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Abstract

Despite the momentous rise in ICT diffusion, and financial development in sub-Saharan Africa (SSA), their plausible joint effect on inclusive growth have not been explored, leaving a lacuna in the literature. This study, therefore, examines the direct and indirect effects of ICT diffusion on inclusive growth in 42 SSA countries over the period 1980–2019. We provide evidence robust to several specifications from the dynamic system GMM to show that: (i) ICT skills, access and usage induce inclusive growth in SSA, and (ii) the effects of ICT skills, access and usage are enhanced in the presence of financial development. These findings remain the same when we focussed on financial institution access. Policy recommendations are provided in line with the region's green growth agenda and striving efforts at improving socioeconomic development.

Keywords: Financial Development, Financial Inclusion, ICT Diffusion, Inequality, Inclusive Growth, Poverty, sub-Saharan Africa

JEL Codes: D63; E5; G2; I3; L96; O11; O55

1.0 **Introduction**

Among others, the coronavirus pandemic has laid bare the porous growth trajectories of the world in recent times. This signifies the need for policy discourses on how shared prosperity can be achieved especially in the developing world. Indeed, policy recommendations on sub-Saharan Africa (SSA) has largely been on economic growth with little attention to equitable/shared growth. However, in the wake of the coronavirus disease (COVID-19), the debate has turned considerably towards building shared prosperity in SSA. The SSA is one of the most unequal and disadvantaged regions of the world (Ravallion and Chen 2019; Roser and Ortiz-Ospina 2016), and this has been cited as one of the reasons why the region slumped into a record 1.9% contraction in 2020 (IMF 2021), down from the last quarter projections[1] of 3.2% of the IMF (2020a) and World Bank (2020a). Though this compares well to that of the world (-3.2), the Latin America and Caribbean (-7.0), and Middle East and Central Asia (-2.6), it is the SSA's worst growth performance on record, complicating the region's fragile fiscal space for redistribution and transformative reforms.

Among others, the concern with COVID-19, especially for the SSA, is its pernicious welfare implications. For instance, the World Bank (2020b), ILO (2020a), and OECD (2020a) report that the pandemic has eroded strides made on Sustainable Development Goals 1, 8 and 10 chalked over the past few years. There is also the projection that 87% of the world's poorest people will reside in SSA by 2030 if current economic challenges are not tackled head-on[2] (World Bank 2020b). Income inequality is also expected to rise due to job losses, food price shocks, slow recovery of informal activities and low social protection (Kovacevic and Jahic 2020; ILO 2020b).

The seriousness of these welfare setbacks and projections in the wake of the pandemic is the empirical evidence that poverty and inequality have deleterious effects on the quality of life, health, education, social protection efforts, and mortality (Pickett and Wilkinson 2015 2010). Going forward, building shared prosperity in SSA is not only imperative for addressing possible human capital development, social cohesion and political stability setbacks, but also offers the surest way of lessening the impacts of future socioeconomic shocks. This is where this study contributes to the current discourse. In doing so, we deviate substantially from the proliferation of opinions without rigorous empirical backing shared on how policymakers can build prosperous and all-inclusive SSA post COVID-19. More germane, we identify two

[1] The IMF projected SSA to contract by 3.2% while the World Bank estimated it to be 3.2%.
[2] Brown *et al.* (2020) indicate that home environment protection for coping with socioeconomic shocks are virtually non-existent in the SSA.

channels in line with the region's green growth agenda— information and communication technologies (ICTs), and financial development through which shared growth can be achieved. The allocative and growth-lubricating effects of financial institutions soared in the lockdown periods as governments relied on it for social protection— reaching out to vulnerable households, boosting online transactions, and extending support to the huge informal sector. Also, quite recently, in the context of SSA, the mode of accessing information or opportunities be it employment or admission into sectors such as education, health, aviation, security services, and communication are only available online, with payment of forms and other add-ons if any made via financial institutions or mobile money.

As Gigler (2011) reckons, ICTs are a complete array of contemporary assets[3] with/through which people can create opportunities for themselves. ICTs have indeed become invaluable in our daily lives and its usefulness deepened in the lockdown periods of the coronavirus pandemic as it facilitated smooth settlements of bills, ordering of consumables, digital banking, accessing e-learning, preservation of jobs, entertainment, and access to general information. Despite evidence on the link between financial sector activities and ICT diffusion (Salahuddin and Gow 2016; Shamim 2007), the lacuna in the literature on SSA is that rigorous empirical works exploring the joint effect of financial development and ICT diffusion on inclusive growth in SSA is hard to find. Indeed, a plethora of the literature in line with our argument only estimate the direct and/or indirect effects of financial development or ICT diffusion on economic growth (e.g., Asongu and Odhiambo 2020; Myovella *et al.* 2020; Adeleye and Eboagu 2019; Opoku *et al.* 2019; Peprah *et al.* 2019; Ibrahim and Alagidede 2018; Albiman and Sulong 2017). Berg and Ostry (2011) labels this as a 'mistake' to limit the analysis of economic development to economic growth as it downplays the relevance of social equity in shared prosperity. This study therefore contributes to the literature on two counts— first, by exploring the joint effects of ICT diffusion and financial development on inclusive growth in SSA, and second, by investigating the ICT diffusion and financial access pathway[4] on inclusive growth in SSA. The relevance of both pathways is that it presents policymakers with a more practical and concrete options of fostering inclusive growth in the SSA through ICT diffusion, financial deepening, and financial development in general.

[3] Examples are mobile phones, tablets, computers, internet, radios, televisions, audio visuals, printers, and related software for application in several facets of life.
[4] This is strictly from policy sense as financial access denotes the public's direct access to resources from the financial system.

The rest of the paper is organized as follows: the next section presents the overview of ICT diffusion, financial development/access and inclusive growth in SSA. Section 3 outlines the methods used for the paper. We present our results and discussion in section 4, and that of our conclusion and policy recommendations in section 5.

2.0 ICT diffusion, financial development, and inclusive growth in Sub Saharan Africa

The world is ever-changing, driven largely by ICTs. As Castells (1999) reckon, lack of ICT materials in our contemporary world is a form of social deprivation, and is akin to lack of access to electricity in the *'industrial age'*. The skepticism regarding the power of ICT diffusion in fostering inclusiveness in the developing world centres on affordability, adaptability, poor infrastructure, and possible inequality– and unemployment–inducing effects (see e.g., Chowdhury 2000; Bedia 1999). These arguments, have, to some extent, been refuted by the likes of Asongu and Le Roux (2017), Torero and von Braun (2006), Grace and Kenny (2003), and Brown (2001), who argue that in both low- and high-income economies, ICT diffusion is (i) driving opportunities and inclusiveness, and (ii) offering a good medium to leapfrog development[5] in the developing world.

For the economies of SSA, which according to the UNFPA (2021) are home to the world's top 10 destinations[6] with youthful populations— a development that presents policymakers opportunities for leveraging on the power of ICTs to support human capital development and shared growth. In fact, an interesting and encouraging information gleaned from the report also indicates that 85% of the children under the age of 16 in SSA are enrolled in education, as are 65% of those aged 16 – 18. There is also the abundance of natural resources and unmet gaps for infrastructure, and a major recipient of foreign direct investment from Europe and Asia (UNCTAD 2019). Two key developments in SSA offer policymakers glimmers of hope in fostering inclusive growth via ICT diffusion. First is the rise in ICT access (proxied by fixed telephone subscription per hundred people), ICT skills (secondary school enrolment gender parity index), and ICT usage (fixed broadband subscription per hundred people) in the region (see, Figure A.1), which as we show in Figure 1 are strongly related to inclusive growth.

[5] Such is the example of the Asia Pacific region, where countries such as Hong Kong, Taiwan, Singapore, and South Korea leapfrogged development through ICT diffusion

[6] These countries are Angola, Burundi, Chad, Congo DR., Mali, Mozambique, Niger, Somalia, Uganda, and Somalia. Niger doubles as the country with the youngest population in the world (15.2 years)

