

Does the Effect of Information and Communications Technology (ICT) Infrastructure on Foreign Direct Investment (FDI) Inflow Depend on the Level of ICT Penetration? Evidence from West Africa

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Abstract

The present study examines the role of Information and Communications Technology infrastructure in relation to Foreign Direct Investment (FDI) inflow to West Africa. Specifically focusing on mobile phone and internet, this study explores whether ICT infrastructure is significant for FDI inflow and whether high levels of ICT infrastructure play a role in such infrastructure affecting FDI inflow as measured by Net FDI inflow in West African countries. The study employed Panel Data Random effects estimation in analysing the data in pursuit of the objectives of the study. The study found that ICT infrastructure in the form of both Mobile phone and internet were both significant for boosting FDI inflow to West Africa. Further, while Internet was significant for FDI inflow in high internet use countries, mobile phone was significant for FDI inflow in high mobile phone use countries. The study consequently recommends amongst others based on its findings that governments of respective West African countries must of a necessity leverage on their country strengths in respective ICT infrastructure as reflected by their respective country ICT penetration levels, via ICT infrastructure provision in order to attract sizeable amounts of FDI inflow in light of increased global competition for capital in the world and the dire need of West African countries for increased levels of capital for domestic investment.

Keywords: Information and Communications Technology (ICT), Mobile use, Internet Use, Foreign Direct Investment inflow, West Africa

1. Introduction

The centrality of Information and Communications Technology (ICT) for the progress of an economy is enshrined in the Leapfrogging hypothesis put forward by Steinmueller (2001), that developing and emerging economies with the aid of ICT can leapfrog developmental stages and so have an advantage over their developed counterparts in their pursuit of development. Consequently, increased investments in ICT infrastructure have been observed especially in the last three decades and this has resulted in the increasing use of modern ICT applications (Alshubiri, Jamil, & Elheddad, 2019; Roztock, Soja, & Weistroffer, 2019).

ICT varies in its definition as observed from the literature (Kaware & Sain, 2015; Niebel, 2014; Wang & Law, 2007). Ajayi (2009) however highlights ICT as a technological means of collecting, collating, and conveying information via technology. Thus Information generation and sharing may be argued as central outcomes of greater ICT use. There exists various ICT infrastructure in countries of the world today including Fixed line telephones, internet, mobile phone, fixed broad band, secured servers, computers, and so on (World Bank, 2022). These have ensured the wide application of ICT to the progress of countries of the world. An important contribution of ICT to domestic economies however especially in the context of developing countries as those of West Africa is Foreign Direct Investment inflow.

Foreign Direct Investment (FDI) inflow constitutes a major source of capital for developing countries in particular in addressing their existing capital shortage on account of the wide investment-savings gap that are a persistent feature of developing countries as highlighted by Todaro and Smith (2011). This is more so as capital has high productivity in such developing countries owing to their capital deficiency relative to developed countries that are capital-abundant.

With recourse to ICT infrastructure, developing countries may be appropriately positioned to attract greater inflows of FDI which as highlighted in the literature portends various benefits for the local economy including increased employment, reduced poverty, inflow of foreign skill and technical know-how, sector development, greater domestic enterprise, and greater standards of living. On account of ICT infrastructure provision, economic agents emerge to profit from various opportunities that may result. For instance, the economic agents may utilize digital platforms to acquire intelligence regarding market conditions locally and internationally, as well as local and international developments having the potential to affect their objectives (Arvin, Pradhan & Nair, 2021). In addition, unprecedented rise in global trade flows and Foreign Direct Investment may result from global knowledge and innovation networks arising from ICT on account of increased Return on Investment (ROI) and Return on Value (ROV) and enhanced investment opportunities majorly for stakeholders in an economy. Evidence in support is provided by Mensah and Traore (2022) and Warsame (2021) who argue the potential of ICT infrastructure to promote FDI inflow in Africa, while in respect of increased international trade occasioned by ICT, Abeliatsky and Hilbert (2017) and Nath and Liu (2017) provide empirical evidence. Centrally, ICT may promote FDI inflow via its role in reducing transaction costs of multinational enterprises that establish in host countries.

