Impact of Digital Infrastructure on Inclusive Growth in Africa

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SUMMARY

This study aims to investigate the role of digital infrastructure in promoting inclusive growth in Africa. The study employs fixed-effects and random-effects econometric techniques, followed by the Generalized Method of Moments (GMM), on secondary data from international databases (World Bank, International Telecommunication Union, International Energy Agency) for a panel of African countries covering the period from 2000 to 2024. The results show that technological indicators such as internet access, mobile and fixed-line telephony have positive and significant effects on inclusive growth as measured by the Human Development Index (HDI) and the Gini coefficient. The influence of ICTs depends on their level of development and they can be used as tools by policymakers.

Context

The impact of digital infrastructure on inclusive growth in Africa is a central issue for the continent's development within a global context of digital transformation. Indeed, the rapid expansion of digital infrastructure, such as internet connectivity and access to fixed and mobile networks, offers unprecedented opportunities to reduce poverty, improve access to essential services, and foster equitable economic growth. However, this transformation also raises significant challenges related to the digital divide, the unequal distribution of resources, and the sustainability of investments.

Since the early 2020s, numerous publications and studies have highlighted the crucial importance of digital infrastructure for fostering inclusive growth in Africa. According to a 2022 World Bank report, the expansion of internet connectivity has enabled millions of people to access financial services, online education, and remote healthcare. The report emphasizes that improving internet access in rural areas is a prerequisite for reducing social and economic inequalities. For example, in Ethiopia and Nigeria, investment in the deployment of 4G and 5G mobile networks has led to deeper integration of marginalized populations into the digital economy, thereby creating opportunities for employment and entrepreneurial development (World Bank, 2022).

Furthermore, a 2023 study published by UNCTAD (United Nations Conference on Trade and Development) highlights that improving digital infrastructure directly contributes to inclusive growth by facilitating the integration of small and medium-sized enterprises (SMEs) into national and international markets. By focusing on digital platforms, these SMEs can access new customers and financial resources, thereby stimulating their development and, by extension, that of local communities. The same study emphasizes that this dynamic is particularly beneficial in rural areas where traditional economic opportunities remain limited (UNCTAD, 2023).

However, these advances are not without challenges. The digital divide remains a major obstacle. According to the African Union's 2024 report, nearly 60% of rural populations remain disconnected due to insufficient infrastructure or prohibitive access costs. The disparity between urban and rural areas limits the reach of the benefits of digitalization and risks exacerbating existing social inequalities. Furthermore, the quality and sustainability of digital infrastructure are questionable, particularly in the context of climate change, where network resilience to natural disasters is becoming a priority (African Union, 2024).

Furthermore, the issue of governance and regulation of digital infrastructure is essential to ensuring inclusive growth. The International Trade Centre (ITC) emphasizes that establishing favorable regulatory frameworks, coupled with transparent investment policies, can maximize the positive impacts of digitalization. It also recommends strengthening regional cooperation to deploy cross-border infrastructure, thereby facilitating the continent's economic and digital integration (International Trade Centre, 2025).

The development of digital infrastructure in Africa represents a major opportunity to promote more equitable economic growth, reduce inequalities, and foster sustainable development. However, this transition must be accompanied by inclusive policies, concerted regional strategies, and a commitment to ensuring access to and effective use of technologies.

Inclusive growth in sub-Saharan Africa is a major challenge for reducing socio-economic inequalities and promoting sustainable development, and digital infrastructure plays a crucial role in this dynamic. However, despite recent technological advances, it remains essential to understand the extent to which this infrastructure actually contributes to equitable growth. The central issue is to analyze the impact of digital infrastructure—such as internet access, mobile telephony, and digital platforms—on economic, social, and territorial inclusion in this developing region.

LITERATURE REVIEWS ON THE IMPACT OF DIGITAL INFRASTRUCTURE ON INCLUSIVE GROWTH

Theoretical literature reviews

Many economists highlight the importance of the digital economy, as measured by information and communication technologies (ICTs), in the economic growth of developing countries (Elouardirhi , S. et al. (2025)). The most classic theories of factors of production, such as neo-Schumpeterian and neoclassical growth theories, have already shown a positive impact on ICTs; they have resulted in contributions on the economic supply side in the form of the capital factor and have stimulated the production process, technological advances, the quality of the workforce and, consequently, economic growth (Pang et al. 2023).

However, contrary to more traditional theories that consider technology as an exogenous factor, recent empirical studies demonstrate an endogenous relationship between ICTs and the growth process, influenced by investment, human capital accumulation, and public policies (Jorgenson DW et al., (2005) & Acemoglu , D. (2002)). This leads to positive effects not only on economic growth but also on inclusive growth, with regard to average life expectancy, education, health, and poverty reduction. Furthermore, recent empirical studies show that in some countries, there can be a positive relationship between ICTs and inclusive growth. Nevertheless, there is evidence of a negative relationship, indicating that its impact depends on the level of economic development of the countries analyzed.

