficient with two more indicators of inequality that capture extreme points of the inequality distribution, namely: the Atkinson index and the Palma ratio. (ii) The Atkinson index is a measure of income inequality which appreciates the percentage of total income that a specific society would forego in an attempt to have more income equality among its citizens. (iii) The Palma ratio represents national income shares of the top 10% of households to the bottom 40%. These three indicators have been used in recent inequality literature in order to enhance the robustness of results (Tchamyou, 2018a, 2018b; Tchamyou *et al.*, 2018; Meniago & Asongu, 2018).

Consistent with recent information technology literature for inclusive development, three ICT indicators are used, namely: mobile phone penetration, internet penetration and fixed broadband subscriptions (Efobi *et al.*, 2018; Asongu *et al.*, 2018b). In line with the attendant inequality literature, three control variables are adopted, notably: political stability, remittances and financial stability (Anyanwu, 2011; Tchamyou, 2018a, 2018b; Meniago & Asongu, 2018). Only three control variables are adopted because after a preliminary investigation, introducing more than three variables in the conditioning information set leads to instrument proliferation (in spite of the collapse of instruments) and failure of the estimated model to pass post-estimation diagnostics tests.

The research expects political stability and financial stability to reduce inequality while remittances should have the opposite effect on inequality. First, Anyanwu (2011) and Meniago and Asongu (2018) have shown that remittances increase inequality in Africa because those leaving the country for abroad are largely from middle-income and wealthy backgrounds. Hence, when income is remitted back to their countries of origin, it instead widens the income inequality gap. Second, while political stability is intuitively expected to reduce income inequality, the potential effect is also contingent on the weight that politically unstable nations exert on the sample. This is most likely when the indicator is negatively skewed, as is the case with political stability which ranges from -2.5 to 2.5. Third, while financial stability decreases economic uncertainty and favours economic output and growth, the effect on inequality is contingent on how the resulting fruits of economic prosperity are distributed across the population.

The definitions and sources of variables are provided in Appendix 1 whereas the summary statistics is disclosed in Appendix 2. The correlation matrix is covered by Appendix 3.

2.2 Methodology

2.2.1 GMM: Specification, identification and exclusion restrictions

The adoption of the Generalised Method of Moments (GMM) as an estimation strategy is motivated by four main insights from the scholarly literature. First, the numbers of countries (i.e. cross sections) are higher than the number of time periods in each country. Hence, the N>T condition for the adoption of a GMM strategy is met because 48>11 (i.e. 2004 to 2014). Second, the inequality variables are persistent because the variables in levels are highly correlated with their corresponding first lags. Accordingly, the correlations are higher than 0.800, which is documented in the literature as the rule of thumb threshold for establishing persistence in a variable (Tchamyou, 2018a, 2018b). In essence, the corresponding correlations for the Gini coefficient, Atkinson index and Palma ratio are respectively, 0.918, 0.958 and 0.964. Third, given that the data structure is panel, in the adopted GMM strategy, cross-country variations are considered in the estimations. Fourth, endogeneity is addressed by the estimation strategy from two main fronts. On the one hand, the concern about simultaneity or reverse causality is tackled by means of an instrumentation process. On the other hand, time invariant variables are also used to account for the unobserved heterogeneity.

In this study, the Roodman (2009a, 2009b) extension of Arellano and Bover (1995) is adopted because it has been established to generate more efficient estimates in relation to traditional GMM techniques (Love & Zicchino, 2006; Baltagi, 2008; Asongu & Nwachukwu, 2016b; Boateng *et al*., 2018). Furthermore, in the light of the supporting literature, the approach with forward orthogonal deviation restrictsover-identification and limits the proliferations of instruments.

The following equations in level (1) and first difference (2) summarise the standard *system* GMM estimation procedure.

$$I_{i,t} = \sigma_0 + \sigma_1 I_{i,t-\tau} + \sigma_2 T_{i,t} + \sigma_3 TT_{i,t} + \sum_{h=1}^{3} \delta_h W_{h,i,t-\tau} + \eta_i + \xi_t + \varepsilon_{i,t} \quad (1)$$

$$I_{i,t} - I_{i,t-\tau} = \sigma_1(I_{i,t-\tau} - I_{i,t-2\tau}) + \sigma_2(T_{i,t} - T_{i,t-\tau}) + \sigma_3(TT_{i,t} - TT_{i,t-\tau}) + \sum_{h=1}^{3}\delta_h(W_{h,i,t-\tau} - W_{h,i,t-2\tau}) + (\xi_t - \xi_{t-\tau}) + (\varepsilon_{i,t} - \varepsilon_{i,t-\tau}) \quad (2)$$

where, $I_{i,t}$ is an inequality indicator (i.e. Gini coefficient, Atkinson index and Palma ratio) of country i in period t, σ_0 is a constant, T entails ICT (mobile phone penetration, internet penetration and broadband subscriptions), TT denotes quadratic interactions between ICT indicators(“mobile phone penetration” × “mobile phone penetration”, “internet penetration” × “internet penetration” and “fixed broadband subscriptions”× “fixed broadband subscriptions”), W is the vector of control variables (political stability, remittances and financial stability), τ represents the coefficient of auto-regression which is one within the framework of this study because a year lag is enough to capture past information, ξ_t is the time-specific constant, η_i is the country-specific effect and $\varepsilon_{i,t}$ the error term.

