Synergy effects of ICT diffusion and foreign direct investment on inclusive growth in Sub-Saharan Africa

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Abstract
The present study critically examines the synergy effect of information communication technology (ICT) diffusion and foreign direct investment (FDI) on inclusive growth in Sub-Saharan African (SSA) countries using a modified system-generalized method of moments (GMM) model based on panel data covering the period 2005–2020. This study differs significantly from the previous studies in four ways: (i) this study uses a more comprehensive measure of ICT by computing a composite ICT index, which takes into account several ICT indicators; (ii) some existing study uses a narrow proxy of inclusive growth using the Gini index as a proxy, while others consider three patterns of economic growth dynamics (GDP growth, real, and per capita GDP). For robust analysis, we computed a composite inclusive growth index that takes into account several shared growth indicators; (iii) our model captures the heterogeneity effect of the interaction term of FDI and ICT diffusions on two groups of SSA countries, unlike the previous studies that estimated the joint impact of FDI and ICT on the whole group of countries; (iv) we contribute to the extant studies by determining the threshold level at which ICT diffusion may determine the effect of FDI on inclusive growth. Overall, empirical results show that the positive effect of FDI on inclusive growth could intensify when ICT diffusion is beyond a given threshold level, while inflation and vulnerable unemployment deteriorate inclusive growth, among others. We are of the opinion that ICTs should engage to cushion present and future environmental threats/natural catastrophes through improving geographical monitoring and concerted reaction coupled with other policy recommendations paying special attention to Sustainable Development Goals (SDGs) fifteen (15)—inclusive growth.

Keywords ICT diffusion · Inclusive growth · Foreign direct investment · Sub-Saharan Africa

Introduction
Following the successful launch of the world’s largest free trade initiative, the African Continental Free Trade Area (AfCFTA) in 2018, and the devastating impact of the COVID-19 pandemic, the push for Sub-Saharan Africa (SSA) countries to promote inclusive growth has been stepped up (Ofori and Asongu 2021). AfCFTA is expected to elevate 30 million people out of extreme poverty and increase the income of another 68 million people living on less than $5.50 per day (World Bank 2020). Indeed, the AfCFTA has significantly influenced the African continent, promoting the free flow of goods and services and attracting

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a large inflow of capital in the form of foreign direct investment (FDI) into the continent.

Moreover, the continent is endowed with an abundant active (youthful) population that has a high appetite for information communication technology (ICT) devices and related services. While ICT penetration in developed and emerging countries is approaching saturation level, it is thriving and has high penetration potential in the African continent (Afutu-Kotey et al. 2017; Tchamyou et al. 2019). Also, ICT access and rapid growth in Africa have the potential to improve impoverished people’s livelihoods and enable them to take advantage of the many opportunities of life. Can this massive potential income redistribution gains from the inflow of FDI and the rapid spread of ICT provide a positive synergetic effect in promoting inclusive growth in SSA countries? The current study addresses this main research question using panel data of 48 SSA countries covering 2005–2020.

The present study is positioned around three key areas in the literature on the subject matter, notably (i) widening gaps in income distributions between the rich and poor despite unprecedented inflows of FDI into the African continent in the last several years; (ii) the impact of the rapid spread of ICT devices and related services on inclusive growth in SSA; (iii) the gaps in the extant literature. We proceed with the discussions on these three key research areas in chronological order.

First, despite the fact that the significant positive impact of FDI on growth has been well established in the empirical literature (Bengoa and Sanchez-Robles 2003; Durham 2004; Li and Liu 2005; Hassan 2005; Solomon 2011; Dunne and Masiyandima 2017; Boamah 2017; Fanta and Makina 2017; Akadiri and Ajmi 2020; Akadiri et al. 2020; Philip et al. 2021; Kirrikakale et al. 2022; Adebayo 2022; Adebayo 2022; Ojekemi et al. 2022) especially for developed and emerging countries, the exact direction and nature of FDI impact on inclusive growth particularly in SSA countries is a subject of intensive debate (Ofori et al. 2022a). For decades, the African continent has been enjoying steady inflows of foreign capital into its hydrocarbons (oil, coal, and gas), extractive industries (precious metals and critical mineral resources), manufacturing, constructions, banking, aviation, and telecommunication sectors (UNCTAD 2020), yet the chronic gap in income and wealth distributions between the poor and rich is not closing but widening. However, there is a glimmer of hope in the tariff reduction and elimination of protectionist trade policies following the successful launched of the AfCFTA: through access to the huge market potential of at least 1.2 billion people, Africa has gained employment opportunities in agricultural, manufacturing, and service sectors as well as the increase in the value-added chain in the continent yield inclusive growth in SSA countries (Obeng et al. 2021). According to a recent World Bank report (2020), trade liberalization measures that cut red tape and improve customs procedures would account for $292 billion of the $450 billion in potential economic benefits associated with adopting the AfCFTA.

Second, despite the high potential of ICT penetration in Africa, the continent lags behind in a knowledge-based economy. There is a growing disparity in income distribution (exclusive development), particularly in SSA countries (Asongu and Le Roux 2017). Although a knowledge-based economy is critical in the 21st century in promoting inclusive developments (Asongu and Odhiambo 2018; Tchamyou 2017; Asongu and Le Roux 2017; Asongu and Nwachukwu 2017), within the SSA region, there is growing exclusive development and increasing inequality and poverty. However, according to Castell (1999), Brown (2001), Ofori and Asongu (2021), through ICT diffusion, poor and marginalized people’s abilities can improve and empower them to exploit the economic opportunities that come along with FDI, thereby promoting inclusive growth. In addition, according to Asongu and Le Roux (2017), ICT-related policies, such as those aimed at increasing mobile phone and Internet adoption, have the potential to improve inclusive human development in the post-2015 era of the Sustainable Development Agenda (SDA). Leveraging on the underlying penetration of ICT in Africa, post-2015 development challenges of the continent like inequality and poverty can be addressed (Asongu and Le Roux 2017; Tchamyou et al. 2019).

Third, ICT breakthroughs and solutions’ capacity to minimize management risk, production, and transaction costs while providing limitless market coverage and innovation transfer can promote FDI inflows, notably into the financial, manufacturing, and telecommunications sectors (Ofori et al. 2022b; Asongu 2013; Sassi and Goaied 2013; Asongu and Nwachukwu 2018; Salahuddin and Gow 2016). Despite the fact that FDI has a modulating effect on the nexus between ICT diffusion and inclusive growth, there is a gap in the literature, particularly in the SSA literature, in that robust scientific studies addressing such links are scarce. The studies that come closest to examining the interaction effects of FDI and ICTs on economic growth are that of Ofori and Asongu (2021) who found their ICT dynamics as modulated by FDI, resulted in favorable synergistic effects on inclusive growth; and Asongu and Odhiambo (2020) whose research found that Internet and mobile phone usage both had a considerable impact on FDI, with overall positive net effects on all three economic growth patterns.

