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ICT Diffusion, Foreign Direct Investment and Inclusive Growth in Sub-Saharan Africa

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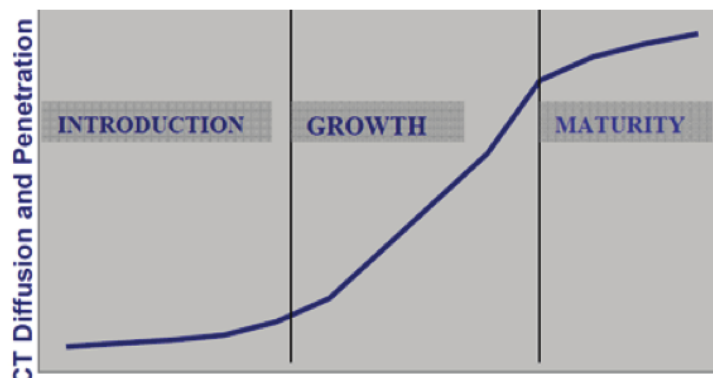ikofori@uninsubria.it;
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Abstract

This study examines the joint effects of ICT diffusion (composed of access, usage, and skills) and foreign direct investment (FDI) on inclusive growth in sub-Saharan Africa (SSA). The study draws on data from the World Bank's World Development Indicators (WDI) and the Global Consumption and Income Project for the period 1980–2019 for the analysis. The study provides evidence robust to several specifications from ordinary least squares and dynamic system GMM estimation techniques to show that: (1) FDI and ICT diffusion and corresponding components (ICT access, usage, skills) induce inclusive growth in SSA; (2) compared to its direct effect, FDI is remarkable in fostering shared growth in SSA in the presence of greater ICT diffusion, and (3) compared to ICT access and usage, ICT skills are more effective in driving inclusive growth in SSA. Overall, FDI modulates ICT dynamics to engender positive synergy effects on inclusive growth. Policy recommendations are provided in line with the implementation of the African Continental Free Trade Area (AfCFTA) Agreement and the projected rise in FDI in SSA from 2022.

1.0 Introduction

The call for sub-Saharan African (SSA) countries to pursue inclusive growth has intensified following the coming into force of the African Continental Free Trade Area (AfCFTA) Agreement and the Coronavirus pandemic. The latter has indeed laid bare the porous growth trajectories of the region in recent times and has been cited as one of the reasons SSA plummeted into a record 3.2 per cent contraction in economic activity in 2020 (Brown *et al.* 2020; IMF 2020a; World Bank 2020a). The World Bank (2020b), ILO (2020a) and OECD (2020a) in particular, report substantial setbacks to Sustainable Development Goals 1, 8 and 10 made over the past few years.

The socio-economic outlook of the SSA region is not encouraging. — Furthermore, 25 –35 million people are expected to slip into the extreme poverty bracket in 2021, down from 110 – 125 in 2020 (World Bank 2020b), while 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; World Bank 2020b). The seriousness of these welfare setbacks and projections is seen in Pickett and Wilkinson (2015), who argue that poverty and inequality have pernicious implications for the quality of life, health, education, social protection efforts, and mortality. Going forward, fostering sustainable and durable growth in SSA is not only imperative for addressing human resource wastage, social tensions and political instability, but also offers the surest way of lessening the impacts of future socio-economic shocks.

Despite SSA's obvious challenges regarding resource mobilisation, gender equality, infrastructure, and social equity; institutions are two key developments in the region that offer glimmers of hope—the rise in information and communication technology (ICT) diffusion, and foreign direct investment (FDI). In a region where there are unmet gaps for infrastructure development, and the population is youthful and innovative, ICTs and FDI can be targeted to foster shared prosperity. This is where this study contributes to the current discourse. If these welfare setbacks due to COVID-19 can be addressed and usher SSA into a path of resilient shared

growth, ICT diffusion and FDI should be looked at carefully. First, even before the coming into force of the AfCFTA, SSA was a major recipient of FDI from the European Union and Asia (UNCTAD 2019). The optimism with FDI in driving inclusive growth in SSA is evident in the projected inflows[1] into the extractive industries of precious metals and hydrocarbons, manufacturing, aviation, telecommunication, banking, and construction in line with the AfCFTA (UNCTAD 2020). Particularly, the elimination/reduction in tariffs and the huge market size of at least 1.2 billion people can incentivize market-seeking FDI, providing opportunities for employment, agricultural-sector revival and increased global value chain participation. If there were any doubts about the inclusive power of ICT diffusion, the pandemic hobbled it all. Indeed, the usefulness of ICTs deepened in the heat of the COVID-19 pandemic. It facilitated smooth settlements of bills, ordering of consumables, digital banking, e-learning, preservation of jobs, entertainment, e-Governance, and access to general information.

Inter alia, ICT can also induce FDI inflow especially into the financial sector, manufacturing and telecommunication sectors due to its power to reduce managerial risk, production and transaction costs while offering limitless market coverage, and innovation transfer (Salahuddin and Gow 2016; Shamim 2007; Mody1997).

Despite the possible modulating effect of FDI on the link between ICTs and inclusive growth, the gap in the literature particularly on SSA is that rigorous empirical works exploring such pathway effects are hard to find. Additionally, the question of which component of ICT diffusion (i.e., access, usage or skills) is strongest in driving inclusive growth in the SSA remains unanswered. The closest studies we sighted are Asongu and Odhiambo (2020) and Adeleye *et al.*(2020). While the former explores the joint effects of FDI and ICTs on economic growth in SSA, the latter pays attention to trade openness (i.e., the sum of export and import as a share of GDP) and ICTs on inclusive growth.

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[1] FDI inflow into SSA is set to rebound in 2022 according to the UNCTAD (2020)

Further, a plethora of the empirical works also estimate the direct effects of FDI/ICT diffusion on economic growth/inclusive growth without paying attention to the joint effects (see., Ejemeyovwi and Osabuohien2018; Tella and Alimi2016; Johnson 2016; Adeleye and Eboagu 2019; Albiman and Sulong2017). As Berg and Ostry (2011) reckon, it is a 'mistake' to limit the analysis of shared growth to economic growth as it downplays the relevance of social equity in economic development. This study fills the attendant gaps and adds to the literature on two counts— first, by exploring the direct effects of ICT diffusion and FDI on inclusive growth in SSA, and second, by investigating the joint effect of ICT diffusion and FDIon inclusive growth in SSA.

The rest of the paper is organised as follows: the next section presents the theoretical link between ICT, FDI and inclusive growth. Section 3 outlines the methods used for the paper. We present our results and discussion in section 4. A conclusion with policy recommendations is provided in section 5.

2.0 The theoretical link between FDI, ICT diffusion and inclusive growth

The theoretical link between trade and shared growth stems from the argument that by specializing in cross-border production activities with abundant factors, countries can put natural resources to the benefit of the masses (Stolper-Samuelson 1941; Ohlin 1933; Samuelson 1939). A related theory is the modernization theory, which suggests that FDI can contribute to the development of recipient countries through employment creation, technological transfer, and economic linkage (Solomon 2011; Li and Liu 2005; Durham 2004; Bengoa and Sanchez-Robles 2003).

The theoretical link between ICT diffusion and inclusive growth also rests on the Sustainable Livelihoods Approach (SLA) framework (see Kwan and Chiu, 2015). The SLA framework takes its roots from Sen's notion[2] of the set of 'functionings' and 'doings' in people's capabilities (Sen, 1999). The SLA denotes the different linkages between livelihood assets, institutions, policies, and people's livelihood outcomes (Messer and Townsley, 2003). The

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[2] 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.

framework thus indicates that if economic agents have access to assets like ICTs; these provide a level playing field by enabling the masses create/take advantage of opportunities. 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).

On the basis of the foregoing theoretical undertones, we test two main hypotheses— (1) whether ICT diffusion and FDI induce inclusive growth in SSA, and (2) whether there is a joint effect of ICT diffusion and FDI on inclusive growth in SSA. To inform policy about which component of ICT diffusion is more effective in driving inclusive growth directly, and indirectly contingent on FDI, ICT access, usage and skills are also considered in the estimation.

2.1 FDI-Inclusive Growth Nexus

Despite evidence that FDI can induce income inequality in the developing world (Mihalache-O and Li, 2011), some studies also argue that FDI can drive shared growth through job creation, revival of industrial capacity of recipient countries, and corporate social responsibility (Kotler and Lee, 2005). Further, in a setting where infrastructure development is growing, institutional frameworks are being developed, natural resources abound, and the population is youthful, FDI can possibly be a game changer in spurring shared growth in SSA (African Development Bank 2010). Before the COVID-19 pandemic, the figure 1 below shows the FDI inflow into SSA and other regions such as South Asia, the Middle East and North Africa (MENA).