2.2.2Identification and exclusion restrictions

Discussing identification and exclusion restrictions is very relevant for a good GMM specification. Consistent with the attendant literature (Asongu & Nwachukwu, 2016c; Tchamyou & Asongu, 2017; Boateng *et al.*, 2018; Tchamyou et al., 2018), the research considers all explanatory variables as predetermined, “suspected endogenous” or “endogenous explaining” whereas, the time invariant variables are considered to be strictly exogenous. This identification strategy is also motivated by the fact that Roodman (2009b) has argued that it is not likely for time invariant variables to be endogenous after a first difference[4].

In the light of this identification process, the assumption of exclusion restriction is examined by assessing whether the identified strictly exogenous variables influence inequality exclusively via the suspected endogenous or predetermined channels. Therefore, given the adopted GMM strategy, the assumption of exclusion restrictions is confirmed if the Difference in Hansen Test (DHT) on the exogeneity of instruments is not valid. Accordingly, a rejection of the null hypothesis is an indication that the adopted strictly exogenous variables or instruments are not valid.

In view of the above insights, in the results disclosed in Section 3, the assumption of exclusion restriction is confirmed when the null hypotheses of the DHT in the bottom left-

[4]Hence, the procedure for treating *ivstyle* (years) is ‘iv (years, eq(diff))’ whereas the *gmmstyle* is employed for predetermined variables.

hand side of the tables are not rejected. It is relevant to also highlight that the discussed criterion is broadly consistent with a standard instrumental variable (IV) approach, in which failure to reject to null hypothesis of the Sargan Overidentifying Restrictions (OIR) test is a reflection of the fact that the instrumental variables affect the outcome variables exclusively through the adopted mechanisms or channels (see Beck *et al*., 2003; Asongu & Nwachukwu, 2016d).

3. Empirical results

This section discloses the empirical findings. Table 1 shows results on the nexus between ICT and the Gini coefficient while Table 2 discloses the corresponding findings between ICT and the Atkinson index. In Table 3 the results on the investigated relationship between ICT and the Palma ratio are also provided. For all tables, four information criteria are employed to assess the validity of the GMM model with forward orthogonal deviations[5].In order to assess the overall impact of enhancing ICT on inequality, net effects are computed. For instance in the fifth column of Table 1, the net impact from increasing internet penetration is-0.0006 (2×[0.00001× 7.676] + [-0.0008]). In the computation, the mean value of internet penetration is7.676, the unconditional effect of internet penetration is -0.0008 while the conditional effect from enhancing internet penetration is 0.00001. The mean value is found in the summary statistics which is disclosed in the appendix whereas the conditional and unconditional effects are apparent in the regression output provided in the table. In the same vein, in the last column of Table 1, the net impact from fixed broadband subscriptions is -0.0008 (2×[0.00007× 0.643] + [-0.0009]). In the computation, the mean value of fixed broadband subscriptions is0.643, the unconditional effect of fixed broadband subscriptions is -0.0009 while the conditional effect from enhancing fixed broadband subscriptions is 0.00007. For each table, there are three specifications pertaining to each of the ICT variables and each ICT-related regression entails two main specifications: one without a conditioning information set (or control variables) and another with a conditioning information set.

[5] "*First, the null hypothesis of the second-order Arellano and Bond autocorrelation test (AR (2)) in difference for the absence of autocorrelation in the residuals should not be rejected. Second the Sargan and Hansen over-identification restrictions (OIR) tests should not be significant because their null hypotheses are the positions that instruments are valid or not correlated with the error terms. In essence, while the Sargan OIR test is not robust but not weakened by instruments, the Hansen OIR is robust but weakened by instruments. In order to restrict identification or limit the proliferation of instruments, we have ensured that instruments are lower than the number of cross-sections in most specifications. Third, the Difference in Hansen Test (DHT) for exogeneity of instruments is also employed to assess the validity of results from the Hansen OIR test. Fourth, a Fischer test for the joint validity of estimated coefficients is also provided*" (Asongu& De Moor, 2017, p.200).

Table 1: ICT and the Gini coefficient

	Dependent variable: the Gini coefficient					
	Mobile phone penetration		**Internet penetration**		**Broadband subscription**	
Constant	**0.014*** **(0.050)**	**0.078***** **(0.000)**	**0.054***** **(0.000)**	**0.086***** **(0.000)**	**0.003** **(0.538)**	**0.013**** **(0.031)**
Gini coefficient (-1)	**0.976***** **(0.000)**	**0.864***** **(0.000)**	**0.910***** **(0.000)**	**0.860***** **(0.000)**	**0.990***** **(0.000)**	**0.973***** **(0.000)**
Mobile (Mob)	-0.000 (0.326)	-0.000 (0.447)	---	---	---	---
Mob×Mob	0.000 (0.364)	0.000 (0.731)	---	---	---	---
Internet	---	---	-0.0003 (0.109)	**-0.0008***** **(0.000)**	---	---
Internet ×Internet	---	---	**0.000007*** **(0.069)**	**0.00001***** **(0.000)**	---	---
Broadband(BroadB)	---	---	---	---	-0.0003 (0.231)	**-0.0009**** **(0.044)**
BroadB×BroadB	---	---	---	----	0.00002 (0.214)	**0.00007**** **(0.028)**
Political Stability	---	0.0009 (0.344)	---	0.004 (0.112)	---	-0.0001 (0.757)
Remittances	---	**-0.0004***** **(0.000)**	---	**-0.0005***** **(0.000)**	---	0.00003 (0.382)
Financial Stability	---	**0.0003***** **(0.004)**	---	**0.0006***** **(0.000)**	---	**0.0002***** **(0.003)**
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes
Net Effects	na	na	na	-0.0006	na	-0.0008
AR(1)	(0.089)	(0.093)	(0.090)	(0.095)	**(0.169)**	**(0.162)**
AR(2)	**(0.386)**	**(0.217)**	**(0.383)**	**(0.219)**	**(0.408)**	**(0.301)**
Sargan OIR	(0.022)	(0.006)	(0.013)	**(0.215)**	**(0.930)**	**(0.791)**
Hansen OIR	**(0.206)**	**(0.820)**	**(0.146)**	**(0.636)**	**(0.427)**	**(0.899)**
DHT for instruments						
(a)Instruments in levels						
H excluding group	**(0.201)**	**(0.452)**	**(0.696)**	**(0.601)**	**(0.378)**	**(0.512)**
Dif(null, H=exogenous)	**(0.261)**	**(0.865)**	(0.072)	**(0.544)**	**(0.407)**	**(0.928)**
(b) IV (years, eq(diff))						
H excluding group	---	**(0.518)**	---	**(0.702)**	---	**(0.834)**
Dif(null, H=exogenous)	---	**(0.864)**	---	**(0.451)**	---	**(0.758)**
Fisher	**1531.70*****	**1619.78*****	**884.96*****	**433.20*****	**4468.62*****	**2506.73*****
Instruments	20	32	20	32	20	32
Countries	42	39	42	39	41	37
Observations	416	331	410	325	350	286