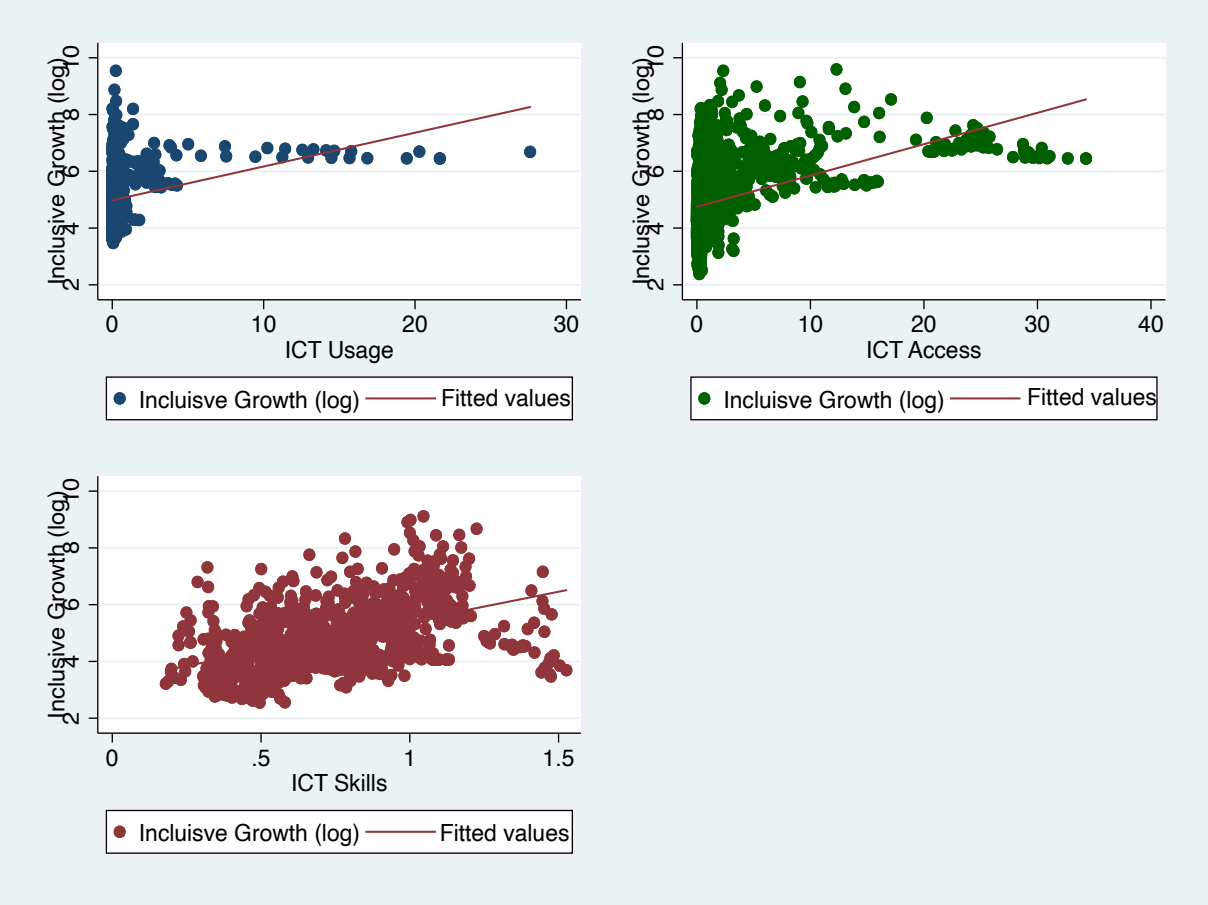

Figure 1: ICT Diffusion – Inclusive Growth Nexus

The second optimism is the springing up of technological hubs[7] (tech-hubs) in the region, markedly, in countries like South Africa, Nigeria, Kenya, and Ghana (see, Figure A.1), connecting young programmers, designers, entrepreneurs, and investors for the cultivation and nurturing of ideas. In fact, information gleaned from Global System for Mobile Communication Association (GSMA) shows the momentous rise in tech-hubs in SSA, from 314 in 2016, to 442 in 2017, and 643 in 2019. This remarkable upward trajectory clearly signifies the growing ICT diffusion in a region where digitalisation is a key development objective. At the backbone of resilient tech-hubs, which can turn the young and creative minds into economic development process is financial access and transformative investment spending in young-friendly modules such as ICT skills, access, and usage (Ofori and Asongu 2021a). Plausibly, therefore, if prioritized with greater financial deepening, ICT access, skills and usage can offer limitless shared opportunities by— (i) creating green wealth through innovation, (ii) enhancing access to greater markets like one offered by the African Continental Free Trade

[7] Major tech-hub in SSA are the SmartXchange, RLABS, and JoziHub of South Africa; Kinu of Tanzania; iSPACE of Ghana; xHub, IHub, Swahili Box, eMOBILIS, and Afrinovator of Kenya; and Co-creation Hub, Wennovation Hub, Focus Hub of Nigeria

Area (AfCFTA), (iii) enhancing access to education, information and knowledge transfers, and (iv) facilitating relationship, network building, and social inclusion.

Regarding financial development and financial access, Figure A.2 shows similar within-country variability. Though financial development and access lag in countries such as Chad, Comoros, Guinea-Bissau, and Congo DR, the region's financial sector is growing. In addition to this development is the growth in mobile money subscription and transactions in SSA. In settings like this, ICT diffusion provides opportunities for greater financial inclusion, reduced physical contact[8], and access to financial products and services that can be targeted to enhance inclusive growth. Also, the link between financial development, financial access and inclusive growth as we show in Figure 2 is direct and strong.

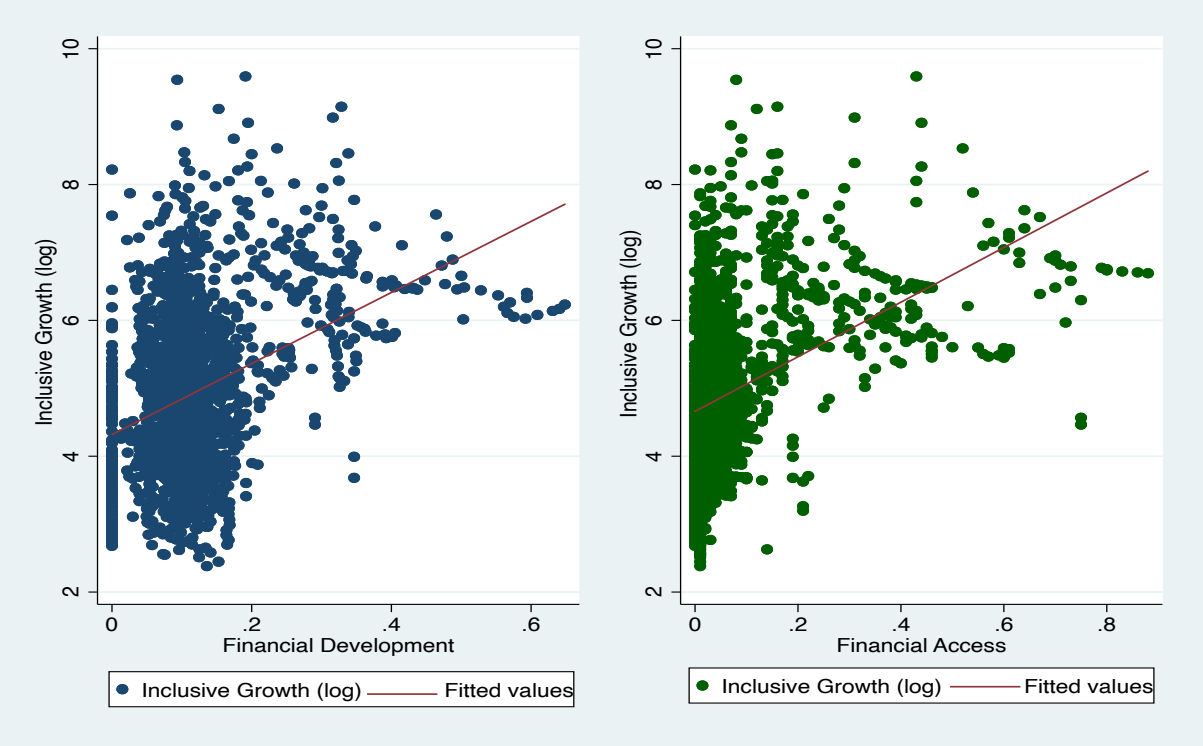

Figure 2: Financial Development/Access – Inclusive Growth Nexus

2.1 The theoretical link between ICT, financial development and inclusive growth

We draw on two streams of ideas— the neoclassical models of economic development, and the Sustainable Livelihoods Approach (SLA) as the theoretical foundation of our paper. The former denotes the link between ICTs and the provision of a level playing field for the masses in economic activity (see, Kwan and Chiu 2015). The import of the theory is that investment in contemporary assets like ICTs can foster inclusive growth, evidence of which is seen in

[8] Example, through the use of Automated Teller Machines (ATM), internet banking, smart cards, and mobile banking, and Quick Response (QR) codes.

China, Hong Kong and Japan. The latter also denotes the different linkages between livelihood assets, institutions, policies, and people's livelihood outcomes (Messer and Townsley 2003). The SLA framework takes its roots from Sen's notion[9] of the set of '*functionings*' and '*doings*' in people's capabilities (Sen, 1999). The framework thus indicates that if economic agents have access to assets, they can create opportunities for themselves. It is in the context of this and the flexibility of the SLA concept in analysing shared growth that ICTs are incorporated into the framework (see, Duncombe 2006).

The link between financial development and inclusive growth is well established in the scholarly works of Mckinnon (1973), Shaw (1973), and King and Levine (1993). A burgeoning financial sector can trigger inclusive growth through efficient resource allocation. Aside the relevance of ICTs in achieving financial inclusion, is the visibly high usage of ICTs in the financial sector for administrative process, and local and international transactions (see e.g., Sassi and Goaied 2013; Shamim 2007; Allen *et al.* 2001). In settings like the SSA where administrative and structural inefficiencies impede financial development and its growth-lubricating effects, ICT diffusion can be used to achieve operational efficiency. Similar arguments are found in Asongu and Odhiambo (2020), Asongu and Nwachukwu (2018), Muto and Yamano (2009) and Shamim (2007) who argue that ICT diffusion can reduce both the processing and information costs of financial players, while enhancing financial competition, inclusion, and long-run growth prospects[10]. The foregoing theoretical links usher us into the hypotheses undergirding this study. First, we test whether ICT diffusion (access, usage and skills) induce inclusive growth in the SSA. Second, we test whether there are higher inclusive-growth effects of ICT diffusion in the presence of financial development. Third, we test whether relative to its direct effects, ICT diffusion have higher inclusive growth-inducing effects through greater financial access.

2.2 Literature survey on measures and drivers of inclusive growth

Achieving economic growth is one thing while achieving shared prosperity is another. Though growth (GDP per capita) in countries like Namibia, South Africa, Gabon, Botswana, Angola, and Seychelles, as we show in Figure A.3, is high, it is not inclusive[11]. For Ravallion and Chen

[9] Sen argues that matters in people's well-being is what they are capable of being or doing with the goods to which they have access.

[10] ICT diffusion thus consolidates financial allocation efficiency of financial institutions through cost reduction, and the optimal channeling of resources from savers to investors.

[11] While GDP per capita of these countries exceeds US$5000, in terms of inclusive growth, no country achieves US$2500.

