INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) AND ITS EFFECT ON BANKS EFFICIENCY IN NIGERIA

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SEPTEMBER 2025

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A PROJECT SUBMITTED TO THE DEPARTMENT OF FINANCE, FACULTY OF MANAGEMENT, UNIVERSITY OF BENIN, BENIN CITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF SCIENCE (B.SC) IN FINANCE

SEPTEMBER 2025

CERTIFICATION

We the undersigned certified that this research work was carried out by Obinna Arthur UHEGBU with the Matriculation Number: MGS2104771 in the Department of Finance, University of Benin. It is adequate in scope and quality for the partial fulfillment of the requirements of the award of the degree of Bachelor of Science in Finance.

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DEDICATION

This project work is dedicated to God Almighty for HIS wisdom and understanding granted to me throughout in the course of this programme. It is also to me beloved sister, Chibuzor.

ACKNOWLEDGMENTS

I wish to first and foremost express my deep gratitude to God Almighty for His unwavering guidance, strength, and wisdom throughout this project. His grace sustained me through every challenge and triumph.

I would like to extend my heartfelt appreciation to my supervisor, Dr. P.E Ohwojero, for his invaluable mentorship, expert guidance, timely suggestions and contributions. His insights and feedback were instrumental in shaping this work. May God Almighty bless him and his family in abundance.

To the esteemed lecturers in my Department, I express my sincere gratitude for their knowledge, encouragement, and dedication to my academic growth. Their contributions have been invaluable.

I am profoundly thankful to my wonderful and lovely parents, Mr. Augustine Uhegbu and Mrs. Alice Uhegbu for their unconditional love, prayers and sacrifices. To my siblings, Uche, Chinyere, Chibuzor and my brother-in-law Muna, thank you for your love, encouragement, and belief in me. Your unwavering support means the world to me.

I wish to thank my dear friends, Desmond, Mrs. Faith Akpologun, Benita, Prince, Erica, Christabel, Osahenomase and Eghosa for their friendship, support, and encouragement throughout this journey. Your presence made the process more enjoyable.

ABSTRACT

This study examined impact of information and communication technology (ICT) on Banks efficiency in Nigeria. The empirical model for this study is formulated based on relevant reviewed literatures, theoretical postulations and significant observed variables selected from highly methodological studies.

The research design employed in this study is ex-post facto. This study is based on Nigeria as such the population of the study covers Access Bank, Zenith Bank, First Bank, GTBank, and UBA across 15 years (2008–2023). The key metrics include Return on Assets (ROA), Number of ATMs, Mobile Banking Transactions, and POS Transactions. The sampled size is more than 5 percent of the population (Five deposit money banks in Nigeria). The estimation procedures adopted in this study are in the following steps: Descriptive statistic of the series in the model, Augmented Dickey-Fuller (ADF) statistic unit root test to test for Stationary, Auto Regressive Distributive Lag (ARDL) model to test for long run relationship among the variables of interest, CUSUM Test to test for Model Stability, and Breusch-Godfrey Serial Correlation LM Test to check the presence of serial correlation among the variables.

The regression results revealed that **ATM Operations:** Significantly and positively affect bank efficiency, highlighting their role in enhancing financial performance. **Mobile Banking (Market Transactions):** Exhibits a significant negative relationship with bank efficiency, suggesting potential implementation challenges or inefficiencies in mobile banking services. **POS Operations:** Shows a mixed impact on bank efficiency, with a significant negative effect in some models, indicating that while POS transactions increase convenience, they may also introduce operational inefficiencies. Based on the findings, the research therefore recommended that; Enhance ATM Services: Banks should continue to invest in ATM infrastructure, ensuring widespread availability and operational reliability to sustain and improve bank efficiency. Optimize Mobile Banking Platforms: Address the challenges associated with mobile banking by improving user experience, security features, and infrastructure to harness its potential for enhancing bank efficiency. Refine POS Operations: Evaluate and streamline POS transaction processes to reduce associated costs and inefficiencies. Training and support for merchants using POS systems should be enhanced to ensure smoother operations. Continuous Monitoring and Evaluation: Banks should implement robust monitoring systems to continuously evaluate the performance of electronic banking services, making necessary adjustments to optimize efficiency.

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CHAPTER ONE
INTRODUCTION

1.1 Background of the Study

Over the last decades, the great diffusion of information and communication technology (ICT) has caused a dramatic transformation having its notable segment as Information Technology (IT) that includes radio, television, and the newest digitalize technology such as computer and the internet which are powerful tool that has experienced enormous growth in present-day times his lays emphasis on the function of the role of consolidated communications and the modification of telecommunications, which include computers telephone lines, wireless signals, as well as necessary applications software, storage, audiovisual systems and other electromagnetic system world into an information society, (Owuuna & Adediwura, 2023; Nair et al., 2020; Brahimi & Fet 2022).

Thanks to ICT infrastructure such as fixed-line telephones, mobile phones, Internet, and broadband, people, firms and governments now have much better access to information, knowledge, and wisdom than before in terms of scale, scope, and speed. ICT diffusion has substantially improved the efficiency of resources allocation, enormously reduced production costs, and promoted much greater demand and investment in all economic sectors". "Recently, ICT is believed to foster sustainable

long-term growth as a production technology through carefully designed ICT systems as level of productivity have a tendency to increase with time. The principal function of ICT is in enabling humans, governments and organizations to transform information into knowledge as a strong driver in evolving lasting change in the economy and society" "The role of ICT in economic growth has a critical place in economic research; although ICT has become an active area for investment because of its dwindling cost of services and equipment most especially with the innovation of cloud computing and the investment into ICT which includes computers and their peripherals, software, and telecommunications devices, (Owuuna & Adediwura, 2023).

It worth note that due to the advancement of information and communication technology (ICT) our lives are changing rapidly which have enhances the deposit money banks performance in the of efficiency over the years as many empirical reviews have attested as The integration of Information and Communication Technology (ICT) into banking operations has been regarded as a critical factor in enhancing the efficiency and competitiveness of Deposit Money Banks (DMBs) Every day, people are using different technological tools that enable to reach information rapidly.

Information and Communication Technology (ICT) plays a pivotal role in enhancing the efficiency of deposit money banks (DMBs). The integration of ICT into banking operations has transformed the banking landscape, making it possible for banks to offer

more reliable, faster, and efficient services. Below are ways ICT influences deposit money bank efficiency: ICT allows for the automation of routine banking operations such as fund transfers, account management, and transaction processing. Automated Teller Machines (ATMs), internet banking, and mobile banking applications are all ICT tools that enhance operational efficiency by reducing the need for human intervention and manual processes. By adopting ICT tools like online banking platforms, DMBs can reduce the costs associated with processing physical transactions in bank branches. This is not only convenient for customers but also cost-efficient for banks. ICT systems enable banks to process transactions in real-time, which reduces the waiting time for customers. This is especially important for high-volume transactions, international money transfers, and financial settlements that would otherwise take longer if done manually. ICT helps to minimize human error in banking operations. Automated systems are more accurate in handling data, calculations, and record-keeping, leading to better quality control and reliability. ICT tools help DMBs to collect, analyze, and store large amounts of data. With advanced data analytics and artificial intelligence, banks can make data-driven decisions to enhance their products, manage risks better, and improve customer service. With ICT solutions such as mobile apps, internet banking, and chatbots, DMBs offer customers more convenient ways to manage their finances. This not only improves customer satisfaction but also leads to more efficient management of bank resources. ICT

enhances deposit money banks' ability to safeguard against fraud through advanced cyber-security systems, real-time monitoring, and encryption technologies. This leads to greater operational security and efficiency in managing financial risks.