***,**,*: significance levels at 1%, 5% and 10% respectively. DHT: Difference in Hansen Test for Exogeneity of Instruments Subsets. Dif: Difference. OIR: Over-identifying Restrictions Test. The significance of bold values is twofold. 1) The significance of estimated coefficients and the Wald statistics. 2) The failure to reject the null hypotheses of: a) no autocorrelation in the AR(1) & AR(2) tests and; b) the validity of the instruments in the Sargan and Hansen OIR tests. The mean value of mobile phone penetration is 45.330, the mean value of internet penetration is 7.676 and the mean value of fixed broad band subscriptions is 0.643.na: not applicable because at least one of the estimated coefficients needed for the computation of net effects is not significant.

Table 2: ICT and the Atkinson index

	Dependent variable: the Atkinson index					
	Mobile phone penetration		Internet penetration		Broadband subscription	
Constant	**-0.053****	-0.007	**-0.050****	0.016	**-0.034****	0.005
	(0.017)	(0.532)	**(0.015)**	(0.405)	**(0.047)**	(0.260)
Atkinson index (-1)	**1.082*****	1.006	**1.081*****	**0.980*****	**1.042*****	**0.990*****
	(0.000)	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Mobile (Mob)	-0.000	**-0.0001***	---	---	---	---
	(0.168)	**(0.080)**				
Mob×Mob	0.000	0.000	---	---	---	---
	(0.280)	(0.126)				
Internet	---	---	**-0.0009*****	**-0.0008*****	---	---
			(0.003)	**(0.005)**		
Internet ×Internet	---	---	**0.00001*****	**0.00001*****	---	---
			(0.003)	**(0.006)**		
Broadband(BroadB)	---	---	---	---	0.0002	**-0.001*****
					(0.576)	**(0.001)**
BroadB×BroadB	---	---	---	---	-0.000	**0.0001*****
					(0.887)	**(0.001)**
Political Stability	---	-0.001	---	**0.008****	---	**0.001***
		(0.672)		**(0.013)**		**(0.078)**
Remittances	---	0.0002	---	**0.0005*****	---	0.00003
		(0.563)		**(0.005)**		(0.786)
Financial Stability	---	**0.0003****	---	**0.0007*****	---	**0.0003*****
		(0.042)		**(0.003)**		**(0.007)**
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes
Net Effects	na	na	-0.0007	-0.0007	na	-0.0009
AR(1)	(0.082)	(0.086)	(0.080)	(0.086)	**(0.166)**	**(0.158)**
AR(2)	**(0.888)**	**(0.768)**	**(0.510)**	**(0.661)**	**(0.532)**	**(0.348)**
Sargan OIR	**(0.657)**	(0.004)	**(0.977)**	(0.028)	**(0.877)**	(0.008)
Hansen OIR	**(0.271)**	**(0.523)**	**(0.795)**	**(0.672)**	**(0.148)**	**(0.222)**
DHT for instruments						
(a)Instruments in levels						
H excluding group	**(0.342)**	**(0.571)**	**(0.482)**	**(0.486)**	**(0.615)**	**(0.361)**
Dif(null, H=exogenous)	**(0.252)**	**(0.429)**	**(0.790)**	**(0.663)**	**(0.081)**	**(0.206)**
(b) IV (years, eq(diff))						
H excluding group	---	**(0.743)**	---	**(0.603)**	---	**(0.483)**
Dif(null, H=exogenous)	---	**(0.297)**	---	**(0.581)**	---	**(0.142)**
Fisher	**1143.86*****	**1616.77*****	**830.50*****	**652.52*****	**21754.8*****	**7883.38*****
Instruments	20	32	20	32	20	32
Countries	42	39	42	39	41	37
Observations	416	331	410	325	350	286

***,**,*: significance levels at 1%, 5% and 10% respectively. DHT: Difference in Hansen Test for Exogeneity of Instruments Subsets. Dif: Difference. OIR: Over-identifying Restrictions Test. The significance of bold values is twofold. 1) The significance of estimated coefficients and the Wald statistics. 2) The failure to reject the null hypotheses of: a) no autocorrelation in the AR(1) & AR(2) tests and; b) the validity of the instruments in the Sargan and Hansen OIR tests. The mean value of mobile phone penetration is 45.330, the mean value of internet penetration is 7.676 and the mean value of fixed broad band subscriptions is 0.643.na: not applicable because at least one of the estimated coefficients needed for the computation of net effects is not significant.

