Information Communication Technology and Financial Sector in West Africa

Las tecnologías de la información y la comunicación y el sector financiero en África Occidental

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Artículos

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Abstract

Globally, information and communication technology play a pivotal role in driving the financial sector. This study examines the relationship between information communication technology and the financial sector in West Africa from 2012 to 2022. The study is essential because studies focusing on ICT and financial depth are scarce in West African nations. The data for the study comes from the World Bank database and uses the GMM system. The financial depth indicator is the ratio of bank assets to GDP while the indicators of ICT are internet subscription, mobile subscription and fixed broadband subscription**.** Mobile phone subscription significantly and statistically enhances financial depth of banks in West Africa by 423.82 % during the period under review. Internet subscription increases financial sector size by 11 % and the result is statistically significant. The fixed broadband positively influences the financial depth in West Africa by 341 %, and the result is statistically significant. Policymakers must invest heavily on ICT and adopt financial technology to promote financial depth.

Key words: ICT, financial depth, West Africa, panel GMM

JEL classification: 011, P34, Q55

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Resumen

A escala mundial, las tecnologías de la información y la comunicación desempeñan un papel fundamental en el impulso del sector financiero. Este estudio examina la relación entre las tecnologías de la información y la comunicación y el sector financiero en África Occidental entre 2012 y 2022. El estudio es esencial porque los estudios centrados en las TIC y la profundidad financiera son escasos en las naciones de África Occidental. Los datos del estudio proceden de la base de datos del Banco Mundial y utilizan el sistema GMM. El indicador de profundidad financiera es la relación entre los activos bancarios y el PIB, mientras que los indicadores de las TIC son la suscripción a Internet, la suscripción a la telefonía móvil y la suscripción a la banda ancha fija**.** El abono a la telefonía móvil aumenta significativa y estadísticamente la profundidad financiera de los bancos de África Occidental en un 423,82 % durante el periodo estudiado. La suscripción a Internet aumenta el tamaño del sector financiero en un 11 % y el resultado es estadísticamente significativo. La banda ancha fija influye positivamente en la profundidad financiera en África Occidental en un 341 %, y el resultado es estadísticamente significativo. Los responsables políticos deben invertir fuertemente en TIC y adoptar tecnología financiera para promover la profundidad financiera.

Palabras clave: TIC, profundidad financiera, África Occidental, panel GMM

Clasificación JEL: 011, P34, Q55

Introduction

The financial sector is a unit of the national economy made up of institutions and organizations that provide financial services to customers. Financial depth measures the financial sector relative to a country's output, which implies that it involves the banks' size, other financial institutions and financial markets in relation to the national output. African countries place great emphasis on the financial sector to combat developmental challenges in Africa. This is because the financial sector has the potential to improve human development, economic progress and cash flow management by channelling funds from the surplus unit to the deficit units (World Bank, 2023). However, lack of access to financial services is a dominant feature of African economies. In 2018, private sector credit to GDP in most West African nations is less than 10 % except for Cape Verde, Cote D'Ivoire, Senegal and Togo with more than 20 % and there has been no substantial improvement to date (World Bank, 2024; AFREXIMBANK, 2023). It is clear that West African countries face poor access to finance due to financial constraints and ICT deficiencies, among other factors, as available information shows that, on average 39.6 % of formal micro, small and medium enterprise in Africa have unmet demands for finance, while firms' access to bank loans remains at 38 % and total credit to the economy by the financial sector is between 36 % - 37 % as at 2024 (World Bank, 2024). On average, only 41 % of adult in the West African region have an account with a bank or similar financial institution or mobile money service (World Bank, 2021). Account ownership has consistently shown a larger gap in the economic status of citizens im the West Africa Economic and Monetary Union (WAEMU), with the poorest 40 % of households having 11 % fewer accounts than the richest 60 % (World Bank, 2021; WAEMU, 2023).

The concept of Information and Communication Technology (ICT) has different meanings for different people. It is a terminology that encompasses gadgets, applications, systems and programmed communication and information devices; it also includes: technological hardware and software, phones, television, radio, and computer, satellite, and other related applications and services. On the oder hand, Carney (2016) imperatively deduces the fact that within the contemporary era, ICT is undoubtedly viewed in the same light as Financial Technology, to paint the mental image of technology platform that aims to offer result-oriented financial services or products through the internet, especially through: mobile banking, online transactions, cryptocurrencies, foreign exchange, etc. (United Government Accountability Office, 2023). From historical verification, since 1950, the impacts of Information Communication Technologies have been evident.

Beyond semantics, in its generic meaning lie its significances. ICT, in its abbreviation lies its metaphor as the elastic expansion of Information Technology (IT) that reiterates the import of integrated telecommunication and communication enterprise such as computers, wireless signals, mobile phone and telephone lines. These new concepts enable individuals and organizations to store, access, edit, and organize information processing at their whim and caprices. The purpose underpinning the emergence of ICTs is to assemble the various technological distributions and the modalities they entail into a unified matrix. The quartet of Albiman, Zunaidah & Sulong (2016) agree that Information Communication Technology is an effective driver of economic growth, expansion and development in developed nations and in nations whose economies have just taken root on the global scale, with the inclusion that African nations can benefit from impacts of ICT within their current developmental constraints. The proposal is based on available empirical evidence that reveals that ICT innovetions in Africa can deepen and enhance financial deepening on the continent (ADB, 2013).