(2004), inclusive growth is defined in absolute terms as growth that is largely beneficial to the poor and marginalized (i.e., sustained growth in GDP per capita). On the contrary, IMF (2011) defines inclusive growth in relative terms as the growth in incomes of the poor compared to the overall population. Ali and Son (2007) also define inclusive growth as growth trajectories that increase social opportunities in terms of incomes, employment, human capital development, and social safety nets.

Inclusive growth thus encompasses several dimensions of national development particularly with regards to the creation of equitable opportunities aimed at increasing the incomes, welfare and participation of especially the poor in economic development (Berg and Ostry 2011). Anand *et al.* (2013) provide evidence to show that globalisation, foreign direct investment, and trade openness induce inclusive growth[12]. Also, Paramasivan *et al.* (2014) and Estache *et al*. (2013) argue that while productivity and employment growth are crucial, interventions in human capital development, gender equality, and social safety nets are equally significant in fostering shared prosperity. Similar argument is found in World Bank (2013, 2009) and Acemoglu and Robinson (2012) who argue that inclusive growth rests on stronger institutions, structures, and policies aimed at building the capabilities of the marginalised. Particularly on safety nets, Lustig *et al.* (2012) show that the recent welfare gains in the Latin America and the Caribbean (LAC) is at the backdrop of efficient fiscal redistribution (social protection).

Particularly in the developing world, IMF and World (2020), and the ADB (2013) reckon that equitable growth can be spurred through efficient resource allocation[13] in building the productive capacity of the private sector. Also crucial for fostering inclusive growth is government expenditure on infrastructure and irrigation, which enhances access to opportunities and productivity especially in the areas of wider market, education and health, which would ordinarily have been inaccessible to the poor and rural folds (Calderón and Servén 2014). A conspicuous lacuna in the literature survey is the non-existence of prior works exploring the effect of ICT diffusion on inclusive growth. This is a shortfall this study addresses and further reveals that, even together with efficient resource allocation, policy actions that seek to enhance ICT skills, access, and usage can prove momentous in the region's inclusive growth pursuit. We begin our contribution to the ongoing debate on ways decisionmakers can foster inclusive growth in SSA in next section.

[12] Inflation however proved deleterious to inclusive growth.
[13] This is because financial inclusion alone may be ineffective in boosting the growth of the vast SME subsector (see, AWID 2011)

3.0 Data and methodology

3.1 Data

The panel dataset underpinning our analysis spans 1980 – 2019 for 42 SSA countries[14]. Data on the outcome variable, inclusive growth, is generated following the Anand *et al.* (2013) approach[15]. The authors calculate inclusive growth[16] based on a utilitarian social welfare function, which incorporates (i) income growth; and (ii) income distribution in shared growth (see calculation in supplementary results). Alternatively, we check the robustness of our estimates using the Palma ratio[17] and GDP per capita. The choice of these two inclusive growth indicators for robustness checks follows the absolute and relative lenses through which pro-poor growth is measured (see, Ofori *et al*. 2022a, 2022b; IMF 2011; Berg and Ostry 2011; Ravallion and Chen 2004). On the variables of interest— ICT diffusion, financial development and access, we capture the former by three indicators (access, usage and skills), and the latter by the IMF's financial development index (Svirydzenka 2016).

Further, informed by policy and the structure of the SSA, we use inflation to capture macroeconomic in (stability); and economic globalisation to capture the impacts of trade, capital flows, and foreign direct investment on inclusive growth. We also control for social protection, population growth, and vulnerable employment to capture the effect of redistribution, and the structure of the region's real sector on inclusive growth (Ofori *et al*. 2022a; Ofori and Asongu 2021a, 2021b). Save for the data on economic globalisation, which is sourced from the Konjunkturforschungsstelle (KOF) index of globalisation[18] (Gygli *et al.* 2019), all other controls and the ICT indicators are drawn from the World Bank's World Development Indicators (World Bank 2021). The description of the variables is provided in Table 1 while their pairwise correlations are reported in Table A.1.

[14] Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Congo DR., Congo, Cote d'Ivoire, Ethiopia, Gabon, The Gambia, Guinea, Ghana, Guinea Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Sudan, South Africa, Tanzania, Togo, Uganda, Zambia.

[15] See pages 5 – 9 of "Anand *et al*. 2013": https://www.imf.org/external/pubs/ft/wp/2013/wp13135.pdf

[16] Authors such as Obeng *et al.* (2021) and Ofori and Asongu (2022; 2021a) have employed the same approach in their empirical works

[17] The Palma ratio denotes the growth in the incomes of the richest 10% of the population relative to the bottom 40%. The ratio thus measures inequalities in households in terms of opportunities.

[18] The KOF index of globalisation is an index measuring the degree of globalisation of 122 countries. The index provides statistics on three main dimensions of globalisation– economic, social, and political.

3.2 Estimation strategy

The theories underpinning our study stem from the neoclassical model of economic development (Kwan and Chiu 2015), the SLA framework (Messer and Townsley 2003), and the established link between ICT diffusion and financial development in inclusive growth (see Ofori *et al*. 2021a; Asongu and Nwachukwu 2017; Asongu 2013; Muto and Yamano 2009; Shamim 2007). The empirical rigor of this paper begins with the specification of a baseline where only the control variables enter our inclusive growth model. We proceed with a stepwise introduction of financial development, financial access, and the ICT diffusion (composed of ICT skills, access, and usage) into the model. Finally, per our hypothesized pathways, we introduce interaction terms for ICT diffusion and financial development on the one hand, and ICT diffusion and financial access on the other hand in the models. Our baseline model is specified as:

$$ln(ingrowth_{it}) = \alpha_0 + \gamma_1 ln(ingrowth_{it-1}) + \gamma_2 ln(ecoglob_{it}) + \gamma_3 ln(pop_{it}) + \gamma_4 ln(inf_{it}) + \gamma_5 ln(vul_{it}) + \gamma_6 ln(socpro_{it}) + \varepsilon_{it}\ , \quad (1)$$

where $ingrowth_{it}$ is inclusive growth in log-difference, generated following the approach of Anand *et al.* (2013) by integrating income equity and growth in a unified manner based on the utilitarian social welfare function. Also, $ingrowth_{it-1}$ is the lag of inclusive growth, $ecoglob_{it}$ is economic globalisation, pop_{it} is population growth rate, inf_{it} is inflation, vul_{it} is vulnerable employment, and $socpro_{it}$is social protection. Next, by incorporating the interaction terms for ICT diffusion and financial development, Equation (1) is modified to obtain Equation (2) as follows:

$$ln(ingrowth_{it}) = \alpha_0 + \gamma_1 ln(ingrowth_{it-1}) + \gamma_2 ln(ecoglob_{it}) + \gamma_3 ln(pop_{it}) + \gamma_4 ln(inf_{it}) + \gamma_5 ln(vul_{it}) + \gamma_6 ln(socpro_{it}) + \gamma_7 ln(ICTdif_{it}) + \gamma_8 ln(findep_{it}) + \gamma_9 ln(findep_{it} \times ICTdif_{it}) + \varepsilon_{it}\ , \quad (2)$$

Further, on grounds of econometric prudence[19], we re-specify Equation (2) by introducing financial access and its corresponding interaction with ICT diffusion as:

$$ln(ingrowth_{it}) = \alpha_0 + \gamma_1 ln(ingrowth_{it-1}) + \gamma_2 ln(ecoglob_{it}) + \gamma_3 ln(pop_{it}) + \gamma_4 ln(inf_{it}) + \gamma_5 ln(vul_{it}) + \gamma_6 ln(socpro_{it}) + \gamma_7 ln(ICTdif_{it}) + \gamma_8{}^{*} ln(finacc_{it}) + \gamma_9 ln(finacc_{it} \times ICTdif_{it}) + \varepsilon_{it}\ , \quad (3)$$

[19] We do this due to multicollinearity concerns if the overall financial development index and financial access index enter the same model.

where $findep_{it} \times ICTdif_{it}$ is the interaction term for financial development and ICT diffusion indicators; $finacc_{it} * ICTdif_{it}$ also denotes interaction term for financial access and ICT diffusion indicators; $ingrowth_{it-1}$ is the lag of inclusive growth; *ln* is the natural logarithm; and $ICTdif_{it}$ denotes ICT access, ICT usage and ICT skills. It is imperative to note that in models 1 – 3, $\varepsilon_{it} = \epsilon_i + \vartheta_t + \mu_{it}$, where ϵ_i is unobserved country-specific fixed effects; ϑ_t is the time effects, and μ_{it} is the idiosyncratic error term. Per our hypothesised inclusive growth-inducing effects of ICT diffusion, financial development, and financial access, we expect γ_7, γ_8, $\gamma_8{}^*$, and γ_9 to be positive. But for γ_4 and γ_5, we expect all other parameters to be positive as well. The attendant net effects from the interactions between ICT diffusion and financial development on inclusive growth in equations (2) is expressed as:

$$\frac{\partial(ln(ingrowth_{it}))}{\partial(ln(ICTdif_{it}))} = \gamma_7 + \gamma_9(\overline{findep_{it}}), \tag{4}$$

where $\overline{findep}$ is the mean of financial development score. Likewise, we express the net effects from the interaction terms for ICT diffusion and financial access on inclusive growth from equations (3) as:

$$\frac{\partial(ln(ingrowth))}{\partial(ln(ICTdif_{it}))} = \gamma_7 + \gamma_9(\overline{finacc_{it}}), \tag{5}$$

where $\overline{finacc}$ is the average financial access score.

