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IMPACT OF TECHNOLOGICAL INNOVATIONS ON BANK PERFORMANCE IN SELECTED WEST AFRICAN COUNTRIES (1997-2020)

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ABSTRACT

Purpose: Technological innovations are understood as new or improved processes, products or services, the technical characteristics of which are significantly different from the previous ones. Technological innovations in the banking sector have undoubtedly improved the functionality and performance of banks across the globe including West African countries such as Nigeria, Ghana and Coted'Ivoire. It has redefined the way and regime in banking operation in West Africa. It enables banks to improve the quality of service delivery to their numerous customers and makes it easy for customers to access banking services at the lowest cost possible. This study, therefore, focused on examining the impact of technological innovations on bank performance in West Africa.

Method: A set of annual time series covering the period 1997 to 2020 and a multiple regression analysis including an autoregressive distributed lag (ARDL) model, a fully modified OLS (FMOLS) model and a dynamic OLS (DOLS) model were used. Bank performance was measured using bank return on assets (ROA) and bank return on equity (ROE), while technological innovation was measured using indicators such as Internet Banking (INB), Automated Teller Machines (ATM), Mobile Banking (MBN) and Point of Sale (POS) whose control variables are inflation rate (INFR) and exchange rate (EXR).

Results and conclusion: Findings from the ARDL panel results show that both positive and negative long-term relationships exist between technological innovation and bank performance in West Africa. We thoroughly verified the results from the ARDL model with FMOLS and DOLS and the findings show that technological innovation has a positive and negative long-run relationship with bank performance in West Africa and the results were the same for Nigeria, Ghana and Ivory Coast.

Originality/Value: This study, therefore, recommends that improving the quality of technologically innovative tools of banks such as internet banking, ATMs, POS and mobile banking with quality apparatus can lead to improved bank performance. Banks should also invest in cyber security to ensure funds deposited in banks are safe which will boost investor and customer confidence, acceptance and lead to increased bank performance.

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IMPACTO DAS INOVAÇÕES TECNOLÓGICAS NO DESEMPENHO DOS BANCOS EM DETERMINADOS PAÍSES DA ÁFRICA OCIDENTAL (1997-2020)

RESUMO

Objetivo: As inovações tecnológicas são entendidas como processos, produtos ou serviços novos ou melhorados, cujas características técnicas são significativamente diferentes das anteriores. As inovações tecnológicas no setor bancário melhoraram indubitavelmente a funcionalidade e o desempenho dos bancos em todo o mundo, incluindo países da África Ocidental, como a Nigéria, o Gana e a Costa do Marfim. Redefiniu a forma e o regime das operações bancárias na África Ocidental. Permite aos bancos melhorar a qualidade da prestação de serviços aos seus numerosos clientes e facilita o acesso dos clientes aos serviços bancários ao menor custo possível. Esse estudo, portanto, focou-se na análise do impacto das inovações tecnológicas sobre o desempenho dos bancos na África Ocidental.

Método: Utilizou-se um conjunto de séries cronológicas anuais abrangendo o período de 1997 a 2020 e uma análise de regressão múltipla incluindo um modelo de desfasamento distribuído autorregressivo (ARDL), um modelo de OLS totalmente modificado (FMOLS) e um modelo de OLS dinâmico (DOLS). O desempenho dos bancos foi medido utilizando o rendimento dos ativos bancários (ROA) e o rendimento dos capitais próprios (ROE), enquanto a inovação tecnológica foi medida utilizando indicadores como o Internet Banking (INB), os Automated Teller Machines (ATM), o Mobile Banking (MBN) e o Point of Sale (POS), cujas variáveis de controlo são a taxa de inflação (INFR) e a taxa de câmbio (EXR).

Resultados e conclusão: os resultados do painel ARDL mostram que existem relações positivas e negativas a longo prazo entre a inovação tecnológica e o desempenho dos bancos na África Ocidental. Verificamos minuciosamente os resultados do modelo ARDL com FMOLS e DOLS e as descobertas mostram que a inovação tecnológica tem uma relação positiva e negativa de longo prazo com o desempenho dos bancos na África Ocidental e os resultados foram os mesmos para a Nigéria, Gana e Costa do Marfim.

Originalidade/Valor: Este estudo recomenda, por conseguinte, que a melhoria da qualidade das ferramentas tecnologicamente inovadoras dos bancos, como a banca via Internet, as caixas automáticas, os pontos de venda e a banca móvel com aparelhos de qualidade, pode conduzir a um melhor desempenho dos bancos. Os bancos devem também investir na cibersegurança para garantir que os fundos depositados nos bancos são seguros, o que reforçará a confiança dos investidores e dos clientes, a aceitação e conduzirá a um maior desempenho dos bancos.

Palavras-chave: Inovações Tecnológicas, Banca Eletrônica, Desempenho Bancário.

IMPACTO DE LAS INNOVACIONES TECNOLÓGICAS EN EL DESEMPEÑO BANCARIO EN DETERMINADOS PAÍSES DE ÁFRICA OCCIDENTAL (1997-2020)

RESUMEN

Finalidad: Las innovaciones tecnológicas se entienden como procesos, productos o servicios nuevos o mejorados, cuyas características técnicas difieren significativamente de las anteriores. Las innovaciones tecnológicas en el sector bancario sin duda han mejorado la funcionalidad y el rendimiento de los bancos en todo el mundo, incluidos países de África Occidental como Nigeria, Ghana y Costa de Marfil. Ha redefinido la forma y el régimen de las operaciones bancarias en África occidental. Permite a los bancos mejorar la calidad de la prestación de servicios a sus numerosos clientes y facilita a los clientes el acceso a los servicios bancarios al menor coste posible. Por lo tanto, este estudio se centró en examinar el impacto de las innovaciones tecnológicas en el desempeño de los bancos en África Occidental.

Método: Se utilizó un conjunto de series de tiempo anuales que cubren el período 1997-2020 y un análisis de regresión múltiple que incluyó un modelo de rezago distribuido autorregresivo (ARDL), un modelo de OLS completamente modificado (FMOLS) y un modelo de OLS dinámico (DOLS). El desempeño bancario se midió mediante el rendimiento bancario de los activos (ROA) y el rendimiento bancario de los recursos propios (ROE), mientras que la innovación tecnológica se midió mediante indicadores como la Banca por Internet (INB), los Cajeros Automatizados (ATM), la Banca Móvil (MBN) y el Punto de Venta (POS) cuyas variables de control son la tasa de inflación (INFR) y la tasa de cambio (EXR).

Resultados y conclusión: Los resultados del panel ARDL muestran que existen relaciones positivas y negativas a largo plazo entre la innovación tecnológica y el desempeño bancario en África Occidental. Verificamos a fondo los resultados del modelo ARDL con FMOLS y DOLS y los hallazgos muestran que la innovación tecnológica tiene una relación positiva y negativa a largo plazo con el desempeño bancario en África Occidental y los resultados fueron los mismos para Nigeria, Ghana y Costa de Marfil.

Originalidad/Valor: Este estudio, por lo tanto, recomienda que la mejora de la calidad de las herramientas tecnológicamente innovadoras de los bancos como la banca por Internet, cajeros automáticos, puntos de venta y banca móvil con aparatos de calidad puede conducir a un mejor rendimiento bancario. Los bancos también

deberían invertir en ciberseguridad para garantizar que los fondos depositados en los bancos sean seguros, lo que aumentará la confianza de los inversores y clientes, la aceptación y conducirá a un mayor rendimiento bancario.

Palabras clave: Innovaciones Tecnológicas, Banca Electrónica, Rendimiento Bancario.

INTRODUCTION

Background to the Study

Technology deployment across sectors has remained a phenomenon and the banking sector is not left out. By engaging technological innovations, the banks deliver improved services in critical areas such as customer feedbacks, inquiries, time savings, complain lodgment, and better access. In order to attend to customers better, banks across the globe adopt varying technologies, one of which is electronic banking channels popularly known as e-banking channels (Evian, Limijaya, Hutagaol-Martowidjojo, 2021). This refers to development, deployment and adoption of technology in banking through electronic channels thus helping customers achieve ease in doing transactions at flexible time and place. This no doubt has resulted in high competitiveness and drive for efficiency and increased earnings. It must be mentioned that competition in financial institutions is ever-changing and shifting with electronic banking channels not only becoming a reasonable advantage but a viable requirement for banks across the globe (Kessey & Abassah-Wesley, 2020; Adewuyi, 2011; Gan, Clemes, Limsombunchai, & Weng, 2006). This shift is mainly driven by information technology and technological innovations.

The world is changing and Information and Communication Technology (ICT) is at the centre of this global change today; ICT has encouraged development of channels geared towards expanding banking operations and improving electronic banking systems (Nwakoby, 0Okoye, Ezejiofor, Anukwu & Ihediwa, 2020). ICT play such a significant role in global economy contributing over 20% to the Ghana's gross domestic product as at 2013 and nearly 18% to Nigeria's economy as at second quarter 2021. This strongly shows that today's banking business has evolved and will continue to experience changes. Asikhia, Nneji, Olafenwa and Owoeye, (2021) conclude that the speed of revolution is so swift and the degree of obsolescence will be so brutal should businesses resist change. The authors added that the surest route out of the looming danger is for organizations to embrace change. Therefore, it becomes a necessity for organizations to design, develop and deploy measures and capabilities geared towards adaptability and steering the changes for internal benefits and advantage. These innovations and further deployment of fresh technology has no doubt stimulated the growth of the banking

systems which as aided the sector especially in creating variant services offered to customers (Atakli & Asiedu, 2020, El-Chaarani & Abiad, 2018).

In particular, considering the present ICT penetration level, huge investments in technological innovations and depth in electronic banking channels across West Africa, it will be necessary to critically examine amongst other things technological innovations, electronic banking channels and their impact on bank performance in West Africa. It will be logical to ask, following the massive opportunities that exist in the sector how innovations in the banking sector contribute and impact profitability and general good of the banks, on the one hand, and how to make the use of technological innovations more effective on the other hand, more specifically, how can the deployment of technology in terms of electronic banking channels improve bank performance in Ghana, CoteD'Ivoire and Nigeria. Overall, it is evident that the fast progress in the banking sector has heartened the introduction and acceptance of technology service providers (Ahaiwe, 2011). By implication, the level of technological inventions and IT based systems in the banking sector will continue to experience a jump more and new innovations are expected to emerge.

Information technology is an essential instrument of competition used by business concern and banks seeking to stay dominant and achieve competitive superiority over others (Roy, 2018). This implies that banks and firms will continue to embrace technological innovations as it improve both product and service quality (Mawutor, 2014; Nworuh & Ahaiwe, 2003). Sharing similar thought, Adewuyi, (2011) opined that banks often invest funds in emerging technologies as a strategic and tactical channel for staying competitive. To them, this is a necessity. This accounts for the massive investment in technology by banks in Africa and it does not look like the expansion will stop anytime soon. That explains why Zu, Gu, Li, & Bonsu, (2019) stated that in the financial sectors, financial innovations like App store, POS, ATM, mobile banking, and internet banking, mobile money, mobile payment and agency banking are taking place at a massive fast pace.

However, the effect of ATM and other electronic channels on services and bank earnings need to be estimated so as to justify its deployment. For instance, Abdullai and Nyaoga (2017) suggest that the overall aim of deploying electronic banking gadgets is to achieve the highest possible level of profits. Also, the introduction of IT solutions to traditional banking brought respite for a while as more and more problems manifested again in a short time. Because the information generated by the computers was sluggish to dissipate, the banks became crowded once more. This is why Prager, (2001) concluded that overall, ICT and IT

backed devices and how they influence the business of banking will remain subject of discuss in empirical research for a long time.

Furthermore, in trying to provide satisfaction for their customers and make banking process seamless, banks have provided IT solutions to replace human deployment, which is envisaged to not only drastically reduce cost but to increase the profit achieved by the banks, boost returns on equity, return on assets and finally improve customer's satisfaction. This is a driving force for more and more investment in technology driven banking channels. This was confirmed when Hernando and Nieto (2007), examined how IT backed banking system influences the performance of banks and conclude that the implementation of the internet as a channel for rendering banking service has to do with a steady drop in overheads and results in higher incomes but only in the long run does it improve return on assets (ROA).

Finally, as a result of their pledge and desire to meet customer's and satisfy them, through quality services, promptness, quickness and ease, financial institutions and banks remain committed to investing immensely in electronic channels and technological innovations. However, how these innovations influence the performance of the banks essentially remain adequately unverified (Obeng-Osei, 2019). It is based on the forgoing therefore that we try to justify and appraise the impact of the huge investments in innovative technological channels on bank performance in West Africa.

Statement of the Problem

Quite a lot of studies that tried to study the impact of technological innovations (IT) or IT-backed system of banking services delivery on bank profitability have shown contradictory and unconvincing findings especially with respect to situation in (Kamau & Oluoch, 2016; Monminder & Tripti, 2015; Weigelt & Sarkar, 2012; Ciciretti et al., 2009; Hernando & Nieto, 2007). Again, quite a few others indicate contrary outcomes (Sathye & Sathye, 2016; Akhisar,Tunay & Tunay, 2015). The results may be because of the nature of data, country specific or data analysis technique adopted. Consequently, this work offers an alternative assessment on the topic by considering how IT-backed channels and products (Internet banking, ATM, POS and Mobile banking) influence the performance of the banking sector in selected West Africa States, using secondary data and adopting ordinary least square technique for data analysis.

Can we say the level of returns and profitability of the banks justifies the huge investments in digital infrastructure and electronic banking channels? For instance, Rozhkova,

Rozhkova and Tozhihonov, (2021) clearly stipulate that while electronic banking channels improve ease of doing banking transactions and customer satisfaction, on the other hand, it exhibits no significant association with the performance of the banks. This suggests that technological innovations only benefits bank customers and do not impact on performance of bank in terms of earning and higher returns. This shows that increasing investments in technological innovations and electronic banking channels do not automatically imply higher earnings and better performance; and this is paramount to investors and other critical stakeholders.

Technological innovations and electronically based systems in the banks in West Africa have gotten more and more popular and attractive across the globe. This is evident in the ever rising and constant increase in transactions consummated via e-channels and the continuous investment in huge sums in technological innovations such as ATM and payment systems. But does an upsurge in transaction levels mean better bank performance? For instance, a review of yearly financial reports of banks in Nigeria tell that dividend and returns are constantly deteriorating while other performance pointers appear to be fragile contrary to shareholder's expectations. Generally, there looks not to be progress on returns on equity (ROE) and assets (ROA) in banks as popularly guessed (Abaenewe, Ogbulu, & Ndugbu, 2013).

The challenge therefore is to justify the increasing championing of digital means for transacting banking business and to clearly proof that more and more need exist for investments in electronic banking channels and that despite its numerous challenges, it continues to stimulate and impact positively on bank performance. It is not sufficient to continue to invest in technological infrastructure and other internet based channels of transactions in the banks whereas earnings and return on assets continue to dwindle. It is based on this that this research tries to evaluate and validate the influence of POS, ATM, internet banking, and Mobile banking on both return on assets and return on equity in West Africa.

Study Objectives

The foremost objective of the study is to observe the impact of technological innovations on bank performance in West Africa covering the period, 1997 to 2020.

Specifically, this study tries to:

a. Observe the impact of internet banking on return on assets

b. Observe the impact of Automated teller machine on return on assets

c. Determine the impact of point of sale (POS) on return on assets

d. Explore the impact of mobile banking on a return on assets
e. Define the impact of internet banking on return on equity
f. Define the impact of Automated teller machine on return on equity
g. Determine the impact of point of sale (POS) on return on equity
h. Explore the impact of mobile banking on a return on equity

Research Questions

a. To what extent did internet banking impact return on assets?
b. To what extent did automated teller machine impact on return on assets?
c. To what extent has Point of Sale (POS) affected ROA?
d. To what extent has mobile banking affected return on assets?
e. To what extent did internet banking impact return on equity?
f. To what extent did automated teller machine impact on return on equity?
g. To what extent has a point of sale (POS) affected ROE?
h. To what extent has mobile banking impacted return on equity?

Hypotheses of the Study

To realize the set objectives mentioned above, the following hypotheses will be estimated:

a. Internet Banking had no affirmative and substantial impact on return on assets
b. Automated teller machine (ATM) transactions had no positive and significant impact on return on assets
c. POS does not have a significant impact on return on assets
d. Mobile banking does not have a major impact on return on assets
e. Internet Banking had no positive and significant impact on return on equity
f. Automated teller machine (ATM) transactions had no positive and significant impact on return on equity
g. POS does not have a significant effect on return on equity
h. Mobile banking does not have a significant impact on return on equity

Scope of Study

This work examined the impact of technological innovations, proxied by electronic banking channels on bank performance in selected West African countries. For proxy for electronic banking, ATM, and internet banking, POS, and mobile payment systems are considered). They are popular and the obviously used in the globe and West Africa is not left out (Obeng-Osei, 2019; Mustapha, 2018; Puopiel, 2014**;** Hossain, et al, 2013; Okechi & Kepeghom, 2013; Tchouassi, 2012); while ROA and ROE represent the performance of the banks (Ajayi & Enitilo, 2016l; Abaenewe, et al 2013).

The period covered by this work is 1997 to 2020. The decision to adopt 1997 to 2020 is based on the fact that prior to 1997, electronic banking data were not available as most of the developing countries began to embrace technological innovations from 1997. Data for later year 2021 was unavailable as at the time of this study. This study concentrated on top economies in West Africa region (Nigeria, Ghana and Cote d'Ivoire) with respect to gross domestic product (Eyisi, 2010), with information communication technology (ICT) driving payments and contributing immensely to their GDP. Also, there are more physical bank branches a well higher aggregate of bank accounts in the region (Sasu, 2021, Edjoukou, 2020).

REVIEW OF RELATED LITERATURE

Conceptual Review

Electronic banking

The term 'electronic banking', is commonly referred to as e-banking. It represents a multiplicity of diverse services and offering ranging from transaction confirmation through sms messages to automated teller machines (A.T.Ms), electronic funds transfer and other services (Eshun, Adu, & Akenten, 2016). Furthermore, it also encompasses using digital channels like internet banking, mobile banking and other self-service technological innovation to convey banking services (Adewoye, 2013). Malhotra, (2004) defined e-banking as the adoption of electronic and communication networks by financial institutions to rightly serve and satisfy their customers.

Overtime, E-banking is conceptualized as a channel aiding and helping bank customers carry out personal transactions and access varying banking services (DeYoung, 2002). Overall, the customer, is not essentially required to officially visit the bank or be physically present to transact or receive banking services and products. Internet banking, personal computer (PC) banking, remote electronic banking, virtual banking, remote electronic banking, phone banking,

and online banking are all examples of online service delivery. Internet/online banking and PC banking is patronized by customers more than the others. With exception of cash withdrawal, all banking transactions can be assessed at the click of the mouse (De Young, 2002). With current venomous competition in the banking sector, internet and technology is not only a competitive tool but it have become critical for financial service delivery (Gan, & Clemes, 2006, Flavian, Torres, & Guinaliu 2004).

Internet banking

The concept of internet banking is anchored on driving banking business basically through the deployment of internet service. It mean banking products and available services are delivered through online means. Banking activities such as bill payments, funds transfer, and mortgage payment, checking and accessing outstanding balances, deposit certificate and investment in financial instruments are easily carried out through internet banking. It is regarded as a significant delivery channel, as it has leveled the playing field to empower banks get unhindered access to customers and stakeholder across the world (Karjaluoto, 2002). Considering the engagement of internet banking by banks, customer can henceforth access their personal accounts from private and diverse locations using a computers and links programmed and enabled by the bank.

Automated Teller Machine (ATM)

Hota, Nasim and Mishra (2013) clearly state that the most interesting experience of bank customer is the deployment of ATM. A technology that functions 24/7 in as much it is enabled. The ATM accepts card linked to accounts of customers. This has changed all the difficulties associated with bank transactions such as individual attendance of the customer, restricted banking hours and paper based authentications. From this time, ATMs give customers unrestricted access to cash at any time of the day and in any location. Aside from that, the ATM allows customers to perform a variety of banking tasks, including cash withdrawals from their accounts, balance inquiries, applications for recurring deposits, money transfers from one account to another, paying insurance bills, charging mobile phones, and making small loans. Besides, non-cash items like coupons dispensing, cinema tickets and issue of gold coins services are now possible through ATMs.

The ATM system is a distinctive electronic payment that functions with smart cards. Basically, these cards are plastic devices with inserted integrated circuit which is used for

settlement of financial obligations. It can be used as a Debit Card, Credit Card, and on ATMs (Automatic Teller Machine) depending on its sophistication. The card system, particularly the ATM card, has gradually gained popularity in Ghana (Osei, Morrissey & Lloyd, 2005).The Smart Card was made known to the Ghanaian market to eradicate or lessen problems of carrying cash (Osei, 2005).

Unpredictably, this huge and diverse activities is performed by using a card from the financial Institutions on the automated teller machines (ATM). So much funds have been invested in ATM infrastructure across Ghana, CoteD;Ivoire, Nigeria and Africa in general. This is geared towards enhancing payments, access to cash and improved services to bank customers. Automated Teller Machine (ATM) is the leading and paramount generally known machines to render electronic access to bank customers. With the initiation and coming on of ATM, banks are well able to serve customers better even outside of the banking hall. By design, ATM perform the utmost essential function of financial institutions such as cash withdrawal, cash deposits, mini statement printouts, bills settlements. (Odusina, 2014).

Mobile banking

According to Nguena, (2019), mobile banking can also be referred to *m*-banking, or SMS Banking. Mobile banking is a terminology used to describe channel for carrying out banking business through an android or smart-phone, with or without a link to a traditional banking account. The benefit of this is that financial services functions properly irrespective of location or phone type. The banking sector has always been the essence of any national economy and especially of emerging economies. With new advances and technical improvements, this industry has evolved from its traditional form to e-banking and, more recently, *m*-banking (Shobhit 2016).

Recognizing the potential of mobile phone services and the potential benefits of lowering transaction costs, banks have adopted the notion of mobile banking, which eliminates the need for consumers to physically visit a bank branch. Mobile banking, often known as m-banking, is the most recent technical breakthrough in which a consumer may do all of his financial activities using his mobile phone. In other terms, m-Banking is a 24/7 bank in its clients' pockets. It uses a mobile application which is a software provided by the financial institution for the performance of such transactions (Shobhit 2016).

In an attempt to expound on the concept of mobile payment system, Kirera (2016) conclude that mobile banking has become one of the most popular in Kenya and that a positive

and substantial association exists between the usage of technology and financial performance. Mobile phones, tablets, and other devices that can connect to mobile telecommunication networks to facilitate payment and receive money from another end are examples of mobile devices used to make mobile payments. Mobile banking, according to Tiwari, Buse, and Herstatt (2006), is any transaction that involves the transfer of ownership of rights to use goods and services and is initiated and/or completed using mobile access to computer-mediated networks via an electronic device. Mobile banking is typically done by SMS or mobile internet, although it can also be done using special apps downloaded to the device (Al-Jabir, 2012). Without a question, the mobile phone offers a fantastic chance to provide financial services to the unbanked (Tchouassi, 2012).