The following can be established from Tables 1-3. Enhancing internet penetration and fixed broadband subscriptions has a net effect on reducing the Gini coefficient and the Atkinson index whereas increasing mobile phone penetration and internet penetration reduces the Palma ratio. It follows from the findings that boosting ICT broadly reduces inequality.

In relation to the control variables, while remittances largely have the expected sign, the positive effect of political stability can be traceable to the fact that the political stability variable is negatively skewed. Accordingly, the minimum (i.e. -2.687) and maximum (i.e. 1.182) values of political stability are indications that the variable is more negatively leaning. With regard to financial stability, the positive nexus is traceable to growing exclusive development in the continent, as discussed in the data section.

Table 3: ICT and the Palma ratio

	Dependent variable: the Palma ratio					
	Mobile phone penetration		**Internet penetration**		**Broadband subscription**	
Constant	**-0.723*** (0.000)**	**-0.145** (0.044)**	-0.249 (0.180)	-0.107 (0.519)	-0.066 (0.682)	**-0.393*** (0.000)**
The Palma ratio (-1)	**1.120*** (0.000)**	**1.028*** (0.000)**	**1.064*** (0.000)**	**1.010*** (0.000)**	**1.007*** (0.000)**	**1.058*** (0.000)**
Mobile (Mob)	**-0.003** (0.036)**	**-0.004*** (0.004)**	---	---	---	---
Mob×Mob	**0.00001* (0.061)**	**0.00001** (0.018)**	---	---	---	---
Internet	---	---	**-0.023*** (0.007)**	**-0.022*** (0.007)**	---	---
Internet ×Internet	---	---	**0.0005*** (0.003)**	**0.0003** (0.010)**	---	---
Broadband(BroadB)	---	---	---	---	0.012 (0.618)	**0.022* (0.096)**
BroadB×BroadB	---	---	---	---	-0.0009 (0.663)	-0.0008 (0.399)
Political Stability	---	0.032 (0.494)	---	0.115 (0.117)	---	**-0.049* (0.065)**
Remittances	---	**0.012*** (0.003)**	---	**0.010*** (0.007)**	---	**0.008*** (0.003)**
Financial Stability	---	0.00001 (0.997)	---	**0.012*** (0.004)**	---	-0.0003 (0.844)
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes
Net Effects	-0.0021	-0.0031	-0.0153	-0.0173	na	na
AR(1)	(0.092)	(0.099)	(0.088)	(0.088)	**(0.166)**	**(0.172)**
AR(2)	**(0.354)**	**(0.321)**	**(0.331)**	**(0.361)**	**(0.334)**	**(0.297)**
Sargan OIR	(0.057)	(0.016)	(0.050)	(0.080)	**(0.379)**	**(0.321)**
Hansen OIR	**(0.302)**	**(0.835)**	**(0.560)**	**(0.569)**	**(0.357)**	**(0.707)**
DHT for instruments						
(a)Instruments in levels						
H excluding group	**(0.191)**	**(0.401)**	**(0.883)**	**(0.405)**	**(0.492)**	**(0.301)**
Dif(null, H=exogenous)	**(0.409)**	**(0.908)**	**(0.349)**	**(0.594)**	**(0.277)**	**(0.840)**
(b) IV (years, eq(diff))						
H excluding group	---	**(0.733)**	---	**(0.389)**	---	**(0.812)**
Dif(null, H=exogenous)	---	**(0.723)**	---	**(0.636)**	---	**(0.454)**
Fisher	**1132.54*** **	**15035.52*** **	**625.63*** **	**526.31*** **	**5095.98*** **	**13811.11*** **
Instruments	20	32	20	32	20	32
Countries	42	39	42	39	41	37
Observations	416	331	410	325	350	286

***,**,*: significance levels at 1%, 5% and 10% respectively. DHT: Difference in Hansen Test for Exogeneity of Instruments Subsets. Dif: Difference. OIR: Over-identifying Restrictions Test. The significance of bold values is twofold. 1) The significance of estimated coefficients and the Wald statistics. 2) The failure to reject the null hypotheses of: a) no autocorrelation in the AR(1) & AR(2) tests and; b) the validity of the instruments in the Sargan and Hansen OIR tests. The mean value of mobile phone penetration is 45.330, the mean value of internet penetration is 7.676 and the mean value of fixed broad band subscriptions is 0.643.na: not applicable because at least one of the estimated coefficients needed for the computation of net effects is not significant.

4. Concluding implications and future research directions

This study has examined if enhancing ICT reduces inequality in 48 countries in Africa for the period 2004-2014. Three inequality indictors are used, namely, the: Gini coefficient, Atkinson index and Palma ratio. The adopted ICT indicators include: mobile phone penetration, internet penetration and fixed broadband subscriptions. The empirical evidence is based on the Generalised Method of Moments. The following main finding has been established. Enhancing internet penetration and fixed broadband subscriptions has a net effect on reducing the Gini coefficient and the Atkinson index, whereas increasing mobile phone penetration and internet penetration reduces the Palma ratio. The results have implications for Sustainable Development Goals (SDGs) from three main perspectives, notably, the: (i) relevance of inequality in SDGs; (ii) growing non-inclusive development in Africa and (iii) low penetration potential of ICT in Africa relative to other regions of the world.