Foreign Direct Investment (FDI) is engaged in by multinational enterprises and is defined by OECD (2008) as the establishment of a lasting interest by a resident enterprise in one economy (direct investor) as reflected by the direct or indirect ownership of 10% or more of the voting power, in an enterprise (direct investment enterprise) that is resident in an economy other than that of the direct investor. ICT may facilitate the investment decision of the multinational enterprise seeking to invest in a host country in several ways. First, it enables information such as market characteristics, country policies and so on regarding host countries to be obtained prior to the foreign direct investor making the decision to enter a host country through FDI. Second, savings in search time and related costs and increases in efficiency and productivity may result from the utilization of ICT infrastructure by multinational enterprises establishing in host countries through FDI as highlighted by Gani and Sharma (2003). Third, ICT infrastructure may enable the exchange of information and promote the development of new ideas and the creation of wealth. Fourth ICT may ensure that multinational enterprises establishing in host countries are able to ensure the existence of effective means of communication in establishing new customer relationship, while old customer relationships are also being maintained, amongst other benefits and so on. For the host country on the other hand, ICT enhances the country's productive capacity in all industries, and at the same time, it integrates the country with the global economy while promoting competitiveness (Hassan, 2004; Warsame, 2021).

Countries in Sub-Saharan Africa (SSA) such as Nigeria, Liberia, Ghana are highlighted by United Nations Conference on Trade and Development (2018) to have experienced substantial inflows of FDI. This is especially in light of the growth potentials of such countries as well as the enabling environment for such investment in a number of the countries. For instance, West African countries such as Nigeria have abundance of natural resources and are in close proximity to the sea which aids their openness to international trade and consequently provides opportunities for access to a wider market than those countries further away from the sea. In the case of Ghana, she has abundant mineral resources, a stable political climate, and bright prospects for mining and commerce and banking, which has enabled improvement in her FDI performance over the last decade. Further for Cote D'Ivoire, another major West African country economy, it is a major cocoa exporter in the world which provides a prospect for future improved FDI performance inspite of her low FDI inflow performance over the last decade.

FDI inflows into West Africa as at 2020 were at \$ 9.8 billion with countries as Nigeria emerging as the third economy that attracted inflows in Africa and Senegal also among the few economies that received higher FDI inflows with a 39% increase to \$1.5 billion (UNCTAD, 2021). On the other hand, World Bank (2022) highlights the advanced level of ICT penetration in West African countries which may provide evidence of the high level of performance of the countries as regards ICT infrastructure. For instance, Cote D'Ivoire, The Gambia, Ghana and Mali are countries which on average have achieved mobile subscriptions of greater than 100 per 100 individuals in Africa. Also as regards internet penetration, Cape Verde is a country with internet penetration at an advanced level compared to most other West African countries. Thus this gives rise to the probable link of ICT infrastructure with FDI inflow, for which studies – especially those utilizing a diverse set of countries as those of West Africa, are rather inexistent in general, while no study exists on West Africa to the best of the researcher's knowledge. In addition, the

heterogeneity in the levels of ICT penetration across West African countries suggests that levels of ICT penetration may further play a role in how ICT affects FDI inflow in West Africa. This is most especially taking into account the close proximity of West African countries as Ghana, Nigeria, Cote D' Ivoire, Sierra Leone, Guinea, Guinea-Bissau to the sea which has positioned the countries appropriately for FDI inflow over the years especially since 2009 with the arrival of fibre optic submarine internet cables on the sea shores of African countries as highlighted by Warsame (2021).

On the basis of the above, the present study explores the contribution of ICT infrastructure to FDI inflow in West Africa focusing on selected ICT infrastructure namely, mobile phone and internet which have the highest levels of penetration amongst ICT variables in West African countries. In particular, the study tests two related hypotheses. First, whether ICT significantly influences FDI inflow to West Africa, and whether the level of respective ICT infrastructure provision informs the extent to which such ICT infrastructure affects FDI inflow to West Africa. Previous studies relating ICT and FDI inflow as Menash and Traore (2022), Warsame (2021), Gold, Rasiah and Kwek (2019), Fakher (2016), Kok and Ersoy (2009) have not focused on West Africa as a major destination of FDI in Sub-Saharan Africa on account of its attractive characteristics, and hence the present study is the first in the literature on West Africa differing from previous studies. Further no previous study to the best of the researcher's knowledge has investigated the contribution of high and low ICT penetration for the role of ICT infrastructure for FDI inflow in the world in general and in West Africa in particular. Consequently, on account of the aforementioned, this present study makes a significant and germane contribution to the ICT and FDI literature. The present study in being performed utilises data covering the period of 2010 to 2020 and covers all the sixteen countries in West Africa.