Bank performance

Different proxies can be used to identify the level of business performance depending on the parameter used for measurement. For instance Ai-Matari, Ai-Swidi and Bt-Fadzil, (2014) in their study on the measurements of firm performance's dimension suggested any of profit margin, return on assets, earning per share (EPS), ROE, dividend yield as representation for organizational performance. According to a research by Abaenewe, et al (2013), performance of a bank could be measured in terms of return on assets (ROA) and return on equity (ROE). Nevertheless, it is important to note that firms' profitability is not the only performance indicator of an organisation. Performance could be identified from different perspectives based on studies carried out by researchers; productivity, increase in sales, cost reduction, competitiveness, efficiency and effectiveness (Ibukunle & James, 2012). Drawing from the above, the study makes a deduction that organizational soundness and performance can be assessed with all or any of the profitability ratios, growth rates and profit margins.

Therefore, in this study, the performance of banks will be represented as ROA and ROE which agrees with Abaenewe et al (2013). Managerial efficiency in the usage of the business assets and capital to achieve high turnover and make profit could be checked through profitability measure. Most recent operations-related studies have assumed that technological innovation has a direct impact on performance improvement and that electronic banking channels have the potential to improve bank productivity, growth, and profitability due to low cost advantages associated with service delivery (Chemtai, 2016; Abubakar, 2014).

Organizational performance is linked to the concepts of growth and sustainability, and firms often strive for excellence in a variety of areas. First and foremost, they strive to achieve

strong financial results, i.e., a good return on their investment. Second, they aim to get a large part of the market, and third, they try to increase the value they provide to their stakeholders.

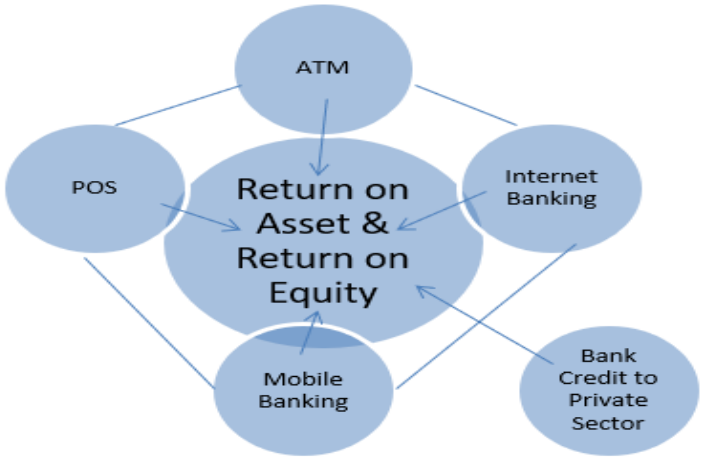
Businesses are concerned about attaining long-term growth; however, given the fast shifting political, economic, competitive, and consumer trends, this is no easy feat.

Abaenewe et al. (2013) compared bank performance to how well it performed throughout a trading period in terms of achieving its goals. Indeed, a company can choose from a variety of metrics to gauge its progress, but the most important metric is one that shows progress toward the ultimate goal of profit, such as the size of the bank, the volume of deposits, and its profitability, which have all been found to be more reliable indicators of a bank's performance (Abaenewe et al., 2013). However, according to Ekwueme et al. (2012), the operational effectiveness of e-banking may be examined by comparing and contrasting pre- and post-e-banking processes. The study will use productivity pointers to illustrate bank performance, specifically the return on assets and return on equity.

Conceptual Framework

In the framework shown in figure 1 below, the independent variable is technological innovations represented as electronic banking and measured by sub variables such as ATM, POS, Mobile Banking, and Internet Banking while Bank Lending to Private sector is the scientific constant, while bank performance, substituted by ROA and ROE is the dependent variable. The arrow implies that the relationship between bank performance and financial innovation is uni-directional. That is, financial innovations represented by electronic banking channels explained by ATM, POS, Internet banking, mobile banking and bank credit to private sector as a control variable impacts both return of asset and return on equity.

Figure 1: Conceptual Framework



Source: Authors' Design: 2021

The diagrammatic representation above shows that the behaviour of the identified electronic banking channels (ATM, POS, Internet, Mobile) and the control variable (Bank Credit to Private Sector) directly affects the direction and outcome of bank performance, measured as Return on Asset (ROA).

Contextual Review

Electronic banking and the performance of banks in Nigeria

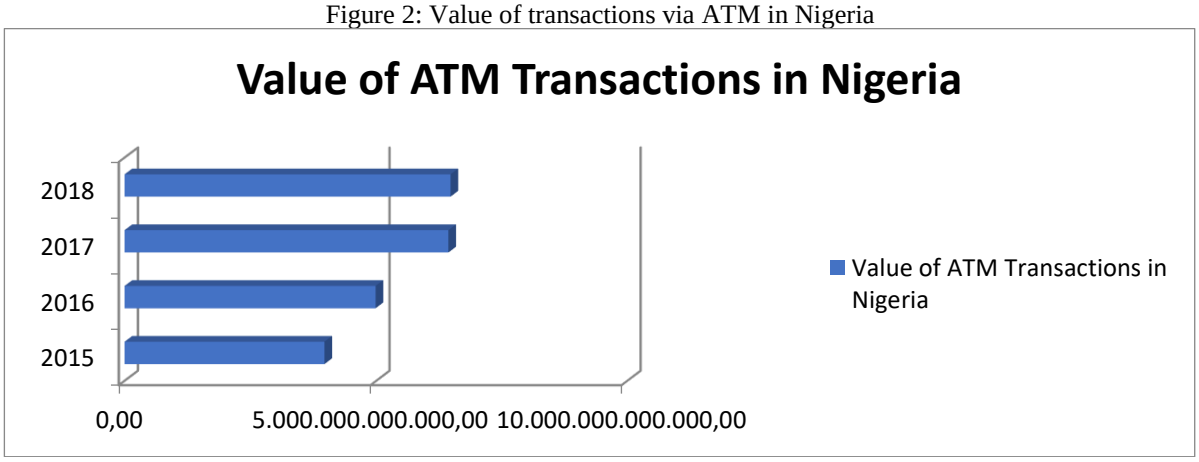
According to Onodugo, (2015), one of the first electronic banking channels to be embraced is the ATM. The author further stated that the ATM was first launched and installed in Nigeria by the National Cash Registers for the erstwhile Societe Generale Bank as an electronic delivery device in 1989. This trend prompted Inter Switch to launch operations in 2003 with five ATMs from First Bank of Nigeria and United Bank for Africa, but the situation has since altered because ATMs can now be found all over Nigeria (Onodugo, 2015; Tope, 2010). According to the Central Bank of Nigeria's (Central Bank of Nigeria Annual Report, 2017) report, ATMs accounted for 78.2 percent of all e-payment transactions in 2017, followed by Point of Sale (PoS) terminals, mobile payments, and web (internet) payments, which accounted for 14.3, 4.7, and 2.8 percent, respectively.

No doubt the banks have encountered deep inventions and innovation in the last decades; this has made service in the industry automated and self-friendly platforms have emerged. Transacting via ATM has also been aided (Agbolade, 2011). But has the adoption of electronic banking totally eradicated the use of cheques and other traditional banking methods in Nigeria? Mustapha (2018) opined that the cashless policy of the Central Bank of Nigeria (CBN) is in line with global trend by ensuring that majority of payments are tilted towards cheques and e-payments rather than raw cash. This implies that e-banking does not totally eradicate the use of cheques for payment. To further buttress this, Enoruwa, Ezuem and Nwani (2019) in their work on e-banking and the performance of banks mentioned that even though cheques have improved cashless policy in Nigeria but it is not an e-payment channel. No wonder there is a continuous decline in cheque related transactions from N29.4billion in 2009 to about N5billion as at year ended 2017.

The apex bank in Nigeria, CBN industry figures on e-payment reveals that the value of transactions on the ATMs in Nigeria continues to increase. For instance, in 2015, total value of transactions on the ATM amounted to N3,971,651,486,420.00 and N4,988,133,401,544.00, N6,437,592,402,748.64 and N6,480,085,899,760.37 in the year 2016, 2017 and 2018

respectively. The report also shows that as at August 2021, ATM transactions had already hit N12trillion. The value of transactions consummated through the ATMs is shown in figure 2 below:

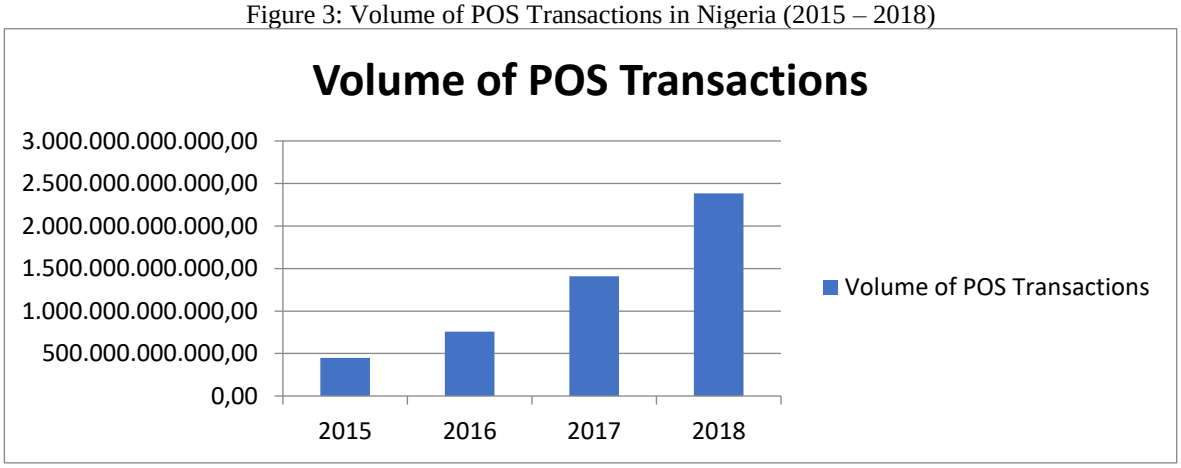
Figure 2: Value of transactions via ATM in Nigeria



Source: Author's Design, 2021

As expected, point of sales (POS) transactions also moved in the direction of the ATM in Nigeria, witnessing huge acceptance and patronage. In 2015, CBN e-payment report shows a total of N448,512,548,727.00 as value of POS transactions. The years 2016, 2017 and 2018 ended with N 758,996,505,702.00, N 1,409,813,091,608.35, N 2,383,108,901,148.12 respectively. Total value of POS transactions as at August 2021 stood at N2, 806,304,086,834. This is shown in the chart below as figure 3.

Figure 3: Volume of POS Transactions in Nigeria (2015 – 2018)



Source: Author's Design, 2021.

From the diagrams above, it is apparent that in the period, the total value of businesses on the identified channels continued to rise despite prevailing challenges.

Electronic banking and bank performance in Ghana

Kessey and Abassah-Wesley, (2020) found that the ATM is the most popular technology among bank customers in Ghana. This is an indicator of the level of acceptance of the channel as a means of payment and means of banking transactions. No wonder, Abor, (2005) reports that in Ghana today, the rivalry in the banking sector has aided technological innovations with the deployment of ATMs, telephone banking, SMS banking and other e-channel products.

In Ghana, technological advancements in the financial sector have significantly improved banking services. This was affirmed by Addae-Korankye, (2014) who argued that banking in Ghana has been undergoing a rapid change in its service delivery due to the advancement of technology and customer demands. Although ATM is widely accepted in Ghana, some authors are of the view that mobile banking product is more encompassed in terms of volume and value of transactions consummated through the channel. For instance, Adams & Lamptey, (2009) opined that banking services in Ghana is experiencing speedy growth with the liberalization of the sector by the apex bank (Bank of Ghana), and the creation of a positive economic atmosphere.

With this, quiet many banks are doing well, and with the ever growing technology, they accept bringing more innovative concepts into the banking sector. This obviously accounted for the introduction of the concept of e-banking to provide 24-hour services customers and all bank clients. In a similar study, Yemofio, (2021) examined the overriding result of cultural dimensions and how it relates with the acceptance of mobile banking in Ghana. The study adopted discussion guide to gather data from twenty panel contributors signed up on mobile banking platform and non-mobile banking customers. From the findings, it is evident that mobile banking substantially have a positive impact on the banking sector in Ghana and results proof mobile banking customers have great assurance in their banks.

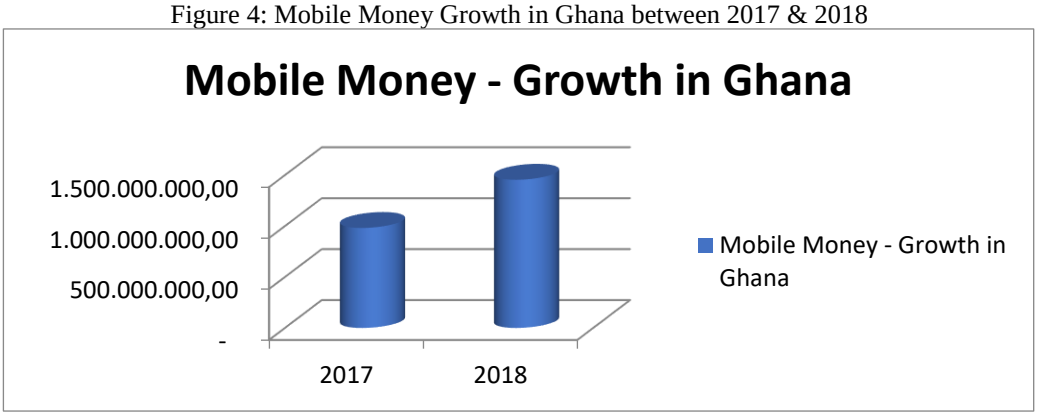
Therefore, the most primitive forms of electronic and communications technologies used were mainly office automation devices. This includes telephones, telex and facsimile. These were used to hasten and make more seamless, the process of rendering services to bank customers. They have remained the primary information and communication technologies for conducting bank operations for decades (Abor, 2005). Banks in Ghana are networking their branches and providing service goods as a result of technological progress combined with the availability of internet services in Ghana. Due to increased competition, practically all banks in Ghana today offer various types of e-banking services. For instance, a report by Abor (2005)

revealed that Barclays Bank (Ghana) Limited and Standard Chartered Bank (Ghana.) Limited opened up this very key electronic innovation, which transformed the banking landscape in the entire country.

The Bank of Ghana facilitated the passage of the Payment System and Services Bill, 2018, with the goal of shaping the payments system landscape and allowing non-bank enterprises to engage in the payment ecosystem. This has created opportunities for Financial Technology Firms (FinTechs) to improve their products' time to market, reduce development cost, enhance product flexibility and improve market competitiveness. For instance, the Bank of Ghana approved 27 products and services for 16 financial institutions compared with 38 products and services approved for 21 institutions in 2017. The approved products were mainly in-bound remittances, agency banking, mobile banking services and mobile money pension service (Bank of Ghana, 2018).

According to Ghana's payment systems annual report for 2018, all major non-cash payment streams saw significant increases in both volume and value of transactions in 2018, with the exception of Ghana Interbank Settlements (GIS) and Cheque Codeline Clearing (CCC), which saw decreases in both value and volume. The performance of mobile money in Ghana as at August 2021 as reported by the Bank of Ghana shows that volume of transactions on mobile money alone hit 377million GHC while total value stood at 81.83billion GHC. The growth in mobile money transactions is shown below:

Figure 4: Mobile Money Growth in Ghana between 2017 & 2018

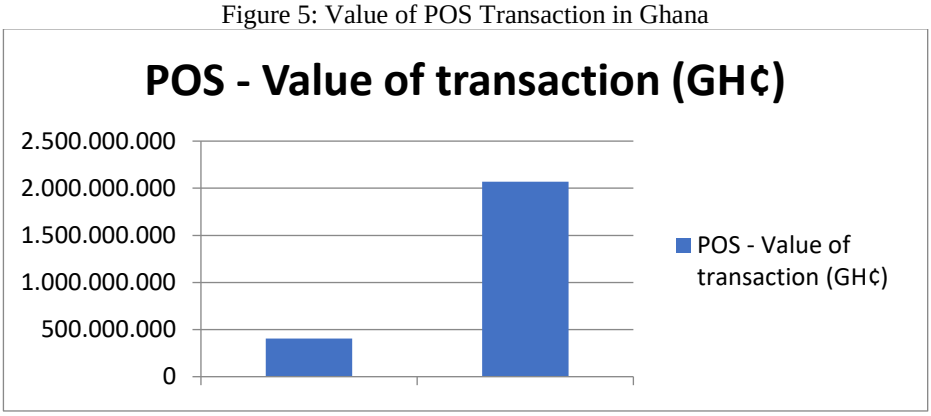


Source: Author's Design (2021)

Aside mobile money and payments, the ATMs are also getting more and more popular in Ghana providing platforms for card related transactions. According to Bank of Ghana, Card transactions continued to increase, with debit card being the most popular means for card payment on account of affordable technologies which enabled merchants to accept card

payments in Ghana (Bank of Ghana, 2016). The report shows how that number of ATM payment channels increased from 912 in 2015 to 1,928 in December 2016, value of transaction in GHC rose from 5,876,478,243 to 13,135,609,757 in the year 2015 and 2016 respectively. This no doubt shows the level of acceptance and usage by the people and customers of the banks in Ghana. This growth is evident in other electronic banking channels as well. For instance, the value of transactions consummated via the point of sales (POS) terminal in Ghana between 2015 and 2016 witnessed a near 81% increase moving from C403,263,712 to C2,067,783,504. The transaction value of POS in Ghana between 2017 and 2018 is represented in figure 5 below:

Figure 5: Value of POS Transaction in Ghana



Source: Author's Design, 2021

With current happenings in the banking sector in Ghana, no doubt a major increase in transaction via mobile platform is envisaged considering that in order to increase the proportion of female customers of its merchant payment service. **Andersson-Manjang and Naghavi (2021) in a research conducted for GSMA** discovered that, both the frequency and value of mobile money transactions increased after adopting MoMo Pay.

To further highlight the huge impact digital automation and innovations in the financial sector plays in the advancement and performance of banks in Ghana, Ankrah (2014) studied six banks in Accra. The operating employees were chosen using simple random sample, whereas the bank customers were chosen using purposive sampling. Data was gathered using feedback form while analysis was conducted using SPSS. The author established that operating profit was higher in banks that invested more in technological infrastructure compared to toher banks with extremely low investments in automation. This is an indicator that investing in IT significantly impacts ROA and ROE.

Electronic banking and bank performance in Cote D'Ivoire

Acceptance of electronic banking channel by Africans is highly commendable even though more and more inclusion is campaigned. In CoteD'Ivoire for instance, mobile payments is prominent and accepted by the majority of the banking population. This is affirmed by Aduo, Migue and Koranye, (2021) who opine that the fast-growing mobile payment systems in various parts of the Africa is due to the accessibility, convenience and simplicity of use of mobile payment systems, hence, mobile users are said to be all the time more opting for mobile payments in doing transactions. This also explains the growth in the tertiary sector in several African countries especially post-independence.

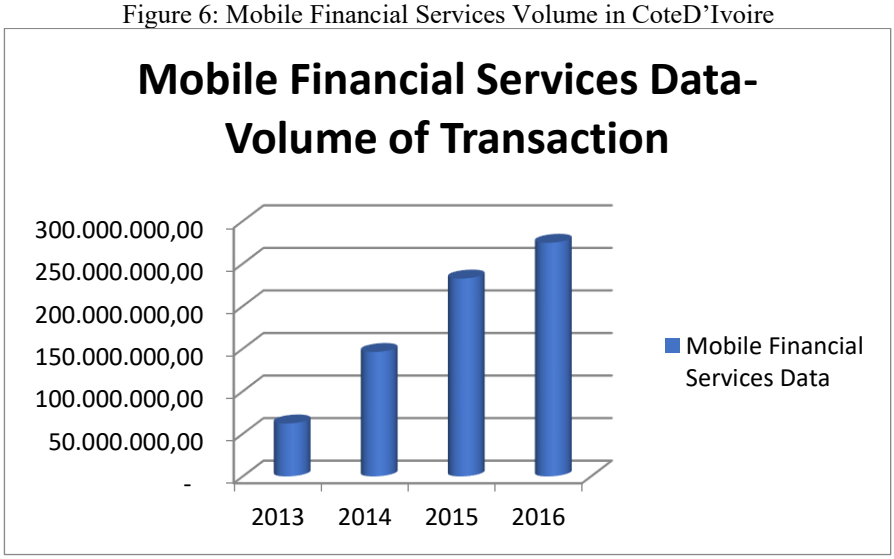
In Cote d'Ivoire, Services account for 48% of the GDP and employ over 22% of its active population (Alain Ducass, 2015). The telecommunications sector is the most activity-driven booming sector, with other industries assisting in its expansion. According to the annual report of the World Economic Forum of the Global competitiveness of 2015-2016, Cote d'Ivoire is ranked 91st out of 140 countries. In accordance with this result, Cote d'Ivoire is doing mildly better than the African average. The country has a pretty robust telecommunications infrastructure as well as a developing Internet market, which has paved the way for additional e-commerce development.

The number of digital devices connected to the Internet has expanded dramatically in the previous five years, and this trend is anticipated to continue. It is estimated that in the coming years, around 37.45% of the population in Cote d'Ivoire will have access to the internet, which is far than the estimation of 2013 (Ministry of Telecom, 2013). In this era of digital technology, the internet accounts for much of this growth. Anecdotal information suggests that Internet penetration has continued to rise substantially in recent months.

Despite an overall slow growth in electronic banking channel adoption in Cote d'Ivoire, the speed at which mobile financial services rise is of quick notice. The West African States Central Bank report of shows that number of electronic wallets accounts increased from 6,175,952 in 2013 to 12, 845, 968 in 2016 with an average activity rate of at least 55%. This is affirmed in a study by AG, LZ, & IAE, (2019) who is of the opinion that CoteD'Ivoire has been undergoing substantial technological progresses leading to higher internet connections and consumption in carrying out varying economic activities. For instance, e-payments and mobile phone transactions have been deployed as a substitute of conducting online businesses and other internet based activities. Financial transactions that passed through mobile phones and e-wallets

doubled within 3years. Figure 6 below represent the growth of mobile financial services in volume between 2013 and 2016 in CoteD'Ivoire.

Figure 6: Mobile Financial Services Volume in CoteD'Ivoire



Source: Author's Design (2021)

A KPMG (2018) report on payment developments in Africa shows that the banking system in West African Monetary Union is enjoying robust growth with about 115 active banks in the region as 2015, of which one in five is located in Cote d'Ivoire. Between 2014 and December 2015, overall bank assets grew by 18.9% to reach CFA28.2billion, at the same time, the number of ATMs increased by 8.9% while the staff employed in banks increased by 5%.

Electronic banking in West Africa

Nigeria has the highest gross domestic product (GDP) in West Africa; closely followed by Ghana and Cote d'Ivoire (Eyisi, 2010). The total GDP of West African countries between 1990 and 2013 is shown in appendix 1. The figures reveal that Nigeria, Ghana and very recently Cote d'Ivoire rank as top beneficiaries of foreign investments and highest GDP. This dominance is expected to continue in coming years especially with increasing population, existence of natural endowments, good governance and adoption of technology. The banking sector is not left out with increasing foreign investments and holdings in the sector.

No surprise, according to Ugbede, Yahaya, and Edicha (2020), banks have always been in the forefront of using technology to better their products and services. In recent years, the banking industry has been operating in a complicated and competitive market characterized by rapidly changing conditions and a highly volatile economic climate. According to Carlos and Ronald (2020), the acceptance of alternative financial services has greatly improved in

underdeveloped countries, particularly on the African continent. Because of the fierce rivalry from local banks and the entry of internal financial institutions, all banks have been obliged to create services that improve consumer delivery and profitability. Nigeria leads all other African countries in the use of alternative banking, followed by Ghana.