However, the present study differs significantly from these previous studies. First, our study uses a more comprehensive measure of ICT by computing a composite ICT index which takes into account several ICT indicators (see Table 2); second, the latter study considers a narrow proxy of inclusive growth using the Gini index as a proxy, the former considers three patterns of economic growth dynamics (GDP growth, real, and per capita GDP), and ours computed a composite inclusive growth index that takes into account
several shared growth indicators (see Table 1). Third, our present study captures the heterogeneity effect of the interaction term of FDI and ICT diffusions on two groups of SSA countries, unlike the previous studies that estimated the joint impact of FDI and ICT on the whole group of countries. Fourthly, the study also contributes to the extant studies by determining the threshold level at which ICT diffusion may determine the effect of FDI on inclusive growth. We argue that the positive effect of FDI on inclusive growth could intensify when ICT diffusion is beyond a given threshold level. Fifthly, unlike most of the existing studies that used the traditional GMM technique, we employed a modified version of it promoted by Kripfganz’s (2019), which is more robust for analysis.

Against the above background, our study bridges the identified research gaps by critically examining the synergy effect of ICT diffusion and foreign direct investment on inclusive growth in SSA countries using a modified system-GMM model based on panel data covering the period 2005 to 2020. The present study adds to the empirical literature on the subject matter by providing a more robust methodological approach. The system GMM estimation technique in our study uniquely takes care of the instruments’ significance. It is very important to give special attention to the strength of instruments in GMM estimations because biased estimate results in a weak and misleading statistical link between endogenous variables and the instruments. It is a well-known fact in the extant literature that testing a weak instrument under the system of GMM is a tedious task. The instruments’ strength for each equation based on level and the first difference was independently examined by Bazzi and Clemens (2013). But their approach fails to evaluate the strength of the joint instrument for the system. In contrast, we deploy a recent technique for assessing the strength of joint instruments in our system GMM based on Kripfganz’s (2019) method. Kripfganz’s method gets the standard diagnostics of the strength of joint instruments. At the same time, it modifies the moment conditions for one level equation based on level and first difference equations in the system GMM.

This study is inspired by the rapid ICT diffusion and the emergence of innovation centers and industrial parks in SSA, especially in countries like Gabon, Mauritius, South Africa, Cape Verde, Namibia, Seychelles, Nigeria, and Ghana, which unite young programmers, designers, entrepreneurs, and investors for the growth and mending of ideas. This development may present an incredible potential for shared prosperity. First, it may generate green riches via innovation and increased access to markets like those provided by the AfCFTA. Second, it may encourage the influx of FDI. Third, it may improve access to education, information, and knowledge transfers. Fourth, it may promote relationship-building, network building, e-governance, accountability, and social inclusion.

In contrast, the classical approach in the literature that employs the instrumental variable (IV) evaluates the instrument’s strength based on the F-statistic. The null hypothesis that the instruments have mutually a zero impact on the endogenous variables is tested. Based on our estimates, the Kleibergen-Paap F-statistic across our system GMM models is largely adequate. Thus, based on Stock and Yogo’s (2005) criteria which assumes independently, identically, and normally distributed error terms, we can conclude that our system GMM models do not suffer from significant weak instrument bias. Also, our study adds to the previous literature because our system GMM models embody, whereas previous studies employing the GMM method fail to handle the instrument significance issue systematically. We argue that it is a major limitation in the previous studies: Avom et al. (2020), Ofori and Asongu (2021), and Adedoyin et al. (2021) are among several studies that suffer from these limitations. Empirical studies apply difference and system GMM to handle nickel bias common in dynamic models with fixed effects and bias peculiar to endogeneity problems. We ensure that our GMM models are devoid of such biases. However, it is common knowledge that system GMM does not effectively treat omitted variable bias. We include time-fixed effects in our models to make our GMM estimates robust to omitted variable bias.

Notwithstanding the evident barriers to capital formation, equal opportunities, infrastructure, and social inclusion institutions, the rise in ICT diffusion on the one hand and the surging inflow of FDI into the SSA on the other are two significant developments in the region that look promising. ICTs and FDI could generate shared prosperity in a region with unfulfilled infrastructure development needs and a youthful, creative population. This is where the findings of this study add to the current debate about the importance of African leaders in generating shared prosperity.

| ICT indicators                                      | Source |
|----------------------------------------------------|--------|
| Secured Internet servers (per 1 million people)    | WDI    |
| Secure Internet servers                            | WDI    |
| Individuals using the Internet (% of the population)| WDI    |
| Mobile cellular subscriptions                      | WDI    |
| Mobile cellular subscriptions (per 100 people)      | WDI    |
| Fixed broadband subscriptions (per 100 people)      | WDI    |
| Fixed telephone subscriptions                       | WDI    |
| Fixed broadband subscriptions                       | WDI    |
| Fixed telephone subscriptions (per 100 people)      | WDI    |
| Mean secondary school enrolment in years            | WDI    |
| Tertiary school enrolment (Gross)                   | WDI    |
| Secondary school education (Gender parity)          | WDI    |
ICT diffusion and FDI should be closely examined if the welfare setbacks are to be resolved and lead SSA down a path of resilient shared growth. Thus, the objectives of the present study are threefold: first, to analyze the direct effects of ICT diffusion and FDI on inclusive growth; second, to investigate the indirect effects of ICT diffusion and FDI on inclusive growth using an interaction term on inclusive growth, and third by using a broader ICT diffusion measure, a more robust econometric model, and taking into account the heterogeneous impact of the interaction term based on two income categories of the countries (middle- and low-income groups), the study fills in methodological and empirical research gaps in the body of existing work on the topic.

The rest of the study is organized as follows: the theoretical framework and empirical literature are highlighted in the “Theoretical framework and empirical literature” section. The “Data and methodology” section presents the study’s data and methods. In the “Results and discussions” section, the empirical data is presented and discussed, along with references to earlier studies. Finally, the study derives conclusions and policy implications from the major findings in the “Conclusion and policy recommendations” section.