Empirical literature review

Africa has experienced accelerated digital transformation over the past decade, with significant expansion of digital infrastructure such as telecommunications networks, internet access, and electronic payment systems. Inclusive growth, which aims to reduce social and economic inequalities, is considered a central issue for the region's sustainable development. This empirical review analyzes the work of authors who have highlighted the mechanisms by which digital infrastructure influences inclusive growth.

Several recent studies highlight that the deployment of digital infrastructure facilitates access to health, education, and financial services for marginalized populations. For example, the study by Dembele , AA (2023), published in *African Development Review* shows that in Côte d'Ivoire, the expansion of telecommunications networks has led to a 25% increase in access to healthcare in rural areas. Increased connectivity thus reduces geographical disparities, fostering more inclusive growth. Similarly, Wang et al. (2024) in the *Journal of African Economies* analyzed the role of mobile platforms in access to education, finding that the use of educational applications increased the participation of children from low-income households by an average of 15%.

Regarding how digital infrastructure contributes to reducing economic inequality, the study by Ouma (2023) published in *Technological Forecasting and Social Change* shows that the adoption of mobile payments (e.g., M-Pesa, Airtel Money) in several East African countries has enabled unbanked populations to access financial services, facilitating financial inclusion. The study indicates that in 2023, the financial inclusion rate increased by 20 percentage points in these areas, making it easier for micro-entrepreneurs to access credit and increase their productivity. Furthermore, research by Nguea , SM (2025), published in *Information Development ,* reveals that areas with intensive digital infrastructure deployment experienced 3% higher annual economic growth than less connected areas, highlighting the role of this infrastructure in reducing economic inequality.

Zanfack , LT (2024) highlights that the adoption of digital technologies contributes to greater financial inclusion, particularly through mobile services, but that this inclusion remains uneven, sometimes exacerbating regional and social disparities . Meanwhile, the analyses of Elouardirhi , S. et al. (2025) emphasize that the positive impact of digital infrastructure also depends on its integration into public policies, the training of populations, and the development of digital skills, underscoring the need for a holistic approach to foster truly inclusive growth.

Regarding the agricultural sector, which employs a majority of the population in sub-Saharan Africa, it also benefits from digital infrastructure. According to a study by Mensah JK et al. (2024) in *Interventions and Challenges* , the introduction of digital platforms for marketing agricultural products has enabled smallholder farmers to access new markets, increase their incomes, and reduce their vulnerability to price fluctuations. The results show an average increase of 18% in agricultural incomes in areas equipped with digital infrastructure. This transformation contributes to more equitable growth by promoting the participation of rural populations in the national economy.

Despite these benefits, several studies highlight limitations. For example, Dlamini R (2025) in *the Association for the Advancement of Computing in Education (AACE)* points out that inadequate electrical infrastructure and a limited digital literature hinder the potential impact of digital infrastructure. Furthermore, the digital divide, particularly between urban and rural areas, remains a major obstacle to inclusive growth. Research by **Adebayo et al. (2025)** in *Environmental Sciences Europe Review further illustrates this point.* This indicates that, although network expansion has progressed, coverage remains uneven, limiting the benefits for vulnerable populations. Finally, governance and cybersecurity issues, discussed in Kamau 's study (2024), can also limit trust in these infrastructures and hinder their adoption.

Furthermore, empirical literature highlights persistent challenges. Poor coverage in some rural areas, inadequate communication infrastructure, and high access costs remain major obstacles. For example, research by Zanfack , LT (2024), shows that in several African countries, internet penetration remains below 20%, thus limiting its potential impact on inclusive growth. These authors emphasize the need for public policies aimed at reducing costs and improving coverage to maximize benefits.

STUDY METHODOLOGY

Basic Model

The objective is to estimate the effect of digital infrastructure (e.g., internet penetration, mobile coverage, or access to technology) on inclusive growth, often measured by a human development index, per capita income, or poverty reduction indicators. Following the studies of Kouladoum, JC (2023). and Elouardirhi , S. et al. (2025), who linked digital infrastructure to growth, define the basic econometric model as follows:

$$\boldsymbol{Growth\_Inclusive_{it}} = \propto + \boldsymbol{\beta Digital\_Infras_{it}} + \boldsymbol{\theta X_{it}} + \boldsymbol{\mu_i} + \boldsymbol{\lambda_t} + \boldsymbol{\varepsilon_{it}} (1)$$

where : i denotes the country, t denotes the year,

$Growth\_Inclusive_{it}$ is the dependent variable representing inclusive growth captured by the poverty reduction rate (GINI index), the human development index (HDI).

$Digital\_Infras_{it}$ is the measure of digital infrastructure captured in this study by: Internet access measured by the percentage of the population having access to the Internet; Mobile coverage measured by the number of mobile lines per 100 inhabitants; Internet usage measured by the proportion of the population using the Internet; Investments in digital measured by spending on digital infrastructure as a percentage of GDP.

$\boldsymbol{X_{it}}$ is a vector of control variables including GDP per capita (to control the general level of development), the literacy or education rate, political stability and governance, investments in physical infrastructure, demographic variables (population, urbanization).