From all indicators, ICT will remain a major topic because it plays a key role in change globally and as it stand, it is transforming banking business and expanding e-banking operations in Nigeria. This no doubt has improved the service sector and result to an upsurge in banks chances of achieving better results in Nigeria. ICT has changed the modus operandi of banking across the globe and West Africa is not left out. This account for the reason banks in the region have embraced technology and massively deploy new channels targeted at improving bank earnings and customer satisfaction. Electronic banking is an attempt to combine multiple diverse technologies, each of which is progressing in its own unique way (Onodugo, 2015).

Mainframes and minicomputers were the initial applications of the computer age in banks.

Customer accounts, bank inventories, personnel information, and accounting packages were all processed using these. At that period, technology was used as a support tool for banking operations, and the idea of direct customer service was less clearThe technology was then employed to help employees complete their tasks more quickly, more conveniently, and with fewer human errors. According to Kondabagil (2007), the Automated Teller Machine (ATM) became commercially available in 1968, and was the first visible face of computerized banking.

The ATM grew from a simple money dispenser to a multi-functional gadget that allows clients to do a variety of operations, including account management, fund transfers, and bill payments. Customers could bank from the comfort of their homes in the latter half of the 1990s, thanks to the development of the Internet and the World Wide Web (WWWW) (Salehi and Alipour, 2010), and the banking industry has been changing since then, as Offei and Nuamah-Gyambrah (2016) assert, in the form of innovative use of information technology and development in electronic commerce. As a result, one of the advantages of e-commerce in connection to the needs of businesses to perform easy, quick, and precise banking operations is the birth of e-banking (Hoseini and Dangoliani, 2015).

With the e-banking system, settlement of transaction either national or international level is speedup; thereby bridging the gap between customer and the bank. The majority of the services are available through a variety of distribution e-channels, with activities ranging from balance inquiries to cash withdrawals, bill payments, fund transfers, electronic payments, and

loan applications, to name a few (Agwu and Carter, 2014). Nigerian banking has progressed significantly since the days of ledger cards and other manual filling techniques (Offei and Nuamah-Gyambrah, 2016). It was a difficult and time-consuming job back then, with huge paperwork stored and retrieved manually, and clients having to wait in long lines for long periods of time, with the possibility that they would not reach their goal at the end of the day.

Now, there is no bank in the country that does not render one form of e-banking service or the other, even banks in the most remote parts of the world (John and Rotimi, 2014). As a result, and in a bid to catch up with the changing nature of modern banking, the ATM was introduced into the Nigerian banking system in 1989 as an electronic delivery channel and followed by the introduction of mobile telephone in 2001. Mobile banking is a technology that has gradually become more prevalent, affecting a variety of financial institutions as well as other areas of the economy. The decision of banks to make more use of e-banking facilities in order to deliver better services is thus linked to the expansion of electronic banking in Nigeria (Abaenewe et al., 2013; Agwu and Murray, 2014).

The decision of banks to make more use of e-banking facilities in order to deliver better services is thus linked to the expansion of electronic banking in Nigeria (Abaenewe et al., 2013; Agwu and Murray, 2014). Though electronic banking was first introduced in 1996 (Ekwueme et al., 2012), according to Abubakar (2014), the evolution of electronic banking in Nigeria dates back to 1986, when the banking sector was deregulated, resulting in a far-reaching transformation through computerization and improved bank service delivery. However, in Nigeria, the lack of proper security for fraud protection, as well as a high illiteracy rate, has a detrimental impact on e-banking. Similarly, the irregular power supply and epileptic network connectivity services are a major problem for the usage of e-banking in Nigeria, since consumers are unlikely to be able to do business at their leisure, hampered the development of an efficient monetary transfer system.

This is because, as Onodugo (2015) suggests, vital infrastructure such as power, security, and telecommunication should be strengthened to ensure the proper use of electronic banking in Nigeria. In a similar vein, John and Rotimi (2014) found that e-banking has increased banking costs and fees for both banks and their clients. However, they believe that providing adequate support and in-depth expertise from the bank and its employees will go a long way toward encouraging clients to use the technology. Aside from that, with the development of e-banking, customers can now carry out most financial operations without having to visit a bank; bills can now be paid and even phones can be recharged via ATMs, POS,

online and mobile banking, and so on. Furthermore, the amount of cash carried is significantly reduced.

In Ghana, the brick and mortal banking system hindered financial access over the years putting banking services out of reach of many people across the country. Many financial goods and services can now be accessible via the internet thanks to the rise of electronic banking. As a result of electronic banking, many goods and services are now available to customers who do not need to visit a branch to obtain financial services. Banking services can thus be accessed in the comfort of the customer's home or office at his or her convenience (Sakoe & Asare, 2015). In fact, Ghana registered a rate of bank account ownership of 57.7 percent of the population aged 15 years and older as at January 2021. In comparison to the previous year, when 42% of the population held a bank account, the percentage has grown (Sasu, 2021).

In a similar study, Addae-Korankye (2014), ten banks where sampled using 250 customers; the result shows that electronic banking improved the profitability of banks in Ghana and recommended that the ATM should be on twenty-four hour monitoring in other to speedily to resolve any failures, thus ensuring sustainable earnings and higher income. This position is also affirmed by Harold, Wen and Ruth, (2019), that Cote D'Ivoire has been undergoing very substantial improvements in banking technology leading to higher internet sign up/consumption and in consunmating economic activities, thus boosting the earnings of the banks. E-payments and mobile phone transactions, for example, have become popular as alternatives to traditional e-commerce methods. This has continued across West Africa and the globe in general.

Benefits of electronic banking channels

From all indications and following literature, it does appear that full implementation and automation of banking services have numerous benefits. Apochi, (2017) mentioned quite a lot of advantages derived from the use of electronic banking channel. Aside ease of carrying out banking business, low risk of cash theft/fraud, varied service alternatives, access to banking

services at any time, ease of credit access, automation also give customers the benefit of transacting globally with their account. Similarly, Nimoh (2016) assessed the impact of IT-backed channels on the performance of banks in Ghana using accidental sampling technique of 196 respondents. The study revealed identified reduced cost of operations in the banks, higher more customer sign up, higher bank revenues, enhancement of public reputation, different and fresh opportunities, enlarged market, better profitability by the bank and increase in the area of

corporate social responsibility as both short and long run benefits for deploying electronic channels.

The introduction of electronic banking channels by banks in Africa has given the operators the opportunity to provide self-service and improved services to its customers. Referring to Mutevu (2015), the development and deployment of technology has meaningfully upgraded the landscape of banking, and this has immensely enhanced the banking business. This has improved the goods that banks offer to add value to client service to a large extent. This explains why bank customers continue to prefer ATM channels to the traditional service type. These channels have become popular and essentially an automated point, where customers can be serviced without being aided by human. This is predicted to continue as banks are expected to increase investments in automation and technology. This has resulted in transference, as more customers are embracing ATM as a self -service automated and personalized channel for accessing banking services as against the traditional banking (Hota, J., Nasim, S., & Mishra, S. 2013). In a field survey study and based on the hypotheses tested, Ahaiwe, (2011) studied the effects of ATMs on bank's services in Nigeria; and concluded that there has been immense improvement by the deployment of ATM in banks especially in areas such as better services, time savings, minimization of risk, quick delivery and increased market shares (Ahaiwe, 2011).

Similarly, Abdullai and Nyaoga (2017) opine that banks, by implementing e-channel had to computerize services; this was made popular by the use of ATMs. This helps in task handling, drastically reducing or eliminating queue and helping employee achieve more at a shorter time, boosting efficiency in the workplace. Other explanations behind the embracing of ATMs include 24/7 access to banking service, reduction of customer service delivery time, improvement of quality of service, bringing services closer to customers and cutting on cost of operations. This is the critical to customer satisfaction and as Addai, Ameyaw, Ashalley and Quaye (2015) puts it, an affirmative connection between customer satisfaction and e-banking convenience, reliability and convenience is established as a result of the benefits electronic banking offers in Ghana. Likewise, greater accessibility, convenience and attractiveness in general have been increasing the customer base of banks (Shobhit, 2016)

According to Chemtai (2016), the move to electronic banking offers significant competitive advantages. It gives banks the For example, it increases the appeal of bank financing by making money appear to be much more easily available (Salehi and Alipour, 2010), and it lets clients to conduct financial transactions with more peace of mind and

convenience (Offei and Nuamah-Gyambrah, 2016). Transactions required a long time to complete before electronic banking was introduced, and this was exhausting. Services are now delivered faster and transactions are far more accurate, saving time and money while also decreasing human errors and clerical overhead costs. Increased customer satisfaction, improved product options, and a broader geographic reach are some of the major advantages of e-banking. These have helped to attract more clients because customer satisfaction is high, and they have also helped to conserve the energy of staff, allowing them to give their all in their responsibilities at the bank. E-banking has a number of advantages, including enhanced bank productivity (Chemtai, 2016), increased comfort and time savings, quick and continuous access to information, better cash management (Salehi and Alipour, 2010), and improved client experience (Onodugo, 2015).

Shortcomings of electronic banking channels in West Africa

However, it must be noted that, while electronic banking provides many benefits to customers and banks, it is yet not popular in some quarters for some reasons ranging from lack of adequate education on e-banking innovations, wrong perceptions, poverty and lack of trust continue to hinder the full adoption of the technological innovations in West Africa (Kessey & Assabah-Wesley, 2020, Ahaiwe, 2011). Also, the cost of its implementation, deployment and maintenance is high. Equipment and machines used to aid electronic banking are quite expensive and may not be easily affordable (Kessey & Assabah-Wesley, 2020). This in itself is an opportunity for developed countries seeking investment in the banking sector in West Africa considering the existing gaps in access to financial products especially as it relates to quality banking experience. Furthermore, Amanuel (2018) employed the total population of CBE workers who are under Addis Ababa four district offices in a study to examine the practice and challenges of the bank implementation of projects in electronic banking, specifically in the POS deployment process in Ethiopia. Both primary and secondary data were utilized but the primary information was sourced through opinion poll and semi-structured interview guides. Frequencies, percentages, and tabular descriptions were used to evaluate and interpret the data using quantitative and qualitative methodologies. The most difficult factor to establish a POS terminal, according to the findings of this study, is network failure. Organizational concerns such as a lack of employees' POS terminal skills, tellers' attitudes, low assistance and follow up, lack of integration across departments, and late material procurement are all regarded obstacles to the POS terminal system's deployment. Another important decline is theft, such as

credit card fraud, foreign currency fraud, stolen checks, and so on. The majority of fraudsters utilize their understanding of information technology to defraud others by designing malicious programs that tamper with sensitive data. According to Kujur and Shah (2015), developing countries face numerous challenges when implementing e-banking initiatives, which, if not properly managed, can exacerbate traditional banking risks such as transaction/operations risk resulting from fraud, processing errors, system disruptions, or other unanticipated events, strategic risk resulting from poor e-banking planning and investment decisions, and security risk resulting from the rights and information of customers.

Other drawbacks of e-banking include unemployment, a lack of qualified people with information security competence, and a low level of IT appreciation among clients, who rely heavily on cash for all transactions. Furthermore, e-banking encourages excessive spending by allowing users to make payments at any time and from any location, as well as having access to cash via ATMs even on non-working days (Karjaluoto et al., 2009).

Though there are numerous benefits associated with the ATM, it has become evident that several sets backs make the use of ATMs as unattractive to many. This was confirmed by Odusina (2014), who in a study on ATM and customer's satisfaction in Nigeria concluded that there exist an affirmative and substantial relationship between ATM usage and customer's satisfaction. Customers' requests are not being met adequately, according to the study, despite the increasing number of ATM installations in Nigeria, as customers are always seen queuing in big numbers at various ATM designated centers, as well as poor service delivery of some of these machines. The implication of this is that substandard service delivery is a critical factor encumbering the effectiveness of the use of debit cards on Nigeria's ATM points. In Ghana, Puopiel, (2014) concludes that although e-banking has huge potentials, it is threatened by several setbacks like unstable and poor network, excessive bank charges, restrictions on maximum cash allowed to be withdrawn per day or per transaction, and disbursement related errors Furthermore, according to Akhalumeh and Ohioka (2011), internet fraud is a problem for 34% of respondents, poor education is a problem for 15.5 percent, and little or no knowledge of how an ATM works is one of the factors impeding the smooth implementation of Nigeria's cashless policy. The adoption of technology and embrace of electronic banking channels may have improved service delivery but according to Adeku, (2020), it has also resulted in fraud and higher financial crimes. Aside from ATMs, several studies have been conducted on the impact of the internet on bank performance, with the findings indicating that the use of the internet in banking services, also known as e-banking, has a substantial association with bank

profitability. The most important and recent advancement in e-banking is m-banking. Mobile banking enables banks to provide financial intermediation by expanding their geographic reach. Greater accessibility, convenience and attractiveness in general have been increasing the customer base of banks. Attracting more customers means more business for banks creating higher revenues and reduced operating costs, thus affecting the profitability of the banks (Shobhit, 2016).

The issue of trust and confidence on electronic banking channels remain paramount as far adoption is concerned. In Ghana, Sanda, (2011) explored the issue of whether the use of the Automated Teller Machines (ATM) as a service delivery tool in the banking industry of many developing countries has achieved its intended objective of increasing the effectiveness of customer service provision and reducing the workload of bank teller. The research found that while most bank customers who utilize ATM services consider the ATM to be a handy, dependable, accurate, and acceptable service delivery medium for their financial transactions, they still underutilize the ATM's service capacity by choosing to withdraw cash from banking halls for amounts that could be obtained from ATMs. It is concluded that, due to customer behavioral challenges to the effective use of ATM technology, banks in developing economies are not realizing the full potential of the technology as a customer service delivery tool and a strategic workload reliever for tellers who serve customers inside banking halls.

Theoretical Review

Theories of bank performance

There are several economic theories concerning profitability and bank performance. However, four are predominant in the literature. According to Biker and Bos (2008), and Haron and Azmi (2004), studies related to bank performance and profitability have focused on profit maximization, Market Power models, and bank efficiency models. Similarly, Asikhia, et al, (2021) identified other theories of firm performance as stakeholders' theory and transaction cost economics.

Profit maximization theory

One critical aspect of the basic model of bank performance is profit maximization (Boos & Kool, 2008). Traditionally, shareholders expect banks and other businesses to achieve profit annually. This is paramount in the hearts of investors. So, profit maximization is critical to shareholders. Furthermore, the banks maximize profit and declare higher return on investments

simply because several efforts have been put into cost reduction and lower overheads. By this theory, the bank does everything possible to stay relevant by carefully monitoring internal operations and ensuring that business of banking is conducted in such a manner as to always declare a positive result. This implies that banks will consider investing more and more funds in technological innovations if such investment is considered strategic to earnings and capable of reducing cost of operations. It is expected that the deployment of technological innovations and e-channels products is meant to add immense value and revenues to the bottom line of the banks and not to increase cost and expenses.

Structure conduct performance

The Structure-Conduct-Performance (SCP) model was first proposed by Bain (1951). The SCP model states that an industry's performance is largely dependent on the conduct of its firms, which then depends on the structure. The main assumption here is that market structure dictates bank conduct, which in turn affects the performance of the banks. Banks are more inclined to engage in collusive behavior in a highly concentrated market, and their oligopoly rents boost performance (profitability). Conduct is an unobservable variable that is quantified indirectly by market concentration in this case. This implies that the structure of a bank's management is directly connected to the conduct, behavior and investment decisions tendencies of the bank.

Efficient-structure theory

The efficient-structure theory (ES) arose from Demsetz (1973) and Peltzman's critiques of the SCP theory (1977). According to the ES, the efficiency of a bank determines the relationship between its market structure and performance. Banks with better management or manufacturing technology have cheaper expenses and, as a result, larger profits. The efficiency theory is based on the assumption that more efficient banks have lower costs, which can immediately lead to increased profitability The efficient-structure-X-efficiency (ESX) and efficient-structure-scale-efficiency (ESS) hypotheses are two versions of the efficient structure hypothesis. According to the ESX hypothesis, banks with improved productivity (better management, technologies, and procedures) have lower costs, bigger profits, and a larger market share. The ESS hypothesis states that the difference in profitability between banks is not caused by differences in the quality of management, but by differences in the level of scale efficiency at which bank is operating. In other words, the ESS hypothesis implies that certain

banks gain greater operational size, resulting in lower costs. Lower costs lead to higher profit and faster growth for the scale-efficient banks (Boos & Kool, 2006).

Theory of economies of scale

Emery (1971) and Vernon (1971) were among the first to make the connection between bank size and profitability (Haron and Azmi, 2004). According to economies of scale, a larger bank might benefit from economies of scale and produce services at a cheaper cost per unit. Because large banks are said to benefit from economies of scale, they are able to deliver their outputs or services at a lower cost and with greater efficiency than small banks. As a result, big banks will make more money than small banks. As a result, bank size is projected to be positively associated to bank profitability. So close to this is the transaction cost economics theory which centres on make or buy decisions. It compares choice to make or buy; but insists the option that is much more economical for a firm should be taken. This is a vital component, because selecting the more proficient option can improve a firm‘s revenues (Al-Matari, et al, 2014). The decision to deploy very experience technological based facilities to drive service delivery is critical to earnings. This implies that the revenue position of the firms increases if viable decisions are made but a reverse occurs for every wrong decision.

Stakeholders theory

This theory which was postulated and made popular by Prof Milton Friedman in 1984, states that the firm is accountable not to shareholders alone, but also to a broader assembly which includes employees, agents, customers, merchants and vendors, government, industries, bodies, and local communities etc. By this, an organization should measure performance by to what extent it is able to please these stakeholders. The theory emphasis that aside satisfying customers and making service delivery affordable, quick and cheap, shareholders and other stakeholders of the firm are pleased when the bank earns more and achieve higher

profitability position (Al-Matari et al, 2014). Furthermore, it must be mentioned that this theory weighs organization performance against the expectancy of a variety of stakeholder groups that have specific interest in the organization’s accomplishments (Hubbard, 2009). In supportive of this theory, Owen (2006), clearly states that organizational performance covers three precise areas of firm outcome and they are financial performance (profits, return on assets, and return on investment), product market performance (sales and market share) and shareholders returns (total shareholders return and economic value added.

Theories of electronic banking

There are several computer aided technology theories. However, four are predominant in the literature, and they include theory of diffusion of innovation, reasoned action theory (TRA), planned behavior theory (TPB), and the theory of technology acceptance (TAM), (Sadeghi, & Farokhian, 2010).

Innovation diffusion theory

This theory was developed by Everett M. Rogers in 1983. Diffusion of innovation is a theory that explains how, why, and at what rate new ideas and technology spread across cultures, both individually and corporately. According to Rogers (1983), diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system. The researcher went on to say that it is a unique form of communication because messages are about new concepts, and the more compatible the technology is with consumers, the less of a behavioral change is required, allowing for speedier adoption. Compatibility (CPT), relative advantage (RAD), complexity (CPX), and trialability and observability (IDT) are five important innovation characteristics (Lou & Li, 2017). It becomes easier to describe end-user adoption of new technologies and the decision-making process when these physical qualities are taken into account (Lee, Hsieh & Hsu 2011).

The level of inclination varies per individuals and each person possess different degrees of disposition to espouse innovations, and thus it is generally observed that the portion of the population adopting an innovation is approximately normally distributed over time (Adeshokan, 2017). There appears to be a link between this theory and the technological adoption model as both of them did emphasis the importance of ease of use as determinant to adoption of a new technology (Lu & Li, 2017). The complexity (its ease of use) of technology will also impact on adoption (Abdullai & Nyaoga, 2017).

Users are less likely to stick with technology if it involves a significant amount of learning. This hypothesis says that the degree to which bankers accept new technology is determined by their willingness to do so, and that the more suitable the technology is with the bankers' demands, the faster the adoption. The IDT theory aims to explain the innovative decision-making process, as well as the elements that influence adoption rates and different types of adopters. It aids in the prediction of an innovation's likelihood and pace of adoption (Chen, Gillenson & Sherrell, 2002). The theory finds innovations as being transmitted through certain channels over time and within particular social systems (Moore & Benbasat, 1991).

Theory of reasoned action

Martin Fishbein and IcekAjzen proposed this theory in 1963. Theory of Reasoned Action (TRA) proposes that an individual's behavior is determined by his/her intention to perform the behavior and that this intention is, in turn, a function of his/her attitude toward the behavior and his/her subjective norm (Oduor, 2012, Sadeghi & Farokhian, 2010). The individual's purpose is the best predictor of conduct. Three factors influence this intention: their attitude toward the specific conduct, subjective norms, and perceived behavioral control. This gives birth to the popular planned behavior theory; it is an extension of TRA (Sadeghi & Farokhian, (2010). The planned behavior theory holds that only definite attitudes toward the behavior in question can be expected to predict that behavior (Kamara, 2017). In the context of this study, this theory puts forth that intention of the bankers and the management affects their behavior towards the technology to be adopted.

Technology acceptance theory (TAM)

Davis, F.D., Bagozzi, R.P., and Warshaw, P.R. proposed the TAM (1989). The simplicity of use and worth of TRA, which are attitude measures, are added to this hypothesis. This position is supported by Ozdemir and Trott (2009) who in their work also described TAM as drawing its root from the TRA. The TAM however, places more emphasis on the context of computer use and conclude that the model is moderately individual focused while other models are organization concentrated. Of all the theories, the Technology Acceptance Model (TAM) is considered the most influential and commonly employed theory for describing an individual's acceptance of information systems (Offei & Nuamah-Gyambrah, 2016; Lee, Kozar & Larsen 2003).

TAM argues that an individual's acceptance of information systems is determined by Perceived Usefulness (PU) and Perceived Ease of Use (PEU), as derived from the Theory of Reasoned Action (Ajzen & Fishbein, 1980) and initially suggested by Davis et al (1986). (PEOU). While PU refers to how much a person feels that utilizing a certain system will improve his or her job performance, PEOU refers to how much a person believes that using the system will be painless (Lou & Li, 2017). This insinuated that the volume and value of transactions consummated via the various electronic banking channels is determined by the acceptance of the underlying technology by both employees of the bank and the users of the technological products, the customers.

More and more users of the various electronic channels are expected to sign on to a new technology if the consumer's perception of the usefulness of the technology and ease of usage is affirmative, thus motivating users to embrace the technology. This theory is useful to this research. Ghani, Rahi, Yasin, and Alnaser (2017) empirically investigated the technology acceptance model (TAM) with customer service and customer satisfaction and seek the internet banking adoption issues in Pakistan. The survey was conducted on behalf of one of Pakistan's traditional banks (HBL). The hypothesis and path coefficient connection among the constructs, as well as their significance, were investigated using SEM. According to the findings of this study, perceived utility, perceived simplicity of use, customer service, and customer happiness may all influence the adoption of internet banking in Pakistan (Surendran, 2012).

TAM is, however, a relatively simple model that can be modified or extended in a variety of ways, and as a result, many modifications including other theories have been published in the literature (Zhang, Guo & Chen, 2008). Users' behavioral intention (BI) to use, which is impacted by users' attitudes (A) toward utilizing, determines technological acceptability, according to the model.