Theoretical framework and empirical literature

Theoretical link between the ICT diffusion, FDI, and inclusive growth

Leading modern theories like neo-Schumpeterian theories (Schumpeter 1934; Pyka and Andersen 2012), as well as neoclassical growth theory (Solow 1956), have emphasized the existence of a meaningful and definite connection between ICT and economic growth. These theories desire that ICT enters as a recommendation into the business-related supply in the mode of capital and creates the enhancement of the resulting process by way of expanding capital and making progress in science and trained workers value. As a result, ICT designs additional worth at the firm level and the sectoral level and then leads to the enhancement of output and business-related development on the national level (Bedia 1999; Quah 2002; Aghaei and Rezagholizadeh 2017). Even though hypothetical everything has proved some definite impact of ICT on economic growth, various practical studies on this link have created varied and aggressive results.

A connected hypothesis is the renovation belief, whichever desires that FDI can influence the advancement of receiver nations through utilization concoction, specialized transfer, and economic linkages (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) structure (view, Kwan and Chiu 2015). The SLA structure takes glamor from Sen’s belief in the functionings and actions in people’s efficiencies (Sen 1999). The SLA connotes the various linkages among occupation property, organizations, tactics, and people’s occupation outcomes (Messer and Townsley 2003). The structure accordingly displays that if business-related handlers have the path to property-related ICTs, they supply a state of equality by permissive common people to devise/impose upon convenience. In the circumstances concerning this and the flexibility of the SLA idea in resolving joint development, ICTs are integrated into the structure (view, Duncombe 2006).

The literature on ICT diffusion and FDI

FDI inflows through new money, management abilities, and technical progress bring about business-related growth through enhancement in the output level (Pegkas 2015). Not only that, but FDI likewise adds to the telecommunications spillovers of the host nation (Eudelle and Shrestha 2017). Economic arguments anticipate that ICT would have an important union with development and employment, as well as productivity. However, few studies establish varied and contradictory evidence, particularly for evolving countries with its government. This is somewhat on account of the lack of information concerning the function of ICT diffusion and novelty in those nations. This is coherent with the conclusions of Toader et al. (2018), whose work demonstrated the essential component for economic growth in ICT. A 2017 United Nations Conference (UNCTAD) study supposed that between 2010 and 2015, the number of Internet consumers had risen by 60%, while the greatest of the globe’s inhabitants remained confused. When feasible, broadband opportunity in underdeveloped countries is commonly prolonged and costly, restricting the skill of arrangements and using these telecommunications in day-to-day transactions. For the moment, in numerous advanced nations, more than 70% of the populace is involved in purchasing merchandise connected to the Internet, but less than 2% of those in the less advanced nations (LDCs) are curious about electronically connected purchases (UNCTAD 2017).

Despite the literature above, digitalization is today a modernized lifestyle because of the early days of the period 2000, when ICTs presented a prime mover in stimulating socio-economic growth. The advantageous effect of ICT on the economic growth in advanced nations like the US and European countries is deep-rooted (Evangelista et al. 2014; Shahiduzzaman and Alam 2014; Hanclova et al. 2015; Das et al. 2016; Toader et al. 2018; Chien et al. 2020). However, due to the deficiency of ICT-growth analyses, there are inadequate backgrounds on the significance of ICT in underdeveloped and small-income nations (Yousefi 2011; Sepehrdoust & Ghorbanseresht 2019; Fernandez-Portillo et al. 2020).
Samimi et al. (2015) establish that both advanced and advancing democracies possess a firm and definite link between ICT and economic growth. This discovery is consistent with the conclusions of Das et al. (2016), Mengesha and Garfield (2019), Palvia et al. (2018), Rondović et al. (2019) and Bahrini and Qaffas (2019). However, Pradhan et al. (2018) found an effective connection between broadband and the information highway with cost-of-living index and economic growth. The impact of the development of gross domestic capital on both broadband and information superhighway consumers is also established to bear an important beneficial impact. Sedika and Emamb (2019) have established that as long as OECD states and developing with advanced economies, ICT’s influence on economic growth exceeds its influence on MENA and underdeveloped countries. Moreover, just before mobile and permanent broadband networks are interested, the expansion of ICT has a meaningful, effective impact on driving development in OECD nations in addition to advanced economies. However, this is not occurring in the MENA and underdeveloped countries.

In another facet, as stated in Latif et al. (2018), the input of ICTs to FDI is likewise crucial. ICT boosts FDI as well as overseas trade in five BRICS nations founded on the info from 2000 to 2014. This outcome is compatible with the discoveries from Pradhan et al. (2017) where enhanced ICT improves effectiveness and competitiveness and assists in beneficial overabundance to the nation. Therefore, it leads to better FDI inflows that, appropriately, command enlarge economic growth. Their research was administered in 32 OECD-advanced nations. Sapuan and Roly (2021) investigated the relationship between ICT dissemination, FDI, and economic growth in ASEAN-8 nations. Using info from 2003 to 2017, the panel regression study results presented that the diffusion of ICT and FDI are main, and they positively impact the ASEAN-8 nations’ economic advancement.

Ofori and Asongu (2021) check the shared, combined effects of ICT diffusion (serene of access, management, and expertise), as well as foreign direct investment (FDI), on inclusive growth in Sub-Saharan Africa (SSA). Their study on its overall demonstrated that FDI modulates ICT gestures to instigate beneficial collaboration possessions on inclusive growth. For the moment, information highway and mobile phone infiltration possess an important influence on FDI inflows which results in beneficial net effects on expediting the economic growth of 25 Sub-Saharan African countries founded on the discovery from Asongu and Odhiambo (2019).

The impact of Internet connectivity on innovation and the economic factors that make this impact possible are analyzed by Kamga et al. (2022). They studied 29 developing nations between 2001 and 2018. The primary findings from the generalized least squares random-effects estimator demonstrate that Internet availability positively impacts creativity. The results indicate that Internet access interacts with foreign direct investment and financial development, providing favorable synergetic effects on innovation.

ICT’s impact on sustainable development and the processes by which it is adjusted are examined by Nchhofoun and Asongu (2022), using 140 nations worldwide from 2000 to 2019. Fixed Effects estimator, Driscoll and Kray estimator, Mean Group estimator, System GMM, and the instrumental variable Fixed Effects Tobit are all used in the methodology. The findings demonstrated that ICT significantly and favorably impacts sustainable development. Although the overall net benefits are favorable, the results depend on the ICT measurement chosen, the economy’s geographical location, and the income group category.