First, it is worthwhile to articulate that the notion of inequality is very closely relevant to at least six of the seventeen global goals in the post-2015 sustainable development agenda. These include: SDG1 on the need to "*end poverty in all its forms everywhere*"; SDG2 on the importance of "*ending hunger, achieving food security, improving nutrition and promoting sustainable agriculture*"; SDG3 on the imperative to "*ensure healthy lives and promote wellbeing for all ages*"; SDG4 on the relevance of "*ensuring inclusive and equitable education and promoting lifelong learning opportunities for all*"; SDG 8 on the need to "*promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all*" and SDG10 on the imperative to "*reduce inequality within and among countries*"[6]. Therefore, reducing inequality by means of policies designed to enhance ICT will also tackle SDGs that are related to inequality.

Second, despite the two decades of growth resurgence experienced by Africa, close to half of the countries on the continent did not achieve the MDG extreme poverty target owing to inequality. This is essentially because the response of poverty to economic prosperity decreases with growing inequality. Accordingly, despite more than two decades of growth resurgence experienced by Africa, the fruits of economic growth have not been trickling down to the poor factions of the population because the inequality elasticity of poverty is higher

[6] For a list of the SDGs, the interested reader can refer to Michel (2016).

than the growth elasticity of poverty[7]. Hence, the importance of economic growth in reducing poverty is more apparent in countries with low levels of inequality compared to their counterparts with higher levels of inequality.

Third, compared to other regions of the World, ICT penetration in Africa is lowest, which implies that ICT penetration can be enhanced by policy makers in order to reduce inequality and by extension, increase the negative responsiveness of poverty to economic prosperity in the post-2015 sustainable development era[8]. Therefore, it is worthwhile for the governments of the countries sampled to put in place policies that enhance ICT. These policies should include: low pricing networks, universal access channels, infrastructure and sharing schemes.

As a caveat to the present study, country-specific effects are eliminated in the GMM approach in order to control for endogeneity. Hence, future research can engage country-specific cases in order to provide more targeted country-oriented policy prescriptions. Moreover, there are some dynamics in the measurement of ICT variables that are not captured in the study because of data availability constraints, *inter alia*: (i) mobile phones can be shared with family members, neighbours and friends and hence, their penetration is underestimated and (ii) mobile phones are increasingly being replaced by smart phones that are connected to the internet. These caveats should be taken on board as more data become available with the passage of time.

[7] More specifically: "*The study finds that the responsiveness of poverty to income is a decreasing function of inequality*" (Fosu, 2010a, p. 818); "*The responsiveness of poverty to income is a decreasing function of inequality, and the inequality elasticity of poverty is actually larger than the income elasticity of poverty*" (Fosu, 2010b, p. 1432); and "*In general, high initial levels of inequality limit the effectiveness of growth in reducing poverty while growing inequality increases poverty directly for a given level of growth*" (Fosu, 2011, p. 11).

[8] This negative responsiveness is clarified in the preceding footnote.

Appendices

Appendix 1: Definitions of Variables

Variables	Signs	Definitions of variables (Measurements)	Sources
Income Inequality	GiniCoefficient	"*The Ginicoefficient is a measurement of the income distribution of a country's residents*".	GCIP
	Atkinson Index	"*The Atkinson index measures inequality bydetermining which end of the distribution contributed most to the observed inequality*".	GCIP
	Palma Ratio	"*The Palma ratio is defined as the ratio of the richest 10% of the population's share of gross national income divided by the poorest 40%'s share*".	GCIP
Mobile Phones	Mobile	Mobile cellular subscriptions (per 100 people)	WDI
Internet	Internet	Internet users (per 100 people)	WDI
Fixed Broad Band	BroadB	Fixed broadband subscriptions (per 100 people)	WDI
Political Stability	PolS	"Political stability/no violence (estimate): measured as the perceptions of the likelihood that the government will be destabilised or overthrown by unconstitutional and violent means, including domestic violence and terrorism"	WDI
Remittances	Remit	Remittance inflows to GDP (%)	WDI
Financial Stability	Z-score	Prediction of the likelihood that a bank might survive and not go bankrupt.	FDSD

WDI: World Bank Development Indicators of the World Bank. FDSD: Financial Development and Structure Database of the World Bank. GCIP: Global Consumption and Income Project.

Appendix 2: Summary statistics (2004-2014)

	Mean	SD	Minimum	Maximum	Observations
GiniCoefficient	0.586	0.034	0.488	0.851	461
Atkinson Index	0.705	0.058	0.509	0.834	461
Palma Ratio	6.457	1.477	3.015	14.434	461
Mobile Phone Penetration	45.330	37.282	0.209	171.375	558
Internet Penetration	7.676	10.153	0.031	56.800	453
Fixed Broad Band	0.643	1.969	0.000	14.569	369
Political Stability	-0.471	0.905	-2.687	1.182	462
Remittances	4.313	6.817	0.00003	50.818	416
Financial Stability	8.713	4.994	-12.024	25.736	404

S.D: Standard Deviation.