While the present section has introduced the study, the study unfolds over subsequent sections. Section 2 highlights relevant literature, while the methodology of the study is discussed in section 3. In section 4, results of the study are presented, interpreted and discussed, while the conclusion and recommendations of the study constitute the final section of the study.

2. Literature Review

The literature on ICT infrastructure and FDI indicates a paucity in recent time in relation to studies focusing on countries of the world in general, and Africa in particular. However most recent studies are concentrated in the last two decades aligning with the turn of the century when there has been a sizeable penetration of ICT in developing countries of the world especially. The importance of infrastructure for FDI inflow is brought to the fore by Pribadi et al. (2019) who highlight the contribution to FDI as a result of boost in productivity of good physical infrastructure such as highways, ports, and ICT. Further infrastructure facilities, such as communications, transportation, and energy supply determine production and transaction costs, thus influencing incentives for the attraction of FDI into a country.

Studies having been performed in Asia and Africa have highlighted the importance ICT for Foreign direct investment inflow. In respect of Asian countries, Chodhury (2018) find both mobile subscription and internet penetration as important for foreign private equity in India's E-

commerce sector over the period of 2000 to 2016. Further in respect of Foreign Direct Investments in Turkey Tandogan and Karis (2020) utilizing the Toda-Yamamoto causality testing find that increased internet use boosts FDI to Turkey while a bi-directional causal relationship between Foreign Direct Investment and Internet was found. ICT can in addition promote outward FDI to a host country as found in China by Huang, Jiang and Zhang (2021) where Internet security is a crucial determinant for Chinese firms to make location decisions overseas

Studies on Africa relating ICT to FDI inflow are limited as observed from the literature, although consistent with the literature in other parts of the world as Asia that ICT boosts FDI inflow. Warsame (2021) examined ICT infrastructure and FDI inflow to Africa using panel data for 53 countries, over the period of 1988 to 2014, and applying both the Fixed Effect and difference-in-difference in estimating their specified model, the study provided evidence in support of the argument that ICT has facilitated FDI inflow to Africa especially for those countries with access to the sea on account of the presence of fibre optic internet cables on the shores of African countries since 2009. Consequently, landlocked countries have been at a disadvantage when it comes to FDI due to their far distance from the fibre optic internet cables location in Africa. Consistent with the aforementioned argument, Mensah and Traore (2022) showed using granular data on FDI projects that the arrival of high-speed internet played a crucial role in stimulating FDI in the banking and technology sectors in Africa and also showed that where reliable electricity is present, high speed connectivity is associated with Increased Investment in the finance and technology sectors.

Ibrahim, Yakubu and Sare (2018) find for a panel data set of 46 countries from 1980 to 2016 that well developed ICT infrastructure robustly spurs FDI regardless of the measure of ICT. In support Kok and Ersoy (2009) find telephone mainlines as the most important determinant of FDI in a sample of 24 developing countries over the period of 1983 to 2005. Including telephone, mobile phone and internet as ICT infrastructure in influencing FDI inflow to D-8 countries, Wang and Rukh (2021) find over the period of 1997 to 2018, positive and significant effect of the infrastructure on FDI inflows. Further Asongu and Odhiambo (2020) find based on the Generalized Method of Moments that both Internet penetration and mobile penetration overwhelmingly modulate FDI to induce overall positive net effects on various economic growth dynamics in 25 countries in Sub-Saharan Africa for the period of 1980-2014. However, Gold, Rasiah and Kwek (2019) found that infrastructure as measured by fixed telephone had a significantly negative impact on Chinese FDI inflow to 18 oil-exporting African countries from 2003 to 2015 thus highlighting possible adverse effect of ICT infrastructure on FDI inflow as it is crowded out. On the other hand, Jahan and Paul (2021) find Mobile phone penetration positive but insignificant for influencing FDI inflow to Next 11 (N-11) countries. This is further consistent with findings of an insignificant positive relationship between ICT investments and FDI in Egypt by Fakher (2016) over the period of 1995 to 2013 and which was explained as resulting from the weakness of the ICT infrastructure in Egypt. Nonetheless the study of Fakher (2016) is the only country-specific study in the literature while generally reflecting the inadequacy of ICT infrastructure amongst other infrastructure in a developing country as Egypt

despite the potentials of ICT for FDI inflow and in line with the literature highlighting the inadequacy and poor quality

3. FDI inflow and Information and Communications Technology performance in Africa

FDI inflows to West Africa relative to that attracted by Africa in general were sizeable as at the turn of the century with most of the inflows being attracted by Nigeria according to Akanegbu and Chizea (2017). At the same time, outflow of FDI from West African countries on account of various economic, political and social factors, give rise to considerable heterogeneity in net FDI inflow performance across West African countries from 2010 to 2020 as observed from table 1 where Nigeria is observed to have had the highest mean net FDI inflow at US\$4.235 Billion, followed by Ghana at US\$3.122 Billion and Liberia at US\$0.914 Billion. Guinea-Bissau on the other hand has the lowest net FDI inflow amongst West African countries.