$\boldsymbol{\mu_i}$ represents the fixed effects specific to each country,

$\boldsymbol{\lambda_t}$ represents the fixed temporal effects,

$\boldsymbol{\varepsilon_{it}}$ **e** is the term for error.

The basic model is estimated using ordinary least squares with all country and time fixed effects. However, there might be inertia in the dependent variable such that its current level is explained by its past level. This may be because economic growth is not an instantaneous phenomenon but follows a time-dependent dynamic. Thus, past growth often influences future growth due to persistence effects, capital accumulation, skills accumulation, or the effects of confidence and institutions. To account for this, we specify a dynamic model by including the lagging of the dependent variable among the explanatory variables. To this end, we rewrite equation (1) as follows:

$$\boldsymbol{Growth\_Inclusive_{it}} = \propto + \boldsymbol{Growth\_Inclusive_{it-1}} + \boldsymbol{\beta Digital\_Infras_{it}} + \boldsymbol{\theta X_{it}} + \boldsymbol{\mu_i} + \boldsymbol{\lambda_t} + \boldsymbol{\varepsilon_{it}} (2)$$

The OLS estimator becomes inconsistent. It is also inconsistent due to certain endogeneity issues that can be attributed to the potentially reverse causality between inclusive growth and digital infrastructure. That is, inclusive growth can encourage investment in digital infrastructure, as an expanding economy can generate more revenue and incentives to develop such infrastructure. Conversely, the presence of modern digital infrastructure can stimulate more inclusive economic growth. Thus, the relationship can work both ways, making it difficult to determine which variable influences the other first.

endogeneity bias arising from measurement errors and omitted variables, an econometric strategy based on instrumental variables must be implemented. Therefore, we use the two-step generalized method of moments (GMM) to estimate equation (2). The estimation method proposed by Arellano and Bond (1991) involves transforming all regressors , usually by differentiation, and uses the GMM (Hansen, 1982); this method is commonly referred to as difference GMM. The estimators of Arellano and Bover (1995) and Blundell and Bond (1998) improve upon the Arellano and Bond (1991) approach by assuming that the first differences of the instrumental variables are uncorrelated with the fixed effects. This allows for the inclusion of a larger number of instruments, which can improve efficiency. The resulting system incorporates two equations—the original equation and its transformed counterpart—and is known as the system GMM (Roodman , 2009). Blundell and Bond (1998) demonstrated that the system-based GMM produces more efficient estimates than the difference-based GMM.

We also implemented the estimation of instrumental variables using the two-step least squares method. This allows us to address the endogeneity problem. in depth using external instruments. Although the GMM effectively handles endogeneity problems by generating instruments from the lagged values of the regressors , it turns out that these lagged values are in some cases weak instruments.

Data Sources for Variables and Stylized Facts

Data Sources

This research relies primarily on secondary data from a panel of 50 African countries for the period 2000-2024. These countries were selected based on data availability. Other African countries were excluded due to the lack of much of the data, particularly data related to the Gini index and the HDI.

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The primary data source used is the World Development Indicators (WDI) calculated by the World Bank (2025). We also rely on the Global Telecommunications/ICT Indicators Database, International Telecommunication Union (ITU) for indicators that capture digital infrastructure such as Internet access, mobile and fixed subscriptions.

Stylized Facts

The aim here is to present the distribution of our sample of countries indicating the correlation between inclusive growth and internet access, the number of mobile and fixed subscriptions.

Figure 1: Correlation between inclusive growth and access to fixed-line telephony