Finally, perceptions regarding the technology, which comprises of PU and PEOU, have a direct impact on attitude. TAM is one of the most often used and discussed theories for predicting and explaining end-user technology behavior. Because of its robust theoretical framework, it is one of the study's cornerstone hypotheses (Ghani et al 2017, Lee, Hsieh & Hsu, 2011). Though Hu,Ding, Li., Chen and Yang, (2019) incorporates user innovativeness, government support, brand image, and perceived risk as determinants of trust to investigate how users adopt Fintech services. Other studies on TAM identified security, quality of internet connection, awareness about electronic banking products, and its benefits as factors that directly have significant effects on perceived usefulness and perceived ease of use of acceptance of electronic products (Al-Somali, Gholami & Clegg, 2008). According to Molla and Licker (2005), technology embraced in developing countries might be different from those of developed countries as the challenges are different in various contexts.

Theoretical Framework

As mentioned in the previous section, the theories underpinning this work are IDT and TAM. Emphasis is on the importance of ease in determining the usage and acceptance of a new technology (Lou & Li, 2017).Both IDT and TAM have been applied to a variety of technologies (e.g. word processors, e-mail, WWW, GSS, and Hospital Information Systems) in a variety of situations (e.g. time and culture), with a variety of control factors (e.g. gender, organizational type and size), and to a variety of subjects (e.g. undergraduate students, MBAs, and knowledge workers), leading proponents to believe in their robustness ((Zhang, Guo & Chen, 2008; Lee, et al 2003).Authors agree that technological innovations such as electronic banking channels thrive with customers and users perception of ease of use and usefulness, thus promoting volume and value of transactions carried out on the channels (Lou & Lee, 2017, Chuttur, 2009)

Empirical Review

This section presents existing empirical works and literature on the dependent and independent variables. In a contemporary study of electronic banking and the performance of banks in Pakistan, Khalid Ullah, and Rahman, (2021) selects volume of Agent Banking transaction, the volume of ATM, POS, and RTOB for the electronic banking and volume of mobile banking (MB) transaction for the channels of Branchless Banking. The period covered in the study is 1st quarter of 2011 to the 4th quarter of 2018 while Johansen co-integration and VECM model for analysis. The outcome of research display that agent banking transaction, the volume of ATM, POS, RTOB and mobile banking transaction has a positive and significant short-run association with Profitability of Pakistani banks. The discoveries of the study implied that there is unilateral causality between the explain variables profit with explanatory variables, the volume of ATM, POS, RTOB, MB and volume agent banking.

Similarly, Kamboh and Leghari (2016), in a study to examine the impact of cashless banking on profitability of Pakistani banking industry, proxied cashless banking using Automated Teller Machines Transactions (ATMT), Point of Sales Transactions (POST), Call Center Banking Transactions (CCT) and Mobile Banking Transactions (MOBT) to examine their impact on aggregate Return on Equity (ROE), which is proxy for bank profitability. Ordinary Least Square (OLS) multiple regression technique was used for data analysis for period covering 2007 to 2014. The results from the analysis show that POS transactions and

Mobile Banking transactions exhibit a positive as well as substantial influence on ROE, CCT, while ATM transactions are negatively significantly connected with profitability.

Evian, et al, (2021) in a study on the analysis of the influence of e-banking on bank performance in Indonesia, examined 36 banks listed in IDX with a 5 year period from 2015 to 2019. Internet banking, mobile banking, and ATM usage were all considered as e-banking indicators in this study. ROA, ROE, and NIM are all indicators of a bank's performance. The study also includes three control variables, namely bank size, efficiency, and CAR. The authors employed multiple regression analysis. From the outcome, it can be concluded that internet banking positively influence the performance of banks and the impact is significant, while ATM is positive but not significant when control variables are considered. Contrary to expectation, mobile banking's influence on bank performance is adverse, with non-significant to weak significant impact.

Similarly, looking at another developed economy, in a recent study in Russia, Rozhkova, et al (2021), submit that internet banking totally alters the form of interface between banks and their customers, brings customer satisfaction; however what happens with performance in the banking industry? The essay raised the possibility of a link between electronic banking and performance (ROE and ROA). The authors found no significant relationship between offering of internet banking and bank productivity. This implies a negative relationship between internet banking and bank performance despite its contribution to improved customer satisfaction and ease of doing transaction.

Nwankwo and Agbo (2021) conducted a study to investigate the impact of electronic banking on the performance of Nigerian commercial banks. They were specifically interested in the impact of automated teller machine transactions, point of sale terminal transactions, and mobile banking transactions on the performance of Nigerian commercial banks. Ex post facto research design was used alongside data covering the period 2013 to 2017. The findings reveal that ATM have positive and substantial effect on the performance of commercial banks in Nigeria while both point of sale terminal transaction and mobile banking transactions have adverse and poor effects on the performance of the commercial banks in Nigeria.

In a study of electronic banking payment system and its impact on the Nigerian economy, Mamudu (2021) used the Phillips-Perron test statistics, Johansen cointegration techniques, Pairwise Granger Causality techniques, and the error correction mechanism on a log linear multiple regression framework to see if electronic banking channels have an impact on economic growth in Nigeria. Quarterly time series data were obtained from secondary

sources, primarily the CBN Statistical Bulletin (2019) on various variables from 2011(Q1-Q4) to 2019(Q1-Q4). The error correction model results revealed positive and significant impact between ATM, WEBP, MOBP and NEFT on GDP. The results further revealed that CHEV, POS and NIPV had negative impact on gross domestic product in Nigeria. GDP was dropped by -0.160983, -2.375795, and -1.054403 percent for each unit change in CHEV, POSV, and NIPV, respectively.

Also, in a study to consider the influence of financial innovations on the performance of banks in Nigeria, Ibekwe (2021), assessed the influence of automated teller machine, mobile banking, internet banking and POS on the bottom line of deposit money banks in Nigeria. Because secondary data was acquired from the Central Bank of Nigeria Statistical Bulletin, CBN Annual Report, and Statement of Accounts, the study used an ex-post facto research design. The outcome of the work indicated that automated teller machine, mobile banking and point of sales had positive and significant effect on return on asset while internet banking showed an adverse and insignificant influence on return on asset. Financial innovation has a beneficial influence on commercial bank profitability in Nigeria, according to the report, and has improved commercial bank return on assets.

Furthermore, Okologume and Musa (2021) investigated the effect of agent banking on the Nigerian economy. Agent banking, according to the authors, has become an important practice of financial institutions in bringing their services closer to the people at the grassroots through electronic banking channels. Secondary data sourced from Central Bank of Nigeria statistical bulletin covering 2013 to 2019 was applied. Data analysis as carried out using the ordinary least square regression technique. The outcomes show that there exist a positive relationship between ATM, MPAY and the Nigerian economy while there is a negative relationship between POS and the Nigerian economy. The influence of technology on business cannot be dismissed, especially in relation to trade.

In a study done to assess the impact of electronic banking on the financial performance of Nigerian deposit money institutions, Madugba, Egbide, Jossy, Agburuga, and Chibunna (2021) confirmed this. The study's data came from the Central Bank of Nigeria's Statistical Bulletin and the National Bureau of Statistics' Statistical Bulletin for the years 2005 to 2019, as well as the banks' public financial statements. An ex-post facto study strategy was utilized, and a normality test was performed to determine the data's goodness. Descriptive statistics and a multicollinearity test were also performed, and the independent variables were found to be good. To test two hypotheses, regression was used. ATM has a positive and significant

relationship with Earning EPS and ROA; POS and NEFT have a major impact on ROA only, whereas WEB has no impact on both EPS and ROA. Electronic banking has a considerable impact on deposit money banks' financial performance in Nigeria, according to the findings.

Carlos and Ronald (2020) in a study sought to evaluate the effect of channels of alternative banking on the financial performance of Kenya Commercial Banks in Burundi, the authors employed descriptive survey as well as correlation to examine the effect of mobile banking, internet banking, and ATMs on financial performance of Kenyan commercial bank. The result showed that that there is a strong relationship between the different banking distribution channels and the financial performance of Kenya Commercial Bank. Similarly, it was established that mobile banking, Automated Teller Machine, agencies and internet banking positively influenced the performance of banks and the impact was found to be statistically significant.

Le and Ngo (2020) carried out a study to investigate the determinants of bank profitability in 23 countries from 2002 to 2016. The system generalized method of moments was used. The results indicate that bank profitability can be improved by the number of bank cards issued, the number of automated teller machines (ATMs) and the number of point of sale (POS) terminals. By implication, we can say these channels have a positive impact on bank performance in those countries. After all, the author recommended that delivery channels should be further expanded. Also, based on the findings, market power has negative impact on bank profitability, implying that competition improves bank profitability. Furthermore, given the favorable association between capital market development and bank profitability, they should be viewed as complementary.

Also, recently Zu et al (2019) investigated the impact of financial innovation on banks profitability performance by means of electronic banking services in Africa from the period of 2015-2018, employed the dynamic panel data method and GMM estimations via a panel data regression model. The result shows that there is a strong persistence in a reliable manner for both ROA and ROE. The results further show that, banks' financial performances is positively affected by bank cards and ATM with the exception of POS terminal and internet banking. More importantly, the profitability of most African emerging countries influenced the ratio of ATMs to branches, which is quite essential.

Bingilar and Bariweni (2019) looked into the impact of electronic payment systems on the performance of Nigerian commercial banks. Regression analysis was used to examine the data. According to the findings, there is a statistically significant positive association between

ATM transactions and commercial bank assets in Nigeria. The asset base of commercial banks showed a favorable link with internet (online) banking transactions. Mobile banking transactions have a favorable and statistically significant association with commercial banks' asset base. In a study of 20 countries in Africa including Cote D'Ivoire, Zu, et al, (2019), reveal that the number of POS and internet banking services by the customers negatively affected profitability.

The distinctness of the sample in electronic banking infrastructure and socio-cultural traits of customer's behavior in the countries makes it clear enough to be understood. The findings however show that ATM and bank cards positively and significantly affect bank performance in those countries. Beyond the banks and financial sector, a study seeking to investigate the relationship between electronic banking and cashless policy and how the electronic banking variables affect the Nigerian economy, Ailemen, Enobong, Osuma, Evbuomwan and Ndigwe (2018) sourced data covering 2006 to 2015 from the Central Bank of Nigeria (CBN) and applied the ordinary least square method for data analysis. The result reveals that there is a positive significant relationship between automated teller machines and gross domestic product (GDP), also a positive significant relationship was found between POS and GDP, and the next variable internet banking and GDP indicated a positive significant relationship.

Similarly, but with specific interest in internet banking, Jimoh and Alamin (2018), carried out a research to examine the relationship of internet banking and performance of banks (A case study of Nigerian Deposit Money Banks). The study used regression technique to analyze sourced data using time series data from 2011 to 2015. Data was gathered from secondary sources such as the Nigerian Central Bank's yearly reports and statistical bulletins. According to the findings, there is a favorable correlation between mobile banking and return on equity, as well as between internet banking and return on assets. There is no correlation between online banking and return on equity or mobile banking and return on assets, though. However, there is no significant link between online banking and return on equity or mobile banking and return on assets.

In India, Sidhu (2018) carried out a research to examine the impact of internet banking on bank performance, discussing the implications of the current level of internet banking on the Indian banking industry. The impact of internet banking on bank performance was investigated using panel data regression on data gathered from a sample of 31 bank websites from 1997 to 2016. The study looked at the influence of internet banking on bank performance using financial

performance data. According to the findings, internet banking aids in the acceleration of banks' financial performance as measured by ROA and ROE. This implies that internet banking positively impacts return on assets and return on equity in India.

Yang, Li, Ma, and Chen (2018) looked into the performance of Chinese banks after they fully adopted the e-banking system, notably in terms of profitability and cost efficiency. Because of the rising prevalence of e-banking, which has redefined banking operations in China and around the world, the study grew more significant with the development of e-banking and the internet. In this study, a secondary data source strategy was used. For the sample analysis, the report and data of five Chinese banks were employed. Return on assets (ROA), return on equity (ROE), operating margin (OM), net interest margin (NIM), and efficiency ratio were used to evaluate the bank's performance. From the study, it was discovered that e-banking is positively related to performance of banks in China as far as ROA, ROE, and OM are concerned.

During an eight-year period, El-Chaarani and El-Abiad (2018) investigated the impact of technological innovation determinants on the performance of Lebanese banks (from 2010 to 2017). Return on assets (ROA) and return on equity (ROE) were used as proxies to quantify performance levels in the study. Internet banking, mobile banking, automated teller machines, and computer software investment are all technical innovation factors. The investment in technical innovation in ATMs and internet banking has a favorable impact on the performance of Lebanese banks.

Similarly, Orji, Ogbuabor, Okon and Anthony-Orji, (2018) in a study to determine how e-banking innovations impact positively and significantly on the performance of banks in Nigeria, using the SURE model on six selected banks in Nigeria found that the performance of banks, both old generation banks and new generation banks is mainly based on the contribution of e-banking innovations such as automated teller machine transactions, point of sale transactions, mobile banking transactions. As a result, the study concludes that the selected banks, as well as other banks, should improve their asset base and continue to engage in e-banking technologies in order to continue performing well and remaining profitable.

It does appear that banks and financial institutions seek to increase non-interest income sources and one sure way to achieve this is to deploy new e-channels technology. This was stipulated by Hamdi, Hakimi and Zaghduodi, (2017) who concluded that one of the main determinants of non-interest income is new e-payments channels, automatic teller machine (ATM) and credit cards). The study examined the impact of non-interest revenue on bank

profitability as assessed by both return on assets (ROA) and return on equity (ROE) using annual data from 20 Tunisian banks from 2005 to 2012. Data analysis was done using a Dynamic Panel Data model (ROE). The study finds that diversification and investment in e-channels and ATMs increase bank performance for both ROA and ROE measures in Tunisia.

Based on a survey of selected developing countries, Obiekwe and Mike (2017) assessed the impact of Electronic Payment Methods (EPM) on the profitability of commercial banks in Nigeria. To reach the overall goal, the study looked into the impact of automated teller machines (ATMs), point of sale (POS), and mobile payment (MPAY) on commercial bank profitability in Nigeria. For the period 2009 to 2015, a total of five (5) banks were evaluated, and the study used the Panel Least Squares (PLS) estimate technique as the analytical tool. The results revealed that automated teller machines (ATMs) and mobile phone payments have a considerable impact on commercial banks' profitability in Nigeria. In Nigeria, however, point of sale (POS) has a negligible impact on commercial bank profitability.

Abdullahi and Nyaoga (2017) examined the relationship between automated teller machine usage and operational performance of commercial banks in Kenya, adopting a correlational cross sectional design focusing on 56 employees of 28 banks as well as used regression and correlation analysis to determine the effect of ATMs usage on operational performance and found that there exist a positive and significant relationship between ATM usage and operational performance. Sujud and Hashem, (2017) conducted a study on bank innovations in the field of mobile banking, debit and credit cards, automated machines (ATM), internet banking, point of sale terminals (PST) and electronic funds transfer (EFT) in relation to their influence on profitability and return on assets (ROA) of Lebanese commercial banks. The findings revealed that bank innovations have a considerable favorable influence on the profitability and return on assets of Lebanese commercial banks, and that the benefit is statistically significant.

On the relationship between financial innovation and bank efficiency as well as the impact of financial innovation on efficiency ratio of deposit money banks in Nigeria, Ibenta and Anyanwu, (2017) analysed secondary data from 2006 to 2014 sourced from the Central Bank of Nigeria statistical bulletin. Because of the nature of the variables, the unit root test was used to guarantee that they were free of the stationarity problem that is associated with practically all time series data. To assess the association between the variables, a multiple regression model was designed and computed. The results show that the value of transactions on Automated Teller Machines (ATMs) and Points of Sale (POS) is inversely connected to

efficiency ratio, but web/internet and mobile banking are positively related, with only web/internet being significantly related.

While e-banking is rapidly gaining acceptance in the Nigerian banking sector and around the world, it does not guarantee improved bank performance, and it is also not economically sustainable, productive, or cost-effective to use the internet as a delivery method. This was what Oyewole, et al (2017) sought to examine in their work on e-banking and the performance of banks in Nigeria. The study tested the influence of electronic banking on the results of banks in Nigeria making use of panel data comprising yearly audited financial statements of 8 banks that have deployed and implemented e-banking. The period of 2000 to 2010 was captured. The result from the pooled OLS show that positive contribution and impact on ROA and NIM is achieved only after two years but a negative impact was observed in the first two years of adoption.

Studies support massive investment in ATM but it must be done with caution as opined by Sathye and Sathye, (2016). The authors discovered that ATM investment intensity has a strong negative relationship with bootstrap DEA technical efficiency in a study of the influence of automated teller machine (ATM) investment intensity on the production efficiency of Indian banks. These findings differ from those of previous studies conducted in industrialized countries. The achievements could be attributed to a large IT expenditure such as ATMs by banks, and their inability to reduce labour costs given that many processes still continue to be manual. As a result, the study indicates that IT investment decisions should be made with extreme prudence. Such investments are unlikely to generate the results that management had hoped for unless the underlying processes are also automated.

Akhisar, et al (2015) studied the influence of electronic backed channel on ROA and ROE analyzing data from 23 developed and developing countries covering 2005 to 2013. The dynamic panel data method, the results demonstrate that bank profitability of advanced and emerging countries affected from the ratio of the proportion of branches to ATMs is significant, and electronic banking services are extensive. Findings reveal that some variables behaved in divergence to the expected adverse relationship, due to differences in the countries' levels of development, socio-cultural structures, and electronic banking infrastructure.

The outcomes show that practically all the banking services under consideration affect bank effectiveness and profitability. However, the number of POS terminals and customers that use the internet banking service have been shown to have a detrimental impact

on profitability. Nonetheless, the number of issued bank cards and the percentage of ATMs to branch locations have a beneficial impact on profitability.

To further evaluate how performance (profitability ratios, noninterest operating expenses and incomes) of banks in Vietnam is affected by internet banking, Dinh, et al (2015) data to be analyzed where obtained from the period of 2009-2014. The random effect model (REM) and fixed effect model (FEM) was used to estimate the relationships between internet indicators and bank's performance. Based on the findings from the regression model, it was determined that internet banking increased bank profitability through increasing revenue from service activities. However, the impact level was minimal, with a lag period of more than three years, which is longer than prior research findings.

On whether e-banking affect bank performance in Ghana, Mawutor (2014) in a study investigated how the electronic banking services through internet and ATM has impacted on banking services in general and the banks' profitability in particular. The methodology was quantitative in nature. To obtain the information about E-banking, 150 questionnaires were distributed to interviewees from the Agricultural Development Bank's selected branches who are customers. The structured self-administered questionnaire data was properly organized. The data was analyzed using Statistical Package for Social Sciences (SPSS) technique. The study was also more descriptive in nature. The result from the hypothesis tested using inferential statistics, showed that the profitability of the Agricultural Development bank is affected by E-banking.

Furthermore, buttressing the effect of electronic channels on bank profitability and market share, Valahzaghard and Bilandi, (2014) in an empirical investigation carried out to study how profitability and market share in Iranian banking industry is effected by electronic banking devices such as automated telling machines (ATM), Point of sales (POS) and Pin Pad on. 16 banks where used as the population for the study, which were made up of five governmental and eleven private, over the period 2007-2012. The study discovered that while Pin Pad may have a positive impact on asset return, ATM and POS may not have a significant impact on profitability using two regression techniques. Furthermore, none of the technological features had a significant impact on market share, according to the survey results, but there was a positive and significant relationship between bank size and market share.

The performance of banks across the globe continues to maintain a high movement due to daily technological improvements. Halili, (2014) studied the influence of online banking on the performance of banks in Europe and also emphasizing the trials that are derived from

implementation of online banking in the selected countries. The study covered 5 European countries (1999 – 2010). The experimental analysis employed data obtained from 22 banks in the United Kingdom, Germany, Czech Republic, Latvia, and Poland. The study showed that the implementation of online banking resulted in an upsurge in the performance indicators of the banks. With the application of the instrumental variable, the study concluded that implementation of online banking is adversely linked with returns on equity, return on assets and Margin (MRG).

Knowledge Gap/Contribution to Knowledge

From review of empirical studies in this subject area, several authors have attempted studies on electronic banking and bank performance in relation to country specific studies. For instance, Mdugba, et al 2021; Ibekwe, 2021; Nwankwo and Agbo, 2021; Mamudu, 2021 concentrated on Nigeria while Remulo, 2018; Abdullahi and Nyaoga, 2017; Kamau and Oluoch, 2016 concentrated on Kenya and Boateng and Nagaraju, 2020; Addai et al 2015 focused on Ghana. This work empirically evaluates the influence of electronic banking channels and technological innovations on the performance of banks in three countries in West Africa (Ghana, Cote D'Ivoire and Nigeria) plus an aggregate impact of the technological innovations on ROA and ROE of the banking sector. This is new and relatively scarce in literature.

The study investigates the relationship between technological innovations on bank performance in top three economies of West Africa (Nigeria, Ghana and Cote D'Ivoire). This is a rare study in this category as previous works adopted panel or country specific studies on Sub Saharan Africa, developing countries or other regions of Africa, leaving out West Africa. Also, whereas several studies, in the past adopted primary data and single dependent variable; using questionnaires and survey method for data gathering and concentrating on two or three e-channel products.

Also, most of the works on electronic banking concentrated on its impact on customer satisfaction and better services (Shobhit, 2016; Mutevu, 2015; Addai et al 2015; Onodugo, 2015; Salehi & Alipour, 2010). Not so much attention has been given to bank performance and profitability; referring to both ROA and ROE as dependent variables. This work is an addition to that space contributing to literature and focusing on selected West African Countries.

METHODOLOGY

Introduction

This chapter presents the procedures and analytical framework to accomplish the objective of the study by employing a model that explains Electronic Channels as a hallmark constituent of bank performance. This chapter covers research design, population of the study, sampling technic, source of data and model specification for the study.

Research Design

The *ex post facto,* research design will be applied in this work as the data represents events that have already occurred. According to Asika (2006), *ex post facto* research design is a systematic empirical study in which the researcher does not in any way control or manipulate the independent variables because the situation for the study already exist or has taken place (Onwumere, 2005). It is a quasi-experimental study examining how an independent variable affects a dependent variable and the connection that exist between them.

Nature and Sources of Data

To test the impact of electronic banking channels on the performance of banks, it is imperative to select variables that have direct theoretical and empirical link with bank performance. The variables to be considered are internet banking transactions, ATM, Mobile Banking, POS transactions, bank lending to private sector, return of assets. Secondary data will be used in this study; data sourced from world development indicator website spanning over twenty two years from 1997 to 2019 considering data availability.

Population and Sample Size

We are taking a census study of selected West African Countries with special focus on Nigeria, Ghana, and Cote d'Ivoire. The aggregate of the economic activities in these countries is over 60% of the entire West African region. They have the highest level of gross domestic product (Eyisi, 2010)

Model Specification

Following the analytical framework presented in the previous section, this study sought to econometrically estimate the impact of technological innovations on bank performance in selected West African countries following an extensive study by Okoye et al. (2019) in their

work on emerging financial technological innovation and economic growth in Nigeria. Okoye et al. specified their model as follows

$$Ingdp = \beta_0 + \beta_1 Inap + \beta_2 Inmt + \beta_3 Init + \beta_4 Inir + \varepsilon_t ---------- (1)$$

Where

GDP = GDP at 2010 constant basic prices ap = Sum of ATM and POS transactions mt = Mobile phone transfer transactions it = Internet transfer transactions ir = Inflation rate ln = Log β0 = Additional factor affecting lngdp β1 - β4 = Coefficients of ap, mt, it, and ir Ɛt = Error term.