Figure 1: Trend of FDI Inflow (%GDP) Across Regions, 1980 – 2020
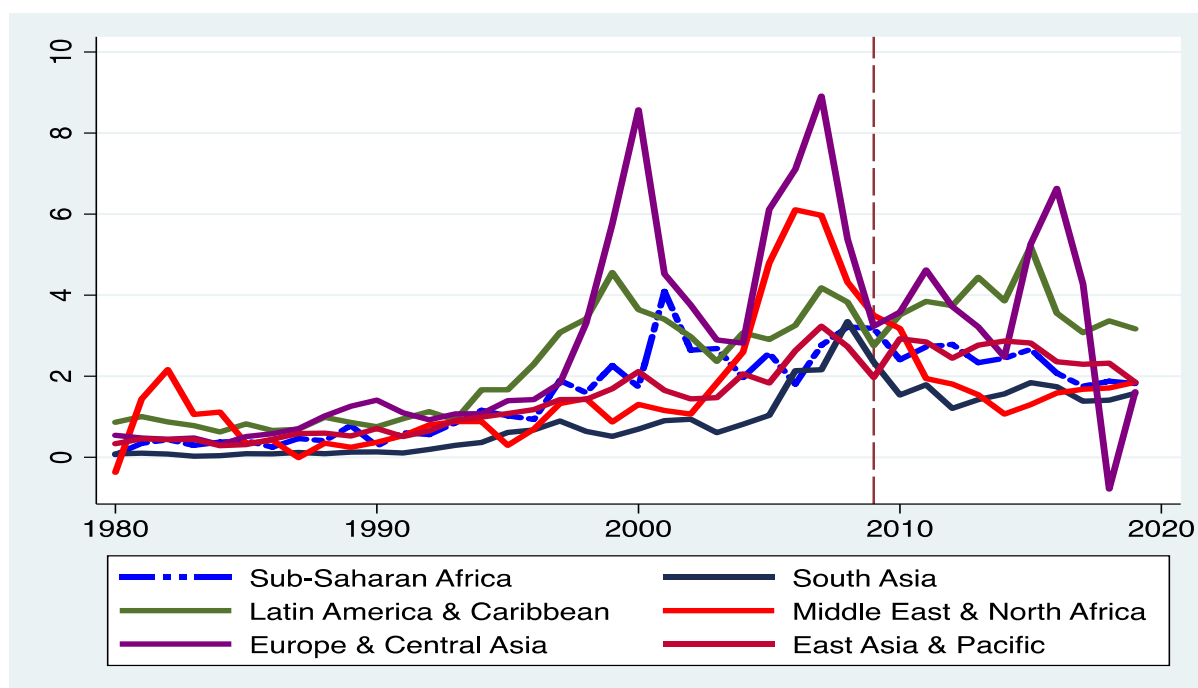
Particularly, despite the continuous inflow of FDI into regions such as South Asia, MENA, European and Central Asia after the 2008/2009 global financial meltdown, FDI inflow into SSA rebounded quickly after the crisis (UNCTAD 2013). Despite the decline of FDI by about 10 per cent in 2019 and 23 per cent in 2020 due to the geopolitical concerns and COVID-19, FDI inflows into the region are expected to rebound in 2022 following the AfCFTA, and the expected finalization of negotiations on the associated investment protocol. Indeed, there is within-country variability in FDI inflow into SSA as shown in Figure A.1, with countries such as Nigeria, South Africa, Ghana, Mozambique, Angola and Gabon ranking favourably. This development means that with appropriate institutions and investment strategies, the inclusive growth-inducing effects of FDI can be harnessed.

2.2 ICT diffusion and inclusive growth in Sub-Saharan Africa

The world is ever-changing in line with the current digital and information age. As Castells (1999) puts it, the lack of ICTs is a form of social deprivation and is akin to the lack of access to electricity in the *'industrial age'*. The skepticism surrounding the growth-inducing power of ICT in the developing world centres on affordability, adaptability, poor infrastructure, possible inequality, and unemployment-inducing effects (see Chowdhury 2000; Bedia

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1999). However, researchers such as Asongu and Le Roux (2017), Grace and Kenny (2003), and Brown (2001) have hobbled such arguments, arguing that ICT diffusion offers a good medium to leapfrog development and enhance inclusiveness[3].

Despite the momentous rise in ICT access, skills, and usage over the last three decades in SSA, the figure 3 in comparison to other regions shows that there exists substantial unmet gaps which can be harnessed to boost shared growth (Humbani and Wiese 2018; Afutu-Kotey *et al.*2017; Asongu 2013)

Figure 2: Average Within-Country ICT Access, Usage and Skills In SSA, 1980 – 2020
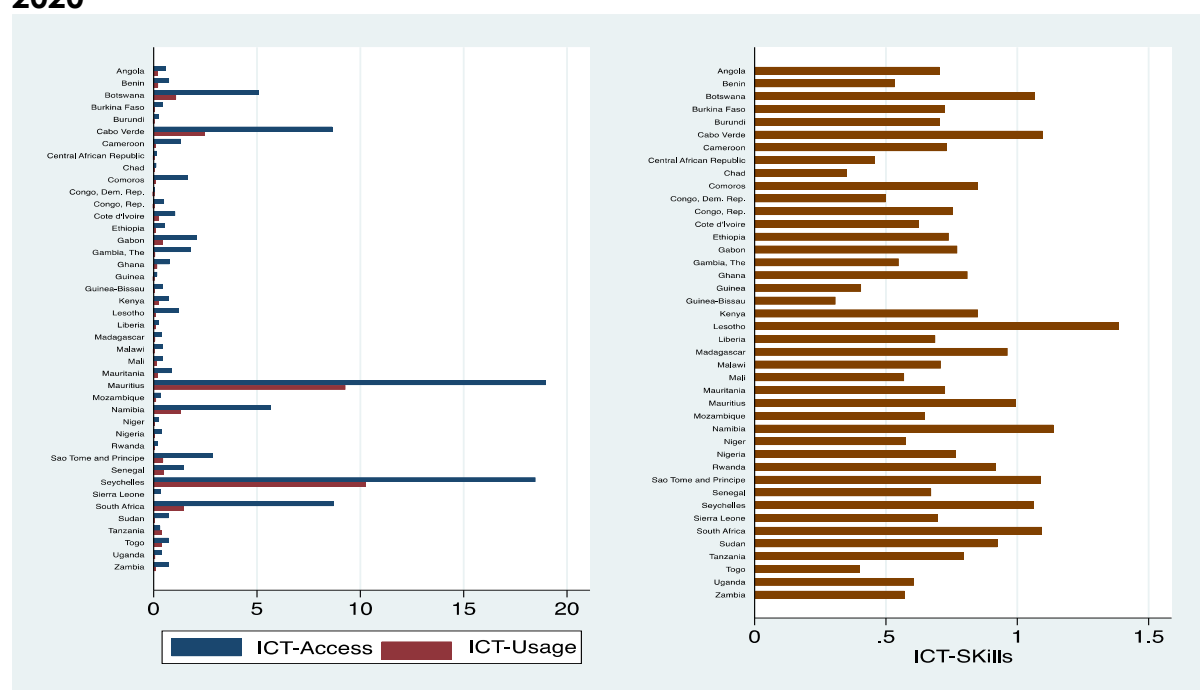
The growing ICT access, skills and usage, markedly, in countries like Gabon, Mauritius, South Africa, Cape Verde, Namibia, Seychelles, Nigeria, and Ghana can offer limitless shared opportunities— first, by creating green wealth through innovation and access to greater markets like the one offered by the AfCFTA; second, by inducing FDI inflow; third, by enhancing access to education, information and knowledge transfers; and fourth, by facilitating relationship, network building, e-Governance, accountability, and social inclusion (see, Donou-Adonsou 2019; Mengesha and Garfield, 2019;

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[3] 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.

Palvia *et al.* 2018; Tchamyou 2017; Asongu and Odhiambo 2019a; Mahmood *et al.* 2019; Rondović *et al.* 2019; Sassi and Goaied 2013). In relation to the growing ICT diffusion in the SSA is the springing up of innovation/technological hubs[4]and industrial parks noticeably in countries such as South Africa, Nigeria, Kenya, and Ghana (see Figure A.2), connecting young programmers, designers, entrepreneurs, and investors for the cultivation and nurturing of ideas. In fact, information gleaned from GSM Association shows the significant rise in tech-hubs in SSA, from 314 in 2016, to 442 in 2017, and 643 in 2019. Plausibly, therefore, if prioritized with ICT access, skills and usage, FDI can yield the inclusive growth dividends, as the visual relationships we provide in Figure 3 indicate.

Figure 3: FDI, ICT Diffusion – Inclusive Growth Nexus
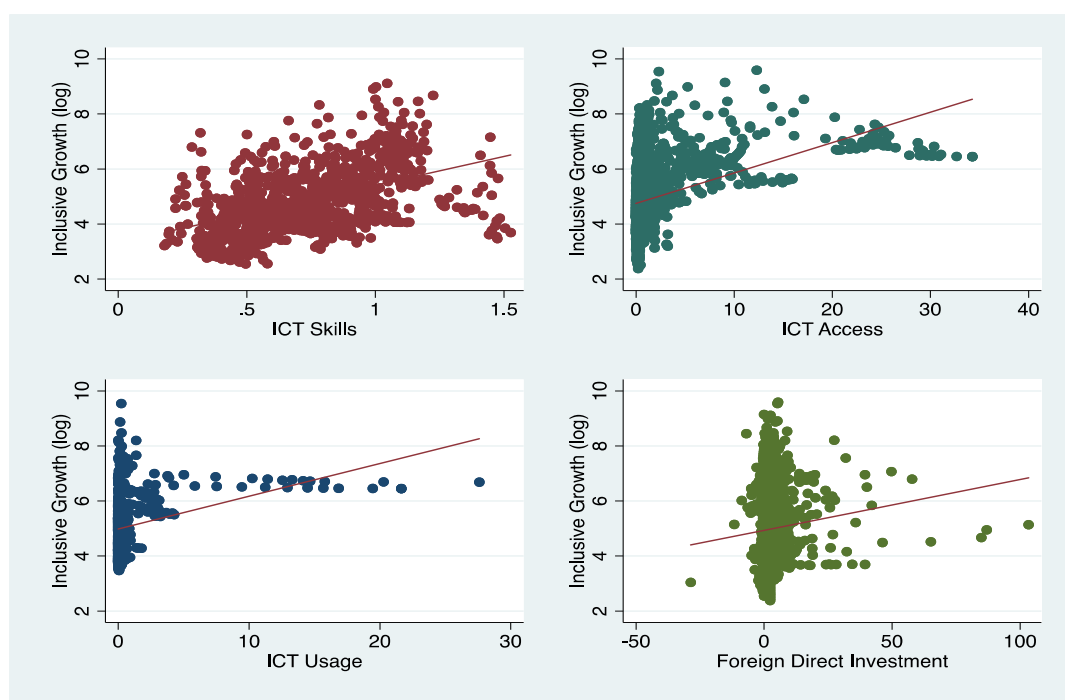
2.3 Definition and Drivers of Inclusive Growth: A Brief Review

Achieving economic growth is one thing, while achieving shared prosperity is another. In SSA, the literature shows that much attention has not been paid

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[4] Major tech-hubs 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.

to inclusive growth (See Greenwald and Stiglitz, 2013). Despite encouraging growth strides in countries like Namibia, South Africa, Gabon, Botswana, Angola, Ghana, and Seychelles over the last three decades, Figure 4 shows that such growth trajectories have not been inclusive[5]. On the one hand, inclusive growth is seen in absolute terms as growth that is largely beneficial to the poor and marginalized (Ravallion and Chen, 2004); and on the another breath as growth in incomes of the poor compared to the overall population (IMF 2011). Ali and Son (2007), Berg and Ostry (2011) and Asian Development Bank (2013) also see inclusive growth as growth trajectories that increase social opportunities in terms of incomes, employment, human capital development, and social safety nets that enhance the capacity of the masses to contribute to national development.