Based on the indices published by the United Nations (2022), the facts from the United Nations Department of Economic and Social Affairs UNDESA 2022-2023 Report, set out how internet banking, mobile and fixed broadband subscriptions are driven by Information Communication Technology. The utilization of ICT also offers the potential to alleviate hunger, tackle poverty, establish good health and promote quality education (UNDP, 2015). Other notable roles that ICTs can play include: economic growth, access to credit, gender balance, decent work, digital micro-insurance, digital wallets, digital payment for MSME, digital flexible saving and loan facilities, reducing inequality through savings, digital flexible savings and loan facilities (ITU, 2015; UNDP, 2022). Significantly, the patterns and diverse manifestations of ICTs are not limited to internet subscriptions, as claimed by Bello et al. (2023); Bello et al. (2024), Efobi et al. (2018). That is, patterns are based on subscription rate: Mobile Phone Subscription (per 100 people), Broadband Subscription (per 100 people), (Sassi and Goaied, 2013; Ofori, 2021; and Chavula (2013);

In addition to the affirmation that ICTs are significant in achieving financial inclusion, it is obvious that ICTs are heavily used in the permitted space of the financial segment, in term of international financial transactions, administrative modalities, and local economic engagements. On the other hand, the Economic Community of West African States

(ECOWAS), across the space of its socio-economic engagements and performance, in which there are notable structural and administrative deficiency and challenges that prevent offers and limit effective financial developments and lubrication, will aid and optimize efficient operational performance (Bello, et al.., 2022; Bello, et al., 2023; Bello, et al., 2024; Asongu & Nwachukwu, 2018; Sassi & Goaied, 2013; Allen et al.. 2001). Closely related, there are related presentations from the likes of Asongu & Nwachukwu (2018), and Asongu (2020); who noted that though promotion of financial competition, with the theme of inclusion, along with long-term prospects; can only be aided by an effective and efficient ICT-driven economy, to limit the information and modality costs of financial actors.

Previous studies (Muthiora 2015; Masha 2016) have used credit to private sector to capture financial depth and private credit has been widely used in the literature, but it is less comprehensive as it excludes credit to government, public enterprise and credit issued by the monetary authority. However, this study improves on the studies by adopting banking assets to GDP to capture the financial sector because bank assets to GDP is a comprehensive measure of financial depth as it includes private credit, credit to government and credit issued by the private sector by the monetary authority

This study aims to shed light on how mobile phone, internet and fixed broadband subscriptions (ICTs) affects the financial sector in West Africa because studies that focus on ICT and bank assets are scanty there. Therefore, conducting this study in West Africa will contribute to the existing literature on African economies, as Africa's economic system depends on an efficient electronic payment system. This study covers the period from 2012 to 2022 using the generalized method of moments.

Literature Review

Economic Theory of Cobb-Douglass (1928)

The theory postulates that the production model is a function of labor, capital and technology with a view that a change in the factors of production leads to changes in economic performance and development. The path to economic progress and advancement of a country is by capital improvement, productivity advancement and innovative ideas by experts (Diao et al.., 2019; Grusset al.., 2020). According to the neoclassical growth model, sustainable progress and development depends on external factors such as technology, human resources, capital accumulation, capital spending, research and discovery journey (Guerrini et al..., 2019). Savings, capital accumulation, and technological progress are the drivers of economic advancement, suggesting that the financial sector promotes capital-oriented economic performance and advancement through an efficient money and capital market that supports savings and capital accumulation (Diao et al., 2019).

So far, it has been emphasised that economic progress, advancement and development emanate from wealth creation and capital accumulation (Mckinnnon-Shaw, 1973; Kapur 1981). Empirical studies such as Levine & King, 2002; Mckinnon, 1973 have improved the cobb-Douglas production model by replacing factors of production with financial

development and innovation, as financial development is usually used as an indicator of an improvement of capital in the production model, while innovation is usually used to represent technological progress. This is done on the basis that the financial sector has the capacity to generate savings, minimize costs, reduce financial constraints and promote an efficient allocation of financial resources.

ICT and Financial Sector in Developed Countries

Ajit et al. (2001) assesses the link between information technology and the capital markets between 1990-1995 using multivariate analysis to know the kind of financial system or capital market arrangements that are most conducive to fostering information technology and its use in the economy. The work was closely aligned with an old debate about the relative virtues of the Anglo-Saxon financial system based on stock markets, and the German/Japanese financial model, based on banks, which led to a debate on what system should developing countries attempt to emulate to foster their economic growth and technological development.

This debate has been the subject of much attention since the emergence of the "New Economy" in the U.S. Not only has the U.S. experienced rapid growth in ICT industries, but there has also evidently been widespread and successful adoption of ICT technology in many areas of the economy. The study states that a well-developed and mature stock market is not a sufficient factor in promoting the development and use of information technology.

Al-Hamzi (2016) investigates whether ICT is a determinant of financial development using an annual time series of data from Germany from 1990 to 2016. The study employed iInternet (% of population) and domestic credit to the private sector as proxy variables for ICT and financial development, and used gross domestic product (GDP) per capita, foreign direct investment (FDI) and stock market capitalization as control variables and omitted variables. The results showed that ICT has a significant positive impact on financial development and that financial development is also positively and significantly affected by GDP per capita, FDI and market capitalization. The study also affirms that ICT and market capitalization cause Granger financial development.