We therefore extended this model to suit our study. Specifically, since this study aims to investigate the impact of technological innovations on bank performance in West Africa, we replaced the measure of the economic growth from the Okoye et al. (2019) model with measures of bank performance (return on assets (ROA) and return on equity (ROE)), and measures of technological innovations with internet banking, automated teller machines, mobile banking, and point of sales, while we controlled for inflation rate and exchange rate. Hence we specified the model that explains the relationship between technological innovations and bank performance below

$$InBPM_t = \beta_0 + \beta_1 InINB_t + \beta_2 InATM_t + \beta_3 InMBN_t + \beta_4 InPOS_t + \beta_5 InINFR_t + \beta_6 InEXR_t + \varepsilon_t ---------- (2)$$

Where:

In entails that the variables are in natural logarithm, β_0 is the constant, β_1 *to* β_6 represents the coefficients, the BPM denotes the bank performance measures which include bank return on assets (ROA) and bank return on equity (ROE), INB denotes the internet banking, ATM denotes the automated teller machines, MBN is the mobile banking, POS is the point of sale, INFR is the inflation rate, and EXR is the exchange rate. In addition, t represents time, while ε_t represents the white noise error term.

Specifically, the hypotheses stated in section one were modelled in a log-linear equation as follows:

Hypothesis One states that "internet banking has no significant impact on return on assets". Thus, the relevant linear equation that explained this relationship is expressed as follows

$$InROA_t = \beta_0 + \beta_1 INB_t + \beta_2 INFR_t + \beta_3 EXR_t + \varepsilon_t ------- (3)$$

Where:

ROA denotes the bank's return on assets,
INB denotes the internet banking
INFR denotes the inflation rate
EXR is the exchange rate
β_0 is the constant,
β_0 *to* β_3 represents the coefficients
t denotes the time and
ε_t denotes the error term

Hypothesis Two states that "ATM has no significant impact on return on assets". Thus, the relevant linear equation that explained this relationship is expressed as follows

$$InROA_t = \beta_0 + \beta_1 ATM_t + \beta_2 INFR_t + \beta_3 EXR_t + \varepsilon_t - - - - - - - (4)$$

Where

ROA denotes the bank's return on assets,
ATM denotes the automated teller machines
INFR denotes the inflation rate
EXR is the exchange rate
β_0 is the constant,
β_0 *to* β_3 represents the coefficients
t denotes the time and
ε_t denotes the error term

Hypothesis Three states that "POS has no significant impact on return on assets". Thus, the relevant linear equation that explained this relationship is expressed as follows

$$InROA_t = \beta_0 + \beta_1 POS_t + \beta_2 INFR_t + \beta_3 EXR_t + \varepsilon_t - - - - - - - (5)$$

Where:

ROA denotes the bank's return on assets,
POS denotes the point of sale
INFR denotes the inflation rate
EXR is the exchange rate
β_0 is the constant,
β_0 *to* β_3 represents the coefficients
t denotes the time and
ε_t denotes the error term

Hypothesis Four states that "mobile banking has no significant impact on return on assets". Thus, the relevant linear equation that explained this relationship is expressed as follows

$$InROA_t = \beta_0 + \beta_1 MBN_t + \beta_2 INFR_t + \beta_3 EXR_t + \varepsilon_t - - - - - - - - (6)$$

Where:

ROA denotes the bank's return on assets,
MBN denotes the mobile banking
INFR denotes the inflation rate
EXR is the exchange rate
β_0 is the constant,
β_0 to β_3 represents the coefficients
t denotes the time and
ε_t denotes the error term

Hypothesis Five states that "internet banking has no significant impact on return on equity". Thus, the relevant linear equation that explained this relationship is expressed as follows

$$InROE_t = \beta_0 + \beta_1 INB_t + \beta_2 INFR_t + \beta_3 EXR_t + \varepsilon_t - - - - - - - - (7)$$

Where:

ROE denotes the bank's return on equity,
INB denotes the internet banking
INFR denotes the inflation rate
EXR is the exchange rate
β_0 is the constant,
β_0 to β_3 represents the coefficients
t denotes the time and
ε_t denotes the error term

Hypothesis Six states that "ATM has no significant impact on return on equity". Thus, the relevant linear equation that explained this relationship is expressed as follows

$$InROE_t = \beta_0 + \beta_1 ATM_t + \beta_2 INFR_t + \beta_3 EXR_t + \varepsilon_t - - - - - - - - (8)$$

Where:

ROE denotes the bank's return on equity,
ATM denotes the automated teller machines
INFR denotes the inflation rate
EXR is the exchange rate
β_0 is the constant,
β_0 *to* β_3 represents the coefficients
t denotes the time and
ε_t denotes the error term

Hypothesis Seven states that "POS has no significant impact on return on equity". Thus, the relevant linear equation that explained this relationship is expressed as follows

$$InROE_t = \beta_0 + \beta_1 POS_t + \beta_2 INFR_t + \beta_3 EXR_t + \varepsilon_t - - - - - - - (9)$$

Where:

ROE denotes the bank's return on equity,
POS denotes the point of sales
INFR denotes the inflation rate
EXR is the exchange rate
β_0 is the constant,
β_0 *to* β_3 represents the coefficients
t denotes the time and
ε_t denotes the error term

Hypothesis Eight states that "mobile banking has no significant impact on return on equity". Thus, the relevant linear equation that explained this relationship is expressed as follows

$$InROE_t = \beta_0 + \beta_1 MBN_t + \beta_2 INFR_t + \beta_3 EXR_t + \varepsilon_t - - - - - - - (10)$$

Where:

ROE denotes the bank's return on equity,
MBN denotes the mobile banking
INFR denotes the inflation rate
EXR is the exchange rate
β_0 is the constant,
β_0 *to* β_3 represents the coefficients
t denotes the time and
ε_t denotes the error term

Based on equations (3, 4, 5, 6, 7, 8, 9 and 10) above, the estimated general equations for the impact of technological innovations on the bank performance are modelled as follows

$$InROA_t = \beta_0 + \beta_1 InINB_t + \beta_2 InATM_t + \beta_3 InPOS_t + \beta_4 InMBN_t + \varepsilon_t - - - - - (11)$$

$$InROE_t = \beta_0 + \beta_1 InINB_t + \beta_2 InATM_t + \beta_3 InPOS_t + \beta_4 InMBN_t + \varepsilon_t - - - - - (12)$$

Equation 11 above captures the impact of technological innovations on the bank's return on assets, whereas equation 12 captures the impact of technological innovations on the bank's

Preliminary Test and Estimation Procedure

This study further investigates the impact of technological innovations on bank performance in selected West African countries by employing multiple (ARDL) models. This model was proposed by Pesaran and Shin (1995) and was further extended by Pesaran et al. (2001) and it is preferred since it has numerous advantages over similar estimation techniques like Engle and Granger (1987) and Johansen (1991) among others. The potency of the model entails that it can be applied in research studies irrespective of the order of integration of the model variables I(0) or I(1), also when the researcher is faced with small sample size, like in this study, it gives more realistic statistically significant estimates when compared to other estimation techniques, and it can estimate both long-run and short-run relationships at once (Bahmani-Oskooee and Ng 2002; Kyophilavong et al. 2013; Pesaran and Shin 1999). The model for the relationships that exist between technological innovations and bank performance in West Africa was properly specified as follows.

$$InBPM_t = \beta_0 + \beta_1 InINB_t + \beta_2 InATM_t + \beta_3 InMBN_t + \beta_4 InPOS_t + \beta_5 InINFR_t + \beta_6 InEXR_t + \varepsilon_t - - - - - - - - - - - - - (13)$$

Where:

BPM represents the bank performance measures which include the bank return on assets (ROA) and bank return on equity (ROE). The In entails that the variables are in natural logarithm, β_0 is the constant, β_1 to β_6 represents the coefficients, INB denotes the internet banking, ATM denotes the automated teller machines, MBN is the mobile banking, POS is the point of sale, INFR is the inflation rate, and EXR is the exchange rate. In addition, t represents time, while ε_t represents the white noise error term.

Furthermore, to investigate the cointegration between technological innovations and bank performance in equation 13, the researcher formulated the ARDL model framework as follows:

$$\Delta InBPM_t = \beta_{01} + \sum_{t=1}^{n1} \beta_{11}\, \Delta InBPM_{t-1} + \sum_{t=1}^{n2} \beta_{12}\, \Delta InINB_{t-1} + \sum_{t=1}^{n3} \beta_{13}\, \Delta InATM_{t-1} + \sum_{t=1}^{n4} \beta_{14}\, \Delta InMBN_{t-1} + \sum_{t=1}^{n5} \beta_{15}\, \Delta InPOS_{t-1} + \sum_{t=1}^{n6} \beta_{16}\, \Delta InINFR_{t-1} + \sum_{t=1}^{n7} \beta_{17}\, \Delta InEXR_{t-1} + \alpha_{11} InBPM_{t-1} + \alpha_{12} InINB_{t-1} + \alpha_{13} InATM_{t-1} + \alpha_{14} InMBN_{t-1} + \alpha_{15} InPOS_{t-1} + \alpha_{16} InINFR_{t-1} + \alpha_{17} InEXR_{t-1} + \varepsilon_{t-1} \quad (14)$$

Where:

In entails that the variables are expressed in natural logarithm, Δ is the first difference operator, BPM denotes the bank performance measures – return on assets (ROA) and return on equity (ROE), INB, ATM, MBN, POS, INFR and EXR are as defined earlier, β_{01} is the constant, β_{11} to β_{17} represents short-run coefficients, α_{11} to α_{17} represents the long-run coefficients, $n1$ to $n7$ represents the lag length and ε_{t-1} represents the stochastic error term in the model.

In addition, if equation 14 holds, it becomes imperative to examine if there is the existence of long-run cointegration between technological innovation and bank performance in West Africa, which was based on the null hypothesis stated below:

Null Hypotheses: $H_0: \alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = \alpha_7 = 0$

Alternative Hypotheses: $H_1: \alpha_1 \neq \alpha_2 \neq \alpha_3 \neq \alpha_4 \neq \alpha_5 \neq \alpha_6 \neq \alpha_7 \neq 0$

These hypotheses were best explained by Pesaran et al. (2001). As recommended by Pesaran et al. (2001), once the existence of cointegration is established among the variables, the next step will be to estimate the error correction model (ECM). Hence, we present the error correction model from the successive long-run component of the equation as follows:

$$\Delta InBPM_t = \beta_{01} + \sum_{t=1}^{n1} \beta_{11}\, \Delta InBPM_{t-1} + \sum_{t=1}^{n2} \beta_{12}\, \Delta InINB_{t-1} + \sum_{t=1}^{n3} \beta_{13}\, \Delta InATM_{t-1} + \sum_{t=1}^{n4} \beta_{14}\, \Delta InMBN_{t-1} + \sum_{t=1}^{n5} \beta_{15}\, \Delta InPOS_{t-1} + \sum_{t=1}^{n6} \beta_{16}\, \Delta InINFR_{t-1} + \sum_{t=1}^{n7} \beta_{17}\, \Delta InEXR_{t-1} + \omega ECT_{t-1} + \varepsilon_{t-1} \quad (15)$$

Where:

all variables are defined in the previous equations above, ω is the coefficient of the error correction model, while ECT_{t-1} is the error correction term. In theory, it is assumed that the coefficient of the error correction model has a negative sign and is statistically significant to measure the speed of adjustment from the short-run to the long-run after a short-run disequilibrium.

To ensure that tenets of ARDL are satisfied for the specified models, various econometric diagnostics like the Normality test, Breusch-Pagan LM test, Ramsey Reset test, and White Heteroscedasticity test was carried out for the specified models. As noted by Pesaran et al. (2001) stability tests (CUSUMQ and CUSUM) are useful in checking the stability of the coefficients of the regression. The tests are updated recursively and plotted against the breakpoints. If the plot lies within the critical bounds of a 5% level of significance, then the null hypothesis of all coefficients in the given regression is stable over the period the research is being carried out.

This study further took consideration of robust checking the previous model to avoid generating spurious regression results by accounting for the problem of time-variant, country-specific effects, and endogeneity which the ARDL model cannot handle. We utilized panel fully modified ordinary least squares (FMOLS) and panel dynamic ordinary least squares (DOLS) in this study to solve the aforesaid problems. Scholars like Beck et al. (2000) and Levine et al. (2001) stated that endogeneity and heterogeneity are common issues in panel studies and should be tackled while estimating long-run coefficients. In addition, Christopoulos & Tsionas (2004) argued that FMOLS and DOLS models have mechanisms that deal with serial correlation and endogeneity problems in econometric models, hence these conjectures, justify the utilization of the FMOLS and DOLS models for robustness checks.

DOLS is also considered a robust technique, commonly used after establishing cointegration between the variables. DOLS is a parametric approach for estimating long-run parameters in a system involving variables integrated of the same or different orders. This

method is rated as more reliable, as it takes care of possible simultaneity bias and small-sample bias among the regressors. This method involves augmenting the cointegrating regression with lags and leads of the regressors in the first differences (Kao & Chiang, 2001). Keeping in consideration the issues mentioned above with other techniques and, for the robustness of the results, this study applied both the FMOLS and the DOLS techniques to estimate the long-run association amongst the variables in a cointegrated panel.

EMPIRICAL RESULTS AND DISCUSSION OF FINDINGS

Introduction

This study investigates the impact of technological innovations on bank performance in selected West African countries. This study specifically examined the impact of internet banking, automated teller machines, mobile money and point of sales on bank return on assets and return on equity in West Africa. Also, this research work is interested in investigating how technological innovations affect bank performance in West Africa. The researcher selected 3 countries in West Africa which include Nigeria, Ghana and Cote d'Ivoire which was motivated by the availability of data. The study utilized the annual time series data which covers the period of 1997 to 2020 – 23 years. In this chapter, the presentation, analysis and discussion of the results obtained from regression will be discussed and the research were carried out with the time series annual secondary data.

Measure of Nature and Behaviour of Data

The very first step in this research work is to study the general and specific behaviour of variables in the specified models before the estimations, by employing the descriptive statistics and Spearman's correlation matrix and it was estimated for both panel and country-specific paradigm. This research work sampled 3 West African countries namely Nigeria, Ghana and Cote d'Ivoire and the total number of observations was 72 and it spread through 23 years – 1997 to 2020. However, the descriptive statistics is a summary of statistics, which quantitatively describes or summarizes features from a collection of information in the form of mean, median, minimum, maximum, standard deviation, skewness, and Kurtosis, thus, below in table 1, is the results of the descriptive statistics.

Table 1: Descriptive Statistics

	PANEL							
	ROA	ROE	INB	ATM	MBN	POS	INFR	EXR
Mean	0.696023	2.944487	0.152616	2.013485	3.747736	7.201309	1.905979	3.835392

Median	0.790349	3.034518	0.000000	2.550044	3.721589	7.280883	2.236545	4.946324
Maximum	2.385970	4.172427	4.816800	3.870249	4.222884	8.473826	3.725922	6.596324
Minimum	-2.462730	-0.446073	0.000000	-2.473207	3.382015	-5.226802	-1.023294	-1.585740
Std. Dev.	0.821326	0.688574	0.686409	1.676442	0.259449	0.801145	1.076896	2.688527
Skewness	-1.579671	-2.424596	5.426966	-0.786450	0.228315	-0.482220	-0.917632	-0.652927
Kurtosis	7.532253	12.17276	34.03281	2.617595	2.362127	3.179320	3.189620	1.811977
Jarque-Bera	83.93759	305.0202	3242.529	5.895552	0.282055	0.801918	10.07061	9.349964
Probability	0.000000	0.000000	0.000000	0.022456	0.008466	0.009678	0.006504	0.009326
Observations	66	68	72	54	11	20	71	72
COUNTRY-SPECIFIC								
NIGERIA								
	ROA	ROE	INB	ATM	MBN	POS	INFR	EXR
Mean	1.785640	2.762990	0.352600	2.432769	3.669655	7.394786	2.406767	4.916898
Median	2.495390	2.892785	0.000000	2.550044	3.737368	7.398443	2.471071	4.946324
Maximum	4.123580	3.763855	4.816800	3.098250	3.813748	7.489895	2.937767	5.882795
Minimum	-15.09640	-0.446073	0.000000	1.195759	3.390136	7.311425	1.684176	3.085847
Std. Dev.	3.713809	0.793425	1.121746	0.590944	0.195371	0.068047	0.327311	0.676365
Skewness	-4.136207	-2.814362	3.258817	-0.523945	-0.873140	0.199446	-0.384024	-1.379121
Kurtosis	19.39382	12.37515	12.49148	2.152876	2.066932	1.950780	2.406682	5.381342
Jarque-Bera	337.1902	119.5760	132.5677	1.361771	0.653352	0.262495	0.941922	13.27869
Probability	0.000000	0.000000	0.000000	0.506169	0.721317	0.877001	0.624402	0.001308
Observations	24	24	24	18	4	5	24	24
GHANA								
	ROA	ROE	INB	ATM	MBN	POS	INFR	EXR
Mean	2.640404	20.49054	0.049155	1.069921	8.162083	703.4208	16.22984	1.948311
Median	2.440085	23.05535	0.000000	0.663431	0.000000	0.000000	13.49804	1.228621
Maximum	10.86960	6.487270	1.179710	2.573631	6.823000	4.021679	4.150950	5.595708
Minimum	-9.698510	-5.242400	0.000000	0.000000	0.000000	0.000000	4.865398	0.204796
Std. Dev.	3.783521	22.89741	0.240807	1.047283	19.66596	1301.347	9.605226	1.684252
Skewness	-0.976383	-1.167262	4.587317	0.394591	2.166661	1.697215	1.482152	0.943237
Kurtosis	6.399794	5.692626	22.04348	1.463129	6.199458	4.228237	4.434970	2.474505
Jarque-Bera	15.37190	12.70024	446.8280	22.98781	29.01421	13.03072	10.84624	9.834927
Probability	0.000459	0.001747	0.000000	0.000035	0.000001	0.001481	0.004413	0.001979
Observations	24	24	24	24	24	24	24	24
COTE D'IVOIRE								
	ROA	ROE	INB	ATM	MBN	POS	INFR	EXR
Mean	0.448102	2.961626	0.954491	3.625549	1.204413	7.196901	0.609377	6.318158
Median	0.612981	3.033084	1.285452	3.652067	1.245648	7.022128	0.885834	6.337580
Maximum	1.034550	3.762532	2.522321	3.870249	3.927109	8.473826	1.841902	6.596324
Minimum	-0.952102	0.012440	-2.861206	3.332986	-1.835954	-6.649438	-1.023294	-6.100319
Std. Dev.	0.491073	0.427938	1.186978	0.149752	1.381319	0.662071	0.811597	0.132076
Skewness	-1.254628	-0.585312	-2.042493	-0.264654	-0.265441	1.374731	-0.401403	0.431855
Kurtosis	4.099162	3.049055	7.259489	2.544773	2.854873	3.481770	2.107081	2.565354
Jarque-Bera	6.879149	10.32768	26.12278	8.365548	16.27657	17.97911	9.381725	87.93914
Probability	0.032078	0.003393	0.000002	0.002956	0.000377	0.000587	0.001144	0.000000
Observations	22	24	18	18	22	6	23	24

Source: Result obtained from Regression Analysis by the researcher

In the cross-country paradigm findings shows that the mean values of the variables did not deviate much from each other and such was observed for median, standard deviation, Skewness and Kurtosis. Also, the results of the minimum and the maximum suggest that the total variations in the series averagely moves from -5.226802 to 8.473826 which represents the most little and highest values in the series. In addition, the values of the Jarque-Bera test

statistics for all the variables have their probability values less than 0.05 which further signifies that each of the variable's error term are normally distributed.

Similarly, to measure the behaviour of each of the model variables, we employed the descriptive statistics for each selected countries. In Nigeria, the total variations in the series ranges from -15.09640 to 7.489895 which represents the minimum and maximum values in the series. In addition, the values of mean, median, standard deviation, skewness and Kurtosis are not too far from each other. In the like manner, the probability values of the Jarque-Bera test are less than 0.05 which implied that the variables are normally distributed and they are also well behaved. In the same vein in Ghana, we discovered that the values of the mean, median, standard deviation, Skewness and Kurtosis are not too far from each other and this suggest that the series and normally distributed and the mean variations moved from 0 to 10.86960 and this represents the least and highest values in the series. Further exploration entailed that the probability values of the Jarque-Bera statistics are less than 0.05 which further confirmed that the series are normally distributed and the variables are well-behaved suitable for the analysis. Moreover in Cote d'Ivoire, the researcher discovered that the probability values of the Jarque-Bera statistics are less than 0.05 which entailed that the series are normally distributed. Also, it was discovered that the average variations in the series moved from -6.649438 to 8.473826 which was the least and highest values in the series and the values of the mean, median, standard deviation, Skewness and Kurtosis are not too far from each other, which implied that the series are normally distributed and suitable for the analysis of the relationship that are being tested. Thus, these findings from the descriptive statistics results shows that variables behaviour would certainly yield to a more consistent estimate in each of the specified models in the study.

The researcher further hired Spearman's Correlation test to test the nature of correlations between technological innovations and bank performance in selected West African countries and the results is presented in table 2. Note worthily, Spearman's correlation matrix measures the degree of linear relationship between each of the pair of variables in the model, and correlation values is ranked between -1 and +1. The larger the absolute value of the coefficient, the stronger the relationship between the variables, likewise, the lower the absolute values, the weaker the relationships between the variables (Gujarati, 2003). According to Cohen (1988), the coefficients of the correlation will be reported based on the following rule of thumb: Strong relationship ±5, Moderate relationship ±3 and weak relationship ±1. Thus, we present the results of the estimated correlation tests for both cross-country and each country in table 2 below.