On the empirical front, Anand *et al.* (2013) provide empirical evidence to show that globalisation, foreign direct investment, and trade openness induce inclusive growth. Studies such as Paramasivan *et al.* (2014), Estache *et al.* (2013) and Lustig *et al.* (2012) also 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. In particular, Lustig *et al.* (2012) sshows that the recent welfare gains in the LAC is at the backdrop of improved social protection efforts. A 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 to build the capabilities of the marginalised. The IMF and World Bank (2020), Calderón and Servén (2014), and the Asian Development Bank (2013) also reckon that while government expenditure on education and health is needed to foster equitable growth, infrastructural development and irrigation are equally relevant for building a good commercial and investor climate for the private sector to thrive.

3.0 Data and Methodology

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

3.1 Data

The dataset underpinning this study is entirely macro and spans 1980 to 2019 for 42 SSA countries[6]. Data on inclusive growth is not directly accessible in databases and as such is generated. Inclusive growth is calculated based on a utilitarian social welfare function drawn from consumer choice literature, where shared growth depends on two factors: (i) income growth (proxied by GDP per capita); and (ii) income distribution (proxied by Gini index) (Anand *et al.* 2013) (See calculation as Supplementary Material in the Appendix Section).

Both GDP per capita and Gini index are sourced from the World Bank's World Development Indicators (WDI), with missing observations in the latter filled using data from the Global Consumption and Income Project (see Lahoti *et al.* 2016). In Section 4.4, our estimates on inclusive growth are robustly checked with another measure of shared growth proposed by the Asian Development Bank (2013). The variables of interest are ICT diffusion (including its key sub-components of access, usage and skills) and FDI. FDI is captured as the net inflow as a percentage of GDP, while ICT diffusion is an index calculated via the Principal Component Analysis (PCA). Additionally, ICT access, usage and skills are captured respectively as fixed telephone subscription, fixed broadband subscription, and secondary school education gender parity.

A number of variables are also controlled to take into consideration the implications of the economic structure of the SSA, macroeconomic management, institutions and finance in shared growth (Tchamyou 2020, 2021). In specifics, human capital, vulnerable employment, inflation and financial access/deepening are considered. Financial deepening is an index sourced from the IMF's financial development index (Svirydzenka 2016) while inflation and human capital are measured by the consumer price index and

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[6]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.

human capital index. Moreover, social protection is also measured as the country's policy and institutional assessment score. Data on all other controls and the ICT variables are drawn from the World Development Indicators. The description of the variables is provided in Table 1, while their pairwise correlations are reported in Table A.1

Table 1: Variable description and sources

Variables	Description	Source
Inclusive Growth	Income growth and distribution	Author
Inclusive Growth Index	Inclusive growth index calculated via PCA	Author
Social protection	Coverage of social protection and labor programs (% of population)	WDI
Foreign Direct Investment	Net foreign direct inflow (%GDP)	WDI
	Gini income inequality indicator	WDI;
Gini index	Financial institutions access capturing the	GCIP
Financial access	access of people to financial institutions	Findex
GDP per capita	Real GDP divided by population	WDI
Inflation	Consumer price index (2010=100)	WDI
Vulnerable Employment	Total contributing family and own-account workers as a share of total employment	WDI
ICT Diffusion	ICT Diffusion Index calculated via PCA	Author
ICT Access	Fixed telephone subscriptions (per 100 people)	WDI
ICT Usage	Fixed broadband subscriptions (per 100 people)	WDI
ICT Skills	Gross secondary school enrolment gender parity index	WDI

Note: WDI is the world development indicators; Findex is IMF's Financial Development Index; GCIP is Global Consumption and Income Project

Source: *Authors' construct, 2021*

3.2 Theoretical and Estimation Strategy

The theoretical foundation of this paper rests on the modernization theory (see Solomon, 2011; Li and Liu, 2005; Durham, 2004) and the SLA framework (see Kwan and Chiu, 2015), which respectively position FDI and ICT diffusion in shared growth. The empirical strategy is thus the exploration of the joint effects of ICT diffusion in general, ICT access, usage, skills and FDI on inclusive growth. The empirical rigor of this paper begins with the specification of bivariate models, testing the relationship between FDI, ICT diffusion, ICT access, usage, skills and inclusive growth. Next, we specify a baseline model to explore the effects of the control variables on inclusive growth. Finally, in

line with the hypothesized joint effects[7] of ICT diffusion and FDI on inclusive growth, both variables as well as their interaction terms are introduced in the model. The bivariate models[8] are specified as follows:

$$ln(igrowth_{it}) = \lambda_0 + \beta_1 ln(fdi_{it}) \tag{1}$$

$$ln(igrowth_{it}) = \lambda_0 + \beta_1 ln(ictdif_{it}) \tag{2}$$

The baseline model is specified in (3) as:

$$ln(igrowth_{it}) = \lambda_0 + \beta_1 ln(igrowth_{it-1}) + \beta_2 ln(hci_{it}) + \beta_3 ln(inf_{it}) + \beta_4 ln(vul_{it}) + \beta_5 ln(findep_{it}) + \beta_6 ln(soc_{it}) + \mu_i + \mu_t + \epsilon_{it} \tag{3}$$

To capture the joint effect of FDI and ICT diffusion, equation (3) is modified to obtained (4)

$$ln(igrowth_{it}) = \lambda_0 + \beta_1 ln(igrowth_{it-1}) + \beta_2 ln(hci_{it}) + \beta_3 ln(inf_{it}) + \beta_4 ln(vul_{it}) + \beta_5 ln(findep_{it}) + \beta_6 ln(soc_{it}) + \beta_7 ln(fdi_{it}) + \beta_8 ln(ictdif_{it}) + \beta_9 ln(fdi_{it} \times ictdif_{it}) + \mu_i + \mu_t + \epsilon_{it} \tag{4}$$

Where **igrowth** denotes inclusive growth; **hci** is the human capital index; **vul** is vulnerable employment; **inf** is inflation; **findep** is financial deepening; **soc** is social *protection* score while **fdi** denotes foreign direct investment. Also, **fdi**×**ictdif** is the interaction term for foreign direct investment and ICT diffusion; i is country; t is time; ln is the natural logarithm; μ_i is the country-specific effects; and ϵ_{it} is the idiosyncratic error term. While we expect the lag of inclusive growth, human capital, FDI, social protection and financial deepening to foster shared prosperity, inflation and vulnerable employment are expected to suppress inclusive growth efforts. There is a suspicion of endogeneity due to the introduction of the lag of inclusive growth. The endogeneity problem arises since $igrowth_{it-1}$ depends on ε_{it-1}, which is a function of the country-specific effect ϵ_i. To the extent that endogeneity can bias our estimates, we address it by applying the system GMM technique[9]put forward by Arellano and Bover (1995). The net effects from the interaction terms of ICT diffusion and FDI on inclusive growth from equations (4) is expressed as:

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[7] It is imperative to note that joint effects for the sub-components of ICT diffusion- ICT access, ICT usage and ICT skills and FDI are also investigated.

[8] For brevity, the bivariate models for the subcomponents if ICT diffusion are not presented in this section.

[9] In estimating our system GMM models, the instruments are the lags of the regressors.

$$\frac{\partial ln(igrowth)}{\partial ln(ictdif)} = \delta_8 + \delta_9\overline{ln(fdi)} \qquad (5)$$

where $\overline{fdi}$ is the average FDI inflow into SSA over the study period.It is imperative to note that in evaluating the reliability of the estimates, several post estimation tests are conducted to test whether—(i) there is evidence of second-order serial correlation in the residuals or not; (ii) whether our instruments are valid or exogenous; (iii), whether the interaction terms are significant, and(iv)the overall model is significant.

4.0 Results and Discussion

4.1 Summary Statistics

Summary statistics of the variables are presented in Table 2. The data shows that growth in SSA is not inclusive. Table 2 shows an average inclusive growth value of US$ 349.8, compared to the average GDP per capita value of US$3834.5 over the study period.

Table 2: Summary statistics

Variables	Obs	Mean	Std. Dev.	Minimum	Maximum
Inclusive Growth	1680	349.778	844.604	10.834	14647.05
Inclusive Growth Index	1680	0.01	1	-1.901	2.855
GDP Per Capita	1680	3834.477	4416.887	436.72	29223.465
Gini Index	1680	53.25	19.83	0	86.832
Foreign Direct Investment	1680	2.939	6.457	-28.624	103.337
Vulnerable Employment	1680	71.022	22.858	8.826	94.759
Inflation	1680	59.364	46.513	0	410.94
Human Capital Index	1680	.395	.072	0	.678
ICT Diffusion Index	1680	0.01	1	-1.712	2.563
ICT Access	1676	2.178	4.855	0	34.273
ICT Usage	1676	.836	2.852	0	27.603
ICT Skills	1680	.772	.274	.18	1.527
Financial Deepening	1680	.077	.129	0	.88
Social Protection	1680	21.545	15.002	0	96.405

Note: Obs is Observation (N × T); Std. Dev. is Standard deviation
***Source:** Authors' construct, 2021*

Indeed, Figure A.3 makes clear the less-inclusive growth trajectories of the region in the past four decades. It is evident from Figure A.3 that non-inclusive growth is marked in countries like Namibia, South Africa, Ghana, Gabon and Seychelles. On the variables of interest, the data shows an average FDI of

2.93 per cent, and an ICT diffusion index of 0.001. For the sub-components of access, usage, and skills, the average values are 2.17, 0.83, and 0.77, respectively. For variables such as inflation, human capital index, vulnerable employment, and financial deepening, the mean values are 59.36, 0.39, 71.02 and 0.08, respectively. The average vulnerable employment and inflation give an indication of a high informal real sector and macroeconomic instability in the region.