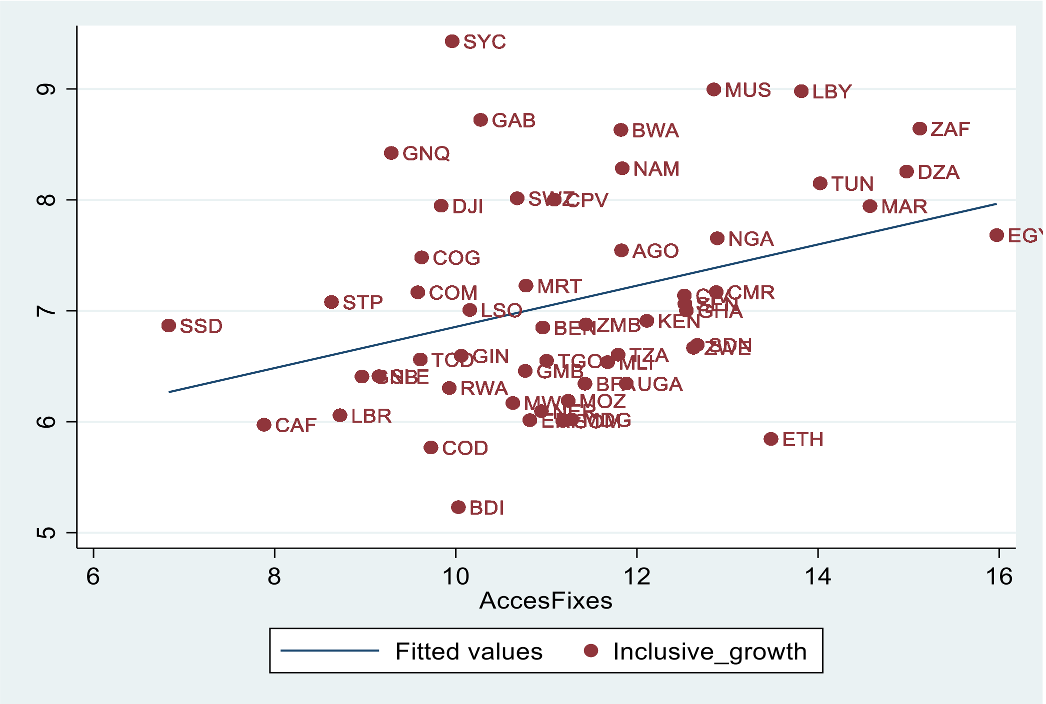

Figure 1 shows that inclusive growth is a function of access to fixed-line subscriptions. Countries such as Libya, Egypt, Tunisia, Morocco, and Zambia, which have high rates of fixed-line subscription access, experience strong inclusive growth. Conversely, countries like Liberia, South Sudan, and Chad have lower rates of fixed-line subscription access and, consequently, experience weak inclusive growth.

Figure 2: Correlation between inclusive growth and access to mobile telephony

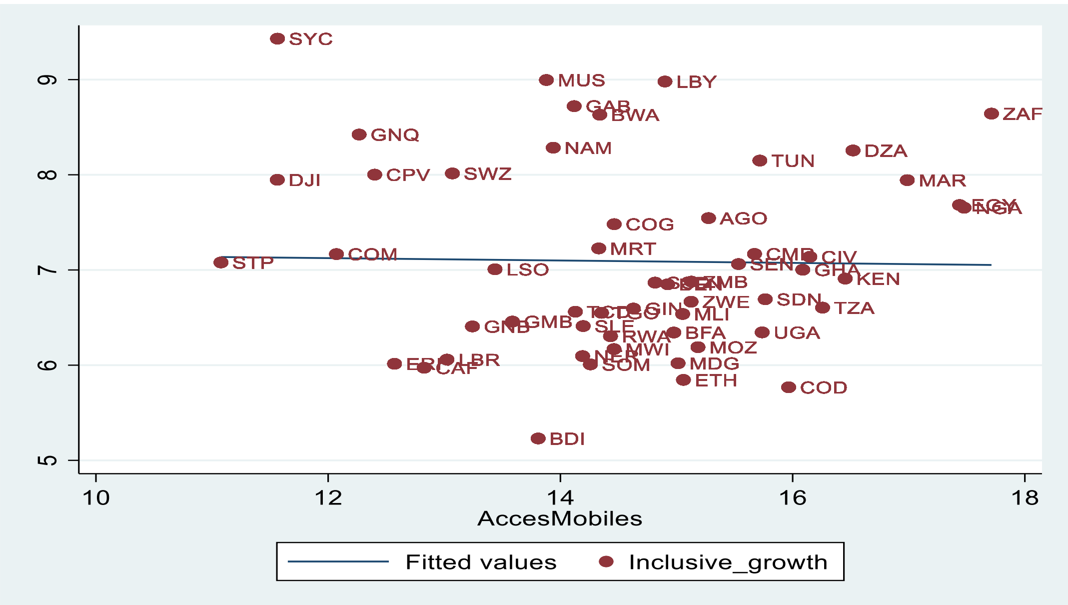

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Figure 2 shows that inclusive growth is a function of access to mobile subscriptions. Countries such as Libya, Tunisia, Morocco, and Zambia, which have high rates of mobile subscription access, experience strong inclusive growth.

Conversely, countries like Liberia, Djibouti, and Lesotho have lower rates of mobile subscription access and, consequently, experience weak inclusive growth.