Table 1: Average Values of FDI inflow and selected ICT indicators of West African Countries from 2010 to 2020

Country	Net FDI inflow (In Billions of US\$)	Mobile Cellular Subscription Per 100 Individuals	Internet Users Per 100 Individuals
Benin	0.212	85.11	13.02
Burkina-faso	0.233	76.48	8.92
Cabo Verde	0.113	101.58	46.19
Cote d'Ivoire	0.533	110.42	25.04
Gambia	0.069	109.27	25.53
Ghana	3.122	114.33	27.21
Guinea-Bissau	0.024	69.11	11.89
Guinea	0.392	78.96	10.38
Liberia	0.914	59.83	10.99
Mali	0.406	107.99	11.78
Mauritania	0.537	96.91	13.35
Niger	0.633	36.75	4.81
Nigeria	4.235	77.74	23.52
Senegal	0.588	95.83	22.79
Sierra Leone	0.406	66.48	8.62

Source: Computations based on data collated from World Bank World Development Indicators

In relation to performance of West African countries concerning mobile use and internet use, on the average mobile use is substantial in all West African countries with heterogeneity observed across countries as Ghana, Cote D'Ivoire and Gambia have the highest levels of Mobile users per 100 individuals on average at 114.27, 110.42, and 109.27 respectively. Internet use relative to mobile use is observed to be low across West African countries, however Cabo Verde has the highest internet users at 46.19 per 100 individuals, followed by Ghana at 27.21 per 100 individuals and Gambia and Cote D'Ivoire at approximately 25 users per 100 individuals.

Combining the heterogeneous performance of West African countries together towards providing an overview of FDI inflow and ICT in West Africa, Figure 1 provides the trend of the averages of each of the aforementioned variables over the period of 2010 to 2020.

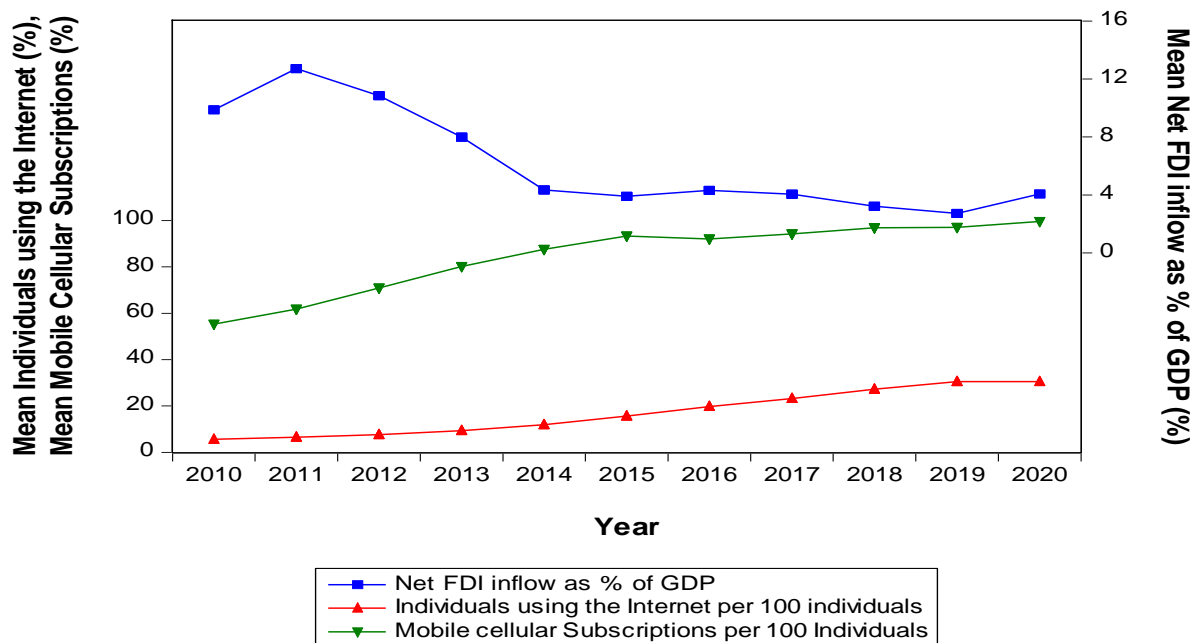


Figure 1: Trend of Annual Mean of ICT Indicators and Net FDI Inflow of West Africa over the Period of 2010 to 2020