It is imperative to point out that, in estimating Equations (2) and (3), techniques that can address potential endogeneity are preferred due to the introduction of the lag of inclusive growth. The endogeneity concern arises since $ingrowth_{it-1}$ depends on ε_{it-1}, which is a function of the country-specific effect ϵ_i. To the extent that the presence of endogeneity can bias our estimates, we address it by applying the system GMM technique[20] (Arellano and Bover 1995). One should also not lose tabs on the fact that the potency of the GMM technique in yielding robust estimates depends on a number of post estimation tests. Following Alagidede and Ibrahim (2017), we evaluate the validity of the instrument using the Hansen's test of over–identification. The Hansen test is premised on the null hypothesis that the set of identified instruments and the residuals are uncorrelated. Hence, the appropriateness of the instruments and thus the robustness of our estimates depends on the failure to reject the null hypothesis. On the other hand, if the null hypothesis is rejected, then the instruments are not robust because

[20] In estimating our two-step system GMM models, the instruments are the lags of the regressors.

the restrictions imposed by relying on the instruments are invalid. Finally, we evaluate the reliability of our estimates based on the post estimation tests of: (a) whether there is evidence of second-order serial correlation in the residuals or not, (b) the significance of the interaction terms, and (c) the Wald test for the overall model significance.

Table 1: Variable description and sources

Variables	Description	Symbol	Parameter	Data Source
Dependent variables				
Inclusive growth	Generated based on Anand *et al.* (2013) approach	ingrowth	–	Authors GCIP
Palma ratio	The ratio of the share of the top 10% to that of the bottom 40 % in the population	Palma ratio	–	
GDP per capita	Real GDP divided by population	GDP per capita	–	WDI
Variables of interest				
Financial development	Financial development index capturing the efficiency, access, and depth of the financial institutions and markets	findep	γ_8	Findex
Financial access	Financial institutions access capturing the access of people to financial institutions	finacc	$\gamma_8{}^*$	Findex
ICT (access)	Fixed telephone subscriptions (per 100 people)	ICTdif	γ_7	WDI
ICT (use)	Fixed broadband subscriptions (per 100 people)	ICTdif	γ_7	WDI
ICT (skills)	Gross secondary school enrolment gender parity index	ICTdif	γ_7	WDI
Control variables				
Social protection	Country policy and institutional assessment score indicating the effectiveness of social inclusion institutions	socpro	γ_6	WDI
Population growth	Annual population growth rate	pop	γ_3	WDI
Economic globalisation	Captures trade in goods and services; customs duties, taxes and trade restrictions; capital account openness and international investment agreements.	ecoglob	γ_2	KOF index
Inflation	Consumer price index (2010=100)	inf	γ_4	WDI
Vulnerable employment	Total contributing family and own-account workers as a share of total employment	vul	γ_5	WDI

Note: WDI is world development indicators; Findex is IMF's Financial Development Index; KOF index is Konjunkturforschungsstelle index;
Source: Authors' construct, 2021

4.0 Results and discussion

4.1 Summary statistics

We show the overview of our dataset in Table 2. The data shows an average inclusive growth value of US$ 343.7, compared to the average GDP per capita value of US$3819.6. Our average inclusive growth value gives an indication of the less-inclusive growth trajectories of the SSA in the past four decades.

Table 2: Summary statistics, 1980 – 2019

Variable	N	Mean	Std. Dev.	Minimum	Maximum
Inclusive growth	1722	343.708	835.271	10.834	14647.05
Inflation	1722	58.382	46.466	0.000	410.940
GDP pe capita	1722	3819.61	4401.845	0.000	29223.465
Economic globalisation	1722	40.048	11.263	0.000	85.299
Social protection	1722	2.985	0.517	0.000	4.500
Vulnerable employment	1722	70.927	22.867	8.826	94.759
Population growth	1722	2.573	0.995	-6.766	8.118
Financial development	1722	0.124	0.089	0.000	0.648
Financial access	1722	0.076	0.128	0.000	0.880
ICT (access)	1722	2.178	4.855	0.000	34.273
ICT (use)	1722	0.836	2.852	0.000	27.603
ICT (skills)	1704	6.301	0.778	4.000	8.000
Palma ratio	1722	7.283	3.75	0.000	30.065

Source: Authors' construct, 2021

We also observe an average social protection score and population growth rate of 2.95, and 2.57% over the study period. The data also shows that vulnerable employment in the SSA is high (70.93), giving an indication of the region's informal sector. Also, our ICT indicators of access, usage, and skills average 2.18, 0.84, and 6.3 respectively over the study period.

4.2 Bivariate results on the effects of financial development and ICT diffusion on inclusive growth

Our analysis begins with the presentation of our bivariate results on the effects of ICT diffusion, financial access, and financial development on inclusive growth in SSA (See, Table 3). Though all the variables are positive and statistically significant, ICT skills, financial development, and financial access are very strong in terms of their relationships with inclusive growth.

Table 3: Bivariate results on the effects of financial development, financial access, and ICT diffusion on inclusive growth (Dependent variable: Inclusive growth)

Variable	(1)	(2)	(3)	(4)	(5)
Financial development	5.2304***				
	(0.2987)				
Financial access		4.0214***			
		(0.2023)			
ICT (access)			0.1105***		
			(0.0054)		
ICT (use)				0.1190***	
				(0.0133)	
ICT (skills)					2.0912***
					(0.1253)
Constant	4.3187***	4.6594***	4.7476***	4.9799***	3.3197***
	(0.0456)	(0.0302)	(0.0286)	(0.0396)	(0.1026)
Observations	1,722	1,722	1,676	610	941
R-squared	0.1513	0.1868	0.2013	0.1160	0.2287
Adjusted R-Squared	0.151	0.186	0.201	0.115	0.228

Standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

4.3 System GMM results on the effects of financial development, financial access, and ICT diffusion on inclusive growth

The results from our baseline model in Table 4 show that with the exception of population growth, all our controls are significant. We find that while social protection and economic globalisation foster inclusive growth in SSA, inflation and vulnerable employment are deleterious to shared growth (Column 1). For our variables of interest, we find that financial development and financial access are remarkable in enhancing inclusive growth. The results show that a 1% increase in financial development and financial access induces inclusive growth by 0.17% and 0.21%, respectively (Columns 2 and 3).

Table 4: System GMM results on the effects of financial development, financial access and ICT diffusion on the inclusive growth (Dependent variable: Inclusive growth)

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Inclusive growth (-1)	0.0043***	0.0068***	0.0109***	0.0059***	0.0118***	0.0049***	0.0061***	0.0119***	0.0059***	0.0104***	0.0114***	0.0130***
	(0.0005)	(0.0011)	(0.0012)	(0.0007)	(0.0013)	(0.0006)	(0.0013)	(0.0015)	(0.0010)	(0.0015)	(0.0021)	(0.0011)
Social protection	0.1098*	0.1826***	0.2666***	0.1607***	0.4612***	0.0639	0.2620***	0.4348***	0.1826**	0.2202***	0.4562***	0.2646***
	(0.0573)	(0.0611)	(0.0321)	(0.0445)	(0.0288)	(0.0514)	(0.0732)	(0.0876)	(0.0815)	(0.0539)	(0.0765)	(0.0772)
Population growth	-0.0309	-0.0443*	-0.0442	-0.0292	-0.0168	-0.0319	-0.0117	-0.0379	-0.0514	-0.0039	-0.0055	-0.0180
	(0.0248)	(0.0260)	(0.0384)	(0.0319)	(0.0347)	(0.0195)	(0.0492)	(0.0307)	(0.0315)	(0.0416)	(0.0481)	(0.0296)
Inflation	-0.0007*	-0.0001	-0.0011***	-0.0001	-0.0013***	-0.0010**	-0.0006**	-0.0009***	-0.0001	-0.0005*	-0.0018***	-0.0012***
	(0.0004)	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0004)	(0.0003)	(0.0002)	(0.0004)	(0.0002)	(0.0003)	(0.0004)
Vulnerable employment	-0.0156***	-0.0130***	-0.0102***	-0.0123***	-0.0158***	-0.0174***	-0.0154***	-0.0147***	-0.0150***	-0.0145***	-0.0099***	-0.0120***
	(0.0026)	(0.0035)	(0.0018)	(0.0024)	(0.0017)	(0.0017)	(0.0030)	(0.0033)	(0.0022)	(0.0027)	(0.0026)	(0.0027)
Economic globalisation (KOF)	0.0247***	0.0217***	0.0158***	0.0133***	0.0168***	0.0276***	0.0082**	0.0156***	0.0213***	0.0128***	0.0049	0.0126*
	(0.0022)	(0.0053)	(0.0030)	(0.0012)	(0.0020)	(0.0024)	(0.0035)	(0.0050)	(0.0022)	(0.0020)	(0.0051)	(0.0069)
Financial development		0.1758***					0.1597**	0.2924***	0.1123			
		(0.0550)					(0.0624)	(0.0883)	(0.1972)			
Financial access			0.2115***							0.0721*	0.2384***	0.1704**
			(0.0329)							(0.0365)	(0.0378)	(0.0761)
ICT (access)				0.0811***			0.1957***			0.0938***		
				(0.0138)			(0.0161)			(0.0161)		
ICT (use)					0.0648***			0.1937***			0.0669**	
					(0.0097)			(0.0234)			(0.0291)	
ICT (skills)						0.1574***			0.0743*			0.1273**
						(0.0412)			(0.0438)			(0.0607)
Financial development x ICT (access)							0.4134***					
							(0.0366)					
Financial development x ICT (use)								0.4530***				
								(0.0772)				
Financial development x ICT (skills)									0.1312			
									(0.1705)			
Financial access x ICT (access)										0.0222*		
										(0.0121)		
Financial access x ICT (use)											0.0042	
											(0.0456)	
Financial access x ICT (skills)												0.1498***
												(0.0253)
Constant	5.4524***	6.0568***	6.7576***	5.5452***	6.8465***	4.2898***	6.6990***	7.2115***	5.5795***	5.8118***	7.6304***	5.9128***
	(0.2396)	(0.6948)	(0.2591)	(0.3041)	(0.2240)	(0.4269)	(0.3905)	(0.5506)	(0.8613)	(0.3019)	(0.6716)	(0.9821)
Observations	1,680	1,594	1,524	1,638	610	1,663	1,560	602	1,577	1,492	599	1,507
Time effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Countries	42	42	42	42	41	42	42	41	42	42	41	42
Instruments	38	39	39	39	39	39	40	40	40	40	40	40
Wald Statistic	19700***	96405***	36708***	37092***	18330***	60572***	37750***	13578***	23568***	6337***	19476***	47419***
Wald P-Value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Net Effect	–	–	–	–	–	–	0.2469	0.2498	–	0.0954	–	0.1386
Joint Significance Test	–	–	–	–	–	–	20.00***	11.04***	–	4.72**	–	8.11***
P-Value	–	–	–	–	–	–	0.0001	0.0019	–	0.0356	–	0.0069
Hansen P-Value	0.431	0.474	0.624	0.562	0.462	0.502	0.531	0.621	0.464	0.530	0.523	0.560
AR(1)	0.0000	0.0004	0.0006	0.0003	0.424	0.0000	0.0009	0.6360	0.0004	0.0030	0.3890	0.0007
AR(2)	0.136	0.0364	0.165	0.251	0.923	0.135	0.0706	0.793	0.0599	0.137	0.539	0.177