Based on Nair et al., (2020) the ICT consists of telephones, mobile phones, fixed broadband, and internet, which are an inevitable part of our daily life, thus in this study are used these ICT indicators as :fixed broadband subscriptions (per 100 people), fixed telephone subscriptions (per 100 people), mobile cellular subscriptions (per 100 people), individuals using internet. There is an increasing number of studies about ICT on GDP and economic growth, and several papers that analyzed the impact of ICT investment on GDP growth (Madden and Savage, 1998; Jorgenson, 2001; Colecchia and Schreyer, 2001; 2002; Ahmed and Ridzuan, 2013; and Pohjola, 2001) and also other studies for ICT on GDP or economic growth (Jacobsen, 2003; Albimanand Sulong, 2016; Chakpitak et al., 2018, and Adedoyin et al., 2020). It is against the above background this study aim to evaluate the impact of information communication technology (ICT) on Deposit Money Banks Efficiency with emphasis on selected deposit Money Banks.

1.2 Statement of Problem

The integration of Information and Communication Technology (ICT) into banking operations has been regarded as a critical factor in enhancing the efficiency and competitiveness of Deposit Money Banks (DMBs). However, despite significant

investments in ICT infrastructure, there remains a lack of comprehensive understanding of how these technological advancements have directly impacted the operational efficiency of Deposit Money Banks in Nigeria from 2015 to 2023. During this period, several ICT innovations, such as mobile banking, internet banking, and digital payment systems, were introduced or rapidly expanded within the Nigerian banking sector. Yet, the actual effects of these ICT investments on key performance metrics, such as transaction costs, service delivery time, customer satisfaction, and profitability, remain unclear. Several researchers have been authored about the impact of ICT in some developed and developing countries.

Yousefi (2011) stated that ICT has positive effect on high income countries rather than in those low income countries. Similarly, many researchers studied the positive effect of ICT on developed countries (Pohjola, 2001; Dimelis and Papaioannou, 2010; Jung et al., 2013; Portillo et al., 2020, and Nair et al., 2020). On the other hand, few studies showed contradictory results, where the impact of ICT was positive in developing countries (Jacobsen, 2003; Bahrini and Qaffas, 2019; Maneejuk and Yamaka, 2020, and Solomon and Klyton, 2020) Thus, most of the studies confirmed positive impact of ICT economic growth especially in the developed countries , since ICT will enable effective and rapid communication, hence a study of Lee et al., (2017) pointed out that in the last decade, society also reached broader connectivity. Hence, this study aims at finding an answer the

following questions: Does ICT indicators impact GDP growth? Therefore, the main goal of the study is to examine if ICT has an impact on the GDP growth.

There are not many studies that have been analyzed if ICT indicators, such as fixed telephone subscriptions (per 120 people), mobile cellular subscriptions (per 120 people), fixed broadband subscriptions (per 120 people), and individuals using the internet, have an impact on GDP growth in Western Balkan countries during the period of 2000-2019, so this study aims to fill a gap in the literature of this region, because the study used four indicators of ICT. Also, most of studies used cross countries regression (Choi & Yi, 2009; Farhadi, et al., 2012), fixed and random approaches that lead lack of robustness of the results due to the endogeneity problems (Fetai, 2018). Considering the econometric issues this study employs pooled OLS, fixed, random effects and Hausman Taylor instrumental variables (IVs). Additionally, the study also includes two macroeconomic control variables as foreign direct investment and general government final consumption expenditure. All the data were taken from World Bank (WB). The practical contribution would be for the government to know the importance and the usage of ICT indicators with the intention of increasing the economic growth in the Western Balkan countries. The period from 2008 to 2023 is particularly relevant for this study due to several reasons. Firstly, this timeframe encompasses critical policy shifts, including the Central Bank of Nigeria's push for a cashless economy and the increased emphasis on digital banking

platforms. Secondly, the period saw rapid technological advancements and increased competition within the banking sector, compelling banks to adopt and integrate new ICT solutions to remain competitive. Lastly, the COVID-19 pandemic from 2020 to 2021 accelerated the need for remote banking services, further highlighting the significance of ICT in maintaining banking efficiency and resilience during periods of economic disruption. Therefore, this research aims to assess the impact of ICT on the operational efficiency of Deposit Money Banks in Nigeria from 2006 to 2023, analyzing whether the anticipated benefits of ICT investments have been realized, and identifying areas where gaps or inefficiencies may still exist.

1.3 Objectives of the Study

The general objective of the study examined the information and communication technology (ICT) and its effect on Banks efficiency in Nigeria while the specific objectives of the study are to:

i Evaluate the impact of Automated Teller Machines (ATMs) on Banks efficiency in Nigeria

ii Assess the impact of Mobile Banking on Banks efficiency in Nigeria

iii Evaluate the impact of Point of Sale (POS) Operations on Banks efficiency in Nigeria

1.4 Research Questions

i. To what extent does ATM operations impact banks efficiency in Nigeria?

ii. To what extent does Mobile Banking operation impact Banks efficiency in Nigeria?

iii. To what extent does of POS Operations impact Banks efficiency in Nigeria?

1.5 Research Hypotheses

This study made used of the following null hypotheses;

i. $H0_1$: ATM Operations has no significant impact on Banks efficiency in Nigeria

ii. $H0_2$: Mobile Banking has no significant impact on Banks efficiency in Nigeria

iii. $H0_3$: POS Operations has no significant impact on Banks efficiency in Nigeria

1.6 Scope of the Study

The study focuses on the impact of Information and Communication Technology on Banks efficiency in Nigeria with scope spanning for the period of 2015 to 2023 to evaluate the impact of various technological innovations such as the Automated Teller Machines operations (ATMO), Mobile Banking operations (MBO), Point of Sale (POS) Operations on the banks efficiency of the selected top five deposit money banks in Nigeria (First Bank, Plc, Access bank, union bank, united bank for Africans and zenith bank Plc) with the availability of data and also to evaluate the different national and international monetary policies and how it affects banks efficiency proxy by return on asset (ROA) of the selected banks. The period from 2015 to 2023 is particularly relevant for this study due to several reasons. Firstly, this timeframe encompasses critical policy

shifts, including the Central Bank of Nigeria's push for a cashless economy and the increased emphasis on digital banking platforms. Secondly, the period saw rapid technological advancements and increased competition within the banking sector, compelling banks to adopt and integrate new ICT solutions to remain competitive. Lastly, the COVID-19 pandemic from 2020 to 2021 accelerated the need for remote banking services, further highlighting the significance of ICT in maintaining banking efficiency and resilience during periods of economic disruption. Therefore, this research aims to assess the impact of ICT on the operational efficiency of Deposit Money Banks in Nigeria from 2015 to 2023, analyzing whether the anticipated benefits of ICT investments have been realized, and identifying areas where gaps or inefficiencies may still exist.

1.7 Limitations of the Study

During the course of the research, the researcher encounters some constraints which limit the scope of the study that slightly mar the accuracy of the result.

At the course of the research, the researchers were constrained by the following;

Time: The research was undertaken at the time the researcher was preparing for his final year examination. Therefore, insufficient time limit him to carry out the work.

Finance: Another constraint was finance; the research would have been widened to a large dimension but could not because of adverse financial position. The money that was required to get some materials and printing became an obstacle.

Data collection: It was not possible to get all the necessary information that would have helped in finishing the work within stipulated time.

1.8 Significance of the Study

This study will give a clear upstanding on impact of Information Communication and Technology on Banks efficiency in Nigeria with scope spanning for the period of 2015 to 2023 to evaluate the impact of various technological innovations (ATM, MB, and OPS operation) on the banks efficiency. The study will be very beneficial to Banks, Investors, and Researchers, Monetary Authority, Lecturers and students. The study will also serve as a reference to other researchers that will embark on related topics.

The Monetary Authority: The study shows how banks perform their mandate of channelling funds from the surplus unit to the deficit unit of This enables the monetary authority to ascertain if the banks are doing well as regards to financial intermediation or not.

Banks: This research report mirrors the activities of banks in relation to financial intermediation. The study further recommends the way forward. As such, banks may rely

on the findings and recommendations of the study to make adjustments for a better operation.

Investors: The findings of this study enlighten the investors on the intermediation role of banks and its effect on economic growth of the country. This helps very well in making proper investment and financing decisions.

Researchers: This study serves as a reference material for further research in this field of study.

Lecturers/students: This research work serves as a study material for both lecturers and students on issues relating to financial intermediation and economic growth.