Appendix 3: Correlation matrix (uniform sample size: 347)

Inequality			ICT variables			Control variables			
Gini	Atkinson	Palma	Mobile	Internet	BroadB	PolS	Remit	Z-score	
1.000	0.835	0.940	0.048	-0.055	-0.087	0.352	0.016	-0.009	Gini
	1.000	0.925	-0.007	-0.116	-0.111	0.393	0.207	-0.114	Atkinson
		1.000	0.076	-0.075	-0.104	0.403	0.111	-0.041	Palma
			1.000	0.706	0.575	0.234	-0.022	0.332	Mobile
				1.000	0.666	0.106	0.008	0.486	Internet
					1.000	0.275	-0.084	0.275	BroadB
						1.000	0.042	-0.005	PolS
							1.000	-0.012	Remit
								1.000	Z-score

Gini :the GiniCoefficient. Atkinson :the Atkinson Index. Palma: the Palma Ratio. Mobile: Mobile phone penetration. Internet: Internet penetration. BroadB: Fixed broad band subscriptions. PolS; Political stability.Remit: Remittances. Z-score: Financial Stability.

References

Abor, J. Y., Amidu, Y., &Issahaku, H., (2018). "Mobile Telephony, Financial Inclusion and Inclusive Growth", *Journal of African Business*, 18(4), pp. 430-453.

Abramowitz, M. (1986)."Catching-up, forging ahead or falling behind", *Journal of Economic History*, 46(2), pp. 385-406.

Afutu-Kotey, R. L. , Gough, K. W., &Owusu, G., (2017). "Young Entrepreneurs in the Mobile Telephony Sector in Ghana: From Necessities to Aspirations", *Journal of African Business*, 18(4), pp. 476-491.

Amavilah, V., Asongu, S. A., & Andrés, A. R., (2017). "Effects of globalization on peace and stability: Implications for governance and the knowledge economy of African countries", *Technological Forecasting and Social Change*, 122 (September), pp. 91-103.

Anyanwu, J.C., (2011)." International Remittances and Income Inequality in Africa".*African Development Bank Working Paper* No. 135, Tunis.

Asongu, S. A., (2013). "How has Mobile Phone Penetration Stimulated Financial Development in Africa?", *Journal of African Business*, 14(1), pp. 7-18.

Asongu, S. A., (2015). "The impact of mobile phone penetration on African inequality", *International Journal of Social Economics*, 42(8), pp.706-716.

Asongu, S. A., (2016). "Reinventing Foreign Aid for Inclusive and Sustainable Development: Kuznets, Piketty and the Great Policy Reversal", *Journal of Economic Surveys*, 30(4),pp. 736–755.

Asongu, S. A., (2017). "Knowledge Economy Gaps, Policy Syndromes and Catch-up Strategies: Fresh South Korean Lessons to Africa", *Journal of the Knowledge Economy*, 8(1), pp. 211–253.

Asongu, S. A., (2018). "Comparative sustainable development in sub- Saharan Africa", *Sustainable Development*. DOI: /abs/10.1002/sd.1733.

Asongu, S. A., & Boateng, A., (2018). "Introduction to Special Issue: Mobile Technologies and Inclusive Development in Africa", *Journal of African Business*, 19(3), pp. 297-301.

Asongu S. A. & De Moor, L., (2017). "Financial globalisation dynamic thresholds for financial development: evidence from Africa", *European Journal of Development Research*, 29(1), pp. 192–212.

Asongu, S. A., & Kodila-Tedika, O., (2017)."Is Poverty in the African DNA (Gene)?",*South African Journal of Economics*, 85(4), pp. 533-552.

Asongu, S. A., & le Roux, S., (2018). "Understanding Sub-Saharan Africa's Extreme Poverty Tragedy", *International Journal of Public Administration*. DOI: 10.1080/01900692.2018.1466900.

Asongu, S. A., le Roux, S., Nwachukwu, J. C., & Pyke, C., (2019a)."The Mobile Phone as an Argument for Good Governance in Sub-Saharan Africa", *Information Technology & People*, DOI: 10.1108/ITP-01-2018-0011.

Asongu, S.A, & Nwachukwu, J. C., (2016a). "A brief future of Time in the monopoly of scientific knowledge". Comparative Economic Studies, 58(4), pp. 638–671.

Asongu, S.A, & Nwachukwu, J. C., (2016b). "The Mobile Phone in the Diffusion of Knowledge for Institutional Quality in Sub Saharan Africa", *World Development*, 86(October), pp.133-147.

Asongu, S. A., & Nwachukwu, J. C., (2016c). "The Role of Governance in Mobile Phones for Inclusive Human Development in Sub-Saharan Africa", *Technovation*, 55-56 (September-October), pp. 1-13.

Asongu, S.A, & Nwachukwu, J. C., (2016d)."Foreign aid and governance in Africa", *International Review of Applied Economics*, 30(1), pp. 69-88.

Asongu, S. A., & Nwachukwu, J. C., (2017)."Quality of Growth Empirics: Comparative Gaps, Benchmarking and Policy Syndromes", *Journal of Policy Modeling*, 39(5), pp.861-882.

Asongu, S. A., & Nwachukwu, J. C., (2018a)."Educational quality thresholds in the diffusion of knowledge with mobile phones for inclusive human development in sub-Saharan Africa", *Technological Forecasting and Social Change*, 129(April), pp. 164-172.

Asongu, S. A., Nwachukwu, J. C., & Aziz, A., (2018b). "Determinants of Mobile Phone Penetration: Panel Threshold Evidence from Sub-Saharan Africa", *Journal of Global Information Technology Management*, 21(2), pp. 81-110.

Asongu, S. A., & Odhiambo, N. M., (2018a)."Basic formal education quality, information technology, and inclusive human development in sub- Saharan Africa", *Sustainable Development*. DOI: 10.1002/sd.1914.