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Additionally, we find empirical evidence for our first hypothesis. We find that ICT access, usage, and skills are positive and statistically significant irrespective of model specification. Our estimates show that for every 1% improvement in ICT skills, access, and usage, inclusive growth is enhanced by 0.15% , 0.08%, and 0.06%, respectively. Our empirical evidence on the unconditional effects of ICT diffusion provides support for the theorised claim that access to productive assets can build capacities and enhance inclusive growth. These estimates are revealing and intuitive. First, compared to ICT access and usage, ICT skills are moderately high and fairly spread across the region. Second, ICT skills are what is ultimately needed to make sense of ICT access and the extent to which ICTs are employed in real sector of the region. Our findings provide evidence for the propositions that ICT diffusion can foster shared prosperity. Particularly, with enhance globalisation in the region following the implementation of the AfCFTA, ICT diffusion can foster commercial connectivity, information dissemination, while deepening the effectiveness of inbound open innovation in the region. This will not only enhance the development of the human capital base needed to meet the technical needs of region seek to industrialise but the emergence of dynamic business class who can realistically supplement policymakers' effort in creating opportunities. This is more so as ICT diffusion can eliminate discrimination, inequalities in accessing information, and high cost of accessing opportunities due to polarisation of administrative procedures in SSA (Asongu *et al.* 2019; Asongu and Odhiambo 2019). With growing tech-hubs in countries like Nigeria, Kenya, and South Africa amid the favourable ecosystems for start-ups in the form of large markets, good network and internet coverage, ICT skills, access and usage can spur inclusive growth through ideation and product development. Additionally, the rise in tech-hubs and industrial parks in countries like Kenya and Mauritius mean that policymakers in SSA can equip the masses through ICT diffusion and greater financial deepening to realise their innovative ideas and contribute meaningfully to national development.

Further, we find evidence for our second and third hypotheses. The uniqueness of our findings is that in the presence of greater financial development or deepening, ICT skills, access and usage are more effective in driving inclusive growth. On hypothesis two, there is a net effect of 0.246% for every 1% improvement in ICT access given current average financial development in SSA. Also, the net effect of enhancing ICT usage by 1% in the presence of financial development is 0.249%. Similar results are evident for the third objective, which indicate that for every 1% improvement in ICT access and skills, inclusive growth increases by 0.09% and 0.13%, respectively. These net effects are computed following Equations 4 and

5, given the average financial development score of 0.124 and financial access score of 0.076. The financial development and ICT access and usage net effects are computed as follows:

$$\frac{\partial(ln(ingrowth)}{\partial(ln(ICTaccess))} = 0.1957 + \left(0.4134 \times \overline{findep}\right)$$

$$\frac{\partial(ln(ingrowth)}{\partial(ln(ICTaccess))} = 0.1957 + (0.4134 \times 0.124) = 0.2469$$

$$\frac{\partial(ln(ingrowth)}{\partial(ln(ICTusage))} = 0.1937 + \left(0.4530 \times \overline{findep}\right)$$

$$\frac{\partial(ln(ingrowth)}{\partial(ln(ICTusage))} = 0.1937 + (0.4530 \times 0.124) = 0.2498$$

Likewise, our financial access and ICT skills and access net effects are calculated as:

$$\frac{\partial(ln(ingrowth)}{\partial(ln(ICTaccess))} = 0.0938 + \left(0.0222 \times \overline{finacc}\right)$$

$$\frac{\partial(ln(ingrowth)}{\partial(ln(ICTaccess))} = 0.0938 + (0.0222 \times 0.076) = 0.0954$$

$$\frac{\partial(ln(ingrowth)}{\partial(ln(ICTskills))} = 0.1273 + \left(0.1498 \times \overline{finacc}\right)$$

$$\frac{\partial(ln(ingrowth)}{\partial(ln(ICTskills))} = 0.1273 + (0.1498 \times 0.076) = 0.1386$$

These complementary results for ICT diffusion and financial access/development mean that: (i) financial inclusion can be enhanced, (ii) financial services/products can be allocated efficiently, and (iii) tech-hubs can be resourced to support the active population contribute meaningfully to shared growth. Indeed, lack of capital is a key roadblock to the effectiveness of ICT diffusion and tech-hubs in transforming innovative/entrepreneurial ideas into real income generating business opportunities. The optimism is that through ICT diffusion, policymakers can provide the active population education, mentorship and funding through tech-hubs to create meaningful economic impacts that can reverberate throughout the region. This is more so as credit constraint often hinders the development or graduation of the region's huge precarious businesses into at least formalised informal sector. Indeed, with empirical work such as Andrés *et al.* (2017) providing evidence that the interplay between ICT adoption

and formal education matters for human development in both low– and middle–income African countries, our results indicate how policymakers can foster shared prosperity in SSA. Particularly, these net effects show that with appropriate resource allocation, policymakers can make giant strides in their bid to nurturing and projecting young business class to take up opportunities presented by the AfCFTA and the expected rebound foreign direct investment into the region in 2022 (UNCTAD 2021). Particularly, the rippling effect of investments in ICT usage, access and skills in the presence of a burgeoning financial sector for effective resource allocation can prove immense in achieving Africa's Agenda 2063 aspiration of '*a prosperous Africa based on inclusive growth and sustainable development*'.

Our ancillary findings are also as expected a priori— social protection and economic globalisation are both positive and statistically significant (see, column 12). The effect of the former is remarkable as we find that a 1% improvement in social protection effectiveness enhances inclusive growth by 0.26%. The modest effect of the latter on inclusive growth signifies the less-inclusive sectors in which FDI, for instance, have been flowing into, markedly, the aviation, mining, and telecommunication sub-sectors (UNCTAD 2019). Additionally, the results show that institutions for preventing, managing, and overcoming situations that affect the welfare of the vulnerable can have greater inclusive growth effects if well resourced. We find that vulnerable employment and inflation have negative effects on inclusive growth though statistical significance eludes us on the latter. The harmful effect of vulnerable employment on inclusive growth signifies the need to build shared prosperity to build capacity to prepare, withstand or cope with socioeconomic challenges like the coronavirus pandemic. Among others, the post estimation tests of AR(2), showing the absence of second-order serial correlation in the residuals, and the Hansen P-value underscore the appropriateness of our estimates. This is re-enforced by the fact that the number of instruments in each specification is consistently lower than the corresponding number of countries, which as Tchamyou *et al*. (2019a) and Tchamyou (2019) argue indicates the absence of instrument proliferation.

4.4 Robustness check 1 for inclusive growth results

In checking the robustness of our estimates in Table 4, the Palma ratio is used as an outcome variable (see results in Table 5). Our baseline results show that, with the exception of economic globalisation, all other covariates are statistically significant— inflation, population growth, and vulnerable employment hinder inclusive growth while social inclusion induces inclusive growth. On our variables of interest, although the coefficients are negative, they are intuitively

appealing since Palma ratio used as the dependent variable measures the growth in income inequalities between the rich and poor. Hence, its reduction points to inclusive growth. For instance, we find strong empirical evidence that for every 1% increase in financial access, Palma ratio declines by 0.17 (column 3). This result implies that financial access is crucial in reducing income disparities leading to inclusive growth. We also find all ICT indicators as significant drivers of inclusive growth because of their decreasing effects on the Palma ratio. This result appeals to logic as ICT skills is needed to make sense of ICT access and usage. Also, we find evidence of the joint effects of ICT diffusion and financial development on inclusive growth on the one hand (columns 7 – 9), and ICT diffusion and financial access on inclusive growth on the other hand (columns 10 – 12). In a region where in-kind fiscal redistribution has proved largely ineffective in bidding down the high levels of inequality and poverty, our results show that strategic investments in production modules like ICT access, skills and usage can trigger durable shared growth in several ways. Aside from the shared income growth and distribution ICT diffusion can trigger, are the several facets of national development that ICTs can be leveraged to foster inclusiveness in opportunities, wealth, and governance. For instance, ICT diffusion can promote good governance, particularly, in accountability and regulatory quality by enhancing the effectiveness[21] and efficiency of administrative procedures (Ofori and Asongu 2021a). It can also present policymakers with cheaper and flexible means of public communication and interaction, which are essential for social inclusion and inclusive growth. Evidence to this effect can be seen in the critical role ICTs continue play since the onset of the coronavirus pandemic in aiding policymakers provide the public with information, services and opportunities. In formal education, ICTs can be leveraged to aid the levelling of the playing field by enhancing access to knowledge, timely and low-cost research, and the streamlining of administrative procedures. Another encouraging development is the deployment of ICTs in the health sector. In addition to the enhancement of data collection, storage, record keeping and information flow in the health sector is the use of ICTs for speeding-up the delivery of drugs, remote consultation and diagnosis as well as timely response to epidemics/pandemics. Such are the promising stories of Rwanda and Ghana, where the tech-company, Zipline, has been employed to help healthcare experts saved lives through the use of drones for delivering drugs, blood and other materials to remote areas.