1.9 Operational Definition of Terms

Bank Efficiency: Refers to the optimal use of resources (inputs) to achieve maximum return on assets (profitability) in banking operations.

Mobile Banking: Refers to banking services provided through mobile devices (smartphones, tablets), enabling customers to access the bank services.

Internet Banking: Refers to banking services provided through online platforms (websites, portals), enabling customers to all forms of financial transactions.

ATM (Automated Teller Machine) Operation: Refers to the use of automated machines for cash transactions, withdrawal and transfer.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Conceptual Review

Information communication and technology (ICT) adoption in banking has been linked to improved efficiency (Alshahrani & Alghamdi, 2017). A study by Hasan et al. (2019) found that ICT investment positively impacts bank efficiency, measured by ROA.

Another study by Abdallah et al. (2019) found that mobile banking and ATM services enhance bank efficiency and customer satisfaction.

A vast majority of empirical studies about the ICT impact on GDP growth which concluded that ICT has positive impact on economic growth (Oliner & Sichel, 2000; Jorgenson and Vu, 2005; Sassi & Goaied, 2013, & Lee and Brahmasrene, 2014). Datta & Agarwal (2004) investigated the 22 OECD countries by using dynamic panel data, and found positive impact of ICT on GDP. Ahmed and Ridzuan (2013) studied Asian countries (Malaysia, Thailand, Singapore, Indonesia, Philippines, Japan, Korea and China) during 1975-2006 by using fixed and random effects and showed that capital, labor and telecommunication investment have positive impact on GDP. Hodrab & Maitah (2016) examined the ICT on GDP growth in 18 Arab countries during the period of 1995-2013 by applying OLS, fixed and random effects model and concluded that ICT has a positive effect. Likewise, Pohjola (2001) conducted a study of ICT in 39 OPEC countries for the period of 1980 -1995, in which he used panel data and found that ICT have a crucial role in economic growth in those countries.

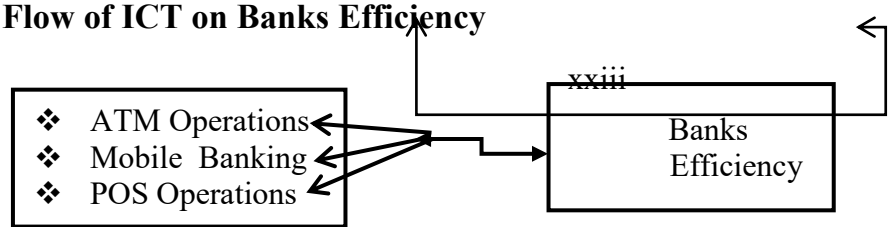
The study of Farhadi, et al., (2012) which examined 159 countries from 2000-2009 by using panel data using the GMM method, claimed that there is a positive relationship of ICT and GDP. Similarly, Bahrini & Qaffas (2019) studied many countries in the Middle East, the North Africa (MENA) region and the Sub-Saharan Africa (SSA) and were investigated during the period of 2007-2016. They used the GMM method and showed that internet usage, broadband adoption, and mobile phones are the main factors of economic growth. Also Toader et al., (2018) analyzed 28 countries of European Union from 2000 to 2017 by using panel data with GMM method, and the findings revealed positive effect of ICT infrastructure on economic growth. Another researcher, Haftu (2019) investigated 40 countries during the period 2006-2015 by using the GMM model, and his results showed that mobile phone and internet access have positive impact on GDP.

Further, Roller and Waverman (2001) analyzed 21 OECD countries for the period 19701990 to reveal the impact of telecommunication infrastructure on economic growth and showed a positive impact on economic growth. However, Portillo et al., 2020 stated in their study that there are other investigations that the impact is limited or mixed. On

the other hand, Lee at al., (2005) investigated ICT in 20 countries for the period of 1980-2000 by using time series analysis and found out that ICT has positive impact on economic growth for new industrialized countries and not in developing countries. Dimelis & Papaioannou (2010) also investigated ICT in 42 developed and developing countries within the period of 1993-2001 by using fixed effect model and showed that ICT has more impact in developed countries. According to Cheng et al., (2021) the effect of ICT is ambiguous in middle- and low-income countries, which may be due to the fact that in developing countries, the accessibility of ICT is lower and they have poor infrastructure.

Furthermore, Koutroumpis (2009) analyzed 22 OECD countries within period of 20022007 and used the indicator of ICT as broadband penetration and economic growth and resulted positively related. In contrast, the study by Bojnec & Fertő (2012) examined 34 OECD countries for the period 1998-2009 by using a dynamic panel model with the GMM model, and it did not find a positive effect of broadband per inhabitant on GDP growth.

2.1.1 Flow of ICT on Banks Efficiency



Sources: *Author's conceptualization*

Information communication and technology refers to the combination of finance and technological innovative that facilitates banking operations at ease. It includes a wide range of tools such as artificial intelligence technology, cloud computing technology, block-chain technology, big data technology, and internet technology. Internet technology comprises a social network, search engines, and internet finance that evolved in 2012, (Khatun & Tamanna, 2021). Xie & Zou (2012) found that the internet and other Fin-tech innovations can significantly lower transaction costs, reduce information asymmetry, enhance the efficiency of risk-based pricing and risk management, and expand sets of feasible transactions.

Internet finance received great attention from both academic studies and the financial industry due to its significant impact on the efficiency of financial activities (Wang et al., 2014). ICT has played a crucial role in revolutionizing the financial services industry since its inception. According to Arner et al. (2015), Fin-tech innovation is an ongoing process that has led to many incremental and disruptive innovations in finance and technology, such as internet banking, mobile payments, crowd funding, peer-to-peer lending, Robo-Advisory, online identification, and others. Editors Chishti & Barberis (2016) highlight how the collaboration between finance and technological innovations has resulted in profound success in the financial services sector, including start-up firms

(e.g., e Toro), incumbent companies (e.g., Citi), government level (e.g., Israel), or per-organization's (e.g. SWIFT). In each of these cases, Fin-tech has encouraged innovation significantly. Due to its innovative nature and potential to disrupt the financial services industry (Ferreira et al., 2015).

2.1.3 Automated Teller Machines (ATMs) Operations

An ATM device allows a bank customer to withdraw cash from his account via a cash dispenser (machine), and the account is debited immediately (Adesolaetal.2013). It combines a computer terminal, a record-keeping system and cash vault, which allows customers to access their banks using cards with a personal identification number (PIN).ATMs used cards to conduct banking transactions and card is a magnetic and PIN protected card, which is normally linked to a customer's account (Alabar,2012). It dispenses cash at any time of the day and night, unlike the traditional method where customers have to queue for a very long time in order to withdraw cash or transfer funds .A fundamental advantage is that it needs not to be located within the banking premises. It is usually located in stores, shopping malls, fuel stations, big time eateries and restaurant, hotels etc. (Adesolaetal, 2013). Ojokwu & Sujuyigbe (2012) argued that ATMs are cost efficient in yielding higher productivity as they achieve higher productivity per period of time than humanely.

2.1.4 Mobile Banking

This mode of e-banking makes use of the Global System for Mobile Communication (GSM) phones as the primary electronic device. Mobile banking refers to provision and availment of banking and financial services with the help of mobile telecommunication devices e.g.

Smart phones (Ojokwu & Sujuyig be, 2012). It is a payment transaction where the mobile phone plays a key role in the initiation, authorization and consummation of the transaction, instead of paying with cash, cheque or credit cards, a customer uses his/her mobile phone to pay for a wide range of services and receive payment as well. GSM has improved the operational efficiency of many banks in the country. Oluwagbemi etal. (2011) stressed that mobile banking services basically allow customers to operate their accounts with the operating banks from mobile phones to a large extent as long as their phones and network support SMS (Short Messaging Service).

2.1.5 Virtual Banking (Electronic/On-line/Internet/E-Banking)

This is the use of internet and telecommunication networks to deliver a wide range of valued product and services to banks customer's either at home or at the comfort of their offices or over the internet. The internet banking offers online real time traditional banking services (Bradley and Stewart (2003). With the aid of information and communication technology (ICT), online banking provides the opportunity of paying bills and performing transactions of any kind electronically. Customers can make

payment for goods or services without necessarily coming in contact with physical cash and running the risk of handling a large amount of money (Oluwagbemietal.2011).