Figure 1 shows that in West Africa, whereas the trend of the mean values of both Internet and mobile phone use were on the rise from 2010 in line with the rapidly rising penetration of ICT in African countries in general since the early 2000s till present, mean net FDI inflow has been generally on the decline. for which a variety of factors

4. Data and Methodology

This present study utilizes a balance panel data et comprising all sixteen West African countries namely: Benin republic, Burkina-faso, Cote D' Ivoire, Cape Verde, The Gambia, Guinea,

Guinea-Bissau, Ghana, Liberia, Mali, Mauritania, Niger, Nigeria, Sierra Leone, Senegal and Togo and covering the period of 2010 to 2020. The data set thus features heterogeneity in country characteristics in terms of the size of respective country economies, growth potentials, population size, natural resources, access to the sea as a gateway to international trade with the rest of the world, ICT penetration and so on which may play a role in countries potentials to attract substantial FDI inflows out of that which flows to globally. The choice of 2010 to 2020 is on account of the observation of significant penetration of ICT in developing countries in general, especially those of Sub-Saharan Africa which include West African countries since 2009. Mensah and Traore (2022) and Warsame (2021) explain the significant penetration of ICT in developing countries including those of SSA since 2000 but more impressively since 2009 as resulting from the arrival from Europe and the Middle East, of fiber optic submarine internet cables in African countries having access to the sea and which has enabled the dramatic development and increase of ICT infrastructure in Africa generally.

This study is founded on the Eclectic paradigm theory of foreign direct investment and in particular is related to the ‘Location’ dimension of the theory wherein ICT acts as a factor attracting FDI to the location that is West African countries primarily on account of ICT as well as other appealing characteristics of the countries. The model employed by this study is based on the adaptation of the model of Warsame (2021) specified in equation (1).

$$FDI = f(\text{INTERNET}, \text{MPHONE}, \text{PC}, \text{GDP}, \text{INC}) \quad (1)$$

Where, FDI = Foreign Direct Investment Inflow of Host Country, INTERNET = Internet users per 100 individuals in Host Country, MPHONE = Mobile cellular subscriptions per 100 individuals in Host Country, PC= Personal Computers per 1000 inhabitants in Host Country, GDP = Gross Domestic Product of Host Country, INC = Per Capita income of Host country

Adapting Equation (1), for the present study and including necessary controls reflecting fundamental characteristics of West African countries as GDP Growth rate (GDPGR), Agriculture as a share of GDP (AGGDP) – which reflects the agriculture sector dependence of host West African countries, Trade openness (TROP), Inflation (INFL) and rule of law index – measure for institution quality, equation (2) is the model employed for this present study.

$$FDII = f(\text{ICT}, \text{GDPGR}, \text{AGQ}, \text{TROPN}, \text{INFL}, \text{RL}) \quad (2)$$

Where, FDII = Foreign Direct Investment Inflow of Host Country, ICT = Information and Communications Technology Infrastructure in Host country, GDPGR = GDP Growth Rate of Host country, AGQ = Agriculture as a share of GDP of Host Country, TROPN = Trade Openness of Host Country, INFL = Inflation in Host Country, RL = Rule of Law in Host Country

Disaggregating ICT infrastructure into Mobile Phone and Internet use while maintaining all other variables in the model, Equation (3) results:

$$FDII = f(\text{MPH}, \text{INTERNET}, \text{GDPGR}, \text{AGQ}, \text{TROPN}, \text{INFL}) \quad (3)$$

Where, FDII = Foreign Direct Investment Inflow of Host Country, MPH = Mobile phone users per 100 individuals in Host country, INTERNET = Internet users per 100 individuals in Host country, GDPGR = GDP Growth Rate of Host country, AGQ = Agriculture as a share of GDP of Host Country, TROP = Trade Openness of Host Country, INFL = Inflation in Host Country, RL = Rule of Law in Host Country