[21]In most SSA countries, ICTs are facilitating the migration of paper-based documents and records onto digital formats in all ministries.

Table 5: System GMM results on the effects of financial development, financial access and ICT diffusion on inclusive growth (Dependent variable: Palma ratio)

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Palma ratio (-1)	0.0283***	0.0306***	0.0349***	0.0275***	0.0178***	0.0294***	0.0308***	0.0029	0.0341***	0.0382***	0.0038	0.0370***
	(0.0028)	(0.0025)	(0.0023)	(0.0029)	(0.0044)	(0.0027)	(0.0028)	(0.0072)	(0.0029)	(0.0030)	(0.0054)	(0.0051)
Social protection	-0.6760***	-0.7251***	-0.6414***	-0.8958***	-0.2730**	-0.6148***	-0.7400**	-0.1661	-0.5755***	-0.9571***	-0.0523	-0.7799***
	(0.1228)	(0.1178)	(0.1111)	(0.1972)	(0.1293)	(0.1392)	(0.2865)	(0.1021)	(0.1772)	(0.2950)	(0.1771)	(0.2188)
Population growth	0.1201***	0.1537***	0.0988	0.0183	0.2174***	0.1326***	0.0320	0.2275***	0.1073*	0.0083	0.1787**	0.0194
	(0.0393)	(0.0406)	(0.0830)	(0.0522)	(0.0702)	(0.0421)	(0.1091)	(0.0745)	(0.0611)	(0.0827)	(0.0873)	(0.0692)
Inflation	0.0071***	0.0076***	0.0082***	0.0074***	0.0043***	0.0075***	0.0081***	0.0039***	0.0077***	0.0097***	0.0046***	0.0107***
	(0.0009)	(0.0011)	(0.0012)	(0.0009)	(0.0005)	(0.0008)	(0.0013)	(0.0006)	(0.0012)	(0.0013)	(0.0005)	(0.0012)
Vulnerable employment	-0.0149***	-0.0146***	-0.0168***	-0.0130***	-0.0279***	-0.0053	-0.0156**	-0.0275***	-0.0062	-0.0115**	-0.0226***	-0.0055
	(0.0026)	(0.0034)	(0.0047)	(0.0043)	(0.0020)	(0.0049)	(0.0065)	(0.0034)	(0.0061)	(0.0049)	(0.0049)	(0.0061)
Economic globalisation (KOF)	-0.0059	-0.0052	-0.0089	-0.0093	-0.0099	-0.0013	-0.0048	-0.0131	-0.0063	-0.0185*	-0.0360***	-0.0094
	(0.0061)	(0.0109)	(0.0088)	(0.0080)	(0.0091)	(0.0058)	(0.0153)	(0.0126)	(0.0100)	(0.0106)	(0.0123)	(0.0133)
Financial development		-0.0212					-0.2735	-0.2484	-0.3971			
		(0.1516)					(0.2148)	(0.1935)	(0.4105)			
Financial access			-0.1736***							-0.2567*	-0.3215***	-0.8386***
			(0.0428)							(0.1275)	(0.0868)	(0.1000)
ICT (access)				-0.0752***			-0.1531***			-0.0142		
				(0.0114)			(0.0390)			(0.0409)		
ICT (use)					-0.0941**			-0.3320***			-0.1071***	
					(0.0366)			(0.0256)			(0.0385)	
ICT (skills)						-0.4968***			-0.4769***			-0.0520
						(0.1293)			(0.1181)			(0.2113)
Financial development x ICT (access)							-0.2130*					
							(0.1253)					
Financial development x ICT (use)								-0.7897***				
								(0.1375)				
Financial development x ICT (skills)									-0.3693			
									(0.5714)			
Financial access x ICT (access)										-0.1542***		
										(0.0488)		
Financial access x ICT (use)											-0.1101**	
											(0.0505)	
Financial access x ICT (skills)												-1.1483***
												(0.1216)
Constant	6.1989***	5.9566***	7.7187***	5.8163***	8.1061***	9.1759***	7.2592***	8.8990***	10.6412***	6.1157***	10.5162***	8.7044***
	(0.5983)	(0.8310)	(0.8717)	(0.8132)	(0.8098)	(0.8844)	(2.1879)	(1.1815)	(2.3101)	(1.5668)	(1.2794)	(2.2068)
Observations	1,680	1,594	1,524	1,638	610	1,663	1,560	602	1,577	1,492	599	1,507
Time effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Countries	42	42	42	42	41	42	42	41	42	42	41	42
Instruments	37	38	38	38	39	39	40	40	40	40	40	40
Wald Statistic	23910***	21070***	51110***	25370***	78636***	76600***	13390***	41400***	51850***	29250***	24840***	38760***
Wald P-Value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Net Effect	–	–	–	–	–	–	-0.1795	-0.4299	–	-0.0259	-0.1154	-0.1392
Joint Significance Test	–	–	–	–	–	–	8.95***	40.15***	–	5.63**	98.10***	12.49***
P-Value	–	–	–	–	–	–	0.0047	0.0000	–	0.0224	0.0000	0.0010
Hansen P-Value	0.660	0.669	0.667	0.758	0.724	0.750	0.731	0.837	0.705	0.555	0.941	0.751
AR(1)	0.566	0.561	0.556	0.556	0.0233	0.566	0.545	0.0721	0.549	0.512	0.0273	0.514
AR(2)	0.535	0.500	0.627	0.472	0.127	0.558	0.587	0.115	0.530	0.712	0.108	0.822

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

First, our net effects show that, for every 1% improvement in ICT access and usage in the presence of financial development, the Palma ratio reduces by 0.17%, and 0.42%, respectfully. We compute these net effects as:

$$\frac{\partial(ln(palmaratio)}{\partial(ln(ICTaccess))} = -0.1531 + (-0.2130 * 0.124\ ) = -0.1795$$

$$\frac{\partial(ln(palmaratio))}{\partial(ln(ICTusage))} = -0.3320 + (-0.7897 * 0.124\ ) = -0.4299$$

Similarly, we find that, in the presence of greater financial deepening, enhancing ICT access, usage and skills reduces inequalities in income growth among the poor and the rich by 0.02%, 0.11% and 0.13%, respectively.

$$\frac{\partial(ln(palmaratio))}{\partial(ln(ICTaccess))} = \ -0.0142 + (-0.1542 * 0.076) = -0.0259$$

$$\frac{\partial(ln(palmaratio))}{\partial(ln(ICTusage))} = -0.1071 + (-0.1101 * 0.076\ ) = -0.1154$$

$$\frac{\partial(ln(palmaratio))}{\partial(ln(ICTskills))} = -0.0520 + (-1.1483 * 0.076) = -0.1392$$

The results show that in fostering inclusive growth in SSA, ICTs and financial deepening can be targeted to bridge the gap in income growth between the poor and the rich. Indeed, ICT diffusion can offer shared opportunities, plausibly through retail ventures, innovation, repairs, preservation of jobs, knowledge transfer and access to wider markets. Further, access to productive assets like ICTs in this current information age can build the entrepreneurial or innovative capacity of the active population while enhancing access to opportunities. For our auxiliary findings, we find that both vulnerable employment and inflation hamper shared growth. The implication of the former leans itself to the lack of capacity or assets and safety nets associated with such jobs. Further, we find that economic globalisation is not strong in propelling the region towards shared prosperity as the results suggest for social protection. The reason for the former is plausibly due to the less-inclusive sectors in which foreign direct investment have been flowing into— the extractive industry, aviation, and telecommunication sector.

4.5 Robustness check 2 for inclusive growth results

Again, we check the robustness of our estimates in Table 4 using GDP per capita as our dependent variable. On grounds of econometric prudence, inflation and population are excluded from the estimation. The results as provided in Table 6 show that all our variables of interest— financial development, financial access, ICT access, usage, and skills, are positive. For instance, there is strong empirical evidence that for every 1% increase in ICT access and usage, GDP per capita rises by 0.03 (column 3) and 0.07 (column 4) respectively.