2.1.6 Banker Automated Clearing Services

This involves the use of Magnetic Ink Character Reader (MICR) for cheque processing. MICR facilitates the faster process of cheque clearing. It is capable of encoding, reading and sorting cheques. Also, equest for cheque books or purchase of draft via electronic devices that are web-enabled (Oluwagbemietal.2011).

2.1.7 Point of Sale Operations

POS terminals handle cheque verification, credit authorization, cash deposit and withdrawal, and cash payment. This enhances electronic fund transfer at the point of sale (EFTPOS).EFTPOS enables a customer's account to be debited immediately with the cost of purchase in an out let such as a super market or petrol station. It consists of the accumulation of electronic payment messages by the retailer, which are subsequently passed on to appropriate institutions for processing. The purchase price is debited on the buyer's account and credited on the seller's account (Adesolaetal, 2013).

2.1.8 Card System

The card system is a unique electronic payment type. The smart cards are plastic devices with embedded integrated circuit being used for settlement of financial obligations (Ojokwu & Sujuyigbe, 2012). The power of card sliesin their sophistication and acceptability to store and manipulate data and handle multiple applications on one card securely. Depending on the sophistication, it can be used as a credit card, debit card and ATM (Automated Teller Machine) card.

2.1.9 Credit Card

This is a payment card issued to users as a system of payment (Agboola, 2006). It allows the card holder to pay for goods and services based on the holder's promise to pay for them. The issuer of the card creates a revolving account and grant saline of credit to the consumer (or the user) from which the user can borrow money for payment to a merchant or as a cash advance to the user.

2.1.10 *Debit* Card

This is also known as a bank card or check card is a plastic payment card that provides the card holder electronic access to his or her bank account (s) at a financial institution (Alabar, 2012). Some cards have a stored value with which a payment is made; while most relay a message to the card holder's bank to with draw funds from a payee's designated bank account. Online debit cards quire electronic authorization of every transaction and the debits are reflected in the user’s account immediately. The transaction

maybe additionally secured with the personal identification number (PIN) authentication system; some on line cards require such authentication for every transaction, essentially becoming enhanced automatic teller machine(ATM)cards (Adesolaet al.2013).

Operations (OPS) efficiency can be improved through ICT adoption, enabling banks to streamline processes and reduce errors (Bharadwaj et al., 2013). A study by Santhosh et al. (2019) found that ICT-enabled OPS improvements lead to increased customer satisfaction and loyalty.

2.1.11 Deposit Money Efficiency

Deposit money bank (DMB) efficiency refers to the optimal use of resources, including capital, labor, and technology, to generate profits while delivering high-quality financial services to customers. Efficiency in DMBs is critical for the overall health of the financial system and the economy. Several factors contribute to the efficiency of DMBs, including operational, allocative, and technological efficiency.

Operational Efficiency: This refers to how well a bank manages its day-to-day activities to minimize costs while maximizing outputs. A bank is operationally efficient if it can provide services at a lower cost without compromising quality. ICT tools, as mentioned earlier, play a crucial role in enhancing operational efficiency by automating routine tasks, thus saving time and reducing costs.

Allocative Efficiency: This refers to how well banks allocate their resources (such as loans and deposits) to areas where they will be most productive. For example, a bank that channels deposits into highly profitable investments or loans will achieve higher allocative efficiency. ICT aids in better allocation through data analysis, risk management systems, and customer profiling.

Technological Efficiency: This is the bank's ability to adopt and use the latest technological advancements to improve its service delivery. A bank that leverages ICT tools effectively is considered technologically efficient, as it is able to handle more transactions, enhance customer service, and process data more effectively than its competitors.

Cost-to-Income Ratio: One of the common measures of bank efficiency is the cost-to-income ratio, which compares operating expenses to operating income. A lower cost-to-income ratio indicates higher efficiency. ICT adoption helps banks lower operational costs, hence improving this ratio.

Profitability and Return on Assets (ROA): Efficiency is also reflected in profitability measures, such as Return on Assets (ROA). Efficient DMBs are better at generating higher returns from their assets. With ICT, banks can improve asset management, reduce operational costs, and ultimately enhance profitability.

Risk Management: Efficient risk management is key to deposit money bank efficiency. ICT helps banks in real-time monitoring and assessment of risks, thus allowing them to adjust strategies, mitigate potential losses, and maintain financial stability. ICT has become a cornerstone in achieving efficiency in deposit money banks. By automating processes, reducing costs, improving service delivery, and enabling data-driven decisions, ICT enhances the overall operational, allocative, and technological efficiency of these banks. Efficient DMBs, in turn, contribute positively to the economy by ensuring financial stability, effective intermediation, and sustained profitability.

2.2 Theoretical Review

The theoretical underpinning for this study is Innovation Diffusion Theory created by Rogers the Innovation Diffusion Theory in 1962. The goal of this theory is to comprehend and describe how people can accept a new concept, technological innovations, service, or item in the bid for financial and business transactions. Five characteristics relative benefit, compatibility, complexity, trialability, and observability were created by Rogers to provide a rationale for why innovations are accepted scientifically. A particular innovation with a low level of complexity is hence more adaptable when it is voluntarily adopted. This seminar work contends that organizations, in particular banks and financial institutions, must reexamine their business models in order to improve the experience of adopting technological innovations. Employees can

utilize them and adjust to them without experiencing any significant change resistance, on the one hand. However, the client can quickly and simply employ this technology. Moore and Benbasat (1991) assert that innovations must also have measurable effects and a considerable benefit. A person is more likely to reject an invention if they are made to utilize it against their will. There is a clear link between voluntarism and the successful adoption of information technology, according to Agarwal and Prasad (1997). The user experience must be improved by the inventive solution. Without a doubt, Fintech has changed how people conduct in person banking. Fintech usage has increased as a result of consumers' appreciation for having free, round-the-clock access to a range of banking and financial services via their Smart phones. According to the Fintech Adoption Index Report (2017), the average adoption rate of fintech is currently 33% globally, up from 15% in 2015. A few advantages that fintech companies provide include reasonable pricing, round-the-clock online support, and other financial services that are extremely in line with user values, especially those of digital natives. Fintech services are incredibly simple to use, and we can test them out without incurring any costs before purchasing them, allowing us to start benefiting from them right away. People are embracing fintech voluntarily rather than under coercion thanks to the use of social media and web 2.0 platforms. These people are part of a group that encourages the use of innovation and ICT, which is primarily comprised of members of generations Y and Z. The bulk of Rogers'

criteria for understanding innovation adoption are met by fintech. Numerous constructs are suggested by another theoretical model for such adoption.

2.2.1 Assumptions of Innovation Diffusion Theory

The following are the assumptions of the diffusion theory:

Relative Advantage: The degree to which an innovation is perceived as better than the idea it supersedes. The greater the perceived relative advantage, the more rapid its rate of adoption.

Compatibility: How consistent the innovation is with the values, past experiences, and needs of potential adopters. Innovations that are perceived as compatible will be adopted more quickly.

Complexity: The degree to which an innovation is perceived as difficult to understand and use. Simplified innovations are adopted more rapidly.

Trialability: The degree to which an innovation can be experimented with on a limited basis. Innovations that can be tried on an installment plan are generally adopted more quickly.

Observability: The extent to which the results of an innovation are visible to others. The easier it is to see the benefits of an innovation, the more likely it will be adopted.

2.3 Empirical Review

Abdullahi and Adam (2023), studied the short-run and long-run impact of ICT on economic growth in Nigeria using quarterly time series data from 1981 to 2021. The Augmented Dickey-Fuller and Phillips-Perron unit root tests suggested that economic growth, information and communication technology services (ICT), as well as trade openness are stationary at first difference, I(1). While, foreign direct investment (FDI) is stationary at level, I(0). The autoregressive distributed-lag (ARDL) model provided the analytical framework for the study. Findings from the ARDL model suggested ICT and FDI positively impacted on economic growth in Nigeria. On the other hand, trade openness has no impact on Nigeria's economic growth. The study therefore found that ICT remains the credible technique of molding growth potentials in Nigeria. Therefore, the study concludes that information and communication technology (ICT) impacts positively on economic growth in Nigeria. The study therefore recommends increase in the expenditure on ICT infrastructure supporting it.