The literature on the nexus between FDI and inclusive growth

Despite proof that FDI may encourage earnings disparity in the advancing world (view, for instance, Bergh and Nilsson 2010; Adams and Klobodu 2017; Kaulihowa and Adjasi 2018; Huang et al. 2020), few authors further support proof to debate that FDI can drive mutual advancement by way of job creation, the rebirth of the industrialized competency of beneficiary nations, and allied collective accountability (Lee et al. 2020; Xu et al. 2021). Furthermore, in a context where infrastructure improvement is increasing, corporate structures are being refined (African Development Bank 2018, 2010), and natural resources thrive. In addition, the populace is immature, and FDI may be a game-dealer in prompting mutual advancement. Indeed, earlier than the COVID-19 pandemic, FDI incursion to SSA as related to areas like South Asia, the Middle East, and North Africa (MENA) was effective (Ofori and Asongu 2021).

Particularly, despite FDI inflow to areas like South Asia, MENA, and Europe as well as Central Asia dropping down steadily later the 2008/2009 global economic calamity, FDI inpouring to SSA revived rapidly after the disaster (UNCTAD 2013). Despite lessening by around 10 per cent in 2019 and 23 per cent in 2020 considering the region’s geopolitical concerns and COVID-19, FDI incursion toward the area beseems to revive in 2022 following the fulfillment of the AfCFTA and the anticipated achievement of bargains on the attending property obligation. According to Ofori and Asongu (2021), there exists inside-country instability in FDI incursion into SSA, alongside nations like Nigeria, South Africa, Ghana, Mozambique, Angola, and Gabon rating successfully. This advancement factor that with appropriate organizations and property plannings, the inclusive growth-inducing belongings of FDI may be controlled (see Fig. 1).

The study by Ofori et al. (2022a) looks at the impact of economic integration and social equality measures on inclusive growth in SSA. It examines how resource allocation
and economic integration interact to affect inclusive growth. Using data on 43 SSA nations over the years 1980–2019, their analysis offered strong evidence from the GMM estimator to demonstrate that, in comparison to economic integration, social equality policies are fairly noteworthy in promoting inclusive growth. The findings also show that while economic integration promotes equitable growth, the effect is stronger when productive resource allocation is present.

In their study, Ofori and Asongu (2022) investigate whether the amazing influx of resources into SSA in the form of FDI positively impacts inclusive growth there, and also explore whether the institutional structure of SSA modifies the impact of FDI on inclusive growth in SSA. 42 SSA nations provided data for the analysis between 1990 and 2020. The results of the GMM estimator demonstrate that: FDI promotes inclusive growth in SSA, but the effect is weak, and SSA’s poor governance quality weakens or entirely negates the FDI-induced weak impact on inclusive growth.

The literature on ICT and inclusive growth

The impact of ICT infrastructure on inclusive growth in Africa was studied by Nchake and Shuaibu (2022). The Blundell-Bond system generalized technique of moments estimator was used to analyze data spanning 46 African countries between 2000 and 2019 and is based on inclusive growth analytics. The fundamental conclusion of the study is that ICT infrastructure has a positive and considerable influence on inclusive growth in Africa, generally and specifically across subregions of the continent.

By setting the 2030 United Nations Sustainable Development Goal 8, Adeleye et al. (2022) evaluated the leapfrogging hypothesis on eight SAARC economies from 2000 to 2020. Utilizing an unbalanced panel data on real per capita GDP along with four ICT metrics (mobile phones, fixed telephones, fixed broadband, and Internet users), their findings suggest that ICT (individual indicators and composite index) has a statistically significant beneficial impact on economic growth, with an effect that is largely felt at the 1% level.

Data and methodology

Data and variables

This study utilizes a macro dataset which covers 2005–2020 for 48 Sub-Saharan African countries. The study considers the start year of 2005 to enable more inclusion of SSA countries, while that is more justified by the absence of data for some of the ICT indicators prior to 2005. The study examines the effect of FDI on inclusive growth as modulated by ICT diffusion (Fig. 2).

The study’s key variables are inclusive growth, FDI and ICT. Inclusive growth and ICT are both captured by indexes (see Tables 1 and 2), while FDI is measured as net foreign direct investment inflow (% of GDP). As recommended by Asian Development Bank (2013), we use several indicators (see Table 1) to construct a composite index for inclusive growth via principal component analysis (PCA). Similarly, per the description of ICT indicators (see Table 2) by the international telecommunication union....

Fig. 1 FDI, ICT diffusion, and inclusive growth

Fig. 2 Impact of ICT and FDI on inclusive growth
ITU, we construct index for ICT diffusion. Inflation, as captured by consumer price index (2010 = 100), vulnerable unemployment as captured by the total contributing family and own-account workers (as share of employment), social protection measured as coverage of social protection and labor programs (% of the population) and trade as captured by trade (% of GDP), constitute our control variables. The selection of these variables is informed by related studies. These studies find that inflation and vulnerable employment are both detrimental to shared prosperity while trade and social inclusion promote it (Ofori and Asongu 2021; Mlachila et al. 2017; Asongu and Nwachukwu 2017). We describe these variables in Table 3. All the data are World Bank Development indicators (WDI 2022).

**Econometric model specification**

We specify the inclusive growth model based on our underpinning theories and the adopted econometric model to estimate both the direct and the indirect effects which Eqs. (1) and (2) represent:

\[
IGR_{i,t} = \beta_1 + \beta_2 IGR_{i,t-1} + \beta_3 FDI_{i,t-1} + \beta_4 ICT_{i,t-1} + \beta_5 X_{i,t-1} + \mu_i + \lambda_t + \epsilon_{i,t}
\]  

(1)

where \(i = 1, 2, \ldots, N\) where \(N\) represents the countries while \(t, t-1\) are current and previous year time periods; \(IGR\), FDI, and ICT are inclusive growth, foreign direct investment, and ICT diffusion. \(X\) is a vector of control variables: inflation, vulnerable employment, and social protection. Equation (2) below contains the interaction term for FDI and ICT diffusion:

\[
IGR_{i,t} = \beta_1 + \beta_2 IGR_{i,t-1} + \beta_3 FDI_{i,t-1} + \beta_4 ICT_{i,t-1} + \beta_5 FDI_{i,t-1} \times ICT_{i,t-1} + \beta_6 X_{i,t-1} + \mu_i + \lambda_t + \epsilon_{i,t}
\]  

(2)

We employ GMM technique to estimate the above equations. Specifically, we use the system GMM as our estimation technique. We check the robustness of the estimated model by estimating difference GMM to compare the