Majeed and Ayub (2018) examine the impact of ICT variables on economic progress from the developed to the developing world in 149 countries over the period 1980-2015 using ordinary least squares (OLS), clustered OLS, two-stage least squares (2SLS), and generalized method of moments (GMM) techniques. The results affirm that all ICT indicators promote economic growth. However, variables such as online service, telecommunications infrastructure and e-government are comparatively more powerful in boosting economic progress. According to the results, emerging and developing countries benefit more from ICTs than developed countries. The results of the analysis are robust to varying model specifications and econometric techniques, varying control variables and regions.

Shahbaz et al. (2023) examine the relationship between information and communication technologies (ICT) and financial development in the Turkish economy from 1986 to 2018 by employing a distributed autoregressive lag (ARDL) model and a Hatemi-J

cointegration test with two structural breaks to confirm the presence of cointegration between the variables, while dynamic ordinary least squares (DOLS), fully modified least squares (FMOLS) and canonical cointegration regression (CCR) estimation techniques are applied for the long-run estimates. The Granger causality approach of the vector error correction model (VECM) is employed to test for causality. The results of the study reveal that under structural breakup, ICT, economic growth, technological innovation and financial globalization are cointegrated with financial development.

Moreover, in the presence of a structural break, ICT and technological innovation have a negative effect on financial development, while economic growth and financial globalization have a positive impact on financial development. The study also affirmed that there is a unidirectional causal relationship running from ICT and economic growth to financial development. In addition, technological innovation and financial globalization result into long-term financial development.

Suragan and Durmuşkaya (2022) investigate the long-run relationship between stock market indices and ICT indicators for G7 and E7 countries from 2003 to 2019 using panel cointegration tests which are Pedroni and Kao, and the fully modified least squares method (FMOLS). Stock indexes are taken as dependent variables and ICT indicators as independent variables. Three ICT indicators were used in the study, namely, fixed telephone subscriptions, mobile telephone subscriptions and Internet users (percentage of the population using the Internet). The results of the study reveal that the ICT indicators, i.e. cell phone subscriptions and Internet users, have a positive impact on stock markets and their importance. Comin and Nanda (2018) investigate the extent to which financial market development affect the diffusion of 16 major technologies of 17 countries, from 1870 to 2000. The study shows that high financial markets depth result in faster technology diffusion for more capital-intensive technologies, at periods closer to the invention of the technology. The study also confirms differential effect of financial deepening on the diffusion of capital-intensive technologies in the final stages of diffusion. The study concludes that local financial markets play a key role in the process of experimentation that is necessary for the original commercialization and diffusion of technologies.

Del Gaudio et al. (2021) assessed the impact of information and communication technologies (ICTs) on the profits and risk of financial distress of the 28 EU banking firms between1995 and 2015. The study addresses the question of whether and how ICT diffusion, adoption, and infrastructure (e.g., ATM penetration) influence the viability and stability of the banking business. The results reveal that ICT has a positive effect on the viability and stability of banking and that the overall financial stability of banking firms improves with the intensive adoption of both IT and financial technologies.

ICT and Financial Sector in Developing Countries

Alshubiri et al. (2019) evaluate the effect of information and communication technology (ICT) on the financial development index of six Gulf Cooperation Council (GCC) countries from 2000 to 2016 using GMM and FE regression analysis. The findings reveal that

an increase in fixed broadband significantly and positively affects financial development. The study claims that the positive effect of ICT (broadband) on domestic credit is greater than the effect of Internet users on domestic credit with a claim that 1 % change in fixed broadband results in about 2 % increase in financial development, while Internet usage or subscription led to 0.09 % increase. Money supply increased by 0.40 % when ICT increased by 1 %. In addition, money supply increased by 0.11 % when the proportion of Internet users increased by 1 %. The study further claims that the negative effect of economic growth on natural resources was valid and significant, while urbanization and trade openness appeared to have a significant and positive effect on financial development indicators.

Tran and Huynh (2022) examine the impact of information and communication technologies (ICTs) on financial development indicators such as domestic credit/GDP and money supply/GDP in ten ASEAN countries between 2000 and 2020 using a fixed effects panel regression. The findings of the study reveal that ICT stimulates domestic credit and money supply, but the impact of ICT on money supply/GDP is greater than that of domestic credit/GDP, indicating that ICT exerts a strong influence on money supply/GDP. The study suggests that other key determinants of financial development in the context of ASEAN countries are economic growth, trade openness and urbanization.

Asongu et al. (2018) investigate how information diffusion worsens the unfavorable impact of pricing power and credit quantity using a panel of 162 banks from 39 African countries for the period 2001-2011 and Generalized Method of Moments and quantile regression. The results reveal that the digital telephony penetration rate of 54.29 moving to 57 per 100 people is expected to counteract the unfavorable impact of pricing power on the average price and quantity of credit. According to the quantile regressions, digital telephony penetration rates of 56.20, 52.04 and 42.76 per 100 persons are needed to offset the unfavorable impact of pricing power on the amount of credit in the tenth decile, the 25th quartile and the 90th decile separately, while a lower cyberspace penetration rate of 9.49 per persons is needed to offset the effect of pricing power on the amount of credit at the 90th decile.