Owuuna and Adediwura, (2023), study examined the impact of information communication technology, using the internet usage and telephone subscription as a proxy on economic growth in Nigeria between 1996 and 2020. Auto Regressive Distribution lag (ARDL) method of estimation was used to achieve the objective of the study. Empirical findings established that, there exists a relationship between internet usage and telephone subscription on economic growth in Nigeria. Hence, the result shows

that mobile telephone subscription has a positive and significant effect on economic growth both in short run and long run, while Internet Usage revealed a negative and insignificant relationship with the economic growth in Nigeria. Though it was expected that the result for Internet Usage should be positive and significant but it was otherwise; this could be as a result of numerous problems facing the Nigerian economy such as lack of power supply, high poverty lever and high ICT illiteracy rate. The key policy implication drawn from the result is that the underlined problems facing the economy need immediate and accurate intervention to experience the true dividend of internet access and its usage.

Kurniawati (2021) studied 25 Asian countries and middle-income countries during the period of 2000-2018 by using co-integration and estimation procedures and found that Asian countries have a positive impact on economic growth from the internet, whereas the middle income countries have had a positive impact from telephone line and mobile phone. Another study done by Maneejuk and Yamaka (2020) also showed that the telephone line and mobile phone have positive effects on economic growth. As seen from literature review, a smaller number of studies showed the negative impact of ICT on economic growth, including Freeman and Soete (1997) who stated that ICT can have a negative impact on employment because it can reduce the labor force.

In a panel study, Chimbo (2020) explored energy consumption and human capital development as channels through which ICT affects economic growth among African economies. To achieve this, pooled OLS fixed and random effects, as well as Generalized Method of Moments (GMM) were used, though without resorting to Haussmann test. The results partly show a significant positive impact of ICT on economic growth in Africa. Contrarily, the dynamic GMM indicated that ICT does not significantly determine economic growth in the selected African economies. Recently, Johnson,

Olabisi and Folake (2021) focused on the impact of telecommunication on economic growth in Nigeria, which a subset of the ICT sector. The study used annual time series data from 1999 to 2018 and adopted OLS as well as Error Correction techniques for analysis. Although labor hour, gross capital stock and electricity supply were found to be good determinants of economic growth in Nigeria, however the impact of real investment in telecommunication on the growth was also found to be remarkable. On that basis, the study recommended investment promotion especially in telecommunication, among other policy actions, to attain a sustained economic growth is the country. It is observed from these studies that the long-run relationship between ICT and economic growth has not received much attention. Moreover, some of these studies have not controlled for appropriate mediating variables in the relationship.

Bahrini et el., (2019), The present study aims to evaluate the impact of information and communication technology (ICT) on the economic growth of selected developing countries in the Middle East and North Africa (MENA) region and the Sub-Saharan Africa (SSA) region by using a panel Generalized Method of Moment (GMM) growth model over the period 2007–2016. The results extracted from the econometric model show that except fixed telephone, other information and communication technologies such as mobile phone, Internet usage, and broadband adoption are the main drivers of economic growth in MENA and SSA developing countries over the recent period 2007–2016. In addition, our findings confirm the superiority of MENA countries over SSA countries in the areas of Internet usage and broadband adoption. From a policy perspective, the results suggest that authorities in MENA and SSA countries should increase investments in ICT infrastructure. To benefit from the ICT drivers of economic growth, policymakers should enact several important policies that permit the development of financial sectors, provide a more convenient regulatory and institutional environment, increase economy openness, prioritize the allocation of resources to the development of ICT infrastructure, and contain the negative effects of inflation and government consumption.

Nasab and Aghaei (2019) examined the relationship between investments in ICT and economic growth in the geographical configuration of the OPEC member-countries by

employing a Generalized Method of Moments (GMM) on the panel data surveyed. Findings suggested that investment in ICT has a significant impact on economic growth in the OPEC member countries. It however recommends favourable policies that will enhance investments in ICT as requisites for sustainable growth. In the same vein, Bahrini& Qaffas (2019) employed panel data to ascertain the impact of ICT on the economic growth of selected developing countries in the Middle East and North Africa (MENA) region and the Sub-Saharan Africa (SSA) region between 2007 and 2016. GMM model was employed for the purpose of analysis. Findings from the study showed that all ICT services, including mobile phones, internet and broadband services, significantly influenced economic growth in both MENA and SSA, with the exception of fixed telephone. Moreover, the results of Sepehrdoust & Ghorbanseresht (2019) corroborated the earlier findings of Nasab & Aghaei (2019), where they investigated the impact of ICT and financial development on the economic growth of developing member countries of Organization of Petroleum Exporting Countries (OPEC). The study employed GMM technique. The findings of Sepehrdoust and Ghorbanseresht (2019) suggested that an increase in the financial development index and ICT services affect economic growth positively, with ICT having a more profound influence. Other controlled variables used in the growth model, which include inflation, labour hour,

aggregate investment and gross fixed capital formation, were all found to be significant determinants of growth in the countries under investigation.

CHAPTER THREE

RESEARCH METHODOLOGY

This chapter is concerned with the methods as well as the techniques used in carrying out the research. It includes the research design, population, sample size

and sampling technique, method of data collection, models specification, measurement of variables and method of data analysis.

3.1 Research Design

The research design employed in this study is ex-post facto, focusing on historical data gathered from annual reports and accounts of selected deposit money banks in Nigeria and the Central Bank of Nigeria Statistical Bulletin

3.2 Source of Data

This study will use secondary data for all variables employed. The study, conducted within the Nigerian banking sector, encompasses twenty-four publicly quoted firms as of December 31, 2020. Utilizing secondary data, the research extracted time series data from 2015 to 2023, with a particular emphasis on factors such as nominal exchange rate, real exchange rate, and exchange rate fluctuations from the CBN statistical bulletins. The population of the study comprises the twenty-four deposit money banks listed on the Nigeria Stock Exchange at the end of 2020. The sample size was purposefully selected, including five deposit money banks—First Bank Nigeria Plc, Access Bank Nigeria Plc, Zenith Bank Plc, United Bank for Africa Plc, and Guarantee Trust Bank Plc—that provided data for a period of up to seventeen years, aligning with the considerations of data availability and sufficiency of observations.

3.3 Population and Sample of the Study

This study is based on Nigeria as such the population of the study covers Access Bank, Zenith Bank, First Bank, GTBank, and UBA across 15 years (2008–2023). The key metrics include Return on Assets (ROA), Number of ATMs, Mobile Banking Transactions, and POS Transactions. The sampled size is more than 5 percent of the population (Five deposit money banks in Nigeria). Therefore, the research is optimistic the result will reflect that of the actual population.

3.4 Model Specification

The empirical model for this study is formulated based on relevant reviewed literatures, theoretical postulations and significant observed variables selected from highly methodological studies. The model adopted for this study is underpinned to the model of Johnson, Olabisi, and Folake (2021) who focused on the impact of telecommunication on Banks efficiency in Nigeria.

The model to be used will be expressed mathematically as thus:

ROA = f (ATMO, MBO, OPSOt) ……eq (1)

However, the model was re-modified and stated in linear forms below:

$ROA = a_0 + a_1 ATMO_{,t,} + a_{2t} MBO_{,} + a_3 EOPSO_t + e$ ……eq(2)

Where;

ROA: Return on Asset (Measuring the banks efficiency)

ATMO: Automated Teller Machines Operations

MBO: Mobile Banking Operations

PSO: Point of Sale Operations

$+a_0$ = Intercept or constant term

$a_1 – a_3$ = Coefficients of independence variables

e = Error Term which is usually 5% (0.05) for social sciences

e = error term

The priori expectation‟ in the model is that all the independent variables are expected to have a negative relationship on bank performance measured by Return on Assets (ROA) except information and communication technology which is expected to have a positive relationship with bank efficiency. The mathematical expression is represented as; $\alpha 1 < 0$ and $\alpha 2 > 0$ implying that a unit increase in the independent variables will lead to decrease in ROA by a unit.