Figure 3: Correlation between inclusive growth and internet access

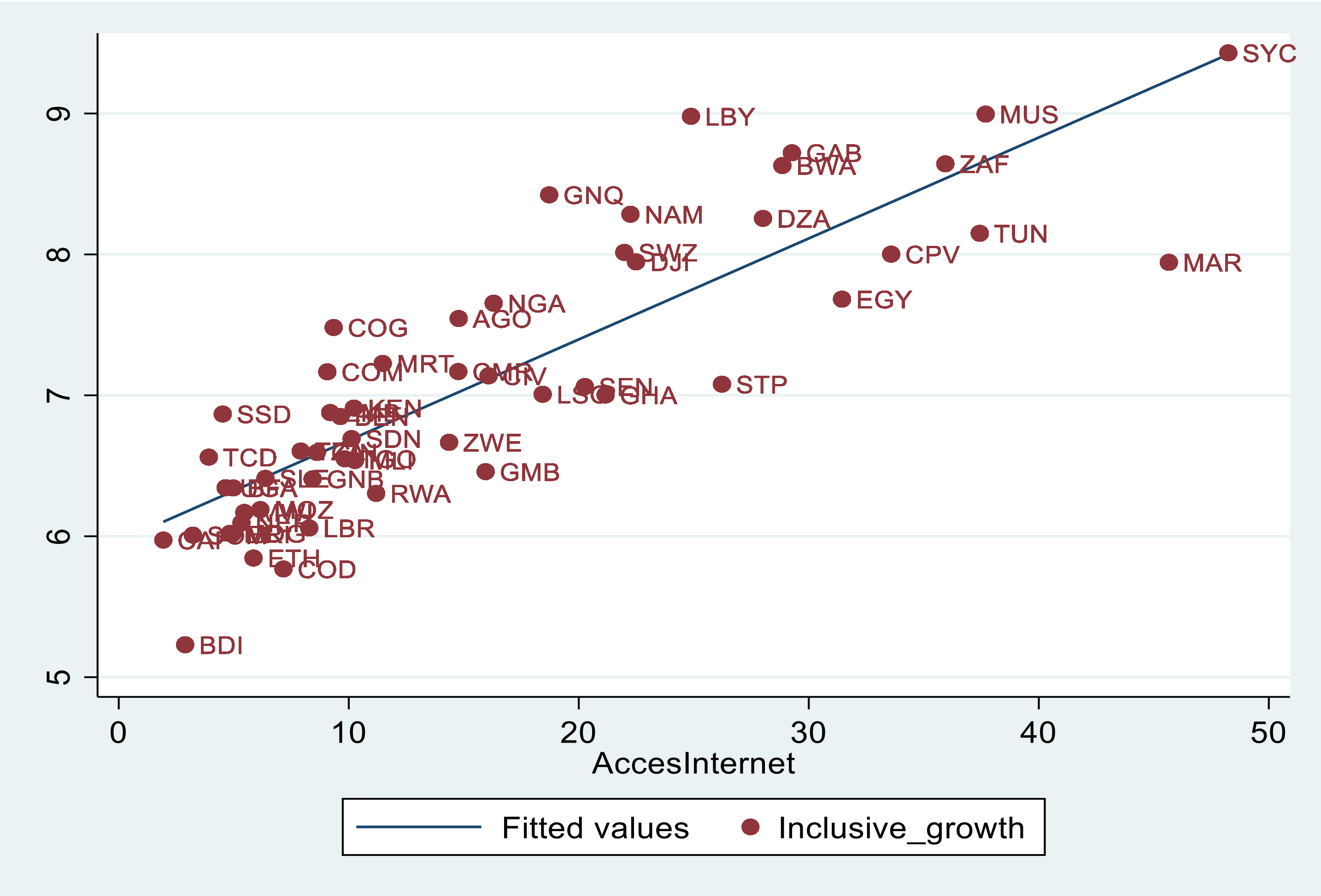

Figure 3 shows that North African countries such as Libya, Tunisia, and Morocco, which have high internet access rates, experience high inclusive growth. Conversely, countries like Chad, Liberia, and Congo have lower internet access and low inclusive growth.

RESULTS

Descriptive statistics of variables

Table 1 presents, for each variable, the number of observations, the mean, the standard deviation, the minimum and the maximum.

Regarding the Human Development Index (HDI), the average is around 53.9%, showing moderate dispersion (coefficient of variation ≈ 0.12). The range indicates that some sub-Saharan African countries have relatively low human development (≈26) while others have rather high levels (≈80). As for the Gini coefficient, the average inequality is moderate, around 42. The dispersion is significant (standard deviation ≈ 7.2), with some countries exhibiting relatively egalitarianism and others more unequal. The Multidimensional Poverty Index indicates a large variability between countries ranging from 0.7% to 88.3% with an average of 48.5% and a high dispersion (CV ≈ 0.49).

Regarding Internet access, there is heterogeneity between countries with a low average (16.11%) and a large dispersion (20.26%); a minimum of 0.005% and a maximum of 91%. Regarding mobile phone access, there is an average of 14.6%; a much lower dispersion (2.26%) than for the Internet; a minimum of 5.43% and a maximum of 19.22%.

Regarding access to landline telephones, we note an average of 11.43%, a moderate dispersion (1.83), the minimum is 5.01% and the maximum is 16.33%.

The logarithm of Foreign Direct Investment has a mean of 4.22, a dispersion of 7.48, a minimum of -17.29, and a maximum of 103.3. The logarithm of GDP per capita shows a mean of 23.07, a dispersion of 1.62, a minimum of 18.14, and a maximum of 27.07. The logarithm of Education Expenditure has a mean of 3.93, a standard deviation of 2.02, a minimum of 0.348, and a maximum of 13.21, suggesting significant variability in education expenditure between countries in sub-Saharan Africa. The logarithm of population has a mean of 15.92, a standard deviation of 1.586, a minimum of 11.3, and a maximum of 19.26. Regarding Urbanization, the average score is 3.5; the standard deviation is 1.53; the minimum is -4.431; and the maximum is 9.89. For Political Stability, the average score is -0.596; the standard deviation is 0.907; the minimum is -3.312; and the maximum is 1.283. Regarding Governance, the average score is 26.6, showing significant dispersion (standard deviation of 20.1), indicating highly variable levels of governance among the observed entities, with a minimum of 0 and a maximum of 84.61.