Table 2: Correlation Matrix

PANEL								
	ROA	ROE	INB	ATM	MBN	POS	INFR	EXR
ROA	1							
ROE	0.543195	1						
INB	0.674086	0.046682	1					
ATM	0.977406	0.071089	-0.111126	1				
MBN	0.888616	0.162678	0.017235	0.051712	1			
POS	0.767948	0.234084	0.103385	-0.140526	0.118144	1		
INFR	0.776962	0.189093	-0.042844	-0.517930	0.016710	0.017353	1	
EXR	-0.996598	0.276209	-0.054708	0.650340	-0.074847	-0.073496	-0.647382	1
COUNTRY-SPECIFIC								
NIGERIA								
	ROA	ROE	INB	ATM	MBN	POS	INFR	EXR
ROA	1							
ROE	0.420131	1						
INB	0.686455	-0.006859	1					
ATM	-0.918855	-0.559511	-0.157754	1				
MBN	-0.970063	-0.194085	-0.141536	0.382393	1			
POS	0.577099	0.565864	0.176076	-0.451369	-0.225591	1		
INFR	-0.701804	0.950768	-0.600906	0.097516	0.118934	0.592215	1	
EXR	0.849071	-0.402906	-0.133915	0.878353	0.395117	-0.221564	0.306969	1
GHANA								
	ROA	ROE	INB	ATM	MBN	POS	INFR	EXR
ROA	1							
ROE	0.668619	1						
INB	-0.694638	-0.190609	1					
ATM	-0.711997	-0.706502	0.305828	1				
MBN	-0.583205	-0.204551	0.650586	0.449802	1			
POS	-0.625059	-0.671403	0.543118	0.542692	0.232077	1		
INFR	0.632440	0.361834	-0.140648	-0.423123	-0.163119	-0.188966	1	
EXR	-0.772635	-0.771204	0.461268	0.940890	0.4570185	0.745106	-0.368539	1
COTE D'IVOIRE								
	ROA	ROE	INB	ATM	MBN	POS	INFR	EXR
ROA	1							
ROE	0.781145	1						
INB	-0.341457	-0.540364	1					
ATM	0.984259	-0.056113	0.157953	1				
MBN	0.690283	-0.321129	0.293783	0.152861	1			
POS	0.525352	0.653890	-0.227891	-0.136329	-0.261522	1		
INFR	0.710140	-0.112499	0.309378	-0.370049	0.283678	0.011307	1	
EXR	0.632011	-0.026940	-0.313573	-0.740910	-0.322483	0.074296	0.030219	1

Source: Computed by the Researcher

From table 2, the result of the Spearman's Correlation test for cross-country (panel) shows that the bank return on assets and bank return on equity have strong positive correlation with the technological innovations in West Africa. Similarly, the internet banking (INB) portrayed a strong positive correlations with the banking performance in West Africa. In the same vein, the automated teller machines (ATM) and the mobile banking (MBN) also have strong positive correlations with bank performance in West Africa. We also observed that the point of sales (POS) and inflation rate (INFR) have strong positive correlations with the bank

performance in West Africa, while exchange rate (EXR) portrayed negative correlations with bank performance in West Africa.

In the country-specific paradigm, we observed that in Nigeria, internet banking (INB), point of sale (POS) and the exchange rate (EXR) have strong positive correlations with both bank return and assets that and return on equity, whereas, automated teller machine (ATM), mobile banking (MBN) and inflation rate (INFR) portrayed strong negative correlations with the bank performance. In Ghana, we discovered that strong negative correlations exists between internet banking (INB), automated teller machines (ATM), mobile banking (MBN), point of sale (POS), and the exchange rate (EXR), while the inflation rate portrayed positive correlations with the bank performance in Ghana. This behaviour of the variables could be attributed to change in government policies in Ghana. It will be required that deposit money banks in Ghana improve the efficiency of the technological innovations in the banking system which would aid in improving the efficiency of the banks in delivering banking services to their customers. The banks should as well invest in cyber-security to prevent cyber-attacks to their esteemed customers using any banking channels. The discoveries from the test further entailed that while internet banking (INB) has strong negative correlations with the bank performance in Cote d'Ivoire, the automated teller machines (ATM), mobile banking (MBN), point of sale (POS), inflation rate (INFR) and the exchange rate (EXR) portrayed strong positive correlations with the bank performance in Cote d'Ivoire.

Based on the above findings, it would be deduced that bank performance, which are affected by various factors was positively influenced by the technological innovations in West African economies. Thus, apart from relying on the proficiency of technological innovations to thrive, performance of banks should also be improved by considering other macroeconomic factors such as improvement of savings mobilization, increase in the investment in West African economy, development of West African key economic sectors and running a financial inclusive economies in West African countries. In addition, Ghanaian banks and government should endeavour to invest more in the banking system especially cyber-security aspects so that people investing in banks will have confidence while investing.

Testing for Stationarity

The researcher conducted unit root tests on set of the variables to investigate if there is existence of unit root or not in each of the model variable. The level of stationarity and integration order of the variables are highly valued by the researcher to make decisions. In the

panel paradigm, the researcher employed the Levine, Lin and Chu (2002) – LLC test, Im, Pesaran and Shin (2003) – IPS unit root tests, Fisher-ADF and Fisher-PP, whereas at country level, we utilized the Augmented Dickey-Fuller (ADF) and Phillips-Perron unit root tests. The Levin, Lin and Chu (2002) treats panel data as being composed of homogeneous cross-sections, thus performing a test on a pooled data series, while the Im, Pesaran and Shin (2003) unit root test on the other hand makes the error term of every variables to be serially correlated and the correlation properties vary across cross sections. Furthermore, we included another unit root tests – Fisher-ADF and Fisher-PP as proposed by Madala and Wu (1999) to robustly check if there is existence of unit root or not in the series. Thus, this serves as the source of combining the both LLC and IPS test in this study. Below in Table 3, are the results of unit root tests. The tests are guided by null hypothesis "unit root" and alternative hypothesis "no unit root" and decision rule "reject the null hypothesis if the probability value is less than 0.05".

Table 3: Unit Root Tests

PANEL						
VARIABLE	**LLC test by Lin et al. (2002)**	**IPS test by Im et al. (2003)**	**Fisher-ADF**	**Fisher-PP**	**Order of Integration**	
					Level	**First Diff.**
ROA	-2.02195** (0.0216)	-2.71592*** (0.0033)	22.4866*** (0.0010)	22.5394*** (0.0010)	I(0)	_
ROE	-2.83623*** (0.0023)	-2.97883*** (0.0014)	19.1266*** (0.0040)	18.8223*** (0.0043)	I(0)	_
INB	-4.38194*** (0.0000)	-3.94715*** (0.0000)	15.4314*** (0.0004)	15.4476*** (0.0004)	I(0)	_
ATM	-3.87677*** (0.0001)	-4.30505*** (0.0000)	29.5922*** (0.0000)	29.8980*** (0.0000)	_	I(1)
MBN	-5.07011*** (0.0000)	-5.36658*** (0.0000)	35.5868*** (0.0000)	34.6829*** (0.0000)	I(0)	_
POS	-3.70889*** (0.0001)	-4.22785*** (0.0000)	37.3644*** (0.0000)	27.0988*** (0.0001)	I(0)	_
INFR	-5.81215*** (0.0000)	-4.67659*** (0.0000)	30.6542*** (0.0000)	30.0313*** (0.0000)	I(0)	_
EXR	-4.80352*** (0.0000)	-3.26008*** (0.0006)	20.9180*** (0.0019)	20.7512*** (0.0020)	_	I(1)
NIGERIA						
Variables	**ADF-Statistic**	**Level**	**First Diff.**	**PP-Statistic**	**Level**	**First Diff.**
ROA	-5.257327*** (0.0003)	I(0)	_	-5.257327*** (0.0001)	I(0)	_
ROE	-3.415565** (0.0210)	I(0)	_	-3.386677** (0.0223)	I(0)	_
INB	-5.107715*** (0.0004)	I(0)	_	-5.111197*** (0.0004)	I(0)	_
ATM	-4.368905*** (0.0026)	_	I(1)	-4.406508*** (0.0024)	_	I(1)
MBN	-4.745693*** (0.0010)	I(0)	_	-4.697408*** (0.0012)	I(0)	_
POS	-4.559072*** (0.0017)	_	I(1)	-4.559072*** (0.0017)	_	I(1)

INFR	-3.601425** (0.0140)	I(1)	_	-3.476554** (0.0184)	I(0)	_
EXR	-3.528384** (0.0169)	_	I(1)	-3.596248** (0.0146)	_	I(1)
GHANA						
Variables	**ADF-Statistic**	**Level**	**First Diff.**	**PP-Statistic**	**Level**	**First Diff.**
ROA	-2.325626** (0.0225)	_	I(1)	-2.673161** (0.0145)	_	I(1)
ROE	-6.229240*** (0.0000)	_	I(1)	-6.263693*** (0.0000)	_	I(1)
INB	-3.313573** (0.0195)	_	I(1)	-5.991828** (0.0105)	_	I(1)
ATM	-15.22655*** (0.0000)	_	I(1)	8.822963*** (0.0000)	I(0)	_
MBN	-3.486799** (0.0196)	_	I(1)	-4.694020** (0.0203)	_	I(1)
POS	-3.763612** (0.0101)	_	I(1)	-3.771221** (0.0100)	_	I(1)
INFR	-3.131528** (0.0388)	I(0)	_	-3.912004*** (0.0070)	I(0)	_
EXR	10.33512*** (0.0000)	I(0)	_	-3.777861** (0.0379)	_	I(1)
COTE D'IVOIRE						
Variables	**ADF-Statistic**	**Level**	**First Diff.**	**PP-Statistic**	**Level**	**First Diff.**
ROA	-5.046339*** (0.0034)	_	I(1)	-5.815368*** (0.0001)	_	I(1)
ROE	-3.168271** (0.0353)	I(0)	_	-3.157642** (0.0361)	I(0)	_
INB	-3.610519** (0.0152)	_	I(1)	-6.279946*** (0.0000)	_	I(1)
ATM	-5.233799*** (0.0004)	_	I(1)	-5.233799*** (0.0004)	_	I(1)
MBN	-3.827346** (0.0112)	_	I(1)	-6.827346*** (0.0000)	_	I(1)
POS	-9.754257*** (0.0000)	I(0)	_	-7.213608*** (0.0000)	I(0)	_
INFR	-8.113589*** (0.0000)	_	I(1)	-4.392580*** (0.0023)	I(0)	_
EXR	-3.337012** (0.0254)	_	I(1)	-3.226740** (0.0319)	_	I(1)

Note: ***, **, and * represents the 1%, 5% and 10% significant levels and (.) denotes the probability values
Source: Computed by the Researcher.

Evidence from the results of the LLC, IPS, Fisher-ADF and Fisher-PP shows that the null hypothesis "has unit root" be rejected for all the variables since their probability values are less than 0.05, thus, leading to conclusion that there is no evidence of unit root in the series. Similarly in Nigeria, Ghana and Cote d'Ivoire, there was no evidence of unit root in the variables since the probability values of the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) statistics are less than 0.05 of which we rejected the null hypothesis and accester the alternative. In addition, we found that while some variables was integrated at level I(0), others are integrated at first difference I(1) and no variables was found to violate the

assumptions of the unit root test by integrating at integration order say I(2) and above. However, this makes these variables very suitable for the estimation of the autoregressive distributed lag (ARDL) model.

Cointegration Test

Furthermore, we deepened our investigations by conducting test for cointegration to ascertain if there is existence of cointegration between technological innovations and bank performance in West Africa. We employed two panel cointegration tests – Pedroni cointgeration propose by Pedroni (2004) and Kao (1999) cointegration tests. Thus, while Pedroni cointegration test served as the main test for cointegration in this study, Kao cointegration test serve as the test for robustness check. Pedroni proposed seven-cointegration test in 1999 and further extended in 2004 with the null hypothesis of "no cointegration" and decision rule to reject the null hypothesis "reject the null if the probability value is less than 0.05". The seven test statistics allow heterogeneity in the panel, both in the short-run dynamics as well as in the long-run slope and intercept coefficients. The seven test statistics are grouped into two categories namely: group-mean statistics that average the results of individual country test statistics and panel statistics that pool the statistics along the within-dimension for nonparametric and parametric within both groups.

The tests' results show that for all the specified models, the null hypothesis "no cointegration" will be rejected at 5% significant level for the specified models since the probability values of most of the Pedroni tests are less than 0.05. Thus, a conclusion was drawn that there is existence of cointegration between technological innovations and bank performance in West Africa. This findings was further robust checked with the Kao (1999) cointegration test and it was confirmed that there is existence of cointegration between technological innovations and bank performance in West Africa since the probability value of the ADF statistic for the specified variables is less than 0.05. These findings are in line with previous findings by various scholars such as (Adeshoka (2017), Yang et al. (2018), Le & Ngo (2020), Lee et al. (2019), and Enoruwa et al. (2019) among others.

Table 4: Pedroni and Kao Cointegration Tests

	Tests	Model 1: Dep. Var.: ROA	Model 2: Dep. Var.: ROE
Between Dimension	**Panel v-Statistic**	-5.630748*** (0.0000)	-6.312698*** (0.0000)
	Panel rho-Statistic	8.651662*** (0.0000)	0.061293 (0.5244)
	Panel PP-Statistic	-6.502120***	-9.831252***

		(0.0000)	(0.0000)
	Panel ADF-Statistic	-4.289874*** (0.0000)	-6.181028*** (0.0000)
Within Dimension	**Group rho-Statistic**	1.850627 (0.9679)	9.721040*** (0.0000)
	Group PP-Statistic	-3.421457*** (0.0003)	-12.37335*** (0.0000)
	Group ADF-Statistic	-7.829832*** (0.0000)	-6.000215*** (0.0000)
Robustness Check Kao's (1999) test	**ADF-Statistic**	-3.458279*** (0.0003)	-4.876407*** (0.0000)

Note: ***, **, and * represents 1%, 5% and 10% level of significance and (.) represents the probability values
Source: Computed by the researcher.

We furthered our investigations by employing the ARDL bounds test to examine if there is existence of long-run cointegration between the technological innovations and bank performance in each of the selected countries (Nigeria, Ghana and Cote d'Ivoire). However, according to Pesaran et al. (2001), ARDL bounds test is used to examine if there is existence of long-run relationships between any variables that is being measured and it is built on the assumption which states that "the 1% upper critical values of the tabulated Pesaran at al. (2001) and Narayan (2004) would be compared with the calculated F-statistics, if the F-statistic is greater, it implies that there is existence of long-run relationship between technological innovations and bank performance, if the F-statistic is less than the critical values, there is no long-run relationship and if they are equal, it implies that the result is inconclusive." We therefore present the estimated ARDL long-run bounds test result in table 5 below.

Table 5: ARDL Long-Run Bound Test Results

Country			**Pesaran et al. (2001)**						**Narayan (2004)**					
	F-stat.	**K**	**1%**		**5%**		**10%**		**1%**		**5%**		**10%**	
			I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
Nigeria	13.44873	6	3.74	5.06	2.86	4.01	2.45	3.52	4.59	6.37	3.28	4.63	2.70	3.90
Ghana	21.48670	6	3.74	5.06	2.86	4.01	2.45	3.52	4.59	6.37	3.28	4.63	2.70	3.90
Cote d'Ivoire	12.83752	6	3.74	5.06	2.86	4.01	2.45	3.52	4.59	6.37	3.28	4.63	2.70	3.90

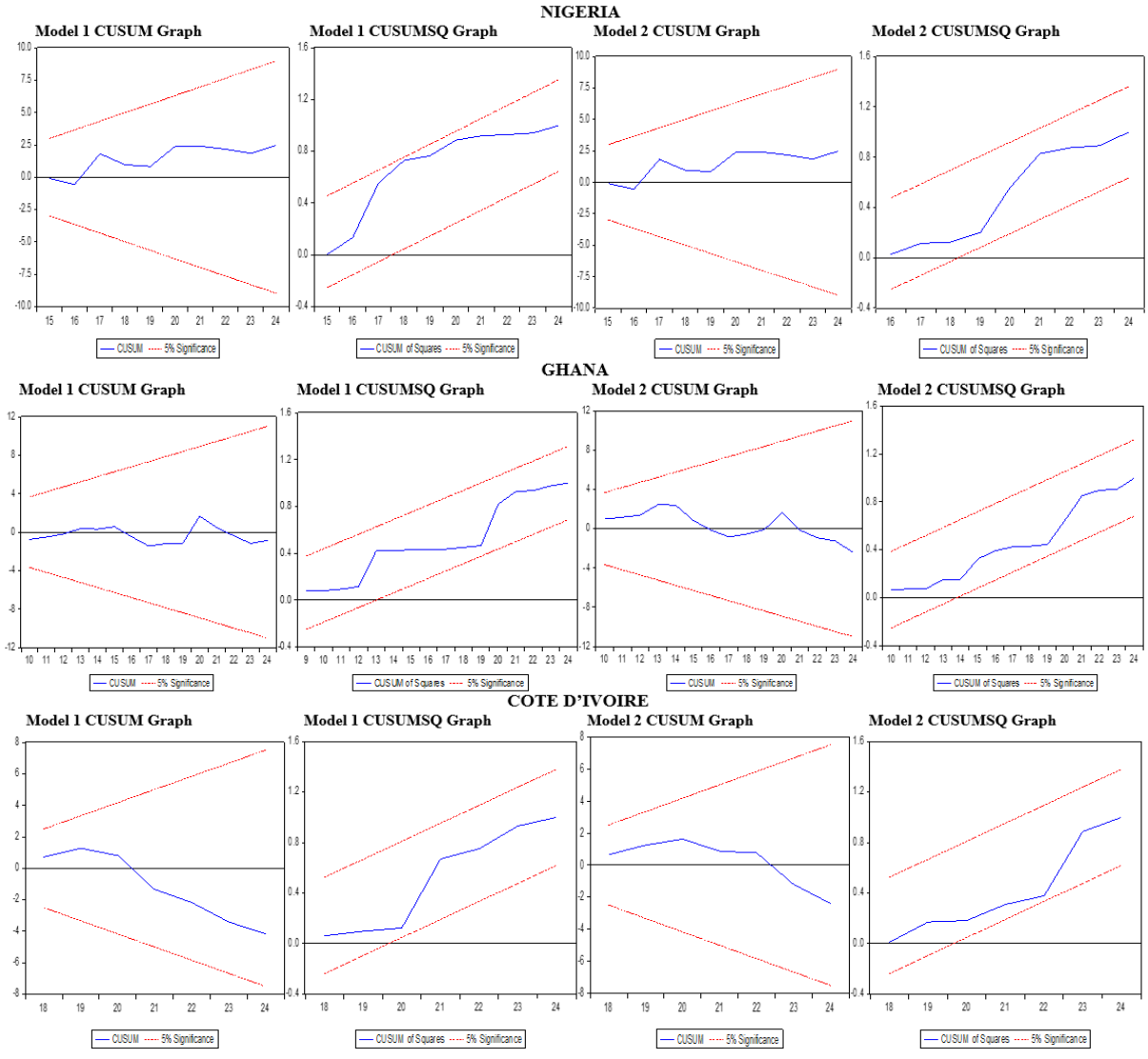
Source: Computed by the Researcher.

We found that for all the selected countries (Nigeria, Ghana and Cote d'Ivoire), the calculated F-statistics are greater than the 1% upper critical values of both Pesaran at al. (2001) and Narayan (2004). Thus, we conclude that there is existence of long-run relationship between the technological innovations and bank performance in West Africa. These results are in line with previous findings of (Ajayi and Enitilo 2016, Abor 2005, and Ajayi 2014) among others in similar studies.

Test for Stability

Haven found the existence of long-run relationships between the technological innovations and bank performance in Nigeria, Ghana and Cote d'Ivoire, we deepened our investigations by employing the recursive cumulative sum (CUSUM) test and recursive cumulative sum square test to ascertain the stability of the variables in the model for each of the selected countries. These tests was one of the assumptions proposed by Pesaran and Pesaran (1997) to check for the stability of variables over the sampled period. The rule of thumb governing the tests states that "if the line of the graph lies inside the 5% bounded area, it suggests that there is stability in the model, but if otherwise, there is no stability in the estimated model over the sampled period". Thus, below in figure 7, we present the graphs of the CUSUM and CUSUMSQ.

Figure 7: Estimated Graphs of CUSUM and CUSUMSQ Tests



Source: Computed by the Researcher

Evidence from the graphs of the recursive cumulative sum and the recursive cumulative sum tests shows that lines of graph lies in the 5% critical bound area which implies that the models 1 and 2 with InROA and InROE as the dependent variables are stable over the samples period (1997 to 2020) and there is no evidence of instability on the model over the sampled period.

Results for OLS Diagnostic Tests and Hausman Test

As put forward by Gujarati (2003), each of the specified models is supposed to pass through basic OLS diagnostic tests such as the normality test, Breusch-Godfrey Serial Correlation test, Ramsey Reset test and White Heteroscedasticity test to ensure that they yield reliable estimates. The researcher ensured that the specified models passed through the aforesaid tests and the results were presented in table 7 below. Findings from the results of the normality test, Serial correlation test and heteroscedasticity show that the error terms of the specified models 1 and 2 are normally distributed, serially uncorrelated and homoscedastic; while the result of the Ramsey Reset test shows that models are correctly specified (see table 5). Furthermore, these tests was carried out in of the selected countries (Nigeria, Ghana and Cote d'Ivoire) for the specified models and the same findings were made. This therefore suggests that the models are suitable for the estimation of the relationships between the technological innovations and bank performance in each of the specified countries.

Table 6: Results from Diagnostic Tests

PANEL				
Econometric Estimation Tests	**Model 1**		**Model 2**	
	Statistic	**Prob. Value**	**Statistic**	**Prob. Value**
Normality	764.9646	0.0000	67.67326	0.0000
Serial Correlation	1.160072	0.3205	0.376003	0.6882
Ramsey Reset	-0.165260	0.0000	0.097725	0.0000
Heteroscedasticity	0.617721	0.9026	1.535858	0.1028
Hausman	13.447487	0.0619	9.254576	0.2349
NIGERIA				
Econometric Estimation Tests	**Model 1**		**Model 2**	
	Statistic	**Prob. Value**	**Statistic**	**Prob. Value**
Normality	9206725	0.0000	58.11676	0.0000
Serial Correlation	0.685251	0.5213	2.556811	0.1225
Ramsey Reset	-0.523429	0.0093	-0.826429	0.0000
Heteroscedasticity	0.701370	0.6712	0.806473	0.7812
GHANA				
Econometric Estimation Tests	**Model 1**		**Model 2**	
	Statistic	**Prob. Value**	**Statistic**	**Prob. Value**
Normality	7.839204	0.0198	9.798396	0.0074
Serial Correlation	1.215521	0.3260	0.305177	0.7421
Ramsey Reset	-0.706515	0.0000	-1.062424	0.0000
Heteroscedasticity	3.569487	0.3204	0.758000	0.6302

COTE D'IVOIRE				
Econometric Estimation Tests	**Model 1**		**Model 2**	
	Statistic	**Prob. Value**	**Statistic**	**Prob. Value**
Normality	6.509992	0.0038	9.572793	0.0083
Serial Correlation	1.727201	0.2192	0.025474	0.9749
Ramsey Reset	-1.016793	0.0000	-0.934289	0.0000
Heteroscedasticity	0.788913	0.6091	0.583316	0.7594

Source: Compiled by the Researcher. Note: Decisions was taken at 5% level of significance.

In addition, the researcher employed a likelihood test – Hausman test to select the most suitable model for estimation of each of the specified models between fixed effects model and random effects model. Hausman test was proposed by Hausman in the year 1987 to be used by researchers to make choice of appropriate models for analysis in panel studies. The rule of thumb, which guide the test, is that "if the probability value of the Chi-Square Statistic is less than 0.05, it suggests that fixed effects is the most suitable model to be adopted in the estimation procedure. But if the probability value of the Chi-Square Statistic is greater than 0.05, it suggests that random effects model is the most suitable estimation procedure". Conclusively, for bot model 1 and 2, random effects model was utilized in the estimation since the probability value of the Chi-Square Statistic is greater than 0.05.

Lag Length Structure

In the bead to choose the most suitable, lag length structure for the specified models, the researcher employed the panel VAR model lag length structure, to determine between Akaike Information Criterion (AIC), Schwartz Information Criterion (SC) and Hannan-Quinn Information Criterion (HQ) since the model will be over-parameterized if the number of lags is too large. Thus, the results of the lag length structure are presented in Table 6 below. According to (Buckle et al. 2002), too long lags results in a rapid loss of degree of freedom and over-parameterization, while too-short lags might introduce biased results caused by omitting important variables and failing to capture the system's dynamics. In this study, Akaike Information Criterion (AIC) will be used for the specified models since in all the results; it has the least values across model1 (see table 6).