3.5 Model Justification

The work adopted ARDL model to express the relationship between one dependent variable (GDP) and three independent variables (FDI, FPI and REM). Scholars such as Lyndon and Ayaundu (2020), Etale and Etale (2016), Ezeaku and Eje (2015) used similar model in their work which confirms adoption of the model as a suitable model to be used. ARDL model is the most suitable model to be used because the variables exhibits a combination of stationarity at level I(0) and at first difference I(1)

3.6 Method of Data Analysis

The estimation procedures adopted in this study are in the following steps: Descriptive statistic of the series in the model, Augmented Dickey-Fuller (ADF) statistic unit root test to test for Stationary, Auto Regressive Distributive Lag (ARDL) model to test for long run relationship among the variables of interest, CUSUM Test to test for Model Stability, and Breusch-Godfrey Serial Correlation LM Test to check the presence of serial correlation among the variables.

3.7 Technique of Analysis

To get sound and reliable results, the researcher faces the hard task of selecting the best among the numerously available methods of analysis data. In line with the general objective of this study, the researcher will employ ordinary least squares (OLS) technique due to its scintillating features and reliability in measuring the linear relationship between the dependent and independent variables.

CHAPTER FOUR

DATA PRESENTATION AND ANALYSIS

4.1.1 Data Presentation and Analysis

The following is the data for Return on Assets (ROA), Number of ATMs, Mobile Banking Transactions, and POS Transactions for the five selected deposit money banks in Nigeria for analysis

Year	Bank Name	ROA (%)	ATMs	Mobile Transactions (Million)	POS Transactions (Million)
2008	Access Bank	1.2	500	0.1	0.05
	Zenith Bank	2.0	700	0.2	0.1
	First Bank	1.5	800	0.3	0.1
	GTBank	2.5	600	0.4	0.15
	UBA	1.8	650	0.2	0.1
2009	Access Bank	1.3	600	0.2	0.1
	Zenith Bank	2.1	800	0.4	0.2
	First Bank	1.6	900	0.5	0.2
	GTBank	2.6	700	0.6	0.25
	UBA	1.9	700	0.3	0.15
2010	Access Bank	1.4	700	0.3	0.15
	Zenith Bank	2.2	900	0.6	0.3
	First Bank	1.7	1,000	0.7	0.35
	GTBank	2.7	800	0.8	0.4
	UBA	2.0	750	0.4	0.2
2011	Access Bank	1.5	800	0.5	0.2
	Zenith Bank	2.3	1,000	0.8	0.5
	First Bank	1.8	1,100	0.9	0.45
	GTBank	2.8	900	1.0	0.5
	UBA	2.1	800	0.6	0.3
2012	Access Bank	1.6	900	1.0	0.3
	Zenith Bank	2.4	1,100	1.5	0.8
	First Bank	1.9	1,200	1.2	0.6
	GTBank	2.9	1,000	1.3	0.7
	UBA	2.2	850	0.8	0.4

2013	Access Bank	1.7	1,000	1.5	0.5
	Zenith Bank	2.5	1,200	2.0	1.0
	First Bank	2.0	1,300	1.5	0.7
	GTBank	3.0	1,100	1.8	0.9
	UBA	2.3	900	1.0	0.5
2014	Access Bank	1.8	1,100	2.0	0.8
	Zenith Bank	2.6	1,300	3.0	1.5
	First Bank	2.1	1,400	2.0	1.0
	GTBank	3.1	1,200	2.5	1.2
	UBA	2.4	1,000	1.5	0.7
2015	Access Bank	1.9	1,200	3.0	1.0
	Zenith Bank	2.7	1,400	4.0	2.0
	First Bank	2.2	1,500	3.5	1.5
	GTBank	3.2	1,300	4.0	2.5
	UBA	2.5	1,100	2.0	1.0
2016	Access Bank	2.0	1,300	4.0	1.5
	Zenith Bank	2.8	1,500	5.0	2.5
	First Bank	2.3	1,600	4.5	2.0
	GTBank	3.3	1,400	5.0	3.0
	UBA	2.6	1,200	3.0	1.5
2017	Access Bank	2.1	1,400	5.0	2.0
	Zenith Bank	2.9	1,600	6.0	3.0
	First Bank	2.4	1,700	5.5	2.5
	GTBank	3.4	1,500	6.0	3.5
	UBA	2.7	1,300	4.0	2.0
2018	Access Bank	2.2	1,500	6.0	2.5
	Zenith Bank	3.0	1,700	7.0	3.5
	First Bank	2.5	1,800	6.0	3.0
	GTBank	3.5	1,600	7.0	4.0
	UBA	2.8	1,400	5.0	2.5
2019	Access Bank	2.3	1,600	7.0	3.0
	Zenith Bank	3.1	1,800	8.0	4.0
	First Bank	2.6	1,900	7.0	3.5
	GTBank	3.6	1,700	8.0	4.5
	UBA	2.9	1,500	6.0	3.0
2020	Access Bank	2.4	1,700	8.0	3.5
	Zenith Bank	3.2	1,900	9.0	4.5
	First Bank	2.7	2,000	8.5	4.0
	GTBank	3.7	1,800	9.0	5.0
	UBA	3.0	1,600	7.0	3.5

2021	Access Bank	1.5	2,500	50	30
	Zenith Bank	2.5	3,000	70	40
	First Bank	2.0	2,100	55	35
	GTBank	3.0	2,300	60	40
	UBA	2.4	2,000	60	40
2022	Access Bank	1.6	2,600	60	35
	Zenith Bank	2.6	3,100	80	45
	First Bank	2.1	2,200	65	40
	GTBank	3.1	2,400	75	45
	UBA	2.5	2,100	70	45
2023	Access Bank	1.7	2,700	70	40
	Zenith Bank	2.7	3,200	90	50
	First Bank	2.2	2,300	75	45
	GTBank	3.2	2,500	80	50
	UBA	2.6	2,200	80	50

Source: *Central Bank of Nigeria (CBN) 2023*

4.2 Data Analysis and discussion of results

Table 4.2 Descriptive Statistics

	ROA	**ATM**	**MT**	**POS**
Mean	16.73319	3217.573	219.9755	273.1796
Median	18.00000	3679.880	312.0700	346.4700
Maximum	36.20000	5710.670	515.0100	777.1800
Minimum	0.400000	399.7100	11.03000	1.270000
Std. Dev.	7.376938	2024.663	182.2293	245.9057
Skewness	0.203267	-0.017178	0.123345	0.089485
Kurtosis	2.856635	1.638046	1.478053	21.256666
Jarque-Bera	0.363905	3.634862	4.655306	5.014519
Probability	0.833641	0.162443	0.097524	0.049427
Sum	686.4600	151225.9	10338.85	12839.44
Sum Sq. Dev.	3227.962	1.89E+08	1527546.	2781602.
Observations	15	15	15	15

Source: *E-views 12*

Evaluation and Discussion of Descriptive Statistics (Table 4.2) showed that the Return on Assets (ROA) The **mean value** of ROA is **16.73**, indicating a relatively high average

return on financial performance for the sampled banks. The **median** value of **18.00** being slightly higher than the mean suggests a relatively symmetrical distribution of financial performance across the banks, with minor positive skewness. This aligns with the **skewness** value of **0.203**, indicating a slight right skew, where a few banks have higher ROA values pulling the mean up. The **minimum value of 0.40** and **maximum value** of **36.20** illustrate a broad range in performance, suggesting significant heterogeneity among the banks, potentially due to differences in operational efficiency or the effectiveness of their electronic banking services. The **standard deviation** of **7.38**, which is lower than the mean, reflects relatively low variability in ROA among the sampled banks, supporting the notion of a generally consistent performance with some outliers. The **kurtosis** of **2.85** indicates a distribution close to normal (mesokurtic), with few extreme deviations, while the **Jarque-Bera (JB) test** value of **0.364** and its associated probability of **0.833** confirm that the ROA data does not significantly deviate from normality.