**Table 2 Inclusive growth indicators**

| ICT indicators                                      | Source |
|----------------------------------------------------|--------|
| International poverty headcount (US$1.90)          | PED    |
| People using at least basic sanitation service     | WDI    |
| GDP per capita (US$’ 2017 PPP)                     | WDI    |
| Effectiveness of institutions for social protection rating (1 = low to 6 = high) | CPIA   |
| Effectiveness of institutions for social inclusion rating (1 = low to 6 = high) | CPIA   |
| Electricity access (overall population)            | WDI    |
| Access to clean fuels and technologies for cooking is the proportion of the total population primarily using clean cooking fuels and technologies for cooking | WDI    |
| Gini index                                         | WDI    |
| Rule of law (estimate)                             | WDI    |
| Government expenditure on health (%GDP)            | WDI    |
| Government expenditure on education (%GDP)         | WDI    |
| Human Capital Index (HCI) (scale 0–1)              | WDI    |
| Labor force participation rate total (% of total population ages 15–64) | WDI    |
| Freedom of the media and general public in terms of association, expression, and institutions of public governments. | WDI    |

**Table 3 Description of variables**

| Variables                          | Unit of measurement                                      | Sources |
|------------------------------------|--------------------------------------------------------|---------|
| Inclusive growth index             | Index constructed using PCA                             | Author  |
| FDI                                | Net Foreign direct investment inflows (% of GDP)         | WDI     |
| ICT index                          | Index constructed using PCA                             | Author  |
| Inflation                          | consumer price index (2010 = 100)                       | WDI     |
| Social protection                  | coverage of social protection and labor programs (% of the population) | WDI     |
| Vulnerable employment (log)        | total contributing family and own-account workers (as share of employment) | WDI     |
| Trade                              | Trade (% of GDP)                                        | WDI     |

Note: WDI means World Development Indicators, while PCA is the principal component analysis.
efficacy of the two models. We use \texttt{xtdpdgmm} command for all the GMM estimations using STATA statistical package. The number of instruments in system GMM rises sharply in accordance with the number of regressors and time periods (see Roodman 2009). We use the orthogonal option to treat the issue of data loss, whereas first differences intensify gaps in unbalanced panel data.

Higher order serial correlation and Hansen tests are the two specification tests for GMM models. We conduct the second-order serial correlation on error terms that are first-differenced. We report no second order serial correlation when the error term is serially uncorrelated. We reject the null if the internal instruments are invalid based on endogenous lagged variables. Hansen’s test known as the over-identification test supplements the second-order serial correlation test for evaluating instrument validity.

Kleibergen-Paap LM test and the Kleibergen-Paap $F$ test are the two diagnostic statistics to descry weak instruments. Using ivreg2 command together with gmm2s option we compute the test statistics for the joint hypothesis based on our specified models. The idea is to test whether the level equation and the first-differenced equations have zero effect of the instruments. It is imperative to mention that ivreg2 command yields the same coefficients as the two-step GMM xtdpdgmm.

Results and discussions

Pre-estimation diagnostics

ICT diffusion index

As mentioned above, the study departs from many previous studies by constructing a composite index for ICT diffusion based on the classification of the international communication union (ICU). A total of twelve indicators are considered, and principal component analysis (PCA) is used to generate the said index. Table 1 presents these indicators.

A certain preliminary test is prerequisite to PCA and the study passes all. Meanwhile, we test to check for the following: (i) an adequate sample from the ICT covariates. (ii) The strength of correlations between these covariates. (iii) The strength of both partial and overall intercorrelations between these indicators. Appendix 1 supports selection of these indicators by showing a highly correlated covariate. The test confirms a significant intercorrelation between these indicators, based on the Bartlett chi () statistic of 1061.52 and the corresponding p-value (0.0000). Table 4 contains the Kaiser-Meyer-Olkin (KMO) statistics, showing the overall and partial intercorrelations between the indicators. The KMO statistics greater than 0.5 implies that the sample used for generating the index of ICT diffusion is adequate.

Having satisfied the preliminary tests, we progress to form a composite ICT index by normalizing these indicators to obtain a zero (0) mean, and a standard deviation equalized to one (1) based on different scales these indicators assume (Jolliffe 2002). Similarly, Table 4 depicts these components’ difference, proportion, cumulative and eigenvalues. In accordance with the Kaiser rule of eigenvalues, as adopted in Ofori and Asongu (2021) and Tchamyou, et al., (2019), we retain three components whose eigenvalues are greater than one (1) to get a composite ICT index. These three retained components cumulatively provide significant (61.6%) information in our data. Table 4 and Fig. 3 both confirm the above said.

Inclusive growth index

The preceding section explains in detail the process of generating a composite index of ICT diffusion. Here, we also

### Table 4 Principal components and eigenvalues (ICT diffusion)

| Component | Eigenvalue | Difference | Proportion | Cumulative | KMO statistic |
|-----------|------------|------------|------------|------------|---------------|
| PC1       | 4.0264     | 1.8227     | 0.3355     | 0.3355     | 0.7652        |
| PC2       | 2.2037     | 1.0421     | 0.1836     | 0.5192     | 0.5483        |
| PC3       | 1.1615     | 0.2680     | 0.0968     | 0.6160     | 0.7832        |
| PC4       | 0.8934     | 0.0434     | 0.0745     | 0.6904     | 0.7856        |
| PC5       | 0.8500     | 0.0895     | 0.0708     | 0.7613     | 0.8247        |
| PC6       | 0.7605     | 0.0657     | 0.0634     | 0.8247     | 0.6873        |
| PC7       | 0.6947     | 0.2510     | 0.0579     | 0.8825     | 0.7130        |
| PC8       | 0.4436     | 0.0752     | 0.0370     | 0.9195     | 0.6576        |
| PC9       | 0.3684     | 0.0990     | 0.0307     | 0.9502     | 0.6937        |
| PC10      | 0.2694     | 0.0932     | 0.0225     | 0.9727     | 0.7022        |
| PC11      | 0.1762     | 0.0245     | 0.0147     | 0.9874     | 0.8867        |
| PC12      | 0.1516     | 0.0126     | 0.0100     | 1.0000     | 0.7622        |
| Overall   | -          | -          | -          | -          | 0.7415        |

Note: KMO is Kaiser-Meyer-Olkin
explain the process of constructing an inclusive growth index. Based on the identification of several variables that define inclusive growth in developing countries, as recommended by Asian Development Bank (2013) we employ a principal component analysis to construct inclusive growth index. We present the indicators considered or selected to construct this index in Table 2.

Like the ICT index, the inclusive growth index passes all the preliminary tests. Appendix 2 reveals a strong correlation between the covariates. We confirm that the overall covariates are interrelated based on the 564.85 chi-square statistic and 0.000 corresponding p-value. The sampling adequacy for generating the index is affirmed by 0.8078 KMO statistics reported in Table 5. As these indicators have different scales, we normalize them to obtain their zero mean and a standard deviation equal to one (1). Figure 4 is the screen plot of components of inclusive growth consistent with Table 5.