Table 7: Lag Length Selection Criteria

MODEL 1			
Lag	AIC	SC	HQ
0	59.73016	59.97239	59.82509
1	53.06858*	55.00643*	53.82804*
2	53.30370	56.93718	54.72770
3	52.27985	57.60894	54.36837
MODEL 2			

Lag	AIC	SC	HQ
0	62.85401	63.09213	62.94766
1	55.71657*	57.62157*	56.46582*
2	55.72345	59.29535	57.12830
3	55.75406	60.99284	57.81450

Note: AIC=Akaike Information Criterion, SC= Schwartz Information Criterion (SC) and HQ=Hannan-Quinn Information Criterion
Source: Computed by the Researcher.

Estimated ARDL Results for Long Run Relationship

The results of the estimated ARDL model was presented and discussed in this section. Thus, haven ascertained the lag length and the most suitable mode for the analysis from the Huasman test, we estimated the specified models and the results are presented in table 7 below. In addition, the discussion of the result findings are based on Pesaran et al. (2001) hypothesis testing which was to investigate if there the existence long-run relationship between technological innovations and bank performance in West Africa and we made decisions based on 5% significant levels.

Findings from model 1 shows that internet banking (INB) has a significant impact of 1.457724 on the bank performance in West Africa and this implied that a unit rise in the internet banking (INB) would result to increase in the bank performance in West Africa by the magnitude of 1.457724. Contrary to this finding, the findings shows that automated teller machines (ATM) portrayed negative and significant impact of -0.022224 on the bank performance (ROA) in West Africa and this implies that automated teller machines would cause about -0.022224 decreases in the bank performance in West Africa. Deep search in the results shows that mobile banking (MBN) have positive and significant impact of 0.6333059 on the bank performance and this suggests that a unit rise in the mobile banking (MBN) would result to about 0.6333059 increase in the bank performance in West Africa. Also, we discovered that point of sale (POS) has a positive and significant impact of 0.008192 on the bank performance. This implies that a unit rise in the POS would increase the bank performance in West Africa by 0.008192. We also discovered that the control variables – inflation rate (INFR) and exchange rate (EXR) portrayed negative and significant impact of -0.121626 and -0.195080 on the bank performance and this suggests that a unit increase in the inflation rate (INFR) and exchange rate (EXR) would result to about -0.121626 and -0.195080 on bank performance in West Africa. This, these findings coincides with previous empirical finding by scholars such as Enoruwa et al. (2019), Ogundipe & Alege (2013), Ogini et al. (2013), Shehu et al. (2013), Yeemofia (2021) and Yang et al. (2018) among others.

Furthermore, in model 2, we discovered that internet banking (INB) has positive and significant impact of 4.370758 on the bank performance (ROE) and this implied that a unit rise in the internet banking would increase the bank performance by 4.370758 in West Africa. A similar finding was made on the automated teller machines (ATM) which has a positive and significant impact of 3.543515 on the bank performance. This implies that a unit rise in the ATM results to increase in bank performance (ROE) in West Africa. Contrary to these findings, we discovered that mobile banking (MBN) has negative and significant impact of -1.408586 on the bank performance in West Africa and this shows that a unit increase in the mobile banking (MBN) would amount to decrease in the bank performance (ROE) by -1.408586 in West Africa. Also, a similar finding shows that the point of sale (POS) portrayed negative and significant impact of -0.020446 on bank performance (ROE) and this suggests that a unit increase in the POS would cause increase in the ROE by -0.020446 in West Africa. The results of the control variables – inflation rate (INFR) and exchange rate (EXR) entailed that, while the former has positive and significant impact of 1.197662 on the bank performance (ROE), the exchange rate has negative and significant impact of -30.36699 on bank performance (ROE). This suggests that if inflation rate and exchange rate increased a unit, it would result to about 1.197662 increase on the ROE, as well as -0.376699 decreases in the ROE. Based on these findings, we drew a conclusion that technological innovations have both positive and negative impacts on the bank performance in West Africa. This is in line with various findings made by scholars such as Flavian et al. (2014), Gan et al. (2006), Le & Ngo (2020), Lee et al. (2011) and Madugba et al. (2021) among others.

Table 8: Results for Estimated ARLD Models

	PANEL							
	Dependent Variable: InROA				**Dependent Variable: InROE**			
	Coefficient	Stand. Error	T-Statistic	Probability	Coefficient	Stand. Error	T-Statistic	Probability
Lag Dep. Var	1.457724***	0.044657	32.64267	0.0000	-0.355362***	0.108791	-3.266480	0.0019
InINB	0.535354***	0.017839	30.01031	0.0000	4.370758***	0.676210	6.463610	0.0000
InATM	-0.022224***	0.002575	-8.630679	0.0000	3.543515***	0.508622	6.966892	0.0000
InMBN	0.633059***	0.021743	29.11553	0.0000	-1.408586***	0.434131	-3.244611	0.0023
InPOS	0.008192***	0.000321	25.52024	0.0000	-0.020446***	0.003979	-5.138942	0.0000
InINFR	-0.121626***	0.027225	-4.467438	0.0000	1.197662***	0.478533	2.502776	0.0163
InEXR	-0.195080***	0.003197	-61.01970	0.0000	-0.376699***	0.064354	-5.853544	0.0000
Constant	-				-			
	COUNTRY-SPECIFIC							
	NIGERIA							
	Dependent Variable: InROA				**Dependent Variable: InROE**			
	Coefficient	**Stand. Error**	**T-Statistic**	**Probability**	**Coefficient**	**Stand. Error**	**T-Statistic**	**Probability**

Lag Dep. Var	0.198826	0.072101	-2.757608	0.0147	-0.612100	0.177781	-3.442999	0.0040
InINB	0.270860	0.041157	6.581140	0.0000	-0.535294	0.057517	-9.306709	0.0000
InATM	0.824346	0.090042	9.155127	0.0000	0.169027	0.027324	6.186026	0.0000
InMBN	0.664655	0.091130	7.293481	0.0000	-0.906296	0.122162	-7.418804	0.0000
InPOS	0.043222	0.002054	21.04284	0.0000	0.002124	0.000450	4.718951	0.0000
InINFR	-0.575417	0.042355	-13.58557	0.0000	-0.460675	0.068517	-6.723513	0.0000
InEXR	0.722128	0.015844	45.57737	0.0000	0.164476	0.026219	6.273160	0.0000
Constant	4.885033				3.161022			
	GHANA							
	Dependent Variable: InROA				**Dependent Variable: InROE**			
	Coefficient	**Stand. Error**	**T-Statistic**	**Probability**	**Coefficient**	**Stand. Error**	**T-Statistic**	**Probability**
Lag Dep. Var	-0.842289	0.185405	-4.542968	0.0000	-0.421196	0.129169	-3.260812	0.0053
InINB	0.960291	0.238271	4.030247	0.0009	1.052516	0.227533	4.625768	0.0003
InATM	0.882165	0.150996	5.842307	0.0000	-0.537968	0.209842	-2.563678	0.0216
InMBN	-0.843697	0.184851	-4.564200	0.0000	-0.919291	0.159977	-5.746394	0.0000
InPOS	0.492329	0.090934	5.414126	0.0000	0.385124	0.188918	2.038580	0.0595
InINFR	-0.814809	0.015413	-52.76816	0.0000	0.714125	0.024518	29.12656	0.0000
InEXR	0.826225	0.038949	21.21299	0.0000	0.088892	0.024486	3.630261	0.0025
Constant	0.134816				-			
	COTE D'IVOIRE							
	Dependent Variable: InROA				**Dependent Variable: InROE**			
	Coefficient	**Stand. Error**	**T-Statistic**	**Probability**	**Coefficient**	**Stand. Error**	**T-Statistic**	**Probability**
Lag Dep. Var	0.397817	0.131544	3.024209	0.0098	0.545338	0.156633	3.481622	0.0033
InINB	-0.834833	0.039627	-21.06727	0.0000	0.262089	0.082112	3.191847	0.0045
InATM	-0.021691	0.002182	-9.940879	0.0000	-0.109793	0.014329	-7.662293	0.0000
InMBN	0.622123	0.028896	21.52972	0.0000	0.853177	0.087645	9.734462	0.0000
InPOS	0.008699	0.000615	14.14471	0.0000	0.005491	0.001946	2.822566	0.0129
InINFR	-0.710899	0.053020	-13.40812	0.0000	0.537680	0.077508	6.937090	0.0000
InEXR	-0.085608	0.003136	-27.29846	0.0000	-0.936548	0.121534	-7.706057	0.0000
Constant	4.554124				32.28721			

Note: ***, ** and * represents the 1%. 5% and 10% level of significance
Source: Computed by the Researcher.

The results from the country specific analysis of Nigeria shows that in model 1, bank performance was measured with bank return on assets (ROA) and we discovered that the internet banking (INB), automated teller machines (ATM), mobile banking (MBN), point of sale (POS), and the exchange rate (EXR) have positive and significant impacts of 0.270860, 0.824346, 0.664655, 0.043222 and 0.722128 respectively on the bank return on assets (ROA). This implies that a rise in the internet banking (INB), automated teller machines (ATM), mobile banking (MBN), point of sale (POS), and the exchange rate (EXR) would result to increases in the bank return on assets at the magnitudes of 0.270860, 0.824346, 0.664655, 0.043222 and 0.722128 in Nigeria. While in the opposite end, the inflation rate portrayed negative and significant impact of -0.575417 on the bank return on assets in Nigeria and a unit rise in the

inflation rate (INFR) would amount to about -0.575417 decreases in the bank return on assets in Nigeria.

In model 2, bank performance was measured with bank return on equity (ROE), thus, we found that the internet banking (INB), automated teller machines (ATM), mobile banking (MBN), and inflation rate (INFR) portrayed negative and significant impact of -0.535294, -0.535294, -0.906296 and -0.460675 on the bank return on equity (ROE). This suggests that a unit rise in the internet banking (INB), automated teller machines (ATM), mobile banking (MBN), and inflation rate (INFR) would reduce the bank return on equity (ROE) by -0.535294, -0.535294, -0.906296 and -0.460675 in Nigeria. We also discovered that the automated teller machines (ATM), point of sale (POS) and the exchange rate (EXR) portrayed positive and significant impacts of 0.169027, 0.002124 and 0.164476 on the bank return on equity (ROE) which implies that any rise in the automated teller machines (ATM), point of sale (POS) and the exchange rate (EXR) would increase the bank return on equity (ROE) in Nigeria by 0.169027, 0.002124 and 0.164476 in Nigeria.

The results of the ARDL long-run successive component in Ghana shows that bank performance was also measured with bank return on assets (ROA) and bank return on equity and the discoveries made entails that in model 1, the internet banking (INB), the automated teller machines (ATM), point of sale (POS) and the exchange rate (EXR) have positive and significant impacts of 0.960291, 0.882165, 0.492329 and 0.826225 on the bank return on assets (ROA) in Nigeria. This implies that a rise in internet banking (INB), the automated teller machines (ATM), point of sale (POS) and the exchange rate (EXR) respectively would result to increases of 0.960291, 0.882165, 0.492329 and 0.826225 in the return on assets (ROA) in Ghana.

Similarly in model 2, which has the bank on equity (ROE) as the dependent variable, we found that internet banking (INB), point of sale (POS), inflation rate (INFR) and the exchange rate (EXR) have positive and significant impacts of 1.052516, 0.385124, 0.714125, and 0.088892 on the bank return on assets (ROE) in Ghana. This implies that if there is a unit increase in the internet banking (INB), point of sale (POS), inflation rate (INFR) and the exchange rate (EXR), it would result to about 1.052516, 0.385124, 0.714125, and 0.088892 in the bank return on equity (ROE) all things being equal. We also found that automated teller machines (ATM) and mobile banking (MBN) portrayed negative and significant impacts of -0.537968 and -0.919291 on the bank return on equity (ROE) in Ghana and it implies that a unit

rise in the automated teller machines (ATM) and mobile banking (MBN) would cause decreases of -0.537968 and -0.919291 on the bank return on assets in Ghana.

Our in-depth investigations in Cote d'Ivoire, the ARDL estimated results revealed that in model 1, which have bank return on assets (ROA) as the dependent variable entailed that the internet banking (INB), automated teller machines (ATM), the inflation rate (INFR) and the exchange rate (EXR) have negative impacts of -0.834833, -0.021691, -0.710899 and -0.085608 on the bank return on assets respectively in Cote d'Ivoire. This implies that a unit rise in the internet banking (INB), automated teller machines (ATM), the inflation rate (INFR) and the exchange rate (EXR) would result to about -0.834833, -0.021691, -0.710899 and -0.085608 decreases in the bank return on assets of Cote d'Ivoire. The researcher also discovered that the mobile banking (MBN) and the point of sale (POS) have positive and significant impacts of 0.622123 and 0.008699 on the bank return on assets (ROA) and this implies that a unit rise in the mobile banking (MBN) and the point of sale (POS) would increase the bank return on assets (ROA) by 0.622123 and 0.008699 in Cote d'Ivoire.

Furthermore, evidence from the results of model 2 with bank return on equity (ROE) as the measure of bank performance in Cote d'Ivoire and our findings also suggest that the internet banking (INB), mobile banking (MBN), point of sale (POS), and the exchange rate (EXR) have positive and significant impacts of 0.262089, 0.853177, 0.005491 and 0.537680 on the bank return on equity (ROE). This implies that a unit rise in the internet banking (INB), mobile banking (MBN), point of sale (POS), and the exchange rate (EXR) in Cote d'Ivoire would increase the bank return on equity (ROE) by 0.262089, 0.853177, 0.005491 and 0.537680 in Cote d'Ivoire. Also, our findings shows that automated teller machines (ATM) and the exchange rate (EXR) have negative and significant impacts of -0.109793 and -0.936548 on the bank return on equity (ROE) in Cote d'Ivoire. This therefore implies that any increase in the automated teller machines (ATM) and the exchange rate (EXR) will cause decrease in the bank return on equity (ROE) by the magnitude of -0.109793 and -0.936548 in Cote d'Ivoire.

Short-Run Dynamics

In the short run, the coefficient of the error correction model – ECM -0.170491 and -0.273053 for model 1 and 2respectively fulfilled the assumptions of the ARDL which states that "the coefficient of the error correction model must possess the negative sign and be statistically significant, in order to measure the speed of adjustment from the short run to the long run, as it was found to be possess negative sign and statistically significant". This means

that it will take about 17% and 27% speed of adjustment to correct the disequilibrium caused in the short run back to the long run. However, these findings coincides with the findings of other scholars like Edioukou (2020), Ekwueme et al. (2012), Eshun et al. (2019), Evian et al. (2021), and Eze & Egoro (2016) among others.

Also at country level, it was discovered from the results of the short-run dynamics that the coefficients of the error correction model in Nigeria -0.498826 and -0.612100 for models 1 and 2 possess negative signs and statistically significant at 1% significant level. This implies that at 49% and 61%, the speed of adjustment from the long-run impacts would be corrected in the short-run. Similarly in Ghana, the coefficient of the error correction model (ECM) -0.421196 and -0.942289 have negative signs and statistically significant at 1m% level of significant. This implies that the speed of adjustments from the long-run to the short-run would cause about -0.421196 and -0.942289 disequilibria in the models. Finally in the stance of Cote d'Ivoire, we discovered that the coefficients of the error correction model (-0.602183 and -0.454662) of models 1 and 2 have negative signs and statistically significance. This entailed that speed of adjustments from the long-run to the short-run would be corrected by -0.602183 and -0.454662 disequilibria in the bank performance of Cote d'Ivoire. These findings are in line with previous empirical findings made by Ekwueme et al. (2012), Eshun et al. (2019), Evian et al. (2021), and Eze & Egoro (2016) among others.

Table 9: ARDL Results for Short-Run Dynamics

	PANEL							
	Dependent Variable: InROA				**Dependent Variable: InROE**			
	Coefficient	Stand. Error	T-Statistic	Probability	Coefficient	Stand. Error	T-Statistic	Probability
ECM(-1)	-0.170491***	0.034790	-4.900574	0.0000	-0.273053***	0.023063	-11.83943	0.0000
InΔINB	-3.101842	2.572536	-1.205753	0.2356	8.911196	12.42818	0.717015	0.4773
InΔATM	-0.152317**	0.062103	-2.452632	0.0190	9.965095	10.03337	0.993195	0.3263
InΔMBN	-0.047328	0.025210	-1.877349	0.0684	0.256451	0.186911	1.372051	0.1773
InΔPOS	0.000347	0.000851	0.408120	0.6855	0.014203**	0.005847	2.429131	0.0195
InΔINFR	-0.108843	0.125920	-0.864383	0.3929	-1.025342	0.616377	-1.663498	0.1037
InΔEXR	-0.026868	0.046995	-0.571710	0.5710	-4.433419	4.496472	-0.985977	0.3298
	COUNTRY-SPECIFIC							
	NIGERIA							
	Dependent Variable: InROA				**Dependent Variable: InROE**			
	Coefficient	**Stand. Error**	**T-Statistic**	**Probability**	**Coefficient**	**Stand. Error**	**T-Statistic**	**Probability**
ECM(-1)	-0.498826***	0.072101	-6.918433	0.0000	-0.612100***	0.077781	-7.869531	0.0000
InΔINB	-0.270860	0.241157	-1.123168	0.2790	-0.535294	0.357517	-1.497254	0.1565
InΔATM	-0.024346	0.090042	-0.270383	0.7906	0.169027	0.267324	0.632291	0.5374
InΔMBN	-0.064655	0.091130	-0.709477	0.4889	-0.106296	0.122162	-0.870122	0.3989
InΔPOS	0.003222	0.002054	1.568585	0.1376	0.002124	0.002450	0.866906	0.4006
InΔINFR	-0.575417	0.402355	-1.430123	0.1732	-0.460675	0.468517	-0.983261	0.3422
InΔEXR	0.022128	0.015844	1.396558	0.1829	0.004476	0.026219	0.170720	0.8669
	GHANA							

	Dependent Variable: InROA				Dependent Variable: InROE			
	Coefficient	Stand. Error	T-Statistic	Probability	Coefficient	Stand. Error	T-Statistic	Probability
ECM(-1)	-0.421196***	0.029169	-14.43985	0.0000	-0.942289***	0.085405	-11.03318	0.0000
InΔINB	1.052516***	0.227533	4.625768	0.0003	0.160291	0.238271	0.672726	0.5121
InΔATM	-0.537968**	0.209842	-2.563678	0.0216	0.242165	0.150996	1.603780	0.1311
InΔMBN	-0.119291	0.159977	-0.745676	0.4674	-0.143697	0.284851	-0.504464	0.6218
InΔPOS	0.385124	0.188918	2.038580	0.0595	0.492329***	0.090934	5.414126	0.0001
InΔINFR	0.014125	0.024518	0.576117	0.5731	-0.014809	0.015413	-0.960775	0.3530
InΔEXR	0.088892***	0.024486	3.630261	0.0025	0.006225	0.038949	0.159816	0.8753
	COTE D'IVOIRE							
	Dependent Variable: InROA				**Dependent Variable: InROE**			
	Coefficient	**Stand. Error**	**T-Statistic**	**Probability**	**Coefficient**	**Stand. Error**	**T-Statistic**	**Probability**
ECM(-1)	-0.602183***	0.131544	-4.577797	0.0005	-0.454662**	0.156633	-2.902711	0.0109
InΔINB	-0.034833	0.039627	-0.879018	0.3953	-0.262089	0.382112	-0.685895	0.5032
InΔATM	-0.021691	0.022182	-0.977868	0.3460	-0.109793	0.104329	-1.052369	0.3093
InΔMBN	0.022123	0.028896	0.765602	0.4576	0.053177	0.087645	0.606731	0.5531
InΔPOS	0.000699	0.000615	1.136683	0.2762	0.005491**	0.001946	2.822566	0.0129
InΔINFR	-0.010899	0.053020	-0.205562	0.8403	-0.537680	0.797508	-0.674200	0.5104
InΔEXR	-0.005608	0.003136	-1.788535	0.0970	-0.036548	0.021534	-1.697187	0.1103

Note: ***, ** and * represents the 1%. 5% and 10% levels of significance
Source: Computed by the Researcher.

Robustness Checks

Due to presence of cross sectional dependency, country-specific effects and endogeneity problems that normally exist in panel models, which may exist in the study and the autoregressive distributed lag model (ARDL) is weak in handling the problems. This study pertinently accounted for the above stated problems by estimating the specified models with another co-integrating models – fully modified ordinary least squares (FMOLS) and dynamic ordinary least squares (DOLS) which was proposed by Christopoulos & Tsionas (2004). FMOLS and DOLS models have mechanisms that deal with serial correlation and endogeneity problems in econometric models and in more specific terms. In more specific terms, the FMOLS and DOLS models was employed to deal with the issues of endogeneity, serial correlations, cross-sectional dependence and country specific effects which ARDL model did not account for. Thus, below in table 10 the results of the estimated FMOLS and DOLS equations for the specified models

Table 10: Estimated FMOLS and DOLS Results

	PANEL							
	Model 1							
	Fully Modified Ordinary Least Squares (FMOLS)				Dynamic Ordinary Least Squares (DOLS)			
	Dependent Variable: InROA				Dependent Variable: InROE			
	Coefficient	Stand. Error	T-Statistic	Probability	Coefficient	Stand. Error	T-Statistic	Probability
Lag Dep. Var	0.338295***	0.086341	3.918121	0.0002	0.222549***	0.104051	2.138849	0.0365
InINB	-0.212255***	0.011822	-17.95423	0.0000	0.773000***	0.019164	8.409815	0.0000

InATM	0.826955***	0.022142	3.734780	0.0002	0.727138***	0.026684	27.24996	0.0000
InMBN	-0.057303***	0.015500	-3.696893	0.0005	-0.058642***	0.018679	-3.139382	0.0026
InPOS	-0.000828***	0.000268	-3.086027	0.0031	-0.009543***	0.000323	-29.54489	0.0000
InINFR	0.131342***	0.024857	5.283969	0.0000	0.117025***	0.029955	3.906691	0.0002
InEXR	0.026982***	0.001304	20.69171	0.0000	0.081178***	0.001571	51.67281	0.0000
No of Obs.	67				67			
R-Squared	0.810033				0.582580			
	Model 2							
	Fully Modified Ordinary Least Squares (FMOLS)				**Dynamic Ordinary Least Squares (DOLS)**			
	Dependent Variable: InROA				**Dependent Variable: InROE**			
	Coefficient	Stand. Error	T-Statistic	Probability	Coefficient	Stand. Error	T-Statistic	Probability
Lag Dep. Var	0.615136***	0.072952	8.432122	0.0000	0.552769***	0.080215	6.891103	0.0000
InINB	1.873720***	0.563979	3.322322	0.0014	1.616742***	0.119697	13.50695	0.0000
InATM	0.916555***	0.036402	25.17869	0.0000	0.975482***	0.106001	9.202573	0.0000
InMBN	0.732966***	0.048298	15.17590	0.0000	0.382905***	0.075098	5.098737	0.0000
InPOS	-0.082008***	0.001238	-66.24232	0.0000	-0.052112***	0.001361	-38.28949	0.0000
InINFR	0.441145***	0.132729	3.323646	0.0015	0.458708***	0.145944	3.143033	0.0026
InEXR	0.084151***	0.006240	13.48573	0.0000	0.067770***	0.016862	4.019096	0.0001
No of Obs.	69				69			
R-Squared	0.843752				0.494986			

Note: ***, ** and * represents the 1%. 5% and 10% level of significance
Source: Computed by the Researcher.