This outcome indicate that while ROA shows low variability and a near-normal distribution, the independent variables (ATM, MT, and POS) exhibit varying degrees of variability and skewness. **ATM and MT** show moderate to low variability and are closer to a normal distribution, whereas **POS** displays high variability and significant deviations from normality, likely due to outliers. These findings suggest that while financial performance (ROA) is relatively consistent across the sampled banks, electronic banking

service variables (ATM, MT, and POS) show differing levels of adoption and effectiveness, which could be influencing overall profitability and performance outcomes.

Table 4.2.2 Correlation Results

	ROS	**ATM**	**MT**	**POS**
ROA	1.000000			
ATM	0.736115	1.000000		
MT	0.646821	0.971899	1.000000	
POS	0.804759	0.959159	0.968903	1.000000

Source: *E-views 12*

The correlation results in Table 4.2.2 provide insights into the strength and direction of relationships between the dependent variable, **Return on Assets (ROA)**, and the independent variables related to variables of ICT: **ATM transactions (ATM), Market Transactions (MT),** and **Point of Sale transactions (POS). ROA and ATM (0.736115):** There is a strong positive correlation between ROA and ATM transactions, indicating that higher ATM transaction volumes are associated with improved financial performance. This suggests that banks with more extensive ATM networks or higher utilization rates might achieve better returns, possibly due to enhanced customer convenience and increased transaction fees. **ROA and MT (0.646821):** The positive correlation between ROA and Market Transactions is also strong, though slightly lower than ATM. This implies that increased market transactions are associated with higher ROA, reflecting that active market engagement can contribute positively to a bank's profitability. **ROA and POS (0.804759):** The strongest positive correlation is between

ROA and POS transactions, suggesting that higher POS transaction volumes significantly contribute to better financial performance. This highlights the importance of POS systems in generating revenue and improving customer reach, potentially through increased transaction fees and enhanced service delivery. **ATM and MT (0.971899):** There is an extremely high correlation between ATM and Market Transactions, indicating that banks with high ATM usage also tend to have high market transaction volumes. This could be due to an integrated approach to electronic banking, where banks that invest in ATM infrastructure also facilitate more market transactions through other channels.

ATM and POS (0.959159): Similarly, a strong correlation between ATM and POS transactions suggests that banks focusing on ATM services are also likely to have robust POS networks. This reflects a comprehensive strategy in electronic banking services to maximize customer engagement across multiple channels. **MT and POS (0.968903):** The high correlation between Market Transactions and POS transactions further supports the interconnected nature of electronic banking services. Banks excelling in one area of electronic transactions are likely to perform well in others, indicating a holistic approach to leveraging electronic banking for enhancing customer experience and operational efficiency. The correlation results reveal strong positive relationships

between ROA and ICT variables, highlighting the critical role of ICT in enhancing financial efficiency of the selected banks.

Table 4.2.3 Summary of Hausman Test for Cross-Section Random Effects

Test Summary	Chi-square statistic	Chi-square prob
Cross section random	0.977	0.96

Source: *E-views 12*

The Hausman test results indicate that the random effects model is appropriate for analyzing the relationship between electronic banking services and financial performance in the sampled banks. This suggests that variations across banks are random and not correlated with the independent variables, making the random effects model a more suitable and efficient choice for this study. The findings support the generalizability of the results, highlighting the broad applicability of the relationship between electronic banking services and financial performance across different banks.

Table 4.2.4 Presentation of Regression Results

Dependent variable: ROA			
Variables	**Panel(A) Panel OLS**	**Panel(B) Random effect**	**Panel (C) GMM**
ATM	0.0041 [0.0547]**	0.0071 [0.0000]*	0.0049 [0.0230]**
MT	-0.0176 [0.4409]	-0.0259 [0.1757]	-0.0339 [0.0359]**
POS	-0.334 [0.0000]*	-0.0221 [0.0332]**	-0.0137 [0.1250]
ROA(-1)			0.7522 [0.0000] *
R-squared	0.6175	0.6091	-
Adjusted R-	0.56101	0.5888	-

squared			
F-statistics	13.6999	35.9488	-
Prob (f-statistic)	0.000	0.0000	0.000
Durbin-Watson stat	1.6106	1.6615	2.2372
J- Statistics	-	-	2.3100

Source: *E-views 12.*

The analysis of Regression Results (Table 4.2.4) table presents the regression results for the dependent variable **Return on Asset (ROA)** using three models: Panel OLS (Ordinary Least Squares), Random Effects, and GMM (Generalized Method of Moments). The independent variables are **ATM transactions (ATM), Mobile Transactions (MT),** and **Point of Sale transactions (POS),** and the lagged value of ROA (ROA (-1)) in the GMM model. The corresponding p-values are presented in brackets.

ATM Transactions (ATM) Panel OLS (0.0041, p=0.0547): ATM transactions have a positive but not highly significant effect on ROA in the Panel OLS model. **Random Effects (0.0071, p=0.0000):** In the Random Effects model, ATM transactions show a significant positive impact on ROA with a p-value indicating strong significance. **GMM (0.0049, p=0.0230):** The GMM results also show a significant positive relationship, though the magnitude is slightly lower than in the Random Effects model. ATM usage positively influences ROA across all models, with stronger significance in the Random Effects and GMM models, indicating that increasing ATM transactions can enhance a bank's equity returns.

Mobile Transactions (MT) Panel OLS (-0.0176, p=0.4409): The coefficient is negative, but not statistically significant in the Panel OLS model. **Random Effects (-0.0259, p=0.1757):** Similar to Panel OLS, the negative effect is not significant. **GMM (-0.0339, p=0.0359):** In the GMM model, the negative relationship becomes statistically significant, suggesting a potential adverse impact on ROA. **Mobile** Transactions generally have a negative effect on ROA, with significance emerging in the GMM model. This could indicate inefficiencies or higher costs associated with market transactions that impact profitability.

Point of Sale Transactions (POS) Panel OLS (-0.334, p=0.0000): POS transactions show a strong and significant negative impact on ROA in the Panel OLS model. **Random Effects (-0.0221, p=0.0332):** The negative relationship is weaker but still significant in the Random Effects model. **GMM (-0.0137, p=0.1250):** In the GMM model, the negative effect diminishes and becomes insignificant. POS transactions show a significant negative impact on ROA in the Panel OLS and Random Effects models, but this effect weakens in the GMM model. This suggests that the negative impact may not be robust across all modeling approaches, and further investigation is needed to understand the underlying factors.

Lagged ROA (ROA(-1)) GMM (0.7522, p=0.0000): The lagged value of ROA has a strong and highly significant positive effect on ROE, indicating that past financial performance is a strong predictor of current equity returns. The significant positive impact of lagged ROA highlights the importance of past performance in influencing current equity returns, suggesting a persistence in profitability over time.

Model Fit and Diagnostics

The R-squared values indicate that the models explain a substantial portion of the variance in ROA, with the Panel OLS and Random Effects models showing good fit. Adjusted R-squared values are slightly lower, reflecting the proportion of variance explained after adjusting for the number of predictors. The F-statistics are significant across all models, indicating that the models as a whole are statistically significant. The Durbin-Watson statistics suggest that there is no significant autocorrelation in the residuals, particularly in the GMM model where the value is closer to 2. The J-statistic in the GMM model tests the validity of the instruments used. A low value suggests that the instruments are valid and the model is appropriately specified.

The regression analysis shows that electronic banking services, particularly ATM transactions, have a significant positive impact on ROA, while Market Transactions and POS transactions may negatively affect ROA depending on the model used. The GMM model, which accounts for endogeneity and dynamic effects, highlights the importance of

past performance (ROA) in predicting ROA. These findings provide insights into the role of variables of ICT in shaping financial performance, suggesting strategic areas for banks to focus on to enhance performance.

4.2.5 Analysis of the hypothesis and decision rule

H01: ATM Operations has no significant impact on Banks' efficiency in Nigeria

The regression results show that ATM operations have a significant positive impact on Return on Asset (ROA) in all models, particularly in the Random Effects and GMM models, where the p-values are well below 0.05. **Reject H01**. The findings indicate that ATM operations significantly enhance banks' efficiency in Nigeria.