Table 6: System GMM results on the effects of financial development, financial access and ICT diffusion on inclusive growth (Dependent variable: Real GDP Per Capita)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
GDP per capita (-1)	0.1472***	0.1467***	0.1480***	0.1222***	0.2804***	0.1488***	0.1254***	0.2791***	0.2454***	0.1307***	0.2727***	0.1408***
	(0.0061)	(0.0063)	(0.0061)	(0.0109)	(0.0064)	(0.0084)	(0.0114)	(0.0084)	(0.0127)	(0.0114)	(0.0105)	(0.0104)
Social protection	1.7729***	1.7356***	1.7147***	1.5241***	1.2826***	1.5858***	1.3478***	1.2956***	0.6785***	1.5390***	1.4678***	1.2432***
	(0.2936)	(0.2999)	(0.3078)	(0.2256)	(0.1083)	(0.2424)	(0.0448)	(0.1386)	(0.0937)	(0.2101)	(0.2105)	(0.3700)
Vulnerable employment	0.0026	0.0018	0.0015	-0.0048	0.0059***	0.0011	-0.0007	0.0092	-0.0048	0.0129	0.0128	-0.0009
	(0.0073)	(0.0084)	(0.0077)	(0.0033)	(0.0019)	(0.0041)	(0.0023)	(0.0069)	(0.0088)	(0.0096)	(0.0081)	(0.0050)
Economic globalisation (KOF)	0.0835***	0.0853***	0.0825***	0.0542***	0.0283***	0.0755***	0.0434***	0.0324**	0.0492***	0.0652***	0.0508**	0.0695***
	(0.0172)	(0.0189)	(0.0172)	(0.0126)	(0.0038)	(0.0147)	(0.0051)	(0.0139)	(0.0100)	(0.0181)	(0.0195)	(0.0172)
Financial development		-0.9102					5.5077***	0.7108	-11.2756			
		(3.6172)					(1.8631)	(1.6520)	(7.0306)			
Financial access			0.3755							3.3008**	-0.3399	18.2429
			(1.0929)							(1.5396)	(1.4903)	(19.6929)
ICT (access)				0.0236***			0.1292***			0.1786***		
				(0.0066)			(0.0224)			(0.0518)		
ICT (use)					0.0090			0.0437			0.0541	
					(0.0144)			(0.0635)			(0.0369)	
ICT (skills)						0.2181			-0.1848*			-0.1753
						(0.1906)			(0.0965)			(0.1846)
Financial development x ICT (access)							-0.4557***					
							(0.1087)					
Financial development x ICT (use)								-0.1649				
								(0.3159)				
Financial development x ICT (skills)									7.4947			
									(7.3650)			
Financial access x ICT (access)										-0.4557***		
										(0.1288)		
Financial access x ICT (use)											-0.1694	
											(0.1549)	
Financial access x ICT (skills)												-3.0823
												(3.0686)
Constant	-8.0593***	-7.8452***	-7.7447***	-5.5302***	-4.0086***	-5.6873**	-5.4822***	-4.5522***	-0.8502	-7.5641***	-5.9959***	-4.4682
	(2.0974)	(2.1721)	(2.1497)	(1.3976)	(0.4815)	(2.7692)	(0.3479)	(1.4397)	(0.9140)	(2.0397)	(1.9541)	(2.9227)
Observations	1,680	1,680	1,680	1,638	610	1,663	1,638	610	915	1,638	610	1,663
Time effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Countries	42	42	42	42	41	42	42	41	42	42	41	42
Instruments	37	38	38	37	37	38	39	38	39	39	38	39
Wald Statistic	2009***	1804***	1666***	27440***	5108***	1350***	16111***	6291***	17858***	4586***	5816***	884.4***
Wald P-Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Net Effect	–	–	–	–	–	–	0.0726	–	–	0.1439	–	–
Joint Significance Test	–	–	–	–	–	–	17.59***	–	–	12.53***	–	–
P-Value	–	–	–	–	–	–	0.000	–	–	0.001	–	–
Hansen P-Value	0.635	0.639	0.648	0.423	0.615	0.581	0.733	0.611	0.599	0.652	0.661	0.676
AR(1)	0.000	0.000	0.000	0.000	0.007	0.000	0.000	0.007	0.000	0.000	0.008	0.000
AR(2)	0.875	0.880	0.870	0.857	0.167	0.984	0.882	0.170	0.964	0.955	0.179	0.948

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Interestingly, for both financial development-ICT diffusion (columns 7 – 9), and financial access-ICT diffusion (columns 10 – 12) pathways, we find that ICT access is the most relevant indicator. Indeed, for ICTs to have valuable impact in economic activity, its access needs to be widespread and robust. The net effect of a 1% improvement in ICT access given the current state of the region's financial sector boosts pro-poor growth by 0.07%. This is computed from Column 7 as:

$$\frac{\partial(ln(GDPpercapita))}{\partial(ln(ICT(access))} = 0.1292 + (-0.4557 \times 0.124) = 0.0726$$

Likewise, we provide strong empirical evidence to show that enhancing ICT access by 1% along with financial access fosters shared growth by 0.14%. We compute this from column 10 as:

$$\frac{\partial(ln(GDPpercapita))}{\partial(ln(ICTaccess))} = 0.1786 + (-0.4557 \times 0.076) = 0.1439$$

The results show that if the absolute definition of pro-poor growth is considered, ICT access and its synergy with financial access are keys for policy actions. Finally, we find that irrespective of the type of model specification, the lag of GDP per capita, economic globalisation, and social protection are all statistically significant in boosting shared growth.

4.6 Financial development policy thresholds to foster inclusive growth

In this section, we speak to policy on how improving the current levels of financial development and financial access in Africa can promote inclusive growth. In other words, we inform policy of the short term to long term inclusive growth gains of improving financial development/access across the continent. We do this by taking cues from the low level of financial development (0.124) and financial access (0.076) in Africa as apparent in Table 2 and the overall positive synergies between ICTs and financial development/access (see Table 4). That said, we proceed by computing the net effects of improving financial development/access from the short-term (0.5) to the medium-term (1.0) and the long-term (1.5), holding all other factors constant. It is worth noting that these net effects are computed based on Equations (4) and (5) and our pathway estimates reported in Columns 7 – 12 of Table 4 (i.e., main inclusive growth results). The attendant results are reported in Table 7.

Table 7 Financial development/access thresholds and inclusive growth net effects

	Net Effects					
FD/FI Thresholds	ICT(Access) (1)	ICT(Usage) (2)	ICT(Skills) (3)	ICT(Access) (4)	ICT(Usage) (5)	ICT(Skills) (6)
0.25	0.2991	**0.3069**	–	0.0993	–	**0.1647**
0.50	0.4024	**0.4202**	–	0.1049	–	**0.2022**
0.75	0.5057	**0.5334**	–	0.1104	–	**0.2396**

Note: FD is Financial Development; FI is Financial Access; Columns 1 – 3 are nets for the ICT-financial development interaction while Columns 4 – 6 are net effects for the ICT-financial access pathway. Results in Columns (4) and (5) are not calculated since their either conditional/unconditional effects are not statistically significant.

The optimism from the threshold analysis is that by channelling resources towards the improvement of financial development/institutions, policymakers can realise some remarkable short-term to long-term shared growth dividends. For the ICT-financial development pathway, the results suggest that though both ICT access and ICT usage yield remarkable short-term to long inclusive growth effects at the various thresholds of financial development, the effect of the ICT (usage)-financial development interaction is the most important pathway. For instance, at the short-run threshold of 0.25, there is an increase in inclusive growth by 0.299 per cent for the ICT (access)-financial development interaction compared to 0.306 per cent for that of the ICT (usage)-financial development. The results for the ICT-financial access are also appealing. Interestingly, we find that the going forward, improving ICT skills would prove crucial for forming significant complementarities with financial access to foster shared prosperity. Our results appeal to logic considering the springing up of mobile money, internet banking and mobile money interoperability services in Africa especially in countries such as Ghana, South Africa, Kenya and Rwanda.

5.0 Conclusion and policy recommendations

This study contributes to the discourse on how SSA can foster inclusive growth. To this end, we explored the effectiveness of financial development, financial access and ICT diffusion, which are in line with the region's green growth agenda on inclusive growth. We use a dataset spanning 1980 – 2019 for 42 SSA countries for the analysis. We provide evidence robust to several specifications from the dynamic system GMM to show that although ICT diffusion enhances inclusive growth in SSA, its effects are remarkable in the presence of greater financial development or deepening. Considering strides made by countries like Hong Kong, China, Singapore and Taiwan in recent times via ICT diffusion, our results provide cautious optimism. First, our results show that ICTs can offer policymakers interested in the SSA growth agenda

realistic means of supporting the region's youthful population to contribute meaningfully to development. Second, enhancing financial access coupled with strategic investment in ICT skills, usage and access can be a game changer in boosting inclusive growth. This does not only result in rising income levels, access to public goods and services, knowledge and skills, and a sense of social belonging but also possible added benefits of fostering equalities in opportunities, wealth and lifetime. Third, considering the region's low resource mobilization performance, geopolitical fragility, and the bleak socioeconomic outlook due to COVID-19, creating shared opportunities may not be about enhancing infrastructural investment per se but infrastructural development of opportunities, inclusiveness, and gender impartiality.

We recommend that policymakers channel resources to boost ICT skills, access, and usage in the region. This can be enhanced if international bodies such as the African Development Bank and the World Bank provide technical, logistical and monetary support to complement various governments efforts in improving ICT access, skills, and usage, especially in the hinterlands where these assets and services are mostly lacking. Further, policymakers should also strive to develop the region's tech-hubs to provide high-tech idea commercialization, patent development and start-up company incubation to offer technical and logistical support for the region's youthful population to realistically contribute to national development. Institutions of higher learning, ICT technocrats, and financial institutions should be fused in this '*value chain'* to mentor, support and turn innovative minds into real income generating ventures. Also, various SSA governments are advised to invest and strengthen institutions for social protection to build capacity, manage, prevent, and overcome situations that adversely affect their citizens welfare. To take advantage of economic integration like one offered by the AfCFTA, it is recommended that policymakers support the private sector build capacity to deepen indigenous forward and backward linkages, which is paramount for improving the region's global value chain participation, and opportunity creation. The study obviously leaves room for further studies. First, this study did not examine the unconditional effects of financial market access, depth and efficiency on inclusive growth, and second, the plausible synergistic relationship between ICT diffusion and financial market access on inclusive growth in SSA.