Findings from the FMOLS in model 1 shows that internet banking (INB), mobile banking (MBN) and point of sale (POS), have negative and significant impacts of -0.212255, -0.057303, and -0.000828 on bank performance (bank return on assets – ROA) in West Africa. This implied that a rise in the internet banking (INB), mobile banking (MBN) and point of sale (POS) would result to decreases in the bank return on assets by -0.212255, -0.057303, and -0.000828 in West Africa. Contrary to this findings, the results also suggests that the automated teller machines (ATM), the exchange rate (EXR) and inflation rate (INFR) portrayed positive and significant impacts of 0.826955, 0.131342 and 0.026982 on bank performance (bank return on assets – ROA) in West Africa. This shows that a unit increase in the automated teller machines (ATM), the exchange rate (EXR) and inflation rate (INFR) would result to about 0.826955, 0.131342 and 0.026982 increases in the bank performance (bank return on assets) in West Africa. The results of the R-squared which is the measure of the goodness of fit shows that overall variations in the bank return on assets (ROA) are explained by the 81%.

From the DOLS result, we discovered that internet banking (INB) and the automated teller machines (ATM) have positive and significant impacts of 0.773000 and 0.727138 on the bank performance (bank return on assets – ROA) in West Africa. This implies that a unit rise in the internet banking (INB) and the automated teller machines (ATM) would cause about 0.773000 and 0.727138 increases in the bank performance in West Africa. In the opposite end, we also discovered that mobile banking (MBN) and point of sale (POS) portrayed negative and

significant impact of -0.058642 and -0.009543 on the bank performance (bank return on assets – ROA) in West Africa. This implied that a unit rise in the mobile banking (MBN) and point of sale (POS) would result to about -0.058642 and -0.009543 decreases in the bank performance (bank return on assets – ROA) in West Africa. In addition to the findings, the R-squared result which measures the goodness of fit shows that the overall variations in the bank return on assets (ROA) was explained by the model at 58%. These findings coincides with previous findings made by Bingilar & Bariweni (2019), Carlos & Ronald (2020), Davis (1989), DeYoung (2002), and Dinch et al. (2015) among others.

In model 2, our aim is to investigate the impact of technological innovations on bank return on equity (ROE) in West Africa. Thus, we made the following findings, from the FMOLS results. We discovered that the internet banking (INB), the automated teller machines (ATM) and mobile banking (MBN) have positive and significant impacts of 1.873720, 0.916555 and 0.732966 on the bank performance (bank return on equity – ROE) in West Africa and this shows that a unit rise in the internet banking (INB), the automated teller machines (ATM) and mobile banking (MBN) would result to about 1.873720, 0.916555 and 0.732966 in the bank performance (bank return on equity – ROE) in the West Africa. The control variable – inflation rate (INFR) and exchange rate (EXR) have positive and significant impact of 0.441145 and 0.084151 on the bank performance (bank return on equity – ROE) in West Africa. This implies that a unit rise in the inflation rate (INFR) and exchange rate (EXR) will cause about 0.441145 and 0.084151 in the bank performance (bank return on equity) in West Africa. The R-squared which measures the goodness of fit shows that over 84% of the total variations in the model are being explained by the dependent variable bank return on equity (ROE) and these findings are in consonant with the previous findings made by scholars such as Adeshokan (2017), Adewuyi (2011), Aduba & Kingoo (2012), Agwu and Carter (2014), Ailemen et al. (2018), Ajayi (2014), Ajayi & Enitilo (2016), and Bikers & Bos (2008) among others.

Closer look on the results of DOLS shows that the internet banking (INB), automated teller machines (ATM) and mobile banking (MBN) portrayed positive and significant impacts of 1.616742, 0.975482 and 0.382905 on the bank return on equity (REO) in West Africa. This implies that a unit rise in the internet banking (INB), automated teller machines (ATM) and mobile banking (MBN) would result to about 1.616742, 0.975482 and 0.382905 increases in the bank return on equity (ROE) in West Africa. Contrary to these findings, we discovered that the point of sale (POS) has negative and significant impact of -0.052112 on the bank return on equity (ROE) in West Africa. This implies that a unit rise in the point of sale (POS) would

result to decrease in the bank return on equity (ROE) in West Africa. Also, our findings from the results shows that inflation rate (INFR) and exchange rate (EXR) have positive and significant impact of 0.458708 and 0.067770 on the bank return on equity (ROE) in West Africa and this however suggests that a unit rise in the inflation rate (INFR) and exchange rate (EXR) would result to rises in the bank return on equity (ROE) by 0.458708 and 0.067770 in West Africa. Furthermore, the results of the R-squared shows that the over 49% of the total variations in the model are explained by bank return on equity (ROE) in West Africa. These findings are related to earlier findings made by Abaenewe et al. (2013), Abdullai & Nyaoga (2017), Abor (2005), Abubakar (2014), Addae-Korankye (2014), Addia et al. (2015) among others.

Robutsness Checks for the Selected Countries

Furthermore, haven robust checked the specified models in panel paradigm and found the existence of long-run relationships between bank performance (bank return on assets (ROA) and bank return on equity (ROE)) and technological innovations in West Africa, it becomes imperative that we deepen our investigations towards finding out if there is existence of long-run relation between the technological innovations and bank performance in at the country level. . Thus, haven found that there was no evidence of unit root and the variables are integrated of I(0) and I(1) for each countries, we used the FMOLS and DOLS models to estimate the specified models for each country and the results are presented in table 11 below.

Table 11: Estimated Results of FMOLS and DOLS for the Selected Countries

	NIGERIA							
	Model 1							
	Fully Modified Ordinary Least Squares (FMOLS)				**Dynamic Ordinary Least Squares (DOLS)**			
	Dependent Variable: InROA				**Dependent Variable: InROA**			
	Coefficient	Stand. Error	T-Statistic	Probability	Coefficient	Stand. Error	T-Statistic	Probability
Lag Dep. Var	-0.872702***	0.149606	-5.833257	0.0000	-1.198826***	0.189942	-6.311541	0.0000
InINB	-0.513802***	0.123949	-4.145269	0.0008	0.270860***	0.064879	4.174848	0.0001
InATM	0.007692***	0.001011	7.608308	0.0000	0.024346***	0.002101	11.58781	0.0000
InMBN	-0.053771***	0.009207	5.840230	0.0000	0.164655***	0.049797	3.306524	0.0000
InPOS	0.003906**	0.001474	2.650185	0.0190	0.003222***	0.000787	4.094027	0.0003
InINFR	-0.697804**	0.246903	-2.826222	0.0135	0.575417***	0.105710	5.443354	0.0000
InEXR	0.021385**	0.006065	3.525968	0.0109	0.322128***	0.019625	16.41416	0.0000
No of Obs.	22				23			
R-Squared	0.887642				0.682211			
	Model 2							
	Fully Modified Ordinary Least Squares (FMOLS)				**Dynamic Ordinary Least Squares (DOLS)**			
	Dependent Variable: InROE				**Dependent Variable: InROE**			
	Coefficient	Stand. Error	T-Statistic	Probability	Coefficient	Stand. Error	T-Statistic	Probability
Lag Dep. Var	-0.629699***	0.127754	-4.928989	0.0002	-0.610609***	0.162030	-3.768486	0.0019
InINB	0.568560***	0.035609	15.96674	0.0000	0.875042***	0.206712	4.233145	0.0000

InATM	0.273605***	0.038261	7.151015	0.0000	0.341788***	0.075280	4.540223	0.0000
InMBN	-0.889675***	0.051152	-17.36277	0.0000	0.713824***	0.064759	11.02277	0.0000
InPOS	0.081412***	0.001861	43.74637	0.0000	0.841419***	0.022264	37.79280	0.0000
InINFR	-0.889684***	0.127555	-6.974904	0.0000	-0.826179***	0.187536	-4.405442	0.0000
InEXR	-0.003953***	0.000528	-7.486742	0.0000	0.898563***	0.026061	34.47922	0.0000
No of Obs.	24				22			
R-Squared	0.835858				0.538713			
	GHANA							
	Model 1							
	Fully Modified Ordinary Least Squares (FMOLS)				**Dynamic Ordinary Least Squares (DOLS)**			
	Dependent Variable: InROA				**Dependent Variable: InROA**			
	Coefficient	Stand. Error	T-Statistic	Probability	Coefficient	Stand. Error	T-Statistic	Probability
Lag Dep. Var	-0.849067***	0.064480	-13.16786	0.0000	-0.876203***	0.099373	-8.817346	0.0000
InINB	1.037194***	0.073049	14.19855	0.0000	1.014865***	0.113695	8.926221	0.0000
InATM	-0.751155***	0.081568	-9.208942	0.0000	-0.643397***	0.126720	-5.077312	0.0000
InMBN	0.440025***	0.051924	8.474404	0.0000	0.733456***	0.080856	9.071138	0.0000
InPOS	0.622875***	0.073720	8.449199	0.0000	-0.817971***	0.114309	-7.155788	0.0000
InINFR	0.116657***	0.008082	14.43417	0.0000	0.916886***	0.012372	74.10976	0.0000
InEXR	0.411571***	0.011314	36.37714	0.0000	0.716380***	0.017488	40.96408	0.0000
No of Obs.	22				23			
R-Squared	0.940142				0.941731			
	Model 2							
	Fully Modified Ordinary Least Squares (FMOLS)				**Dynamic Ordinary Least Squares (DOLS)**			
	Dependent Variable: InROE				**Dependent Variable: InROE**			
	Coefficient	Stand. Error	T-Statistic	Probability	Coefficient	Stand. Error	T-Statistic	Probability
Lag Dep. Var	-0.621392***	0.126078	-4.928623	0.0002	-0.627348***	0.203576	-3.081642	0.0071
InINB	0.224416**	0.098836	2.270593	0.0383	0.259776***	0.064949	3.999692	0.0012
InATM	0.313853***	0.103096	3.044280	0.0082	0.287451***	0.072096	3.987058	0.0014
InMBN	-0.821245***	0.074327	-11.04908	0.0000	-0.852247***	0.024322	-35.04016	0.0000
InPOS	0.945834***	0.122702	7.708382	0.0000	0.920795***	0.201350	4.573106	0.0000
InINFR	-0.912115***	0.011627	-78.44800	0.0000	-0.811360***	0.019205	-42.24733	0.0000
InEXR	0.189060***	0.011509	16.42714	0.0000	0.711275***	0.019111	37.21809	0.0000
No of Obs.	22				23			
R-Squared	0.666548				0.682448			
	COTE D'IVOIRE							
	Model 1							
	Fully Modified Ordinary Least Squares (FMOLS)				**Dynamic Ordinary Least Squares (DOLS)**			
	Dependent Variable: InROA				**Dependent Variable: InROA**			
	Coefficient	Stand. Error	T-Statistic	Probability	Coefficient	Stand. Error	T-Statistic	Probability
Lag Dep. Var	0.425562***	0.095059	4.476802	0.0008	0.397817**	0.173093	2.298286	0.0388
InINB	0.135396***	0.019769	6.848904	0.0000	-1.834833***	0.037772	-48.57653	0.0000
InATM	0.024686**	0.008734	2.826507	0.0153	-0.621691***	0.014593	-42.60200	0.0000
InMBN	0.025362*	0.011355	2.233613	0.0453	0.722123***	0.021575	33.47035	0.0000
InPOS	0.000747***	0.000188	3.968819	0.0019	0.180699***	0.016348	11.05327	0.0000
InINFR	0.545950***	0.040169	13.59132	0.0000	-0.610899***	0.075341	-8.108453	0.0000
InEXR	-0.005896***	0.001453	-4.058520	0.0016	-0.045608***	0.010485	-4.349833	0.0000
No of Obs.	20				21			
R-Squared	0.496015				0.489812			
	Model 2							
	Fully Modified Ordinary Least Squares (FMOLS)				**Dynamic Ordinary Least Squares (DOLS)**			
	Dependent Variable: InROE				**Dependent Variable: InROE**			
	Coefficient	Stand. Error	T-Statistic	Probability	Coefficient	Stand. Error	T-Statistic	Probability
Lag Dep. Var	0.451965***	0.106762	4.233388	0.0000	0.340102***	0.028761	11.82511	0.0000

InINB	-0.861513***	0.204231	-4.218326	0.0000	0.809292***	0.075022	10.78739	0.0000
InATM	0.863749***	0.104008	8.304640	0.0000	0.383276***	0.027749	13.81224	0.0000
InMBN	0.088546***	0.017278	5.124782	0.0000	0.819987***	0.036773	22.29861	0.0000
InPOS	0.021100***	0.002118	9.962228	0.0000	0.081579***	0.003599	22.66712	0.0000
InINFR	0.527500***	0.015298	34.48163	0.0000	0.519237***	0.040454	12.83524	0.0000
InEXR	0.318362***	0.012682	25.10345	0.0000	0.914899***	0.021292	42.96914	0.0000
No of Obs.	21				22			
R-Squared	0.570920				0.563318			

Note: ***, ** and * represents the 1%. 5% and 10% level of significance
Source: Computed by the Researcher.

In Nigeria, the estimated results of the FMOLS of model 1 shows that while internet banking (INB), mobile banking (MBN), and inflation rate (INFR) portrayed negative and significant long-run effects of -0.872702, -0.053771 and -0.697804 on the bank return on assets (ROA), the automated teller machines (ATM), point of sales (POS) and exchange rate (EXR) portrayed positive and significant long-run effects of 0.007692, 0.003906 and 0.021385 on the bank return on assets (ROA). This implies that a unit rise in the internet banking (INB), mobile banking (MBN), and inflation rate (INFR) would decrease the bank return on assets (ROA) in Nigeria by -0.872702, -0.053771 and -0.697804 magnitude respectively. While a unit rise in the automated teller machines (ATM), point of sales (POS) and exchange rate (EXR) would cause increases of 0.007692, 0.003906 and 0.021385 on the bank return on assets (ROA) in Nigeria. Furthermore, the results of the DOLS also shows that variables of the technological innovations – internet banking (INB), automated teller machines (ATM), mobile banking (MBN) and point of sale (POS) as well as the control variables – inflation rate (INFR) and exchange rate (EXR) have significant positive effects of 0.270860, 0.024346, 0.164655, 0.003222, 0.575417 and 0.322128 on the bank return on assets (ROA) and this implies that a unit rise in the internet banking (INB), automated teller machines (ATM), mobile banking (MBN) and point of sale (POS) as well as the control variables – inflation rate (INFR) and exchange rate (EXR) would cause about 0.270860, 0.024346, 0.164655, 0.003222, 0.575417 and 0.322128 increases in the bank return on assets (ROA) in Nigeria. In the like manner, model 2 results of the FMOLS revealed that internet banking (INB), automated teller machines (ATM), and point of sales (POS) are portrayed positive and significant long-run effects on bank return on equity (ROE), while the mobile banking (MBN), inflation rate (INFR) and exchange rate (EXR) have significant negative long-run effects on the bank return on equity (ROE). Also, from the results of the DOLS in model 2, all the variables have positive and significant long-run effects on the bank return on equity (ROE).

In Ghana, the results of the model 1 of FMOLS show that there is existence of long-run relationships between the technological innovations and bank performance in Ghana.

Specifically, the internet banking (INB), mobile banking (MBN), point of sale (POS), inflation rate (INFR), and the exchange rate (EXR) portrayed positive and significant long-run relationships with the bank return on assets (ROA), while the automated teller machine (ATM) has negative and significant long-run relationships with the bank return on assets (ROA). The results of the DOLS shows that while the internet banking (INB), mobile banking (MBN), inflation rate (INFR) and the exchange rate (EXR) have positive and significant long-run relationships with the bank return on assets in Ghana, the automated teller machines (ATM), and point of sale (POS) have negative and significant long-run relationships with the bank return on assets in Ghana.

Our findings was deepened by employing another measure of bank performance – bank return on equity (ROE) to measure bank performance of Ghana which formed model 2. From FMOLS results, it was observed that internet banking (INB), the automated teller machines (ATM), point of sale (POS) and exchange rate (EXR) have portrayed positive and significant long-run relationships with the bank return on equity (ROE) in Ghana, whereas the mobile banking (MBN) and inflation rate have a negative and significant long-run relationships with the bank return on assets in Ghana. In addition, findings from the results of the DOLS suggests that while the internet banking (INB), automated teller machines, point of sale (POS) and exchange rate have a positive and significant long-run relationships with the bank return on equity (ROE). But the mobile banking (MBN) and inflation rate (INFR) was found to have negative and significant long-run relationships with the bank return on equity (ROE). The R-squared which measures the goodness of fit for FMOLS and DOLS and for models 1 and 2 shows that the model was explained by 94%, 94%, 66% and 68% overall variations in the model.

In the context of Cote d'Ivoire, the model was estimated with the FMOLS and DOLS and the following findings were made. In model 1 for FMOLS, the researcher discovered that the internet banking (INB), automated teller machines (ATM), mobile banking (MBN), point of sale (POS) and inflation rate have positive and significant long-run relationships with the bank return on equity (ROA) in Cote d'Ivoire, while the exchange rate (EXR) was found to portray negative and significant long-run relationship with the bank return on assets (ROA) in Cote d'Ivoire. Furthermore, for DOLS estimations, it was discovered that while the internet banking (INB), automated teller machines (ATM), inflation rate (INFR) and exchange rate (EXR) have negative and significant long-run relationships with the bank return on assets (ROA) in Cote d'Ivoire, it was discovered that mobile banking (MBN) and the point of sale

(POS) showed positive and significant long-run relationships with the bank return on assets (ROA) of Cote d'Ivoire. Also, the results of the measure of goodness of fit –R-squared shows that over 49% and 48% variations in the models are explained by the explanatory variable.

In model 2, closer look from the results of FMOLS revealed that while the internet banking (INB) have a long-run negative significant relationship with the bank return on equity (ROE), the results of the automated teller machines (ATM), the mobile banking (MBN), point of sales (POS), inflation rate (INFR) and the exchange rate (EXR) have positive and significant long-run relationships with the bank return on equity in Cote d'Ivoire. Similar findings were made from the results of the DOLS which shows that all the variables of the model portrayed positive long-run significant relationships with the bank return on equity (ROE). Specifically, the measures of the technological innovations – internet banking (INB), automated teller machines (ATM), mobile banking (MBN) and point of sale (POS), as well as the control variables – inflation rate (INFR) and exchange rate (EXR) have positive and significant long-run relationships with the bank return on assets (ROE) in Cote d'Ivoire. The R-squared which measures the goodness of fit shows that about 57% and 56% of the total variations in the models are explained by the dependent variable.

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

Introduction

This chapter examines the summary of the study findings, conclusion and policy recommendations. This chapter is important because it could aid the readers, the policymakers and the government agencies to draw conclusions and formulate possible economic policies based on recommendations made in this study. Thus, at a glance, the reader will grasp the conclusion on the impact of technological innovations on bank performance in West Africa in this chapter.

Summary of Findings

The sole aim of this research is to examine the impact of technological innovations on the bank performance in West Africa with major interest on Nigeria, Ghana and Cote d'Ivoire. The researcher utilized annual time series data which covers the period of 23years i.e. (1997 – 2020) and two measures of bank performance including bank return on assets (ROA) and bank return on equity (ROE) to measure bank performance. Also, technological innovations was measured with indicators such as internet banking (INB), the automated teller machines (ATM), mobile banking (MBN) and point of sale (POS) while the general effects of technological

innovations on bank performance was controlled with inflation rate (INFR) and exchange rate (EXR). Thus, the bank performance indicators and the control variables was sourced from the World Bank's World Development Indicators (WDI), while the technological innovation measures was sourced from the International Monetary Funds (IMF) financial access survey (FAS) and the availability of the data informed both the choices of the variables and scope of the study.

From the results findings, results of the descriptive statistics for both panel and countries shows that the series of the data are normally distributed since the probability values of the Jarque-Bera statistics for virtually all the variables are less than 0.05 and the values of mean, median, standard deviation, Skewness and Kurtosis are not far from each other. Findings from the correlation matrix shows that strong positive correlation exists between technological innovations and bank performance in West Africa. The researcher did not find any form of unit root problem among the variables and the variables was integrated at level I(0) and first difference I(1) which are very suitable for the estimations of the ARDL model. Findings further shows that there was existence of cointegration between the technological innovations and bank performance in West Africa as was found from Pedroni cointegration results which were confirmed by Kao (1999) cointegration test. In addition, it was found from the results of the diagnostic tests that the error terms of the specified models are normally distributed, serially uncorrelated and homoscedastic and thus, the models are correctly specified. The results of the Hausman test suggested random effects model for the estimation of model 1 and 2.

The ARDL model was used to estimate with the specified models. Findings from the ARDL results show that technological innovations have both positive and negative long-run significant impacts with the bank performance in West Africa. While in the short run, the coefficients of the error correction models possess negative signs for all the specified models as well as statistically significance. Similarly, the result of the ARDL on the country-specific paradigm also suggests that the technological innovations have both negative and positive long-run relationships with the bank performance in Nigeria, Ghana and Cote d'Ivoire.

These findings were robust checked by employing the fully modified OLS (FMOLS) and dynamic OLS (DOLS) models. The essence of employing the FMOLS and DOLS models was due to its efficacy in correcting the problem of endogeneity, country-specific effects, cross-sectional dependency and serial correlations in the model of which the ARDL model was not able to correct. Findings entailed that in panel FMOLS and DOLS results for model 1 and 2, technological innovations have both positive and significant long-run relationships with the

bank performance in West Africa. The results of the selected countries shows that in Nigeria as well as Ghana and Cote d'Ivoire, both negative and positive significant long-run relationships were found between technological innovations and bank performance at various degrees. Specifically, the poor technological infrastructure in Nigeria greatly constrain acceptance of electronic channels and more impact can be achieved with greater acceptance of technological innovations in West Africa. These findings were as a result of change in government policies as well as the nature of macroeconomic variables in the selected countries.

CONCLUSIONS

Technological innovation is a new or improved product or process whose technological characteristics are significantly different. Technological innovations increases productivity and bring citizens new and better goods and services that improve their transaction efficiency in terms of speed, accuracy, and convenience and overall standard of living. And there is no doubt it has improved banking sector in the recent times since most banks and other financial institutions have shifted from normal conventional banking which requires manual operation of banking businesses to use of technological equipment such as computer, internet and mobile phones to render bank services to the customers.

The continuous breakdown of electronic banking channels, failed transactions and difficulty in resolving disputes have adverse effect on bank performance and hinders acceptance of technological innovations in West Africa. Based on the research findings, this study concludes that technological innovations have both positive and negative significant impacts on the bank performance in West Africa.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations are provided:

1. To ensure that quality banking services are offered to customers, banks should incorporate digital financial tools like internet banking, web banking, mobile banking, automated teller machines and point of sales (POS) and educate customers on their proper utilizations which will improve bank performance in West Africa.
2. Beyond electronic banking channels, there is a need to invest more in robust tech infrastructure in banks to boost confidence and acceptance of existing and new

technological innovations. Increasing failures in electronic banking channels will do the banking sector no good especially in Nigeria.

3. To improve bank performance, banks should be prepared to invest in cyber security to protect customers' funds against frauds and cyber-attacks.

4. Also, banks should collaborate with fintech companies to improve the quality of improved financial services they offer to their customers in order to improve the bank performance in West African countries.

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