Table 1: Descriptive statistics of variables

Variables	Obs.	Average	Standard deviation	Min.	Max.
Human Development Index	1075	53.86	6,254	26.0	80.2
Gini Index	1275	42,135	7,205	27.6	64.8
Multidimensional Poverty Index .	1175	48,533	23.87	0.7	88.3
Internet access	1233	16,112	20.26	0.005	91
Mobile phone access	1251	14,603	2,265	5,438	19.22
Landline access	1203	11.43	1.832	5,010	16.33
Foreign Direct Investment	1260	4,229	7,481	-17.29	103.3
GDP per capita	1318	23,076	1.627	18.14	27.07
Education Expenditure	1254	3.934	2,020	0.348	13.21
Ln Population	1350	15.92	1,586	11.30	19.26
Urbanization	1349	3,503	1,530	-4.431	9,893
Political stability	1232	-0.596	0.907	-3,312	1,283
Governance	1231	26.60	20.10	0	84.61

Source: Authors

Table 2 presents the fixed-effects and random-effects OLS estimates assessing the impact of digital infrastructure on inclusive growth in sub-Saharan Africa (SSA), based on 998 observations across 50 countries. Regarding internet access, a one-unit increase in internet access is associated with a significant rise in inclusive growth in SSA, of 0.13% and 0.16% for the fixed-effects and random-effects models, respectively. Regarding mobile phone access, a one-unit increase in this access is associated with a notable increase in inclusive growth; both models confirm the robustness of this effect, which is more pronounced in SSA.

Furthermore, the effect of access to landline telephones is weaker and less robust; in FE it is significant at an average level, but in RE the estimate is very small and its importance is uncertain. No statistically significant effect of the logarithm of FDI (LnFDI) on inclusive growth was observed in either specification.

However, a very strong and highly significant effect of GDP is observed. A 1% increase in the logarithm of GDP per capita (LnGPI) is associated with a substantial rise in inclusive growth. Regarding education spending, a positive but modest effect is noted, with varying significance depending on the specification. In FE, the effect is weak and borderline; in RE, it is slightly more robust but remains modest. Concerning population, a strong negative effect is observed. A one-unit increase in the logarithm of population (LnPop) is associated with a notable decrease in inclusive growth. This effect is robust in both models.

With regard to urbanization, a negative effect is robust and significant only in the FE specification; in RE the effect is not significant.

Regarding political stability, a positive and highly significant effect is observed in both models; thus, political stability is favorable to inclusive growth. The impact of governance is uncertain; robust in the RE model but not in the FE model. This may reflect differences in how governance is captured between countries or endogeneity issues .

The goodness of fit (R^2 within or R^2 on variations within countries) for the models adequately explains intra-country variation (i.e., how observations within the same country change over time). Regarding R^2 between , FE is 0.736 and RE is 0.995, reflecting that differences between countries largely explain the variability in average levels (between countries). This underscores the highly informative nature of the cross-country dimension in the RE specification.

overall R2 fit quality , we note that overall, RE (0.986) captures a very high proportion of the total variance, especially via differences between countries; FE (0.766) captures less of the variance between countries but remains robust on the intra-country dimension.

The Hausman test suggests that the FE specification is preferable. It indicates that country-specific unobserved variables are correlated with the regressors , providing consistent estimates, whereas the RE specification can be biased/consistent but inefficient.

Table 2: Fixed and random OLS estimates of the effects of digital infrastructure on inclusive growth

Variables	OLS Fixed Effects	OLS Random Effects
Internet access	0.00138***(0.000323)	0.00160***(0.000260)
Mobile phone access	0.0296***(0.00552)	0.0353***(0.00388)
Fixed_access	0.00768**(0.00615)	0.00120**(0.00494)
LnIDE	0.000210(0.000557)	−3.71e-05(0.000548)
LnPIBH	0.859***(0.0165)	0.899***(0.0129)
LnDep_Educ	0.00451**(0.00409)	0.00643**(0.00339)
LnPop	−0.627***(0.0585)	−0.936***(0.0115)
Urban_Rate	−0.00538***(0.00203)	−0.000137(0.000646)
Political stability	0.0499***(0.00995)	0.0381***(0.00920)

Governance	0.000857(0.000545)	0.00126***(0.000456)
Constant	−3.081***(0.850)	0.658***(0.149)
Observations	998	998
Number of countries	50	50
R^2 (within)	0.934	0.932
R^2 (between)	0.736	0.995
R^2 (overall)	0.766	0.986
Hausman test (χ^2)	241 (0.000)	—

Source: Authors

endogeneity problem that can be attributed to the potentially reverse causality between inclusive growth and digital infrastructure leads us to estimate the effects of digital infrastructure on inclusive growth using the GMM method (Tables 3 and 4).

The estimation of inclusive growth captured by the HDI highlights its lagged level, that is, the persistence of inclusive growth from one period to the next. The tests performed indicate: AR(1) with p-values close to 0.06–0.08; AR(2) with p-values between 0.20 and 0.30; Sargan with p-values = 0.000; Hansen with p-values around 0.46–0.465. However, the Hansen tests suggest that the robust instruments do not present any major problems.