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

The bivariate results on the effects of ICT diffusion, access, usage, skills, and FDI are presented in Table 3. The results show that all the variables exerts a positive influence on inclusive growth in SSA. The relationships are strong at the 1 per cent level of significance, with the effect of ICT skills being the most remarkable.

Table 3: Bivariate results on the effects of FDI and ICT diffusion on inclusive growth (Dependent variable: Inclusive growth)

Variables	(1)	(2)	(3)	(4)	(5)
Foreign Direct Investment	0.0185***				
	(0.0045)				
ICT Diffusion		0.5918***			
		(0.0503)			
ICT Access			0.1105***		
			(0.0054)		
ICT Usage				0.1190***	
				(0.0133)	
ICT Skills					2.0912***
					(0.1253)
Constant	4.9321***	4.8839***	4.7476***	4.9799***	3.3197***
	(0.0319)	(0.0501)	(0.0286)	(0.0396)	(0.1026)
Observations	1,680	164	1,676	610	941
R-squared	0.0100	0.4608	0.2013	0.1160	0.2287
Adjusted R-Squared	0.0093	0.457	0.201	0.115	0.228

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

4.3 System GMM results in the effects of FDI and ICT diffusion on inclusive growth

In Table 5, the results on the effect of FDI and ICT diffusion on inclusive growth in SSA are presented. The baseline results in Column 1 show that human

capital and financial deepening are positive and statistically significant. Albeit, statistically insignificant, institutions for social protection enhance inclusive growth in SSA. Moreover, we find that inflation and vulnerable employment are harmful to the region's inclusive growth fight.

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

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Inclusive Growth (Lag)	0.8193***	0.8299***	1.0229***	0.7828***	0.9834***	0.7932***	1.0244***	0.8182***	0.9843***	0.7686***
	(0.0058)	(0.0097)	(0.0066)	(0.0078)	(0.0037)	(0.0109)	(0.0108)	(0.0135)	(0.0038)	(0.0174)
Vulnerable Employment	-0.0025**	-0.0030***	-0.0013***	-0.0022***	-0.0002**	0.0001	-0.0010***	-0.0024*	0.0003	-0.0026
	(0.0009)	(0.0008)	(0.0003)	(0.0005)	(0.0001)	(0.0013)	(0.0003)	(0.0014)	(0.0002)	(0.0017)
Inflation	-0.0004***	-0.0011***	-0.0002***	-0.0003***	-0.0002***	-0.0014***	-0.0002***	-0.0021***	-0.0001***	-0.0014***
	(0.0001)	(0.0001)	(0.0000)	(0.0001)	(0.0000)	(0.0001)	(0.0001)	(0.0002)	(0.0000)	(0.0002)
Human Capital	0.9405*	1.1365*	0.1117***	0.1612	0.1501	0.4355***	0.1789**	1.3124	0.0452	0.1075
	(0.5028)	(0.5758)	(0.0371)	(0.1083)	(0.0897)	(0.0816)	(0.0735)	(1.1463)	(0.1978)	(0.4410)
Social Protection	0.0001	0.0005	0.0001	-0.0007	0.0011***	0.0025***	0.0001*	-0.0000	0.0010***	0.0006
	(0.0007)	(0.0007)	(0.0001)	(0.0004)	(0.0001)	(0.0005)	(0.0001)	(0.0009)	(0.0004)	(0.0006)
Financial Deepening	0.3052***	0.2254**	0.1444***	0.7289***	0.0546***	0.0904	0.0878*	0.7838***	0.0262	1.6103***
	(0.0969)	(0.1104)	(0.0468)	(0.0972)	(0.0190)	(0.0989)	(0.0516)	(0.2135)	(0.0209)	(0.2038)
FDI		0.0322***					0.0053***	0.0731***	0.0005	0.2865***
		(0.0031)					(0.0004)	(0.0127)	(0.0005)	(0.0224)
ICT Diffusion			0.0547***				0.0355**			
			(0.0078)				(0.0162)			
ICT Access				0.0463***				0.0591***		
				(0.0051)				(0.0096)		
ICT Usage					0.0122***				0.0235***	
					(0.0036)				(0.0051)	
ICT Skills						0.5742***				0.6413**
						(0.0650)				(0.2606)
FDI× ICT Diffusion							0.0014***			
							(0.0003)			
FDI× ICT Access								0.0115***		
								(0.0022)		
FDI× ICT Usage									0.0010***	
									(0.0002)	
FDI× ICT Skills										0.3492***
										(0.0310)
Constant	0.7279**	0.6025**	-0.1707***	1.1756***	0.1314***	0.4236***	-0.1128	0.0779	0.0081	0.7969**
	(0.2731)	(0.2879)	(0.0516)	(0.0715)	(0.0392)	(0.1362)	(0.0742)	(0.5473)	(0.0942)	(0.3830)
Observations	1,638	1,638	164	1,638	610	915	164	1,638	610	915
Countries	42	42	32	42	41	42	32	42	41	42
Instruments	39	39	30	39	39	39	30	39	39	39
Net-effect	–	–	–	–	–	–	0.039	0.092	0.026	1.667
Joint Significance Test	–	–	–	–	–	–	21.18	27.87	16.94	127.22
P-Value	–	–	–	–	–	–	0.000	0.000	0.000	0.000
Wald Statistic	137100	191193	496500	364509	101000	120800	165600	641000	545000	436800
Wald P-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hansen P-Value	0.347	0.312	0.951	0.302	0.464	0.494	0.967	0.238	0.631	0.649
AR(1)	0.000	0.000	0.045	0.000	0.0220	0.001	0.0418	0.000	0.021	0.004
AR(2)	0.0652	0.0696	0.787	0.0664	0.143	0.610	0.843	0.108	0.140	0.924

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

The results in Columns 2 – 6 provide evidence for the first hypothesis. First, FDI is positive and significant at the 1 per cent level. The magnitude of the coefficient indicates that a 1 per cent increase in FDI induces inclusive growth in the SSA by 0.03 per cent. Also, there is strong empirical evidence on the favourable effects of ICT diffusion, access, usage, and skills on inclusive growth in SSA. The results show that while ICT diffusion in general fosters inclusive growth by 0.05 per cent, ICT access, usage and skills drive inclusive growth in SSA by 0.04 per cent, 0.01 per cent, and 0.57 per cent, respectively (see Columns 3 – 6).

Considering the rise in economic integration of the region after the implementation of the AfCFTA and the projected rise in FDI from 2022, our results should not be taken lightly. FDI can drive inclusive growth in SSA through poverty alleviation, corporate social responsibility and macroeconomic stability as job creation and access to a variety of goods and services are improved in line with expanding industrial base, forward and backward linkages and increased global value chain participation. The momentous rise in ICT diffusion can also be targeted to foster shared prosperity in SSA in several ways. For instance, in education, ICT diffusion can help level the playing field in SSA by enhancing access to knowledge/information, timely and low-cost research, and the streamlining of administrative procedures. In the health sector, the rise in ICT diffusion can be helpful in healthcare by speeding-up the delivery of drugs, data collection and storage, remote consultation and diagnosis, and quick response to epidemics/pandemics. Indeed, in Rwanda and Ghana for instance, lives are being saved through drones[10]for delivering drugs, blood and other materials to remote areas.

Also germane is the power of ICTs in informing policymakers and the public on the seriousness of potential environmental threats/natural disasters by enhancing spatial monitoring and coordinated responses. Further, withtech-hubs and industrial parks sprouting-out in the SSA, markedly, in countries like

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[10] This service is provided by the company called Zipline.

South Africa, Ghana, Nigeria, Mauritius and Kenya, policymakers in SSA can equip the youthful population of the region through ICT diffusion to realise their innovative ideas and contribute meaningfully to national development. Moreover, ICT diffusion can promote good governance and accountability by enhancing administrative effectiveness[11], efficiency and reach of public communication and interaction, which are essential for social inclusion and inclusive growth. Indeed, in many countries of the region, policymakers are leveraging the power of ICT in providing public information, services and opportunities.