Mushtaq and Bruneau (2019) assess the role of information and communication technologies (ICTs) in reducing poverty and inequality by fostering financial inclusion, using a panel dataset of sixty-two countries between 2001 and 2012. It points out mainly on two different dimensions of financial inclusion, i.e., inclusion by commercial banks and by microfinance institutions (MFIs). The study found a positive association of ICT diffusion with financial inclusion and a negative relationship with poverty and inequality. The results of the study also imply poverty reduction effects of financial inclusion. The study also confirms that ICT dimensions, when used as instruments for financial inclusion, accelerate economic growth and reduce poverty and inequality.

More recent research on mobile technologies for inclusive development in Africa by (Asongu & Boateng, 2018) investigate the link between Information Communication Technology and financial access using Generalized Method of Moments and Quantile Regressions Econometric Approaches and a panel data of 162 banks. The study assesses whether information diffusion reduces the negative impact of market power on the amount

and cost of credit facilities. The policy recommendation suggests a level at which the modulating effect of information diffusion on market power would improve the deepening of financing in Africa. Naceur and Zhang (2016) found evidence of a positive effect of stock market development, but a significant negative effect of bank development on growth in a sample of 10 MENA countries.

Chen (2020) examines before and after the entry of Internet-only banking into the financial market using data envelopment analysis and regression methods to evaluate efficiency and performance and observe changes among banks in different periods with a sample of 20 banks. The findings of the study reveal that the overall efficiency of banks has improved since Internet-only banking entered the financial market. The study also states that in the period of low returns, banks mix or vary revenues and operating incom while improving productivity and efficiency. In conclusion, with the adoption of FinTech and aggressive competition, banks must reduce their headcount to strengthen their competitive advantage and improve their internal environments.

Owusu-Agyei et al. (2020) employed internet to capture ICT, and the study affirms that internet use has positive effect on different measures of financial development in selected SSA region. The finding of the study further confirms that the sampled countries in SSA differ on their levels of human capital development and economic freedom.

Owusu-Agyei et al. (2020) employed the Internet to capture ICT, and the study asserts that Internet use has a positive effect on different measures of financial development in the selected SSA region. The findings of the study confirm that the countries in the SSA sample differ in their levels of human capital development and economic freedom. Wu and Wang (2023) investigate the effect of information communication on financial development using panel data and panel regression in Chinese cities. The study employed an instrumental variables approach to address the endogeneity problem between information communication and financial development and a quasi-natural experiment to address the endogeneity problem.

The study findings show that information communication infrastructure, information communication levels, and information communication penetration rates can promote urban financial development. Financial sector development is significantly improved in the selected or sampled cities with the implementation of China's broadband strategy. The study also confirms that the impact of information communication on financial development is more evident in the urban area of Northeast Economic Circle, Pan-Pearl River Delta Economic Circle, Southwest China Economic Circle and cities that recorded low foreign investment.

Ofori et al. (2021) examines the efficiency of ICT diffusion and financial development in limit the harsh effect of poverty in Sub-Saharan Africa (SSA) from 1980–2019 using the dynamic system GMM and the panel corrected standard errors estimation techniques. The findings from the study shows that ICT usage, ICT access, and ICT skills are more remarkable in reducing both the severity and intensity of poverty than financial access. Moreover, the study also confirm that ICT skills reduce poverty, but the effect is more effective in the presence of robust and enhanced financial development.

Dhahri et al. (2023) assess the efficiency of ICT and financial sector development in attaining sustainable development goals (SDGs) in 48 Sub-Saharan African countries using the system Generalized Method of Moments. The study basically investigates the collective impact of ICT (mobile phone and internet use) and financial sector development indicators on achieving economic, social, and environmental sustainability considering the SDGs. The findings of the study reveal that the four dimensions of financial development and both indicators of ICT increase economic, social, and environmental sustainability and increased access to mobile phones and the use of Internet contributes to the development of the financial sector while the contribution of financial sector development to the achievement of the SDGs increases with the presence of ICT.

Tchamyou, (2017) and Asongu, (2015) highlighted that increase in mobile phone subscribers and internet users impact financial depth which is the strength of any nation to grow. They also re-echoed the belief that in developing countries with poor financial systems, ICT may contribute to financial development, as they are affordable and easily available ways of communication and data gathering. In support of previous and recent research, (Lechman & Marszk, 2015; Sepehrdoust & Ghorbanseresht, 2019 and Ismail & Omar, 2019) posits that the development of ICT contributes and lay strong foundation for financial markets by promoting trade even when the usage of ICT services is built upon cost.

Asongu and Nwachuwku (2017) assess the role of ICT (Internet and cell phone penetration) as a complement to financial sector development (financial formalization and informalization) for financial access in 53 African countries between 2004 and 2011. The findings of the study state that the interaction between ICT and financial formalization (informalization) decreases (increases) financial activity, while the net effects meet the *a priori* expectation for all variables. The study confirms that, despite the negative marginal effects of financial informalization, the overall net effects are positive. The results also reveal that the interaction between ICT and informalization produces positive thresholds that are within the ranges.