The econometric specification of Equation (3) is as in Equation (4), allowing for controls for country and year effects (as reflected by dummy variables)

$$FDII_{it} = \alpha_0 + \alpha_1 MPH_{it} + \alpha_2 INTERNET_{it} + \alpha_3 GDPGR_{it} + \alpha_4 AGQ_{it} + \alpha_5 TROP_{it} + \alpha_6 INF_{it} + \alpha_7 RL_{it} + \alpha_8 \delta_i + \alpha_9 \omega_t + \varepsilon_{it} \quad (4)$$

Where, FDII = Foreign Direct Investment Inflow of Host Country, MPH = Mobile phone users per 100 individuals in Host country, INTERNET = Internet users per 100 individuals in Host country, GDPGR = GDP Growth Rate of Host country, AGQ = Agriculture as a share of GDP of Host Country, TROP = Trade Openness of Host Country, INFL = Inflation in Host Country, RL = Rule of Law in Host Country, δ = Country dummy, ω = Year Dummy, ε = Error Term, i = country 1-16, t = 2010 – 2020

From Equation (4) the α s are the respective parameters of the model to be estimated, with α_0 as the constant of the model and $\alpha_1 \dots \alpha_9$ as the coefficients of respective independent variables. While FDI inflow is measured using Net FDI inflow, the variables MPH and INTERNET are the respective variables of interest in the above model in line with the research hypotheses. The δ and ω are country and year effects and captures the specific-effect of location and time on FDI inflow, respectively. The panel data random effects estimation was used in estimating the above specified model based on evidence from the insignificant Hausman test statistic.

Data employed for this present study is secondary data with data on all variables except Rule of law sourced from the World Bank World Development Indicators (WDI) while Data on Rule of Law was sourced from the World Bank World Governance Indicators.

In light of the twin objectives of this study equation (4) is estimated in relation to the full sample of West African countries and also in relation to the countries disaggregated into high and low ICT infrastructure countries on the basis of the levels of penetration of the ICT infrastructure of interest –Mobile phone and internet. A country is deemed to be a high ICT infrastructure country on the basis of the ICT infrastructure of interest, if the mean value of ICT penetration for the ICT infrastructure for the country is higher than the mean value of ICT penetration in regard to the ICT infrastructure for the full sample of West African countries. The inverse is equally true for a low ICT infrastructure country.

4. Results

The descriptive statistics of variables employed in this study are shown in Table 2. All variables depict heterogeneity in their levels of variability, while in respect of ICT infrastructure, West African countries have a higher level of Mobile phone relative to Internet use.

Table 2: Descriptive Statistics of Variables

Descriptive Statistics	Net FDI Inflow	Mobile Cellular Subscriptions (% of Population)	Individuals Using the Internet (% of Population)	GDP Growth (%)	Agric as a % of GDP	Trade Openness (% of GDP)	Inflation Rate (%)	Rule of Law (In Decimals)
Mean	0.789	84.43	17.14	4.33	26.75	15.94	4.88	-0.649
Median	0.339	83.00	13.00	4.99	22.88	13.27	2.64	-0.672
Maximum	8.84	152.00	62.00	20.72	60.61	55.26	23.56	0.635
Minimum	-0.884	22.00	1.00	-20.60	4.63	3.83	-3.23	-1.586
Std. Dev.	1.33	27.85	14.46	4.19	12.21	10.53	5.54	0.471
Skewness	3.10	0.00	1.10	-1.56	0.798	2.39	1.25	0.670
Kurtosis	14.54	2.50	3.66	12.65	3.234	8.76	4.27	3.435
Observations	176	176	176	176	176	176	176	176

Analysing data using Random effects estimation, the results of data analysis are presented in table 3. While column (1) are the random effect estimates for the full sample of observations, columns (2) and (3) are the results from estimating random effects model for the sample of countries with high and low mobile phone penetration, while columns (4) and (5) are the results from estimating random effects model for the sample of countries with high and low internet penetration