Finally, we find evidence for the last hypothesis. The relevance and uniqueness of this finding is that though FDI spurs inclusive growth in SSA, the effect is more remarkable in the presence of ICT diffusion in general, ICT skills, access and usage. Comparatively, the ICT skills and FDI pathway is the most remarkable channel in fostering inclusive growth in the SSA. The net-effect of boosting ICT diffusion, access, usage and skills in line with FDI on inclusive growth in SSA are 0.04, 0.09, 0.03 and 1.67 respectively (see Columns 7 – 10). These net-effects are computed following equations (5), given the average FDI value of 2.939.

$$\frac{\partial(igrowth)}{\partial(ictdif)} = 0.0355 + (0.0014 \times 2.939) = 0.0396$$

$$\frac{\partial(igrowth)}{\partial(ictaccess)} = 0.0591 + (0.0115 \times 2.939) = 0.0928$$

$$\frac{\partial(igrowth)}{\partial(ictusage)} = 0.0235 + (0.0010 \times 2.939) = 0.0264$$

$$\frac{\partial(igrowth)}{\partial(ictskills)} = 0.6413 + (0.3492 \times 2.939) = 1.6675$$

These findings provide support for the theorized claim that boosting ICT diffusion in the form of access, usage and skills can drive inclusive growth in the SSA. In the service sector for instance, ICT diffusion can provide a number

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

of job opportunities in line with the growing demand for technicians, software and hardware engineers/technicians, repairers, distributors, and marketers. Also, considering the rise in FDI into SSA over the last decade and the expected rise in FDI in line with the AfCFTA, enhancing access to productive assets like ICTs can build the technical capacity of the masses/private sector to take advantage of the numerous economic opportunities FDI offers.The optimism is that through ICT diffusion, policymakers can spur innovation/ideation, product development, and technological transfer to harness the inclusive growth potential of the AfCFTA, which can create meaningful economic impacts that can reverberate throughout the region. Further, ICT diffusion can offer limitless opportunities to the masses in line with FDI by triggering intense competition, market reach, and scale economies. In the financial sector for instance, ICT diffusioncan attract FDI as it enhancesfinancial inclusion, allocation efficiency, and reduction in administrative and operational costs.

The ancillary findings are also in order— inflation and vulnerable employment are deleterious to shared prosperity in SSA. Though moderate effects, the result shows that a 1 per cent increase in inflation and vulnerable employment reduces inclusive growth in the SSA by 0.002 per cent (Column 8) and 0.001 (Column 7), respectively. The harmful effect of vulnerable employment and inflation on inclusive growth signifies the need for prudent macroeconomic management and the creation of decent economic opportunities, which are essential for sustaining wealth accumulation and the building of the capacity of the masses to prepare, withstand or cope with socioeconomic shocks. The effect of financial deepening in inducing inclusive growth is strong and pronounced.

In Column 8 for instance, the results show that for every 1 per cent increase in financial deepening, inclusive growth is enhanced by 0.78 per cent. This is more so as credit constraint often hinders the expansion of the region's huge vulnerable businesses into at least formalized informal sector. Likewise, for

every 1 per cent improvement in human capital development, there is a 0.43 upsurge in inclusive growth in SSA.

Finally, we find that institutions for preventing, managing, and overcoming situations that adversely affect the welfare of the poor and vulnerable can have higher inclusive growth-inducing effects if well resourced. The reliability of the estimates are evident in the post estimation tests of AR(2), showing the absence of second-order serial correlation in the residuals, and the Hansen P-value, providing evidence of the validity of our instruments. Moreover, the number of instruments is consistently lower than the corresponding number of countries in each specification, confirming the absence of instrument proliferation (Tchamyou *et al.* 2019a; Tchamyou 2019).

Overall, it is apparent form the findings in Table 4 that FDI modulate ICT dynamics to engender positive synergy effects on inclusive growth. Positive synergy effects build on the perspective that both the unconditional and conditional (i.e. interactive) effects of ICT dynamics on the outcome variable are positive. This conception of synergy is consistent with contemporary interactive regressions literature (Asongu and Acha-Anyi 2017; Asongu and Nwachukwu 2017).

4.4 Robustness check for inclusive growth results

To check the robustness of the estimates in Table 4, we use the inclusive growth index calculated via the principal component analysis (PCA).To this end, we follow the Asian Development Bank (2013)in selecting 15 variables that drive inclusive growth in the developing world. In Table 5, the variables underpinning our inclusive growth index are presented.

Table 5: Variables used in constructing inclusive growth index

Variable	Variable Definition	Source
Women seats	Women in parliaments are the percentage of parliamentary seats in a single or lower chamber held by women.	WDI
Poverty headcount	International poverty headcount (US$1.90)	PED
Sanitation	People using at least basic sanitation services	WDI
GDP per capita	GDP per capita (US$' 2017 PPP)	WDI
Social protection	Effectiveness of institutions for social protection rating (1=low to 6=high)	CPIA

Social inclusion	Effectiveness of institutions for social inclusion rating (1=low to 6=high)	CPIA
Electricity access	Electricity access (overall population)	WDI
Clean fuel	Access to clean fuels and technologies for cooking is the proportion of total population primarily using clean cooking fuels and technologies for cooking.	WDI
Gini	Gini index	WDI
Rule of Law	Rule of law (estimate)	WGI
Health expenditure	Government expenditure on health (%GDP)	WDI
Education expenditure	Government expenditure on education (%GDP)	WDI
Human capital index	Human Capital Index (HCI) (scale 0-1)	WDI
Labour force	Labour force participation rate total (% of total population ages 15-64)	WDI
Voice and accountability	Freedom of the media and general public in terms of association, expression and institutions of public governments	WGI

Note: WDI is World Development Indicators; WGI is Worldwide Governance Indicators; PED id Poverty and Equity Database; CPIA is Country Policy and Institutional Score
**Source**: *Authors' construct, 2021*

The screeplot of the PCA in Figure 4shows a total of 15 principal components as defined in Table 5. Per the eigenvalue rule of at least 1 (Tchamyou *et al.* 2019b), the inclusive growth index is generated based on the first five components, which cumulatively explain 74.8 per cent information in the 15 components of inclusive growth (see results in Table 6).

Table 6: Principal components eigenvectors (Inclusive growth index)

Components	Eigenvalue	Difference	Proportion	Cumulative
PC1	**4.906**	**2.051**	**0.327**	**0.327**
PC2	**2.855**	**1.583**	**0.190**	**0.517**
PC3	**1.272**	**0.122**	**0.085**	**0.602**
PC4	**1.150**	**0.113**	**0.077**	**0.679**
PC5	**1.037**	**0.174**	**0.069**	**0.748**
PC6	0.863	0.221	0.058	0.806
PC7	0.642	0.108	0.043	0.848
PC8	0.534	0.064	0.036	0.884
PC9	0.470	0.142	0.031	0.915
PC10	0.329	0.051	0.022	0.937
PC11	0.278	0.060	0.018	0.956
PC12	0.218	0.005	0.015	0.970
PC13	0.213	0.064	0.014	0.985
PC14	0.149	0.065	0.010	0.994
PC15	0.084	.	0.006	1.000

Source: *Authors' construct, 2021*

Figure 4: Screeplot of Principal Components of Inclusive Growth
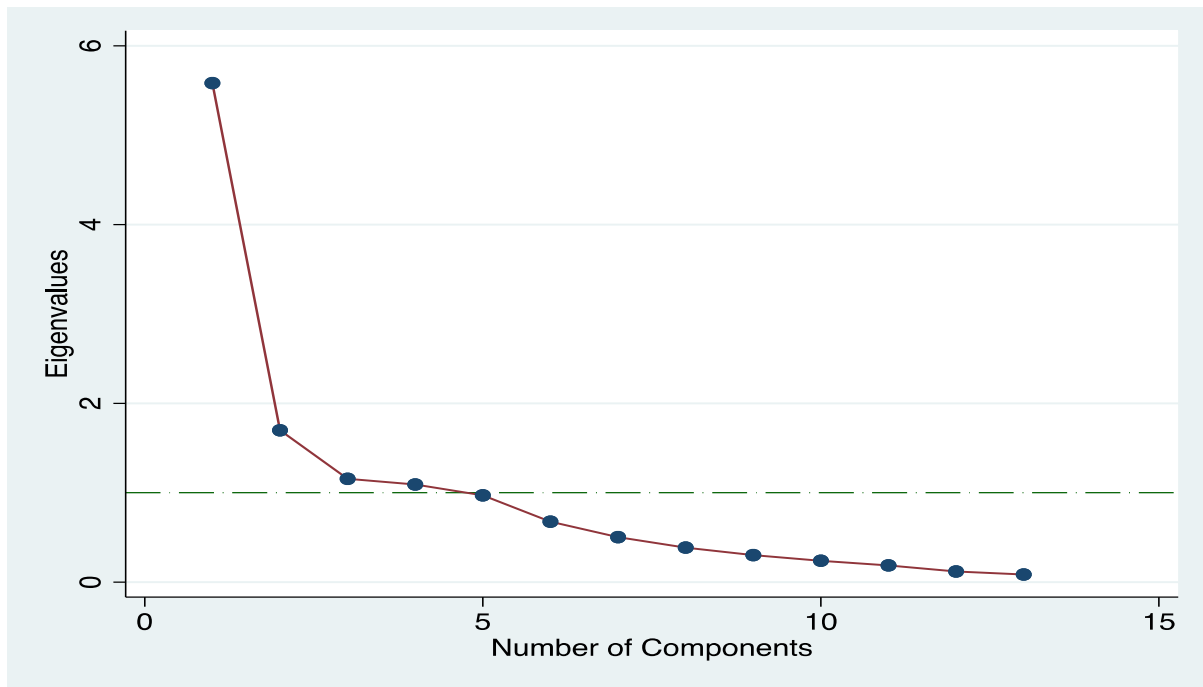
4.4.1 Robustness check results based on inclusive growth index

From the baseline results in Column 1 of Table 7, financial deepening, human capital and social protection are positively related to inclusive growth though there is no statistical backing for human capital and social protection. The lag of inclusive growth is also strong and statistically significant irrespective of the type of model specification, signifying that inclusive growth momentum built in previous years is crucial for fostering inclusive efforts in present times. The results in Columns 2 – 6 provide evidence for the first hypothesis of the study as all ICT variables and FDI are positively related to inclusive growth. For instance, we find that, for every 1 per cent improvement in ICT diffusion and access, inclusive growth is induced by 0.16 per cent (Column 3) and 1.45 per cent (Column 6), respectively. Again, the results show that 'ICT skills' is remarkable in fostering inclusive growth. This result appeals to logic as making sense of ICT access and usage require some level of ICT skills.