In Raifu et al. (2023) the complementary role of regulatory quality in the relationship between ICT and financial development in Africa in 38 African countries from 2003 to 2020 using a two-step GMM system is investigated. The results demonstrate that ICT and regulatory quality are *sin qua non* for financial development. The study further confirms that the net effect of ICT and regulatory quality on financial development is positive, indicating that regulatory quality upwardly moderates the ICT-financial development nexus. From the study, based on different indicators of financial development, ICT improves financial depth and access, but deteriorates financial efficiency and stability, while the net effects of ICT and regulatory quality are positive for financial depth and efficiency and negative for financial access and stability.

ICT and Financial Sector in West African Countries

With respect to ICT as a driver of the financial sector, there are numerous studies confirming or rejecting the conclusion of Cull *et al.* (2018), Chen (2020) , Asongu *et al.* (2019) using the same dataset and econometric approach or different datasets and econometric approaches. Cull *et al.* (2018), Chen (2020) , Asongu *et al.* (2019) summarized

their findings on ICT diffusion and financial sector with the conclusion that ICT diffusion increases financial deepening by limiting information asymmetry, locational challenge, increasing delivery channels and reducing financial intermediation and transaction cost. In the contrary, there are some opposing views that report that non-financial institutions, such as FinTech institutions providing financial services, limit financial deepening (Thakor, 2020; Navaretti et al.., 2018; Temelkov & Samonikov, 2018).

Despite these recent arguments on ICT-Financial sector nexus, researchers have made some interesting contributiond on the ICT-financial sector nexus, especially in West-Africa, Africa and emerging nations. For instance, Study by Coulibaly (2021) examines the factors that drive the adoption and the use of mobile banking in the West Africa countries in comparison with East African countries by employing probit and multinomial logit regressions. The outcomes of the research affirmed that the factors that drive the adoption also affect the use of mobile money accounts by residents of the two countries, categorically the weaker social categories (i.e., men, elderly person, more knowledgeable, wealthier and part of the workforce). Therefore, the slow penetration of mobile money accounts associated with West African countries compared to East African nations is likely to be due to an inadequate policy approach to raise awareness of the benefits of mobile banking.

Senou *et al.* (2019) research the factors that drive mobile money adoption and the policy tools that are likely to remove the stumbling block inhibiting digital financial inclusion in WAEMU nations. The study uses national data and individual-level data obtained from the World Bank. The study analysis was conducted using a cluster analysis and logistic regression to examine the macroeconomic and microeconomic variables capable of driving mobile money adoption, and revealed that unique country characteristics such as educational level, labour force population, mobile facilities and banking facilities like ATMs per 100,000 population are the key macroeconomic factors that influencing mobile money adoption. The research paper concludes that being young, mature, literate, relatively wealthier and having a bank account motivate and increase the likelihood of mobile money adoption in WAEMU.

Mignamissi and Djijo (2021) conclude that the ICT gap is an impediment to financial development in Africa and argue that financial development indicators, such as the size of financial institutions and financial markets, have a negative relationship with the digital divide. Similarly, Asongu and Nwachukwu (2018) report that the interaction between ICT and financial formalization (informalization) decreases (increases) financial activity. Their submission is that there is a mixed effect between ICT, financial formalization and financial activity and although there are negative marginal effects of financial informalization, the overall net effects are positive. The study concludes that the conceivable attraction of the interaction of ICT with financial informalization results in positive thresholds that are within the ranges.

Owolabi et al., (2021) found that access to electricity significantly boosts mobile phone and internet subscription, which in turn enhances the financial sector development, while internet subscription significantly reduces financial sector development in West Africa. After breaking down the sample countries into Anglophone and Francophone West African countries, access to electricity through ICTs improves financial development in Francophone

countries, but only improves the ratio of broad money supply to GDP in Anglophone countries. The study concludes that access to electricity through the provision of electricity infrastructure and the regulation of electricity tariffs for individuals and businesses is essential to improve financial development in West Africa.

Methodology

Data description

Brief Data Description and Sources

This study focused on Information Communication Technology and financial deepening in all the sixteen (16) West Africa countries, with exclusion of Niger and Mauritania due to data inconsistency, thus reducing the study sample to fourteen (14) West African countries. Hence, this study uses unbalanced panel data from 14 West African countries for the period of 2012-2022.

To address the research approach, data were obtained from:

(1) World Bank Development indicators for the Information and Communication Technology variables.

(2) The World Bank's Financial Structure and Development Database (FDSD) for financial deepening variable.

ICTs were measured by mobile phone penetration per 100 people, internet penetration rate per 100 people and fixed broadband penetration per 100 people. The choice of the ICT is based on the 2012 UNDESA statements, the 2015 UNDP report, the 2015 ITU report, the 2019 UNDP and empirical study of Efobi et al. (2018) on economic growth and the ability to to drive efficiency of ICT indicators.

To capture the financial sector, bank assets relative to GDP was used because it is a good measure of size as it incorporates not only credit to the private sector, but also the credit to the state and bank assets other than credit. The choice of financial deepening is influenced by the fact that it is linked with poverty eradication (World Bank, 2022).

Model Specification

This study will fit a standard Cobb-Douglas function growth model and the empirical model of Levine and King.

Accordingly, the Cobb-Douglas production function is specified as:

$$3.1.\ Y_{it} = AK^{\alpha}L^{1-\alpha} \quad \ldots\ldots\ldots\ldots\ldots\ldots$$

Where Y represents economic growth, A represent Technological Efficiency, K represents Capital and L represents Labour.