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Table A.1: Pairwise correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) Inclusive growth	1.000												
(2) Inflation	-0.012	1.000											
(3) Initial GDP growth	0.037	0.140	1.000										
(4) Economic globalisation	0.186	0.239	0.158	1.000									
(5) Social protection	0.070	0.005	0.160	0.004	1.000								
(6) Vulnerable employment	-0.247	-0.062	-0.080	-0.454	0.100	1.000							
(7) Population growth	-0.107	-0.044	-0.044	-0.226	-0.021	0.289	1.000						
(8) Financial development	0.211	0.147	0.086	0.475	-0.014	-0.513	-0.300	1.000					
(9) Financial access	0.260	0.173	0.104	0.560	0.069	-0.381	-0.386	0.674	1.000				
(10) ICT (access)	0.265	0.106	0.115	0.536	0.023	-0.436	-0.430	0.611	0.775	1.000			
(11) ICT (use)	0.121	-0.062	0.062	0.470	0.030	-0.220	-0.467	0.388	0.568	0.737	1.000		
(12) ICT (skills)	0.084	-0.025	-0.109	-0.262	-0.077	0.424	0.116	-0.214	-0.149	-0.068	0.135	1.000	
(13) Palma ratio	-0.010	-0.098	-0.030	0.045	0.085	-0.077	0.013	0.039	-0.021	-0.029	0.043	-0.144	1.000

Source: Authors' construct, 2021

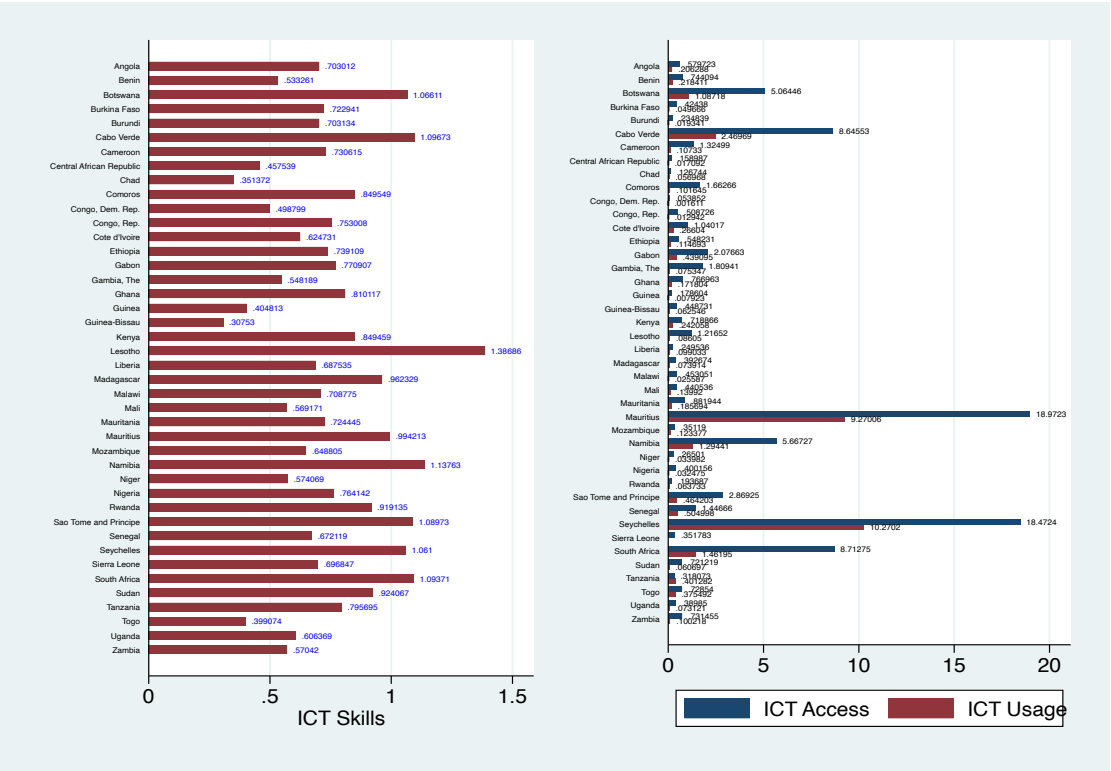

Figure A.1: Average ICT Access, Usage and Skills in SSA, 1980 – 2019

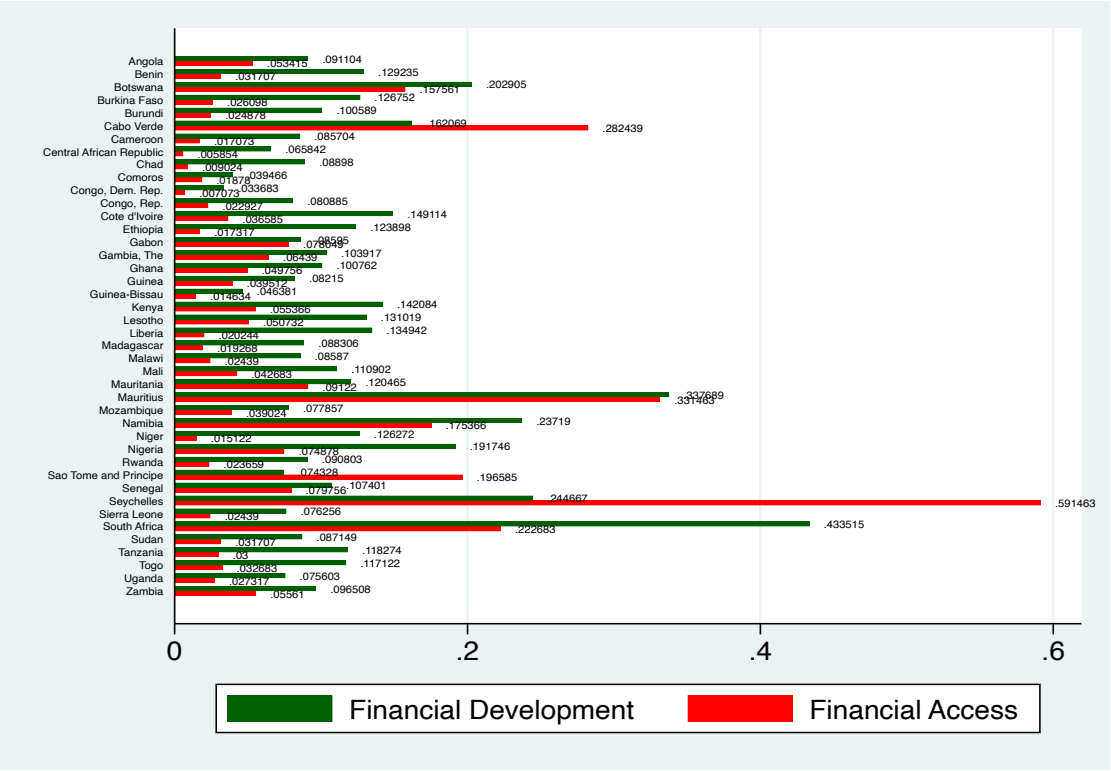

Figure A.2: Average Within Country Financial Development and Financial Access In SSA, 1980 – 2019

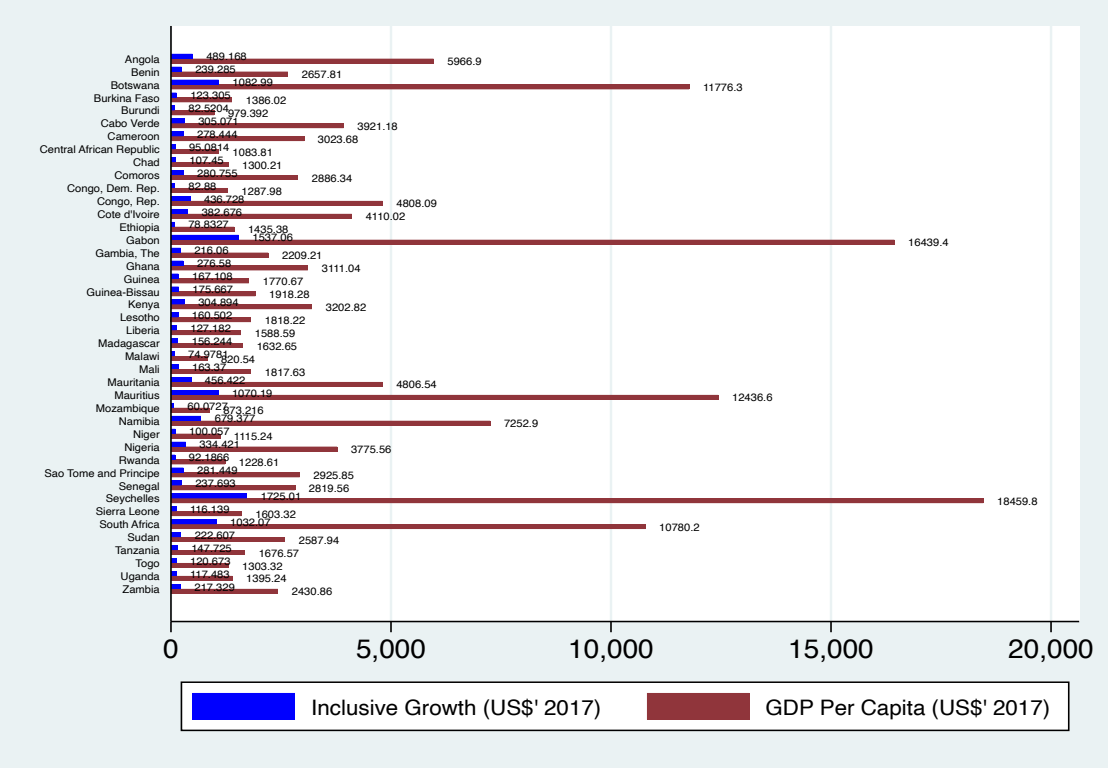

Figure A.3: Average Within Country Inclusive Growth and GDP Per Capita In SSA, 1980 – 2019