**Summary statistics**

Table 6 presents a summary statistic of the variables. The average values of inclusive growth, FDI, and ICT are 0.014, 4.798, and 0.022. Inflation, social protection, vulnerable employment, and trade have average values of 93.978, 14.531, 2.971, and 76.408. Inflation and trade are the most dispersed variables, while inflation and social protection have 422.891 and 105.526 as maximum values. Appendix 3 correlation matrix indicates that the dependent and independent variables have strong positive and negative correlations.

**Results and discussion of the impact of FDI and ICT on inclusive growth**

Table 7 presents the results of OLS models. In all the models, FDI and ICT significantly positively affect inclusive
growth. Their joint effects are also positive and significant across all the models. While inflation and vulnerable employment are significantly negative across the models, social protection is positively insignificant in the fixed-effect model. Trade openness is negatively significant in the pooled-OLS model but positively insignificant in both fixed effect and random effect models.

Table 8 presents results of GMM estimates. GMM estimates take care of potential unobserved heterogeneity and biased estimates of the OLS models. The difference GMM (both one-step and two-step) models pass both serial correlations of order one (AR(1)) and order two (AR(2)) tests. The first two models also successfully pass the Hansen-Sargan tests with p-values well above 0.1. However, they have weak instruments relative to system-GMM models in the same table. Comparing the one-step system GMM with the two-step, we observe that p-value of AR(1) for the former is 0.055 relative to the 0.000 p-value of AR(1) for the latter. So, we drop one-step for the two-step GMM. More so, two-step GMM is more robust to heteroscedasticity and serial correlation.

Column (4) presents the results of the baseline model. The results show that both FDI and ICT diffusion positively and significantly affect inclusive growth. A 1% improvement in FDI enhances inclusive growth by 0.011% at 1% level of significance, whereas a 0.110% boost in inclusive growth accompanies a 1% rise in ICT diffusion. Our findings are
supported by Kang and Martinez-Vazquez (2021), Munir and Fatima (2020), and Ofori and Asongu (2021) who posit that FDI is a significant tool for achieving inclusive growth, especially for low- and medium-income countries.

Our results also show that inflation and vulnerable employment are significantly negative, implying that the two deteriorate inclusive growth. This calls for concern and the adoption of macroeconomic measures to cushion their effect on the standard of living. Social protection is significantly negative to inclusive growth. A 1% rise in social protection brings about a ~0.003% reduction in inclusive growth. This implies that social protection (income redistribution) programs like universal basic income program have not been effective in the region. Hence, there is a need for policy shift to protect vulnerable people and promote inclusion realistically. Our findings are consistent with the findings of Asongu and Le Roux (2017), Mlachila et al. (2017), and Ofori and Asongu (2021).

Table 8 Dynamic panel model estimation results (inclusive growth model)

| Variables                      | One-step diff-GMM | One-step syst.-GMM | Two-step diff-GMM | Two-step syst.-GMM | Long-run syst-GMM |
|--------------------------------|-------------------|--------------------|-------------------|--------------------|-------------------|
| Inclusive growth               | 0.6701***         | 0.5621***          | 0.7241***         | 0.4187***          | -                 |
|                                | (0.1608)          | (0.1349)           | (0.1737)          | (0.0899)           | (0.1303)          |
| FDI                            | 0.0253            | 0.0007*            | 0.0042*           | 0.0028*            | 0.0314***         |
|                                | (0.0023)          | (0.0002)           | (0.0010)          | (0.0039)           | (0.0075)          |
| ICT diffusion                  | 0.1277***         | 0.1320***          | 0.1890***         | 0.1106***          | 0.0537***         |
|                                | (0.0672)          | (0.0633)           | (0.0453)          | (0.0391)           | (0.0128)          |
| Inflation                      | -0.0062**         | -0.0036*           | -0.0002           | -0.0014***         | -0.0008***        |
|                                | (0.0014)          | (0.0009)           | (0.0000)          | (0.0032)           | (0.0001)          |
| Social protection              | 0.0007**          | 0.0035             | 0.0006            | -0.0031***         | -0.0012**         |
|                                | (0.0002)          | (0.0008)           | (0.0001)          | (0.0027)           | (0.0002)          |
| Vulnerable employment (log)    | -0.0072***        | 0.0042*            | -0.0045*          | -0.0029***         | -0.0021***        |
|                                | (0.0018)          | (0.0010)           | (0.0011)          | (0.0061)           | (0.0005)          |
| FDI*ICT diffusion              |                   |                    |                   |                    | 0.0172***         |
|                                |                   |                    |                   |                    | (0.0006)          |
| Trade openness                 | 0.0843            | 0.0031             | 0.0036**          | 0.0011             | 0.0022            |
|                                | (0.0202)          | (0.0007)           | (0.0009)          | (0.0012)           | (0.0005)          |
| Constant                       | 2.1991            | -0.9145            | 3.0562            | 3.5632             | 0.9673            |
|                                | (0.4618)          | (0.1829)           | (0.0112)          | (0.7126)           | (0.1934)          |
| Net effects of FDI             | -                 | -                  | -                 |                    | 0.1362            |
| ICT threshold                  | -                 | -                  | -                 |                    | 3.1220            |
| Time effect                    | Yes               | Yes                | Yes               | Yes                | Yes               |
| Hansen-Sargan test             | 0.1964            | 0.2537             | 0.1725            | 0.3574             | 0.2482            |
|                                | (0.045)           | (0.0061)           | (0.0023)          | (0.0556)           | 0.2135            |
| AR(1)                          | 0.2967            | 0.4168             | 0.4655            | 0.8492             | 0.5926            |
|                                | (0.0150)          | (0.0072)           | (0.0005)          | (0.0002)           | 0.7463            |
| Kleibergen-Paap LM stat.       | 3.674             | 2.142              | 14.573            | 27.144             | 19.373            |
| Kleibergen-Paap Wald stat.     |                   |                    |                   |                    |                   |
| Stock-Yogo critical value:     | 10% maximal IV relative Bias | 8.43             | 7.16              | 12.72              | 18.99             |
|                                |                    |                    |                   |                    | 15.44             |
|                                | 20% maximal IV relative Bias | 5.20             | 4.42              | 8.32               | 9.152             |
|                                |                    |                    |                   |                    | 7.48              |
|                                | 30% maximal IV relative Bias | 4.01             | 3.40              | 6.41               | 7.05              |
|                                |                    |                    |                   |                    | 5.76              |

Column (5) gives findings of the interaction term. As in column (4), FDI and ICT diffusion enhance inclusive growth. However, the positive influence of FDI on shared prosperity is greater with ICT development. The joint effects of FDI and ICT diffusion bring more shared prosperity. The net effects of FDI are calculated as 0.0537+(0.0172*0.7983) = 0.1362 where the interaction coefficient is multiplied by the average value of FDI and added to the coefficient of ICT diffusion. Amidst positive role of ICT development, the net effect of enhancing the role of FDI in shared prosperity is 0.1362.