Table 3: Panel Data random Effects Regression Estimates

Sample	Total Sample	High Mobile Phone penetration	Low Mobile Phone Penetration	High Internet penetration	Low Internet Penetration
Equation	(1)	(2)	(3)	(4)	(5)
Dependent Variable	FDII	FDII	FDII	FDII	FDII
Constant	-0.414 (0.645)	-0.0554 (0.527)	1.737** (0.869)	0.969 (1.450)	-0.221 (0.318)
MPH	0.0104** (0.00493)	0.00997* (0.00551)	-0.00205 (0.0105)	-0.00563 (0.0135)	0.000895 (0.00269)
INTERNET	0.0253** (0.0120)	-0.0219* (0.0127)	0.169*** (0.0307)	0.0925*** (0.0331)	-0.0122 (0.0140)
GDPGR	0.0401*** (0.0150)	0.0680*** (0.0224)	0.0378 (0.0350)	0.137*** (0.0470)	0.0232** (0.0104)
AGQ	0.00283 (0.0129)	-0.00306 (0.0123)	0.00397 (0.0130)	-0.0847 (0.0519)	-0.000247 (0.00560)
TROPN	-0.0108 (0.0133)	-0.0139 (0.00975)	-0.0557* (0.0306)	-0.0553* (0.0291)	0.0374*** (0.0111)
INFL	-0.0173 (0.0189)	0.143*** (0.0201)	0.0217 (0.0251)	0.297*** (0.0413)	-0.00186 (0.0107)
RL	-0.678* (0.383)	1.108*** (0.298)	0.788* (0.472)	-0.560 (0.587)	0.0731 (0.221)
Country Dummies	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes
Countries	16	8	8	6	10
Observations	276	88	88	66	110
R-Squared	0.2246	0.6624	0.5234	0.6662	0.2453
Wald Chi-Sq (17)	39.42***	137.36***	76.86***	95.78***	45.89***

P-values in parenthesis. ***, **, * indicates significance at 1%, 5% and 10% levels.

Table 2, Column (1), shows that both ICT infrastructure - mobile phone (MPH) and internet are positive and statistically significant for FDI inflow to West Africa. Specifically, a unit rise in each of Mobile phone and internet results in 0.0104-unit and 0.0253-unit increases respectively in Foreign direct investment inflow to West Africa, with both contributions of ICT infrastructure important for FDI inflow to West Africa. However, internet relative to Mobile phone ICT infrastructure makes a greater positive contribution to FDI inflow to west Africa by 0.0149 units – reflecting a greater marginal impact of internet relative to mobile phone on FDI inflow to West Africa. The finding of positive and significant effect of both mobile phone and internet use on FDI inflow is evidence that Information and Communications Technology (ICT) boosts Foreign Direct Investment inflow to West Africa, and is consistent with similar findings by Mensah and Traore (2022), Warsame (2021), Wang et al (2021), and Asongu et al (2020). This may be explained by the reduction of transaction costs for business associated with the provision of ICT infrastructure and which ensures that multinational enterprises are attracted to host countries on account of their expected profitability as a result of their utilisation of the ICT infrastructure on establishing their enterprise in the host country.

Further Mensah and Traore (2022) and Warsame (2021) in particular associate the boost of FDI inflow to Africa resulting from ICT infrastructure provision, to submarine internet cables arrival to Africa. This will especially be the case for countries close to the sea which includes most West African countries. Specifically, with the exception of Burkina-Faso, Mali, and Niger that are land-locked countries, all other West African countries have close proximity to the sea. However, this present study is germane to the ICT - FDI literature to the extent that it focuses on West Africa which has received little focus in the literature despite the evident heterogeneity of countries in terms of infrastructure and FDI inflow and the importance of the country region for rapid progress of Sub-Saharan Africa in virtually all metrics of development.

The control variables from Table 3, column (1), GDP growth rate (GDPGR) and Rule of Law (RL) are significant for FDI inflow, Rule of law however adversely affects FDI inflow while GDP growth as expected boosts FDI inflow to West African countries. The adverse effect of rule of law may reflect the weak enforcement of laws which impedes FDI inflow, while the boost in FDI inflow resulting from GDP growth highlights the importance for FDI inflow to West Africa of the presence of a large and expanding market as that present in West Africa for the sale of goods and services, which informs the FDI inflow decision of multinational enterprises located in foreign countries. Note however that the present study is unable to determine the source countries of FDI inflow to West African countries and so does not distinguish between FDI inflow that may emanate from other West African countries and those that emanate from countries that are not in west Africa.

Agriculture as a share of GDP (AGQ), Trade Openness (TROPN) and Inflation (INFL) which are further control variables in the estimated model are found to be insignificant for FDI inflow to west Africa from column (1) in Table 3.