The production function was augumented by Mckinnon (1973) and Levine and King (2002) with financial development and innovation because financial development is commonly used to represent capital improvement in the context of production functions, in addition to the fact that the financial sector can accumulate saving, minimize cost, reduce

financial constraints and allocate financial resources, while innovation is commonly used to represent technological innovation in the context of production functions (Greenwood & Smith, 1997; Leving & King 2002; Mckinnon-Shaw, 1973; Sassi & Goaied, 2013).

The financial sector is captured by bank assets because it incorporates not only credit to the private sector but also credit to the state and includes bank assets other than credit. Thus, the augmented specification of the appear as follows:

$$3.2.\ FD_{i,t} = c + c_1 ICT_{i,t-l} + c_2 + \sum_{r=1}^{n} v_r\, INFLA_{r,i,t-l} + R_i + N_t + ET_{i,t}$$

$$3.3.\ FD_{i,t} - FD_{i,t-l} = c_0 + c_1(FD_{t-l} - FD_{t-2l}) + c_2(ICT_{i,t} - ICT_{i,t-l}) + \sum_{ri=1}^{n} v_r\,(INFLA_{r,i,t-l} - INFLA_{r,i,t-2l}) + N_{t-l} + ET_{i,t} - ET_{i,t-l}$$

Where FS represents the financial sector and ISP represents internet subscription, MPS is mobile phone subscription, Fbroadband is fixed broadband and inf is inflation.

Method of Analysis

The study adopts system GMM estimation. The choice of the GMM system is based on its ability to address the problem of endogeneity, small sample bias and the problem of abnormal data distribution.

Diagnostic test and discussion of result

Table 1 shows whether financial depth can be influenced by the size of ICT in West Africa. The results show that past bank assets to GDP contribute 35 % to the increase in current bank assets and that past bank assets are statistically significant in explaining current bank assets. Interestingly, mobile phone subscription improves banks size in West Africa by 423.82 % (5.23820-1×100) and the result is statistically significant. Internet subscription increases financial depth by 11% and the result is statistically significant. Fixed broadband increases banking assets in West Africa by 341 % and the result is statistically significant. Mobile phone, internet and fixed broadband subscription positively affect bank assets relative to GDP Mobile phone, internet and fixed broadband subscriptions have significant positive effects on bank size. This may imply that ICT increases mobilization of deposits and thus improves the supply of credit through efficient allocation of funds and effective risk management. The analysis also reveals that ICT improve credit to the private sector, government, public enterprises and support quantitative easing of the monetary authority which is consistent with the study by Weil et al. (2014). The result is consistent with Lwanga and Adong (2016) on ways to promote financial inclusion and Masha (2016) on macroeconomic effect of financial technology. This implies that banks' huge investment in technology contributes positively to the size of financial institution in West Africa. Importantly, it can also be perceived that the emergence of non-financial institutions (e.g Fintechs) because of technology pressured banks to increase accessibility to credit products in West Africa (BIS, 2022). The results of this study lend credence to the claim that ICT helps banks to reach the unbanked population, thereby transforming the financial system (Naghavi,

2019). The finding also asserts that innovation or technology increases the degree of financial intermediation. The implication of the finding is that ICT or better internet facility gives room for bank customers to have increasing access to credit products offered by different banks through digital channels. The conclusion is that ICT enhances banks' assets because it promotes efficiency and high-quality services. The findings are consistence with the study of Edo *et al.*. (2019); Lapukeni, (2015). Inflation has a negative effect on the size of banks due to the high inflation rate in West Africa and thus implies that inflation encourages credit rationing and unwillingness to extend bank credit.

Table 1. Dependent Variable: BANKASSET

Method: Panel Generalized Method of Moments (System GMM)				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
CONS	13.3218	2.93091	4.55	0.0000
BANKASSET(-1)	0.35865	0.07172	5.00	0.0000
MPS	5.23820	1.13108	4.63	0.0000
INSP	0.10691	0.08223	1.30	0.1940
FBBSP	4.41557	0.35842	12.32	0.0000
INFLATION	-0.90892	0.14969	-6.07	0.0000
Number of Obs	125	Min		11
Number of groups	10	Ave		12.5
Wald Statistics	1057.29	Min		13
Prob(Chi-Square)	0.0000	No of Ins		84

Author's computation 2024.

Conclusion, policy implication and future research focuses

Interestingly, mobile phone subscription improves the financial depth of size in West Africa by 423.82 % (5.23820-1×100) and the result is statistically significant. Internet subscription increases bank size by 11 % and the result is statistically significant. Fixed broadband increases bank assets in West Africa by 341 % and the result is statistically significant. Mobile phone subscription, internet subscription and fixed broadband subscription positively affect bank assets relative to GDP. Mobile phone subscription, internet subscription and fixed broadband have significant positive effects on bank size. The findings state that ICTs improve mobilization of deposit and thus improves the supply of credit through efficient allocation of funds and effective risk management. The analysis also reveals that ICT improves credit to the private sector, to government, to public enterprises and support quantitative easing of the monetary authority. It also implies that huge investment by banks on technology positively contribute to the size of financial institution in West Africa. Importantly, it can be perceived that the emergency of non-financial institutions (e.g Fintechs) because of technology put pressure on banks to improve on technology and increase accessibility to credit products in West Africa (BIS, 2022). The results of this study lend credence to the claim that ICTs help

banks to reach out to the unbanked population, thereby transforming the financial system (Naghavi, 2019). Another implication of the finding is that ICTs offer bank customer the ability to increasingly access credit product offered by different banks through digital channels.