Table 7: System GMM results on the effects of FDI and ICT diffusion on inclusive growth (Dependent variable: Inclusive Growth Index)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Inclusive Growth Index (Lag)	0.6392***	0.5971***	0.9259***	0.6588***	0.6480***	0.6860***	0.9761***	0.5796***	0.6211***	0.6358***
	(0.0491)	(0.0599)	(0.0117)	(0.0474)	(0.0501)	(0.0429)	(0.0323)	(0.0692)	(0.0835)	(0.0568)
Vulnerable Employment	0.0002	0.0013	-0.0030**	-0.0009	-0.0005	-0.0062**	0.0036	-0.0042	0.0021	-0.0141***
	(0.0015)	(0.0015)	(0.0012)	(0.0018)	(0.0014)	(0.0025)	(0.0021)	(0.0058)	(0.0062)	(0.0041)
Inflation	-0.0005***	-0.0004***	0.0001	0.0003	0.0002	-0.0002	0.0003*	0.0003	-0.0007*	-0.0004
	(0.0001)	(0.0001)	(0.0001)	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0004)	(0.0004)	(0.0003)
Human Capital	0.0185	0.1766	-0.0072	1.4660**	0.6065	0.5405	-0.5422*	1.8031*	-0.0550	1.4786**
	(0.4324)	(0.5094)	(0.1628)	(0.5816)	(0.5739)	(0.3759)	(0.2844)	(1.0599)	(0.8619)	(0.5651)
Social Protection	0.0003	0.0003	0.0007	0.0012	0.0021	0.0047***	0.0029***	0.0025	-0.0019	0.0078***
	(0.0012)	(0.0014)	(0.0007)	(0.0019)	(0.0015)	(0.0013)	(0.0009)	(0.0029)	(0.0044)	(0.0019)
Financial Deepening	0.1741***	0.3407**	0.5002***	0.2937	0.1924	0.2337	1.4152***	0.2893	0.0170	-0.3378
	(0.0293)	(0.1685)	(0.0780)	(0.4426)	(0.3186)	(0.1682)	(0.2237)	(0.2570)	(0.1088)	(0.3458)
FDI		0.0074					0.0006	0.0051	0.0046	0.1058
		(0.0083)					(0.0101)	(0.0088)	(0.0118)	(0.0716)
ICT Diffusion			0.1620***				0.2678***			
			(0.0456)				(0.0565)			
ICT Access				0.0246				-0.0659		
				(0.0212)				(0.0498)		
ICT Usage					0.0311				0.0336	
					(0.0331)				(0.1632)	
ICT Skills						1.4581***				3.2237***
						(0.3201)				(0.7143)
FDI× ICT Diffusion							0.0233***			
							(0.0033)			
FDI× ICT Access								0.0027		
								(0.0027)		
FDI× ICT Usage									0.0031	
									(0.0121)	
FDI× ICT Skills										0.1577**
										(0.0750)
Constant	-0.1297	-0.2397	-0.1294*	-0.5263***	-0.2598	1.6333***	0.1044	-0.3815	-0.1629	3.3080***
	(0.2033)	(0.2382)	(0.0699)	(0.1862)	(0.2296)	(0.4051)	(0.2345)	(0.4335)	(0.3546)	(0.7649)
Observations	569	569	164	569	569	337	164	569	569	337
Countries	41	41	32	41	41	38	32	41	41	38
Instruments	25	25	25	25	25	23	21	25	25	23
Net-effect	–	–	–	–	–	–	0.336	–	–	3.687
Joint Significance Test	–	–	–	–	–	–	48.91	–	–	4.42
P-Value	–	–	–	–	–	–	0.000	–	–	0.042
Wald Statistic	45.80	26.92	16606	43.24	43.45	690.9	39127	27.46	11.38	104.6
Wald P-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hansen P-Value	0.472	0.353	0.765	0.757	0.565	0.593	0.421	0.728	0.776	0.137
AR(1)	0.013	0.010	0.012	0.017	0.013	0.102	0.081	0.012	0.017	0.038
AR(2)	0.249	0.271	0.609	0.247	0.249	0.343	0.924	0.185	0.236	0.094

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

Moreover, there is evidence for the second hypothesis of the study. Indeed, all the ICT and FDI pathways are positive (see, Columns 7 – 10).However, statistical significance is evident for the FDI – ICT diffusion, and FDI – ICT skills pathways. The net-effects are therefore computed for these two significant pathways. For the FDI – ICT diffusion pathway, we find a net-effect of 0.33 per cent, and a remarkable 3.68 per cent for the FDI and ICT skills interaction. These pathways are calculated as follows taking into account the average FDI value of 2.939.

$$\frac{\partial(igindex)}{\partial(ictdif)} = 0.2678 + (0.0233 \times 2.939) = 0.3363$$

$$\frac{\partial(igindex)}{\partial(ictskills)} = 3.2237 + (0.1577 \times 2.939) = 3.6872$$

The results show that ICT diffusion can amplify the effect of FDI on inclusive growth. Possible opportunities FDI provide in line with growing ICT diffusion is employment, wider markets, innovation, repairs, preservation of jobs, and knowledge transfer. 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. This is more so as UNCTAD (2019) indicate that inflow of FDI into the region has been to the extractive, aviation, and telecommunication sector industries, which require ICT skills to take advantage of associated opportunities. Additionally, with growing tech-labs and start-ups in the region, enhancing ICT diffusion can possibly prevent human resource wastage by empowering the teaming youth to realise their innovative potentials, earn decent living while contributing to national development. The pooled least squares estimates, which we provide as additional results in the Appendix section also yield similar effects (see Table A.2).

5.0 Conclusion and policy recommendations

This study contributes to the discourse on how SSA can foster inclusive growth post COVID-19. To this end, we deviate from the proliferation of opinions on how this can be achieved without empirical content. Motivated by the momentous rise in ICT diffusion and the expected rise in FDI inflow into SSA following the coming into force of the AfCFTA, we examine the direct and indirect effects of ICT diffusion and FDI on inclusive growth in SSA. We use data for the period 1980 – 2019 on 42 SSA countries for the analysis. We provide evidence robust to several specifications from the least squares and the dynamic system GMM to show that: (1) both ICT diffusion and FDI foster inclusive growth in SSA, (2) the inclusive growth-inducing effect of FDI is rather remarkable in the presence of greater ICT diffusion, (3) compared to ICT access and usage, ICT skills is more effective in driving inclusive growth in SSA. Overall FDI modulates ICT dynamics to engender positive synergy effects on inclusive growth.

Considering strides made by countries like Hong Kong, China, Singapore and Taiwan in recent times through ICT diffusion and FDI, our results offer glimmers of hope in fostering shared prosperity in SSA. First, our results show that ICTs can offer policy makers interested in SSA's growth agenda realistic means of addressing human resource wastage and social tensions by enhancing equity in education, healthcare delivery, access to opportunities, accountability, and social inclusion. Second, FDI can induce inclusive growth through poverty alleviation, macroeconomic stability, increased global value chain participation and corporate social responsibility. Our pathway results on FDI and ICT indicate that creating shared opportunities in SSA may not be about enhancing infrastructural investment per se but infrastructural development of opportunities, inclusiveness, and gender impartiality.

We recommend that policymakers should channel resources to boost ICT skills, access, and usage in the region. This can be enhanced if organisations interested in the SSA agenda such as the African Development Bank and the World Bank provide technical, logistical and monetary support to complement various governments efforts in boosting ICT diffusion in the region. This also calls for policy actions aimed at developing the region's

tech-hubs and industrial parks to promote high-tech product commercialization, patent development and incubation to offer technical and logistical support for the region's youthful and innovative population to realistically contribute to national development. To attract FDI into the region, various governments should strive to improve the legal framework, energy supply and infrastructure of which digital infrastructure is a major component. To take advantage of the AfCFTA, policy makers are advised to support the private sector in building capacity to deepen indigenous forward and backward linkages, which are paramount for improving the region's industrial base, global value chain participation and opportunity creation.

This study leaves room for improvement, especially as it relates to exploring other mechanisms by which FDI or other external flows (e.g., foreign aid and remittances) influence inclusive development. Moreover, other dimensions of inclusive development such as gender political and economic empowerment can be envisaged.

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APPENDICES

Table A.1: Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) Inclusive Growth	1.000													
(2) Inclusive Growth Index	- 0.173	1.000												
(3) GDP Per Capita	0.370	-0.087	1.000											
(4) Gini Index	0.032	0.009	-0.104	1.000										
(5) FDI	0.041	-0.040	0.098	-0.095	1.000									
(6) Vulnerable Employment	- 0.250	0.102	-0.521	0.032	-0.014	1.000								
(7) Inflation	- 0.018	0.042	0.100	-0.237	0.192	-0.067	1.000							
(8) Human Capital	0.308	0.081	0.610	-0.002	0.028	-0.311	-0.006	1.000						
(9) ICT Diffusion	0.716	0.029	0.715	-0.180	0.194	-0.576	0.003	0.536	1.000					
(10) ICT Access	0.265	0.054	0.734	-0.057	0.123	-0.436	0.106	0.625	0.707	1.000				
(11) ICT Usage	0.121	0.030	0.703	-0.165	0.076	-0.220	-0.062	0.426	0.642	0.737	1.000			
(12) ICT Skills	0.271	0.122	0.409	-0.234	0.195	-0.668	0.263	0.374	0.721	0.415	0.253	1.000		
(13) Financial Deepening	0.262	0.062	0.695	-0.156	0.196	-0.392	0.174	0.635	0.740	0.775	0.568	0.487	1.000	
(14) Social Protection	0.045	0.012	0.172	0.054	0.016	0.048	-0.005	0.100	0.152	0.161	0.251	-0.074	0.116	1.000