Our findings affirm the proposition that promoting ICT diffusion could stimulate shared prosperity. ICT development makes information more accessible, creates employment opportunities and increases positive externalities in terms of knowledge spillover effects. ICT diffusion could help the masses optimize the opportunities the increasing inflow of inflow of FDI provides in the SSA.
We add to the extant literature by calculating the threshold level at which ICT diffusion may determine the effect of FDI on inclusive growth. We compute the ICT diffusion threshold value by dividing the FDI coefficient by the interaction term coefficient; 0.0537/0.0172 = 1.83 (see Asongu et al. 2020). The result indicates that the positive effect of FDI on inclusive growth could intensify if the calculated ICT diffusion threshold is exceeded.

Other variables maintain the same sign as in the preceding column. So, qualitatively sub-model (5) is the same as sub-model (4) but quantitatively, the magnitude of the coefficients differs depending on a particular variable. Columns (4) and (5) have valid and relevant instruments. Based on the reported p-values which are less than 0.01 for the Kleibergen-Paap LM statistic, the instruments are valid. The Kleibergen-Paap F-statistics are also above the critical values proposed by Stock and Yogo (2005) and so our models are properly identified.

We present the long-run results in column (6). At first, we observe a qualitative convergence of the coefficients in column (5) and (6). Quantitatively, the short-run coefficients have less magnitude than the long-run ones. We stress that ICT diffusion threshold should be exceeded while FDI inflow should be substantially raised to strengthen shared prosperity in the region.

Our findings should not be underestimated in view of the growing economic integration of the region under the AfCFTA and the anticipated increase in FDI beginning in this year 2022. In fact, as the industrial base grows, forward and backward connections are strengthened, and more people participate in the global value chain, FDI may lead to inclusive growth in SSA via reduction of poverty, corporate social responsibility, and macroeconomic stability. The dramatic increase in ICT penetration can be used in a number of ways to promote shared prosperity in SSA. Adoption, for instance, assist to level the playing field in education by improving information accessibility, conducting timely and affordable research, and reducing administrative processes. The increase in ICT diffusion in the healthcare sector might be beneficial by accelerating data collection and storage, remote consultation and diagnosis, and rapid reaction to epidemics and pandemics. Moreover, using drones to deliver medicines, blood, and other supplies to remote locations is saving lives in places like Rwanda and Ghana.

Furthermore, noteworthy is the ability of ICTs to inform policymakers and the general public about the gravity of future environmental threats/natural catastrophes through improving geographical monitoring and concerted reactions. Additionally, policymakers can empower the region’s youthful population with ICT diffusion to actualize their creative ideas and significantly contribute to national development as a result of the innovation hubs and industrial parks that are cropping up in SSA, particularly in nations like South Africa, Ghana, Nigeria, Mauritius, and Kenya. By increasing administrative effectiveness, efficiency, and the reach of public interaction and communication—which are essential for social inclusion and inclusive growth—ICT development can also promote good governance and accountability. In fact, authorities in a number of countries in the region are utilizing ICT to offer information, opportunities, and services to the general people.

### Results for different income-level countries

Here we investigate the effects of FDI and ICT diffusion on inclusive growth based on a country’s income level. The purpose is to see if these effects are heterogeneous across these SSA countries. Based on World Bank’s classification of SSA countries, we split these countries into two—middle-income (high and low) countries and low-income countries.

#### Results for middle-income countries

Table 9 presents the results for middle-income countries. Columns (1) and (2) show that FDI is significantly positive at 10% and 5% levels, implying that FDI is a significant determinant of shared prosperity. The same columns also show that ICT diffusion positively affects inclusive growth at 5% significance level, signifying that ICT is very much relevant for shared prosperity. These results show that the coefficient of ICT diffusion have bigger magnitude for middle-income group than the full sample, indicating that the effects of ICT diffusion are higher in this income group.

The interaction term shows the same pattern for this income group—it is positively higher at 5% significance level than what the full sample shows. Overall, the results are very much consistent with our full sample’s results and our expectations. Here, we emphasize that although both FDI and ICT diffusion directly affect inclusive growth positively, their interaction could bring higher effects.

The control variables maintain the same sign as in the full sample. Column (3) shows the long run coefficients for all the variables. The long run results show that the direct effects of FDI and ICT diffusion and their interactive (indirect) effects intensify in the long run. The same applies to the control variables, except for insignificant trade openness. In all the columns AR (1) is less than the 0.05 significance level while AR (2) and the Hansen test have values well above 0.01. The p-values for the Kleibergen-Paap LM statistic are well below 0.01 while the Kleibergen-Paap F-statistics are also above the critical values proposed by Stock and Yogo 2005 These show that our models pass all the specification and identification tests.

#### Results for low-income countries

Different from what is obtained for the middle-income group, FDI is not significant for the low-income countries...
Table 9 Dynamic GMM estimates: middle-income countries

| Variables                  | (1)          | (2)          | (3)          |
|---------------------------|--------------|--------------|--------------|
| Inclusive growth          | 0.7163***    | 0.5784***    | -            |
|                           | (0.1382)     | (0.1221)     | -            |
| FDI                       | 0.0060*      | 0.0297***    | 0.0704****   |
|                           | (0.0032)     | (0.0055)     | (0.0337)     |
| ICT diffusion             | 0.2870***    | 0.1740***    | 0.4127***    |
|                           | (0.0771)     | (0.0168)     | (0.1980)     |
| Inflation                 | -0.0006***   | -0.0004***   | 0.0009***    |
|                           | (0.0000)     | (0.0002)     | (0.0004)     |
| Social protection         | 0.0094       | 0.0069**     | 0.0163**     |
|                           | (0.0056)     | (0.0051)     | (0.0112)     |
| Vulnerable employment (log)| -0.0013**   | -0.0173*     | 0.0410*      |
|                           | (0.0007)     | (0.0029)     | (0.0098)     |
| FDI*ICT Diffusion         | 0.0186***    | 0.0417***    |             |
|                           | (0.0149)     | (0.0300)     |             |
| Trade openness            | 0.0028*      | 0.0425       | 0.1008       |
|                           | (0.0053)     | (0.0351)     | (0.0675)     |
| Constant                  | 1.7245       | 1.2472       | 0.7594       |
|                           | (1.069)      | (0.6512)     | (0.5725)     |
| Time effect.              | Yes          | Yes          | Yes          |
| Hansen-Sargan test        | 0.3212       | 0.2741       | 0.2482       |
|                           | (0.0953)     | (0.0351)     | (0.0675)     |
| AR(1)                     | 0.0026       | 0.0000       | 0.0000       |
|                           | (0.0264)     | (0.3782)     | 0.2936       |
| Kleibergen-Paap LM stat.  | 0.0062       | 0.0014       |             |
| Kleibergen-Paap Wald stat| 27.372       | 31.726       |             |
| Stock-Yogo critical value:| 10% max. IV rel. bias. | 9.74 | 12.33 |
|                           | 20% max. IV rel. bias. | 5.62 | 7.12 |
|                           | 30% max. IV rel. bias. | 4.13 | 5.24 |