Asongu, S. A., & Odhiambo, N. M., (2018b). "Environmental Degradation and Inclusive Human Development in Sub- Saharan Africa", *Sustainable Development*, DOI: 10.1002/sd.1858.

Asongu, S. A., Nwachukwu, J. C., & Pyke, C., (2019b). "The Comparative Economics of ICT, Environmental Degradation and Inclusive Human Development in Sub-Saharan Africa", *Social Indicators Research*, DOI: 10.1007%2Fs11205-018-2009-x.

Arellano, M., & Bover, O., (1995), "Another look at the instrumental variable estimation of error components models", *Journal of Econometrics*, 68(1), pp. 29-52.

Baltagi, B. H., (2008). "Forecasting with panel data", *Journal of Forecasting*, 27(2), pp. 153-173.

Bayraktar, N., & Fofack, H., (2018). "A Model for Gender Analysis with Informal Productive and Financial Sectors", *Journal of African Development*, 20(2), pp. 1-20.

Beck, T., Demirgüç-Kunt, A., & Levine, R., (2003), "Law and finance: why does legal origin matter?",*Journal of Comparative Economics*, 31(4), pp. 653-675.

Bernard, A., & Jones, C. (1996)."Technology and convergence", *The Economic Journal*, 106 (437), pp. 1037-1044.

Bicaba, Z., Brixiova, Z., & Ncube, M., (2017). "Can Extreme Poverty in Sub-Saharan Africa be Eliminated by 2030?," *Journal of African Development*, 19(2), pp. 93-110.

Boateng, A., Asongu, S. A., Akamavi, R., & Tchamyou, V. S., (2018). "Information Asymmetry and Market Power in the African Banking Industry", *Journal of Multinational Financial Management,* 44(March), pp. 69-83.

Bongomin, G. O. C., Ntayi, J. M., Munene J. C., & Malinga, C. A., (2018). "Mobile Money and Financial Inclusion in Sub-Saharan Africa: the Moderating Role of Social Networks", *Journal of African Business,*18(4), pp. 361-384.

Chandy, L., Ledlie, N. & Penciakova, V. (2013a). "The Final Countdown: Prospects for Ending Extreme Poverty by 2030", *Brookings Institution Policy Paper* No.2013-04, Washington D.C.

De Magalhães, L., & Santaeulàlia-Llopis, R., (2018). "The consumption, income, and wealth of the poorest: An empirical analysis of economic inequality in rural and urban Sub-Saharan Africa for macroeconomists", *Journal of Development Studies*, 134(September), pp. 350-371.

Efobi, U. R., Tanaken, B. V., & Asongu, S. A., (2018). "Female Economic Participation with Information and Communication Technology Advancement: Evidence from Sub- Saharan Africa", *South African Journal of Economics*, 86(2), pp. 231-246.

Elu, J., (2018). "Gender and Science Education in Sub-Saharan Africa-Keynote address at the African Development Bank/African Finance and Economic Association Luncheon, Chicago, January 7, 2017", *Journal of African Development*, 20(2), pp. 105-110.

Fisher, J., & Rucki, K., (2017). "Re-conceptualizing the Science of Sustainability: A Dynamical Systems Approach to Understanding the Nexus of Conflict, Development and the Environment", *Sustainable Development*, 25(4), pp. 267–275.

Fosu, A. K., (2010a). "Does Inequality Constrain Poverty Reduction Programs? Evidence from Africa", *Journal of Policy Modeling*, 32(6), pp. 818-827.

Fosu, A. K., (2010b). "Inequality, Income and Poverty: Comparative Global Evidence", *Social Sciences Quarterly*, 91(5), pp. 1432-1446.

Fosu, A. K., (2011). "Growth, Inequality and Poverty Reduction in Developing Countries: Recent Global Evidence", *UNU WIDER Working Paper* 2011/01, Helsinki.

Fosu, A., (2013). "Growth of African Economies: Productivity, Policy Syndromes and the Importance of Institutions", *Journal of African Economies*, 22(4), pp. 523-551.

Fosu, A. K. (2015). "Growth, Inequality and Poverty in Sub-Saharan Africa: Recent Progress in a Global Context", *Oxford Development Studies*, 43(1), pp. 44-59.

Gosavi, A., (2018). "Can mobile money help firms mitigate the problem of access to finance in Eastern sub-Saharan Africa", *Journal of African Business*. 18(4), pp. 343-360.

Humbani, M., & Wiese, M., (2018). "A Cashless Society for All: Determining Consumers' Readiness to Adopt Mobile Payment Services", *Journal of African Business*, 18(4), pp. 409-429.

Issahaku, H., Abu, B. M., & Nkegbe, P. K., (2018). "Does the Use of Mobile Phones by Smallholder Maize Farmers Affect Productivity in Ghana?", *Journal of African Business,*19(3), pp. 302-322.

Jones, S., & Tarp, F., (2015). "Priorities for Boosting Employment in Sub-Saharan Africa: Evidence for Mozambique", *African Development Review*, Supplement: Special Issue on "Aid and Employment", 27,(S1), pp. 56–70.

Kaulihowa, T., & Adjasi, C., (2018). "FDI and income inequality in Africa", *Oxford Development Studies*, 46(2), pp. 250-265.

Kwan, L.Y-Y, & Chiu, C-Y (2015). "Country variations in diiferent innovation outputs: The interactive effect of institutional support and human capital", *Journal of Organisational Behavior*, 36(7), pp. 1050-1070.