Inclusive growth lagged approximately 0.477 to 0.481 across specifications, highly significant, indicating strong persistence of inclusive growth.

Internet access is positive and significant, indicating that a one percent increase leads to a 0.09% improvement in inclusive growth. Similarly, the coefficients for fixed-line and mobile phone access are significantly positive, indicating that a one percent increase in these indicators leads to an improvement in inclusive growth of 0.16% and 0.35%, respectively. These results corroborate those found by Kone et al. (2024), which highlight that the adoption of digital technologies contributes to greater financial inclusion; as well as the analyses of Elouardirhi , S. et al. (2025), which show that the positive impact of digital infrastructure, dependent on its integration into public policies, population training, and the development of digital skills, fosters truly inclusive growth.

Conversely, some classic determinants are clearly associated with inclusive growth: the logarithms of GDP per capita (LnPIBH), education expenditure (LnDep_Educ), and FDI (LnIDE) have positive and highly significant effects. In contrast, population size (LnPop) has a significant negative effect. However, political stability strengthens inclusive growth, while governance does not emerge as a strong factor in these specifications.

Table 3 : GMM estimates of the effects of digital infrastructure on inclusive growth (HDI)

VARIABLES	**(1)**	**(2)**	**(3)**
Inclusive growth (-1)	0.480*** (0.0125)	0.481*** (0.0122)	0.477*** (0.0127)
Internet access	0.000903** (0.00163)		
Landline telephone access		0.00165**	

		(0.00502)	
Mobile phone access			0.00352*** (0.00468)
LnIDE	0.000665** (0.000251)	0.000675** (0.000287)	0.000634** (0.000277)
LnPIBH	0.547*** (0.0182)	0.540*** (0.0177)	0.540*** (0.0191)
LnDep_Educ	0.00734*** (0.00219)	0.00908*** (0.00221)	0.00669*** (0.00227)
LnPop	-0.518*** (0.0189)	-0.508*** (0.0165)	-0.512*** (0.0171)
Tx_Urban	-0.00113** (0.000619)	-0.000888 (0.000676)	-0.00118** (0.000601)
Political stability	0.0358*** (0.0109)	0.0330*** (0.0109)	0.0396*** (0.0112)
Governance	6.59e-05 (0.000624)	-0.000121 (0.000540)	0.000158 (0.000563)
Constant	-0.597*** (0.158)	-0.640*** (0.121)	-0.572*** (0.166)
Observations	1.055	989	1.038
Number of countries	51	51	51
AR 1 p value	0.0595	0.0809	0.0709
AR 2 p value	0.207	0.301	0.276
Sargan p value	0.000	0.000	0.000
Hansen p value	0.461	0.465	0.454

The estimation of inclusive growth captured by the Gini index highlights its lagged level, that is, the persistence of inclusive growth from one period to the next. The model stability tests indicate the following AR(1) p-values: 0.0881 (model 1), 0.0201 (model 2), 0.0555 (model 3), which shows that there is no serious violation of first-order autocorrelation in models 1 and 3; a slight indication exists in model 2 ($p<0.05$). The AR(2) p-values: 0.628, 0.173, 0.415 show that no second-order correlation is detected.

The Hansen test with p-values of 0.281, 0.201, 0.155 shows that the results therefore, remain plausible under the robust approach.

The estimated lagged inclusive growth is -0.222, -0.360 and -0.322, Across specifications (1), (2), and (3) respectively, the correlation is negative and highly significant, indicating that some current inequality remains determined by its past level; persistence is moderate and relatively stable across specifications. The negative sign indicates a moderate reversion (partial convergence toward lower levels of inequality).

Table 4: GMM estimates of the effects of digital infrastructure on inclusive growth (GINI index)

VARIABLES	(1)	(2)	(3)
L.GINI_Index (-1)	-0.222*** (0.0251)	-0.360*** (0.0274)	-0.322*** (0.0196)
Internet access	-0.581*** (0.186)		
Mobile phone access		-2.276** (1.608)	
Fixed Access			-2.781*** (1.032)
LnIDE	-0.0114** (0.0115)	-0.0120* (0.00617)	-0.00491** (0.00673)
LnPIBH	-1.788*** (0.345)	-0.557** (0.282)	-1.169*** (0.316)
LnDep_Educ	-0.0920 (0.0873)	0.0489 (0.0770)	-0.0280 (0.0776)
LnPop	3.610*** (0.893)	-3.140*** (1.018)	0.302** (0.724)
Tx_Urban	0.0412** (0.0337)	0.0191** (0.0216)	0.0861*** (0.0226)
Political stability	-0.0444** (0.213)	-0.369** (0.313)	-0.0991** (0.186)
Governance	-0.0204** (0.0237)	0.00659** (0.0180)	-0.0352** (0.0281)
Constant	24.38** (10.16)	59.57*** (17.33)	42.77*** (12.10)
Observations	1.066	1.066	1.066
Number of ID	50	50	50
AR 1 p value	0.0881	0.0201	0.0555
AR 2 p value	0.628	0.173	0.415
Sargan p value	0.000	0.000	0.000
Hansen p value	0.281	0.201	0.155