Note: the parentheses contain the robust standard errors. ***p < 0.01, **p < 0.05, *p < 0.1.

category. Table 10 shows that FDI, although significant at 10% level in column (1), appears insignificant in column (2), which contains the interaction term. ICT diffusion is positively significant across all the columns, indicating that even in the low-income group, ICT is a significant determinant of inclusive growth. We cannot confirm the interaction effect of FDI and ICT diffusion on inclusive growth. Column (2) shows that the interaction term is not significant. We attribute this to the insignificance of FDI effect in this income group. Column (3) presents the long-run coefficient. As in Table 10 all the variables show more significant effects in the long run, except FDI and its interaction with ICT, and trade openness, that are insignificant. These results show that the level of FDI inflows into these countries is very insignificant in bringing about shared prosperity. As in above, considering the results of AR (1), AR (2), Hansen test, Kleibergen-Paap LM statistic and Kleibergen-Paap F-statistics, we can conclude that our models are correctly specified and over-identified.

Comparing the results of middle-income group and low-income group, we present the following findings: Based on the magnitude of ICT coefficients, we can argue that the effect of ICT diffusion on inclusive growth is higher in the middle-income countries than the low-income ones. Digital divide may be the major reason for the divergent effects of ICT diffusion across the SSA countries. Differences in terms of socio-economic advantages among different economic agents and geographical locations which divide them based on their capabilities to diffuse ICT explain digital divide (Pepper & Jackman 2019; Donou-Adonsou 2019; OECD 2010). This is also supported by “Mathew effect” which implies that high-income countries have a comparative advantage in ICT use and early development against low-income ones (Tewathia et al. 2020). More so, middle-income...
countries like Nigeria, Ghana, South Africa, Mauritius and Kenya experience growth of innovation hubs and industrial sparks, which allow people, especially youths, to leverage the abundant ICT opportunities to achieve inclusive growth. Despite the increasing inflow of FDI into Sub-Saharan Africa and anticipation for its rebound in 2022, our results suggest that this development is more peculiar to middle-income countries. The low-income countries seem to lag in attracting FDI into their countries and benefit from it in achieving inclusive growth. These low-income countries need robust policy and institutional reforms coupled with a stable environment to converge with other SSA countries in terms of attracting FDI into the region.

The reports of UNCTAD (2019) reveal that telecommunication, aviation and extractive industries are the major recipient of FDI in SSA. These industries require effective ICT use to exploit the opportunities which FDI offers. The interaction of FDI with ICT diffusion is a significant one in the region and policymakers need to recognize this significant interaction so as to be able to make the required policy shifts toward attracting more FDI and effective ICT diffusion in the region.

Conclusion and policy recommendations

Conclusion

In this paper, we critically examined the synergy effect of ICT diffusion and foreign direct investment on inclusive growth using a modified system-GMM model based on 48 SSA countries covering the period 2005 to 2020. All the data are sourced from the World Bank Development Indicators (WDI, 2022). The system GMM estimation technique in our study uniquely takes care of the instruments’ significance. We deploy a recent technique to evaluate the strength of joint instruments in our system GMM based on Kripfganz’s (2019) method. Kripfganz’s method gets the standard diagnostics of the strength of joint instruments while it modifies the moment conditions for one level equation based on level and first difference equations in the system GMM. Our GMM models are devoid of biases, although system GMM does not effectively treat omitted variable bias. We include time-fixed effects in our models to make our GMM estimates robust to omitted variable bias. Overall, this study focuses on three areas: first, we analyze the direct effects of ICT diffusion and FDI on inclusive growth. Second, we investigate the indirect effects of ICT diffusion and FDI on inclusive growth using an interaction term on inclusive growth, and lastly, this study contribute methodologically and empirically to the extant literature on the subject matter.

Policy recommendations

Based on the empirical findings, we provide policy suggestions as follows: empirical results show that both FDI and ICT diffusion positively and significantly affect inclusive growth. We are of the opinion that policymakers in these regions could come up with policies that would attract foreign direct investment since it tends to boost inclusive growth in Africa by creating several opportunities. This would help to raise the average income of its citizenry by creating more employment opportunities. Facilitate the technology diffusion process and enhance the innovative capacity of the average poor in the receiving country. In addition, as discussed earlier, FDI would stimulate knowledge spillover, as it improves the technical know-how of the average worker and thereby enhances his skills. FDI should be directed toward enhancing corporate social responsibility in education, health, social amenities, and other areas that could directly better the life of people. ICT diffusion should be pursued rigorously since it makes access to information easier, breaks information barriers, exposes people to new opportunities, and makes teaching and learning more effective, and research cost-effective.

We find that inflation and vulnerable employment are significantly negative, implying that they deteriorate inclusive growth. This calls for concern and adoption of macroeconomic measures by governments and policymakers to cushion their effect on the standard of living. Also, social protection is significantly negative to inclusive growth. This indicates that social protection (income redistribution) programs like universal basic income program have not been effective in the region. Policymakers should revisit these social protection programs to understand why they have not been effective and come up with more workable policies that align with these regions’ macroeconomic objectives for an all-inclusive and sustainable economic growth, while protecting the vulnerable groups and promote inclusion.

Empirically and methodologically, we have shown that FDI and ICT diffusion enhance inclusive growth. We affirm this proposition that promoting ICT diffusion could stimulate shared prosperity. ICT development makes information more accessible, creates employment opportunities, and increases positive externalities in terms of knowledge spillover effects. ICT diffusion could help the masses optimize the opportunities the increasing inflow of FDI provides in the SSA. Conclusively, this study is confined to some selected SSA countries, due to data availability. Future researcher should focus on examining the interactions among the observed series for Africa at large, to substantiate findings from this study. In addition, the use of more advance methods such as econometric techniques that capture regime switch is suggested to carry out future studies.
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