Source: Author's construct, 2021

Table A.2: PooledOLS results on the effects of FDI and ICT diffusion on inclusive growth (Dependent variable: Inclusive growth)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Vulnerable Employment	-0.0168***	-0.0170***	-0.0046**	-0.0160***	-0.0149***	-0.0117***	-0.0049**	-0.0157***	-0.0161***	-0.0114***
	(0.0012)	(0.0012)	(0.0022)	(0.0012)	(0.0015)	(0.0017)	(0.0023)	(0.0015)	(0.0012)	(0.0017)
Inflation	0.0014***	0.0012**	0.0005	0.0014***	-0.0017***	-0.0000	0.0005	-0.0017**	0.0012**	-0.0002
	(0.0005)	(0.0005)	(0.0009)	(0.0005)	(0.0007)	(0.0007)	(0.0009)	(0.0007)	(0.0005)	(0.0007)
Human Capital	3.5764***	3.6808***	1.8879***	3.2165***	1.8948***	2.6999***	1.6191**	1.9394***	3.3213***	2.6073***
	(0.4389)	(0.4404)	(0.6491)	(0.4531)	(0.5173)	(0.5335)	(0.6479)	(0.5184)	(0.4547)	(0.5391)
Social Protection	0.0041**	0.0041**	0.0062**	0.0035**	0.0009	0.0062***	0.0069**	0.0011	0.0035**	0.0058***
	(0.0016)	(0.0016)	(0.0030)	(0.0016)	(0.0021)	(0.0021)	(0.0030)	(0.0021)	(0.0016)	(0.0021)
Financial Deepening	1.4918***	1.3624***	1.3304***	0.9524***	1.4448***	1.7816***	1.3550***	1.3143***	0.8403**	2.0171***
	(0.2596)	(0.2649)	(0.3331)	(0.3182)	(0.2883)	(0.2990)	(0.3308)	(0.2955)	(0.3314)	(0.3185)
FDI		0.0093**					0.0142**	0.0024	0.0095**	0.0640***
		(0.0039)					(0.0062)	(0.0037)	(0.0041)	(0.0205)
ICT Diffusion			0.2027***				0.1646**			
			(0.0722)				(0.0799)			
ICT Access				0.0249***					0.0256***	
				(0.0084)					(0.0091)	
ICT Usage					0.0210			0.0049		
					(0.0140)			(0.0168)		
ICT Skills						0.6194***				0.7918***
						(0.1695)				(0.1806)
FDI ×ICT Diffusion							0.0081*			
							(0.0042)			
FDI × ICT Usage								0.0021*		
								(0.0012)		
FDI ×ICT Access									0.0001	
									(0.0007)	
FDI × ICT Skills										0.0762***
										(0.0245)
Constant	4.4815***	4.4461***	4.0174***	4.5683***	5.2761***	3.8971***	4.1882***	5.3117***	4.5258***	3.7810***
	(0.1991)	(0.1993)	(0.2999)	(0.2005)	(0.2356)	(0.2897)	(0.3055)	(0.2383)	(0.2037)	(0.2910)
Observations	1,680	1,680	164	1,676	610	941	164	610	1,676	941
R-squared	0.317	0.319	0.624	0.320	0.382	0.400	0.640	0.386	0.322	0.406
Adj R-Sqr	0.315	0.317	0.610	0.318	0.376	0.396	0.622	0.378	0.319	0.401

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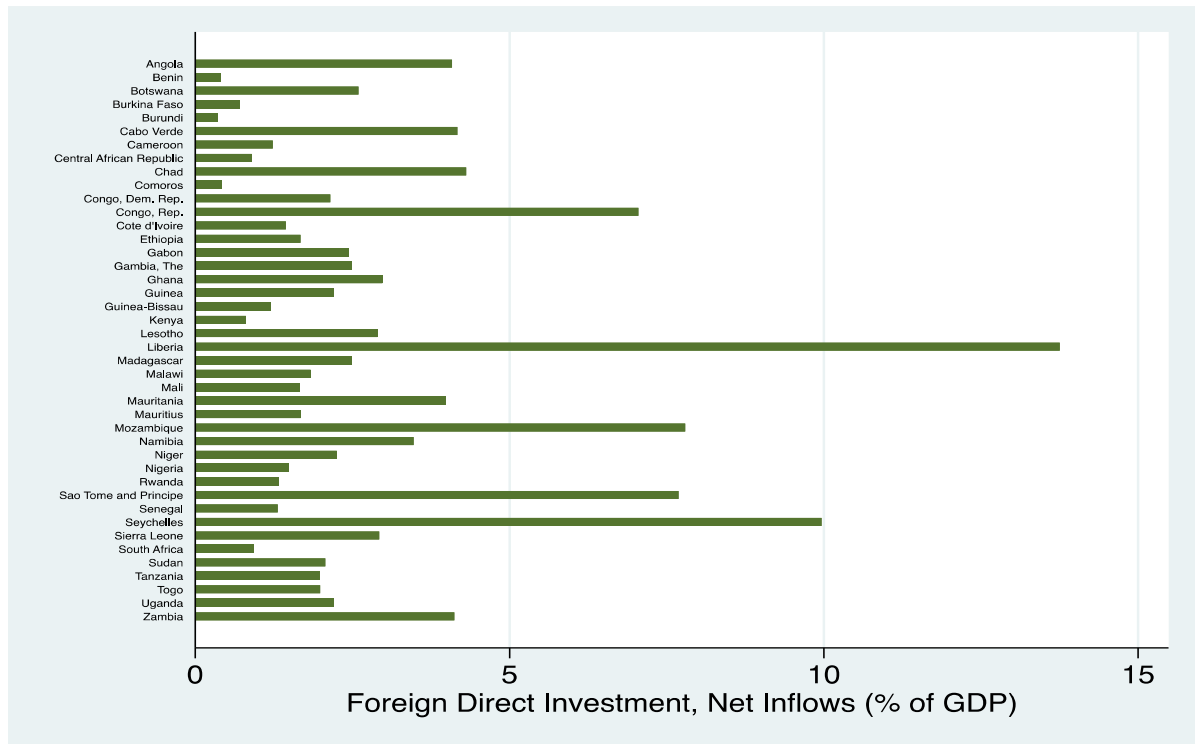*** p<0.01, ** p<0.05, * p<0.1

Figure A.1: Average Within-Country FDI InflowIn SSA, 1980 – 2020

Tech-Hubs, D.R. Congo, 11
Tech-Hubs, Benin , 10
Tech-Hubs, Togo, 14
Tech-Hubs, Ugansa, 10
Tech-Hubs, Rwanda, 10
Tech-Hubs, Zimbabwe, 23
Tech-Hubs, Tanzania, 17
Tech-Hubs, Cameroon, 18
Tech-Hubs, Cote d'Ivoire, 22
Tech-Hubs, Ghana, 25
Tech-Hubs, Kenya, 48
Tech-Hubs, South Africa, 80
Tech-Hubs, Nigeria, 85
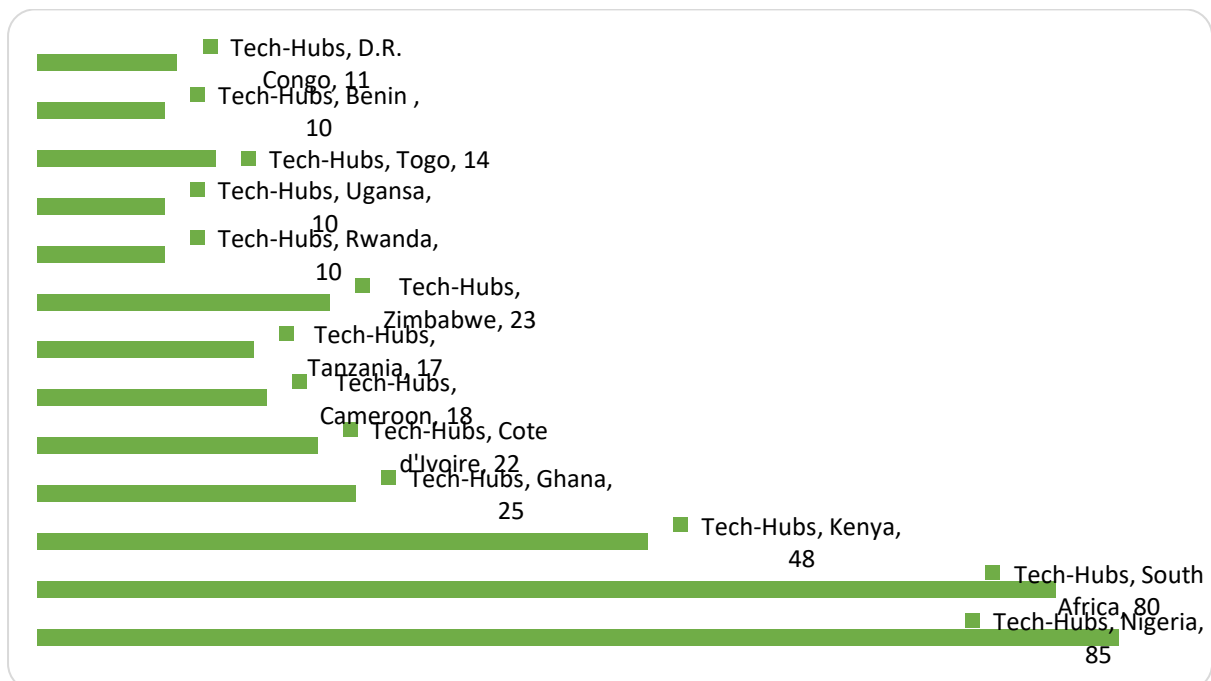
Figure A.2: Major Tech-Hub Countries In Sub-Saharan Africa
Source: GSM Association Data, 2021