Love, I., & Zicchino, L., (2006). "Financial Development and Dynamic Investment Behaviour: Evidence from Panel VAR" .*The Quarterly Review of Economics and Finance*, 46(2), pp. 190-210.

Mannah-Blankson, T., (2018). "Gender Inequality and Access to Microfinance: Evidence from Ghana", *Journal of African Development*, 20(2), pp. 21-33.

Meniago, C., & Asongu, S. A., (2018). “Revisiting the finance-inequality nexus in a panel of African countries”, *Research in International Business and Finance*, 46 (December), pp. 399-419.

Michel, J., (2016). “Beyond Aid: the Integration of Sustainable Development in a Coherent International Agenda”, *Centre for International Private Enterprises*, http://www.cipe.org/publications/detail/beyond-aid-integration-sustainable-developmentcoherent-international-agenda (Accessed: 19/07/2016).

Minkoua Nzie, J. R., Bidogeza, J. C., &Ngum, N. A., (2018).“Mobile phone use, transaction costs, and price: Evidence from rural vegetable farmers in Cameroon”, *Journal of African Business*, 19(3), pp. 323-342.

Muthinja, M. M., & Chipeta, C., (2018). “What Drives Financial Innovations in Kenya’s Commercial Banks? An Empirical Study on Firm and Macro-Level Drivers of Branchless Banking”, *Journal of African Business*, 18(4), pp. 385-408.

Naceur, B.S.,&Zhang, R., (2016). “Financial development, inequality and poverty: some international evidence”. *IMF Working Paper*, Washington DC.

Ncube, M., Anyanwu, J. C., & Hausken, K., (2014). “Inequality, Economic Growth and Poverty in the Middle East and North Africa (MENA)”, *African Development Review*, 26(3), pp. 435-453.

Page, J., & Söderbom, M., (2015). “Is Small Beautiful? Small Enterprise, Aid and Employment in Africa”, African Development Review, Supplement: Special Issue on “Aid and Employment”, 27,(S1), pp. 44–55.

Penard, T., Poussing, N., Yebe, G. Z., & Ella, P. N., (2012). “Comparing the Determinants of Internet and Cell Phone Use in Africa : Evidence from Gabon ”, *Communications & Strategies*, 86(2), pp. 65-83.

Ravallion, M., (2013). “How long will it take to lift one billion people out of poverty?”, The *World Bank Research Observer*, 28(2), pp. 139-158.

Roodman, D., (2009a). “A Note on the Theme of Too Many Instruments”, *Oxford Bulletin of Economics and Statistics*, 71(1), pp. 135-158.

Roodman, D., (2009b). “How to do xtabond2: An introduction to difference and system GMM in Stata”, *Stata Journal*, 9(1), pp. 86-136.

Saifulina, N., & Carballo-Penela, A., (2017).“Promoting Sustainable Development at an Organizational Level: An Analysis of the Drivers of Workplace Environmentally Friendly Behaviour of Employees”, *Sustainable Development*, 25(4), pp. 299–310.

Shaikh, A.A., & Karjaluoto, H. (2015).“Mobile banking adoption: A literature review”, *Telematics and Informatics*, 32(1), pp. 129-142.

Smith, M.L., Spence, R., & Rashid, A. (2011).“Mobile phones and expanding human capabilities”, *Information Technologies and International Development*, 7(3), pp. 77-88.

Sulemana, I., & Kpienbaareh, D., (2018). "An empirical examination of the relationship between income inequality and corruption in Africa", *Economic Analysis and Policy*, DOI: 10.1016/j.eap.2018.09.003.

Tchamyou, S. V., (2017). "The Role of Knowledge Economy in African Business", *Journal of the Knowledge Economy*, 8(4), pp 1189-1228.

Tchamyou, V. S., (2018a). "Education, Lifelong learning, Inequality and Financial access: Evidence from African countries". *Contemporary Social Science*. DOI: 10.1080/21582041.2018.1433314.

Tchamyou, V. S., (2018b)."The Role of Information Sharing in Modulating the Effect of Financial Access on Inequality". *Journal of African Business*: Forthcoming.

Tchamyou, V. S., & Asongu, S. A., (2017)."Information Sharing and Financial Sector Development in Africa", *Journal of African Business*, 18(7), pp. 24-49.

Tchamyou, V.S., Erreygers, G., & Cassimon, D., (2018). "Inequality, ICT and Financial Access in Africa", *Technological Forecasting and Social Change*. DOI: 10.1016/j.techfore.2018.11.004.

Uduji, J.I. & Okolo-Obasi, E. N., (2018a). "Adoption of improved crop varieties by involving farmers in the e-wallet programme in Nigeria". *Journal of Crop Improvement, Journal of Crop Improvement*, 32 (5), pp. 717-737.

Uduji, J.I. & Okolo-Obasi, E. N., (2018b). "Young rural women's participation in the e-wallet programme and usage intensity of modern agricultural inputs in Nigeria", *Gender, Technology and Development*, 22(1), pp. 59-81.

Ureta, S. (2008)."Mobilising poverty?: Mobile phone use and everyday spatial mobility among low-income families in Santiago", *Chile, Information Society*, 24(2), pp. 83-92.

Wang, E, S-T., & Lin, H-C., (2017). "Sustainable Development: The Effects of Social Normative Beliefs On Environmental Behaviour", *Sustainable Development*, 25(6), pp. 595-609.

Yoshida, N., Uematsu, H., & Sobrado, C. E., (2014). "Is Extreme Poverty Going to End?",*World Bank Policy Research Working Paper* No. 6740, Washington D.C.