The estimates in columns (2) – (5) in Table 3 result from testing the hypothesis whether the level of respective ICT infrastructure provision as measured by level of respective ICT penetration informs the extent to which such ICT infrastructure affects FDI inflow to West Africa. In respect of columns (2) and (3) mobile phone is positive and statistically significant for FDI inflow in High penetration mobile phone ICT infrastructure West African countries, while it is negative but not statistically significant in low penetration mobile phone ICT infrastructure West African countries. This highlights the value of high mobile phone penetration in West Africa resulting from the high demand for mobile phones possibly due to their affordability, as well as, the possibility that such West African countries with high penetration can leverage on such ICT infrastructure to attract substantial FDI inflows from the global economy. However, the coefficient of mobile phone for high penetration mobile phone ICT infrastructure countries of 0.000997 while statistically significant is low which possibly reflects the saturation of the mobile phone market in West African countries and thus the adverse effects of rising costs of access to mobile phones due to high demand for the phones. Such high demand for mobile phones in West African countries is likely to harm the potential high levels of FDI inflows to West African countries which could have been attained with the aid of internet in the high penetration mobile phone ICT countries as potential new purchasers of mobile phones may be dis-incentivised from purchasing new mobile phones for undertaking business transactions. Rule of law as a control variable is in addition found to be positive and statistically significant for FDI inflow in high and low mobile phone countries highlighting the importance of strong institutions for the potency of mobile phone infrastructure to translate to FDI inflow in high and low mobile phone infrastructure countries. Interestingly GDP growth is of importance and boosts FDI inflow only in high penetration mobile phone infrastructure countries.

Further as regards high penetration internet ICT infrastructure countries in comparison with low penetration internet ICT infrastructure countries, column (4) reveals that, internet is statistically significant for boosting FDI inflow to high penetration internet ICT infrastructure countries and resulting in a sizeable impact given the coefficient of 0.0925. On the other hand, column (5) reveals that internet ICT infrastructure while adversely affecting FDI inflow to low penetration internet ICT infrastructure countries is insignificant. GDP growth however boosts FDI inflow in both high and low penetration internet ICT infrastructure countries.

The aforementioned findings from the results of columns (2) – (5) regarding ICT infrastructure and FDI inflow are a further significant contribution to the ICT infrastructure – FDI literature as previous studies such as Mensah et al (2022), Warsame (2021), Wang et al (2021), Pribadi et al (2019), and Ibrahim, Yakubu and Sare (2018) have not explored the role of high or low ICT penetration for FDI inflow in the context of any country or group of countries, whether African or not. Such an analysis enables an assessment of the ICT strengths of countries for positioning the countries for sizeable and invaluable inflows of the share of world FDI inflows.

5. Conclusion and Recommendations

This present study examined whether the effect of Information and Communications Technology (ICT) on Foreign Direct Investment (FDI) inflow was dependent on the level of ICT penetration in West Africa for a balanced panel data of sixteen West Africa countries from 2010 to 2020.

The study found evidence suggesting ICT infrastructure – mobile phone and internet, to significantly boost FDI inflow to West Africa. Further while mobile phone was found to be significant for boosting FDI inflow to High penetration Mobile phone ICT infrastructure countries, and internet was found significant for boosting FDI inflow to High internet penetration ICT infrastructure countries, both mobile phone and internet were found negative and insignificant for FDI inflow in low penetration mobile phone and internet ICT infrastructure countries. The findings are germane for the ICT infrastructure - FDI literature especially in the contest of Sub-Saharan Africa in general and West Africa in particular. Arising recommendations are certain to inform the use of FDI inflow in maximizing of the potentials of ICT infrastructure – both mobile phone and internet, in West Africa. Future studies may look to control for other indicators of ICT infrastructure and use alternative model specifications and estimation techniques in testing the robustness of findings.

This present study makes a number of recommendations based on the findings of the study. First, governments of respective West African countries must of a necessity leverage on their country strengths in respective ICT infrastructure as reflected by their respective country ICT penetration levels, via ICT infrastructure provision in order to attract sizeable amounts of FDI inflow in light of increased global competition for capital in the world and the dire need of West African countries for increased levels of capital for domestic investment. Second, the use of ICT in the form of mobile phones and internet by individuals in West African countries must be promoted and encouraged in order to raise the levels of ICT infrastructure so that it may serve as a tool for attracting FDI inflow to West African countries. Third, Governments of West African countries should develop their ICT infrastructure including its quality in enabling the effectiveness of ICT in acting as a tool that can promote FDI inflow. Fourth, correlates with ICT such as GDP growth rate, trade openness and inflation should be given focus by West African country governments so as to ensure that they can act as channels through which ICT infrastructure may impact FDI inflow to West African countries.

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