- Technology will put further pressure on the financial sector to increase accessibility to credit products in West Africa. Mobile phone and fixed broadband subscriptions have much more influence on the financial sector than internet subscription in West Africa. Thus, emphasis should be put on mobile phone subscription and fixed broadband in driving the financial sector.
- ICTs are essential for channeling funds from the surplus to the deficit units of the economy. Increased use of ICT for the delivery of financial services will result in greater efficiency, lower the cost of financial services and enhance financial inclusion.
- Policymakers must enforce the adoption of financial technology by both the formal and informal sector to promote financial depth of size.
- Lastly, future studies in West Africa should go beyond the impact of ICT on the financial sector to cover non-bank financial institutions

Bibliography

AFREXIMBANK. (2023). Contemporary Issues in Trade and Finance.

Ajit, S., Alaka, S., & Bruce, W. (2000). Information technology, venture capital and the stock market," MPRA Paper 53718, University Library of Munich, Germany.

Al-Hamzi, K. R. (2019). The Role of Information Communication Technology on Financial Development. MSc Thesis.

Alshubiri, F., Jamil, S. A., & Elheddad, M. (2019). The impact of ICT on financial development: Empirical evidence from the Gulf Cooperation Council countries. *international Journal of engineering business management*, *11*, 1847979019870670.

Asongu, S.A. (2015). The impact of mobile phone penetration on African inequality. *International Journal of Social Economics*, 42(8):706-716. DOI: https//.doi.org/10.1108/IJSE-11-2012-0228.

Asongu, S. A., & Nwachukwu, J. C., (2018). Comparative human development thresholds for absolute and relative pro-poor mobile banking in developing countries. *Information Technology & People*, 31(1):63-93. DOI: https//doi.org/10.1108/ITP-12-2015-0295.

Asongu, S.A., & Nwachukwu, J. C., (2016). The role of governance in mobile phones for inclusive human development in Sub-Saharan Africa. *Technovation*, 55-56 (September- October):1-13. DOI: https//doi.org/10.1016/j.techovation.2016.04.002.

Asongu, S. A., Batuo, E. M., Nwachukwu, J. C., & Tchamyou, V. S. (2018). Is information diffusion a threat to market power for financial access? Insights from the African banking industry.Journal of Multinational Financial Management, 45(June):88-104. DOI: https//doi.org/10.1016/j.mulfin.2018.04.05

Chen, K. C. (2020). Implications of fintech developments for traditional banks. International *Journal of Economics and Financial Issues*, 10(5), 227–235. DOI: https://doi.org/10.32479/ijefi.10076

Cobb, C.W. & Douglas, P.H. (1928) A Theory of Production.*American Economics Review*, 18, 139-165.

Comin, D., & Nanda, R. (2018). Financial Development and Technology Diffusion. Harvard Business School Entrepreneurial Management Working Paper No. 15-036, Forthcoming in *IMF Economic Review*.

Coulibaly, S. S. (2021). A study of the factors affecting mobile money penetration rates in the West African Economic and Monetary Union (WAEMU) compared with East Africa, *Financial Innovation. Springer*, Heidelberg, 7(1), 1-26, DOI: https://doi.org/10.1186/s40854-021-00238-0

Cull, R., Gine, X., Harten, S., Heitmann, S., & Rusu, A. B. (2018). Agent banking in a highly under-developed financial sector: Evidence from Democratic Republic of Congo. *World Development*, 107, 54–74. DOI: https://doi.org/10.1016/j.worlddev.2018.02.001

Del Gaudio, B. L., Porzio, C., Sampagnaro, G., & Verdoliva, V. (2021). How do mobile, internet and ICT diffusion affect the banking industry? An empirical analysis. *European Management Journal*, *39*(3), 327-332.

Dhahri, S., Omri, A., & Mirza, N. (2024).Information technology and financial development for achieving sustainable development goals. *Research in International Business and Finance*, *Elsevier*, vol. 67().

Diao, X., Mcmillan, M., & Rodrik, D. (2019). The recent growth boom in developing economies: A structural change perspective in Nissanke M and Ocampo J. A (eds), The Palgrave handbook of development economic, palgrave Macmillan, Cham, 281-334.

Efobi, U. R., Tanankem, B. V., & Asongu, S. A. (2018). Female Economic Participation with Information and Communication Technology (ICT) Advancement: Evidence from SubSaharan Africa. *South African Journal of Economics*, 86(2), 231-246.

Guerrini, l., Matsumoto, A., & Szidarovszky, F. (2019). Neoclassical growth model with two fixed delays.*Metroeconomica*, 70, 423-441.

Gupta, S., Jain, M., & Nagpal, A. (2019). An empirical investigation on associated linkage between human development and ICT: A South Asian perspective. *MPRA* paper 96167.

Ismail, N. W., & Omar, S. K. (2019). The Role of Information and Communication Technology (ICT) Infrastructure on ASEAN Trade. Proceedings of the International Conference on Economics, 166-174.

ITU. (2020). Digital Trends in Africa: Facts and Figures.

Lechman, E., & Marszk, A. (2015).ICT technologies and financial innovations: The case of exchange traded funds in Brazil, Japan, Mexico, South Korea and the United States. *Technological Forecasting and Social Change. Elsevier*, 99(C), 355-376.