Internet access (model 1) indicates that better internet connectivity is associated with a reduction in inequality as measured by the Gini coefficient (58.1%). Similarly, greater mobile phone accessibility is associated with a substantial reduction in inequality (-2.276), and fixed-line access is associated with a strong reduction in inequality (-2.781). Thus, access to digital infrastructure is, on average, associated with a reduction in inequality, with markedly stronger effects when moving to fixed and mobile communications (and a still present, but more modest, effect with internet access alone). This suggests that improved digital access can foster inclusive growth by reducing disparities. These results are found in Mensah JK et al. (2024), Zanfack , LT (2024), Wong, K. et al. (2025), and beki et al. (2025) which also showed the positive impact of digital infrastructure on inclusive growth.

Furthermore, we note small but significant negative effects of the logarithm of FDI (LnFDI) on inequality, at -1.14%, -1.2%, and -0.49% respectively. Similarly, higher levels of the logarithm of GDP per capita (LnGPI) are associated with a reduction in inequality; the effect is strong at -1.788, -0.557, and -1.169 respectively in models (1) and (3), and moderate in (2). Overall, this is consistent with the idea that average growth can reduce disparities if it is inclusive. Urbanization is positively associated with inequality as measured by the Gini coefficient (more urbanization = more inequality) and is statistically robust across all models. The effects of the logarithm of population (LnPop) are highly unstable depending on the specification, which may reflect multicollinearity or interactions with other variables. Political stability has negative but not robustly significant coefficients, implying that there is no clear and robust effect on the Gini coefficient in these regressions. However, governance has significant effects on reducing inequality and thus promoting inclusive growth. The constant is positive and significant across all models, which is expected in regressions with dynamics (a high initial jump in the Gini coefficient).

DISCUSSION

The estimation results show that mobile phone subscriptions (per 100 inhabitants) have a positive and significant effect on inclusive growth using different estimation techniques . An increase in internet users (percentage of the population) leads to a significant increase in inclusive growth of 2.96% and 3.53%. Regarding fixed-line telephone subscriptions (per 100 inhabitants), a one percent increase leads to an increase of 0.72% and 0.12% in inclusive growth. Concerning internet access, a one percent increase leads to a significant increase in inclusive growth in the sub-Saharan African region (SSA), of 0.13% and 0.16% respectively for the fixed-effects and random-effects models. This result also confirms what has been demonstrated by many authors in the literature (Dembele , AA (2023), Avom , D., et al. (2023). Kouladoum, JC (2023), Abdelkader, H. (2024) Mensah JK et al. (2024) and Elouardirhi , S. et al. (2025).

CONCLUSION

This study analyzes the effects of digital infrastructure on inclusive growth for a panel of 50 African countries over the period 2000-2024. The empirical analysis was conducted using fixed-effects and random-effects methods, followed by the generalized method of moments. The variables used were mobile phone subscriptions, internet access, fixed broadband subscriptions, and inclusive growth as measured by the HDI and the e-GINI index.

The study revealed that mobile phone subscriptions and internet usage positively influenced economic growth. This is consistent with empirical findings in the literature, particularly those of authors such as Avom , D., et al. (2023) and Abdelkader, H. (2024), who demonstrated that the number of unique mobile phone subscribers and the penetration of mobile broadband devices significantly contributed to poverty reduction in developing countries. Similarly, an increase in internet users (as a percentage of the population) led to a significant increase in inclusive growth of 2.96% and 3.53%, respectively . These results are consistent with those found by Kouladoum, JC (2023). Elouardirhi , S. et al. (2025). Regarding fixed-line telephone service subscriptions (per 100 inhabitants), a one percent increase leads to an increase of 0.72% and 0.12% in inclusive growth. This corroborates the results of Elouardirhi , S. et al. (2025).

After presenting the main results, we offer some suggestions to policymakers to reduce the digital divide and increase the use of digital technologies by families, businesses and governments.

Policymakers must ensure the physical infrastructure that enables access to ICTs for all of society. It seems essential that all countries have access to broadband coverage, allowing everyone to use the internet. These policymakers can create social measures that provide internet access for all, as families and businesses cannot always afford these services. Furthermore, policymakers can diversify or create training programs in public policy, increasing investment in ICTs, which aim to harness the potential of ICTs and stimulate the economy. To accelerate the development of the digital economy, various stakeholders (government, universities, and businesses) must work to raise qualification levels in higher education and develop R&D partnerships.

This study should raise awareness among managers, infrastructure investors, and policymakers should recognize the importance of adopting a multidimensional approach. to measure the impact of their infrastructure investments, so that they so that they can get a clearer idea of the investments that bring added value to the society and promote human development. Relying solely on indicators such as the HDI and the Gini index could limit and hinder awareness of the different societal infrastructures. It would be up to the decision-makers to ensure a comprehensive due diligence process before investing in various infrastructure projects, followed by a thorough cost-benefit analysis in order to determine the value of this project

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