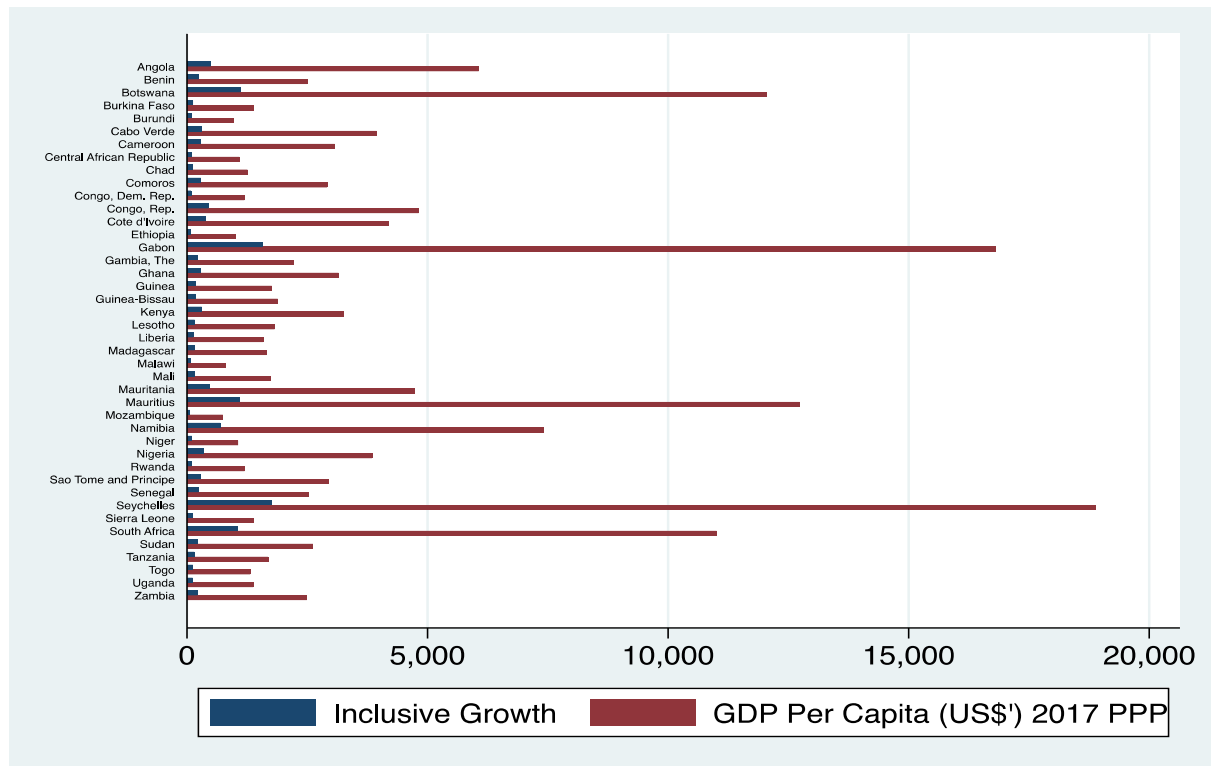*Figure A.3: Average Within Country Inclusive Growth and GDP Per Capita In SSA, 1980 – 2020*

Measurement of Inclusive Growth by Anand *et al.* (2013)

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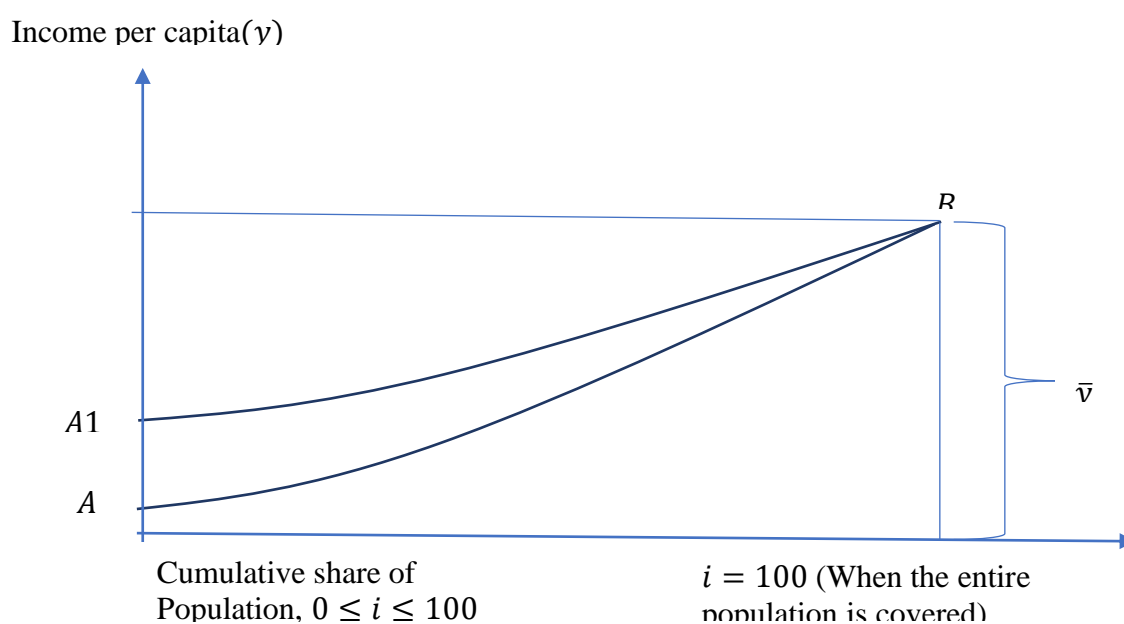
To integrate equity and growth in a unified measure, Anand, Mishra and Peiris (2013) proposed a measure of inclusive growth based on a utilitarian social welfare function drawn from consumer choice literature, where inclusive growth depends on two factors: (i) income growth; and (ii) income distribution. Similar to the consumer theory where the indifference curves represent the changes over time in aggregate demand, Anand, Mishra and Peiris (2013) decomposed the income and substitution effect into growth and distributional components. The underlying social welfare function must satisfy two properties to capture these features: (i) it is increasing in its argument (to capture growth dimension) and (ii) it satisfies the transfer property – any transfer of income from a poor person to a richer person reduces the value of the function (to capture distributional dimension).

A measure of inclusiveness is based on the concept of a concentration curve. Following Ali and Son (2007), Anand, Mishra and Peiris (2013) defined a generalized concentration curve, which they called social mobility curve, S^c, such that:

$$S^c \approx \left(y_1, \frac{y_1 + y_2}{2}, \ldots \ldots \ldots, \frac{y_1 + y_2 + \cdots + y_n}{n} \right)$$

Where n is the number of persons in the population with incomes $y_1, y_2, \ldots \ldots, y_n$, where y_1 is the poorest person and y_n is the richest person. This generalized concentration curve is basically a cumulative distribution of a social mobility vector $S \approx (y_1, y_2, \ldots \ldots \ldots, y_n)$ with an underlying function $W = W(y_1, y_2, \ldots \ldots \ldots, y_n)$ satisfying the two properties mentioned above to capture growth and distribution dimensions. Since S^c satisfies the transfer property, a superior income distribution will always have a higher generalized concentration curve. Similarly, since it is increasing in its argument, higher-income will also have a higher generalized concentration curve. As in Ali and

Son (2007), the generalized concentration curves can be presented in continuous time to be more amendable to econometric analysis. The population is arranged in the ascending order of their income. Let $\bar{y}_i$ is the average income of the bottom i per cent of the population, where i varies from 0 to 100 and y_i is the mean income. Anand, Mishra and Peiris (2013) plotted $\bar{y}_i$ for different values of i (curve AB in Appendix A below). Curve AB represents a social mobility curve discussed above. Since a higher curve implies greater social mobility, growth is inclusive if the social mobility curve moves upward at all points. However, there may be degrees of inclusive growth depending on: (i) how much the curve moves up (growth); and (ii) how the distribution of income changes (equity). This feature of the social mobility curve is the basis of our integrated measure of inclusive growth. Thus, if two generalized concentration curves do not intersect, they could be ranked on social mobility (i.e. inclusiveness of growth). To illustrate the point made above, Appendix A depicts two social mobility curves with the same average income ($\bar{y}$) but different degrees of inclusiveness (i.e. different income distribution). Social mobility curve (A1B) is more inclusive than the social mobility curve AB, as the average income of the bottom segment of the society is higher.

Income per capita(y)

R

$\bar{v}$

A1

A

Cumulative share of
Population, $0 \le i \le 100$

$i = 100$ (When the entire
population is covered)

Source: Anand et al. (2013)

To capture the magnitude of the change in income distribution, Anand, Mishra and Peiris (2013) used a simple form of the social mobility function by calculating an index (or social mobility index) from the area under the social mobility curve:

$$\bar{y}^* = \int_0^{100} \bar{y}_i \, di$$

The greater the $\bar{y}^*$, the greater is the income. If the income of everyone in the population is the same (i.e. if income distribution is completely equitable) then $\bar{y}^*$ will be equal to $\bar{y}$. If $\bar{y}^*$ is lower than $\bar{y}$, it implies that the distribution of income is inequitable. So, the deviation of $\bar{y}^*$ from $\bar{y}$ is an indication of inequality in income distribution. Ali and Son (2007 use this feature of $\bar{y}^*$ and propose an income equity index (IEI) as:

$$\omega = \frac{\bar{y}^*}{\bar{y}}$$

For a completely equitable society, $\omega = 1$. Thus, a higher value of ω (closer to one) represents higher income equality. Rearranging,

$$\bar{y}^* = \omega * \bar{y}$$

Inclusive growth requires increasing $\bar{y}^*$, which could be achieved by: (i) increasing $\bar{y}$, that is increasing average income through growth; (ii) increasing the equity index of income, ω, through increasing equity; or (iii) a combination of (i) and (ii). Differentiating the above equation:

$$d\bar{y}^* = \omega * d\bar{y} + d\omega * \bar{y}$$

Where $d\bar{y}^*$ is the change in the degree of inclusive growth. Growth is more inclusive if $d\bar{y}^* > 0$. It also allows us to decompose inclusive growth into income growth and change in equity. The first term is the contribution of an increase in average income (keeping income distribution constant) while the second term is the contribution of changes in the income distribution (keeping the average income unchanged). Inclusive growth depends on the sign and the magnitude of the two terms.