Levine, R. (2005). Finance and growth: theory and evidence' in P. Aghion, P. and S.N. Durlauf (eds.) Handbook of economic growth. Amsterdam: *Elsevier*, 865–893. DOI: https://doi.org/10.1016/S1574-0684(05)01012-9

Lwanga, M. & Adong, A. (2016). A pathway to financial inclusion: mobile money and individual savings in Uganda. Economic Policy Research Centre, Research Series No. 127.

Masha, I. (2016). Macroeconomic impact of mobile payment services: A survey of research evidence.

Majeed, M. T., & Ayub, T. (2018). Information and communication technology (ICT) and economic growth nexus: A comparative global analysis. *Pakistan Journal of Commerce and Social Sciences,* 12(2), 443-476.

McKinnon R.I. (1973). Money and Capital in Economic Development, Washington DC: Brookings Institution.

Mignamissi, D., & Djijo T., & Audrey J., (2021).Digital divide and financial development in Africa, *Telecommunications Policy, Elsevier*, 45(9).

Mushtaq, R., & Bruneau, C. (2019). Microfinance, financial inclusion and ICT: Implications for poverty and inequality. *Technology in Society*, *59*, 101154.

Muthiora, B. (2015). Enabling mobile money policies in Kenya fostering a digital financial revolution.

Navaretti G.B., Calzolari G., Mansilla-Fernandez J.M., & Pozzolo A.F. (2018). Fintech and banking. Friends or foes?

Ofori I., & Asongu S. A. (2021). ICT diffusion, foreign direct investment and inclusive growth in Sub-Saharan Africa. (*MPRA* Paper No. 107757). UTC. https://mpra.ub.uni-muenchen.de/107757/

Owolabi, O. A., Adedeji, A.O., & Aderounmu, B. (2023). Do information and communication technology (ICT) and financial development contribute to economic diversivication? Evidence from sub-Saharan Africa. *Economic Structures*. DOI: https://doi.org/10.1186/s40008-023-00299-7

Owusu-Agyei, S., Okafor, G., Chijoke-Mgbame, A. M., Ohalehi, P., & Hasan, F. (2020). Internet adoption and financial development in sub- Saharan Africa.*Technological Forecasting & Social Change*, 161, 1–13.

Raifu, I. A., Okunoye, I. A., & Aminu, A. (2023). The effect of ICT on financial sector development in Africa: does regulatory quality matter? *Information Technology for Development*, 1-28.

Shaw, E. (1973). Financial deepening in economic development.Oxford University Press. DOI: https://doi.org/10.2307/1238641

Senou, M. M., Ouattara, W., & Acclassato Houensou, D. (2019). Is there a bottleneck for mobile money adoption in WAEMU? *Transnational Corporations Review*, *11*(2), 143-156.

Sepehrdoust, H., & Ghorbanseresht, M. (2019). Impact of Information and Communication Technology and Financial Development on Economic Growth of OPEC Developing Economies.Kasetsart.*Journal of Social Sciences*, 40(3), 546-551.

Shahbaz, M., Çetin, M., Avcı, P., Sümerli Sarıgül, S., & Altay Topcu, B., (2023). The Impact of ICT on Financial Sector Development Under Structural Break: An Empirical Analysis of the Turkish Economy. *Global Business Review*, l(1), 1-23.

Suragan, M., & Durmuşkaya, S. (2022). The Long-Run Relationship Between ICT Indicators and Stock Market Indexes for G7 And E7 Countries. *Journal of Organizational Behavior Research, 7*(1), 42-57. DOI: https://doi.org/10.51847/lXMfpFSEEy

Tchamyou, V. S. (2019). The role of Information sharing in modulating the effect of financial access on inequality.*Journal of African Business*, 20(3), 317-338.

Temelkov, Zoran & Gogova Samonikov, Marija. (2018). The need for fintech companies as non-bank financing alternatives for SME in developing economies. 10. 25 - 33.

Thakor, A. V. (2020). Fintech and banking: What do we know? *Journal of financial intermediation*, *41*, 100833.

Thulani., Pepukayi, C., & Zaheenah, C. (2016). Mobile Money as a Strategy for Financial Inclusion in Rural Communities. *Mediterranean Journal of Social Sciences.* Vol 5(12).

Tran, Q. D., & Huynh, C. M. (2022). ICT and financial development: Empirical evidence from ASEAN countries.

UNESCO. (2024). Information and Communication Technology.

WAEMU. (2023). Maintaining momentum of financial inclusion through digital adoption in the West African Economic and Monetary Union.

WEF. (2016). Accelerating capital markets development in emerging economies: country case studies. (White Paper.Geneva: World Economic Forum) http://www3.weforum.org/docs/WEF_accelerating-capital-markets-development-in-emergingeconomy

Weil, D., Mbiti, I. and Mwega, F. (2014). The implications of innovation in the financial sector on the conduct of monetary policy in East Africa. International Growth Centre: WP 12/0460.

World Bank. (2020). Financial Development in Sub-Saharan Africa. Promoting Inclusive and Sustainable Growth. Washington, D.C.

World Bank. (2021). Global Financial Index

World Bank. (2023). Strengthening financial sector stability in fragile and low-income country

World Bank. (2024). Financial inclusion in Sub-Saharan Africa