H02: Mobile Banking has no significant impact on Banks' efficiency in Nigeria

The regression results for mobile Transactions (MT), a proxy for mobile banking, show a negative relationship with ROE. This effect becomes significant in the GMM model, with a p-value of 0.0359. **Reject H03**. The results suggest that mobile banking (Market Transactions) has a significant, albeit negative, impact on banks' efficiency in Nigeria.

H03: POS Operations has no significant impact on Banks' efficiency in Nigeria

POS operations exhibit a significant negative impact on ROE in the Panel OLS and Random Effects models. However, the effect is not significant in the GMM model. **Partially Reject H03**. The findings indicate that POS operations can have a significant impact on banks' efficiency, but the effect varies depending on the model used. More

investigation may be needed to fully understand the impact of POS operations on efficiency. These evaluations suggest that ATM and mobile banking have a significant influence on banks' efficiency, with ATM operations positively contributing, while mobile banking and POS operations show mixed impacts.

4.3 Discussion of findings

The study's findings offer significant insights into the impact of electronic banking services on bank efficiency in Nigeria, with implications for the broader financial sector. The regression analysis evaluates the hypotheses concerning ATM operations, mobile banking, and POS operations, providing evidence that supports or refutes these claims.

The significant positive relationship between ATM operations and bank efficiency (as measured by ROE) aligns with prior studies that emphasize the role of technology in enhancing banking performance. Research by [Adewale et al. (2020)] found that the proliferation of ATMs improved customer satisfaction and operational efficiency in Nigerian banks, corroborating the positive impact identified in this study. The increased use of ATMs reduces transaction costs and improves service delivery speed, which are critical factors in enhancing bank efficiency.

The negative impact of mobile banking (proxied by mobile Transactions) on bank efficiency is somewhat surprising but aligns with findings from [Eze & Odibo (2018)], who reported that while mobile banking expands access to financial services, it may

initially strain existing infrastructure, leading to inefficiencies. The significant negative effect observed in the GMM model suggests that mobile banking's potential benefits might be undermined by implementation challenges, including security concerns and technological adoption issues

The mixed findings on POS operations reflect the complexities of integrating POS systems into traditional banking operations. Studies like [Ojo & Akinwale (2019)] have shown that while POS systems enhance transactional convenience, they may introduce inefficiencies due to high maintenance costs and transaction fees. The negative relationship in the Panel OLS and Random Effects models supports this view, indicating that while POS operations have the potential to enhance bank efficiency, their current implementation may need refinement to realize these benefits fully. The findings of this study contribute to the growing body of literature on electronic banking services' impact on financial performance, highlighting the nuanced effects of different technological platforms. The positive impact of ATMs underscores the importance of continued investment in this area, while the challenges associated with mobile and POS banking suggest a need for strategic improvements. Future research should explore these dynamics further, considering factors such as customer adoption rates and technological infrastructure.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings

This study investigates the impact of Information communication technology (ICT) on the efficiency of banks in Nigeria, focusing on ATM operations, mobile banking, and POS transactions. The regression results revealed that **ATM Operations:** Significantly and positively affect bank efficiency, highlighting their role in enhancing financial performance. **Mobile Banking (Market Transactions):** Exhibits a significant negative relationship with bank efficiency, suggesting potential implementation challenges or inefficiencies in mobile banking services. **POS Operations:** Shows a mixed impact on bank efficiency, with a significant negative effect in some models, indicating that while POS transactions increase convenience, they may also introduce operational inefficiencies.

5.2 Conclusions

The findings conclude that impact of Information communication technology (ICT), particularly ATMs, are crucial in improving bank efficiency in Nigeria. However, the negative impacts observed in mobile banking and POS operations suggest that these

services require further optimization to contribute positively to bank performance. The study underscores the importance of effectively managing and integrating technological advancements in banking operations to enhance efficiency.

5.3 Recommendations

Based on the findings, the research therefore recommended that;

1. **Enhance ATM Services:** Banks should continue to invest in ATM infrastructure, ensuring widespread availability and operational reliability to sustain and improve bank efficiency.
2. **Optimize Mobile Banking Platforms:** Address the challenges associated with mobile banking by improving user experience, security features, and infrastructure to harness its potential for enhancing bank efficiency.
3. **Refine POS Operations**: Evaluate and streamline POS transaction processes to reduce associated costs and inefficiencies. Training and support for merchants using POS systems should be enhanced to ensure smoother operations.
4. **Continuous Monitoring and Evaluation**: Banks should implement robust monitoring systems to continuously evaluate the performance of electronic banking services, making necessary adjustments to optimize efficiency.

5. **Policy and Regulation Support:** Policymakers should support banks with frameworks that encourage the adoption and improvement of electronic banking services, ensuring a balance between innovation and operational efficiency.

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Appendix

1. Appendix1: Data for the analysis

Year	Bank Name	ROA (%)	ATMs	Mobile Transactions (Million)	POS Transactions (Million)
2008	Access Bank	1.2	500	0.1	0.05
	Zenith Bank	2.0	700	0.2	0.1
	First Bank	1.5	800	0.3	0.1
	GTBank	2.5	600	0.4	0.15
	UBA	1.8	650	0.2	0.1
2009	Access Bank	1.3	600	0.2	0.1
	Zenith Bank	2.1	800	0.4	0.2
	First Bank	1.6	900	0.5	0.2
	GTBank	2.6	700	0.6	0.25
	UBA	1.9	700	0.3	0.15
2010	Access Bank	1.4	700	0.3	0.15
	Zenith Bank	2.2	900	0.6	0.3
	First Bank	1.7	1,000	0.7	0.35
	GTBank	2.7	800	0.8	0.4
	UBA	2.0	750	0.4	0.2
2011	Access Bank	1.5	800	0.5	0.2
	Zenith Bank	2.3	1,000	0.8	0.5
	First Bank	1.8	1,100	0.9	0.45
	GTBank	2.8	900	1.0	0.5
	UBA	2.1	800	0.6	0.3
2012	Access Bank	1.6	900	1.0	0.3
	Zenith Bank	2.4	1,100	1.5	0.8
	First Bank	1.9	1,200	1.2	0.6
	GTBank	2.9	1,000	1.3	0.7
	UBA	2.2	850	0.8	0.4
2013	Access Bank	1.7	1,000	1.5	0.5

	Zenith Bank	2.5	1,200	2.0	1.0
	First Bank	2.0	1,300	1.5	0.7
	GTBank	3.0	1,100	1.8	0.9
	UBA	2.3	900	1.0	0.5
2014	Access Bank	1.8	1,100	2.0	0.8
	Zenith Bank	2.6	1,300	3.0	1.5
	First Bank	2.1	1,400	2.0	1.0
	GTBank	3.1	1,200	2.5	1.2
	UBA	2.4	1,000	1.5	0.7
2015	Access Bank	1.9	1,200	3.0	1.0
	Zenith Bank	2.7	1,400	4.0	2.0
	First Bank	2.2	1,500	3.5	1.5
	GTBank	3.2	1,300	4.0	2.5
	UBA	2.5	1,100	2.0	1.0
2016	Access Bank	2.0	1,300	4.0	1.5
	Zenith Bank	2.8	1,500	5.0	2.5
	First Bank	2.3	1,600	4.5	2.0
	GTBank	3.3	1,400	5.0	3.0
	UBA	2.6	1,200	3.0	1.5
2017	Access Bank	2.1	1,400	5.0	2.0
	Zenith Bank	2.9	1,600	6.0	3.0
	First Bank	2.4	1,700	5.5	2.5
	GTBank	3.4	1,500	6.0	3.5
	UBA	2.7	1,300	4.0	2.0
2018	Access Bank	2.2	1,500	6.0	2.5
	Zenith Bank	3.0	1,700	7.0	3.5
	First Bank	2.5	1,800	6.0	3.0
	GTBank	3.5	1,600	7.0	4.0
	UBA	2.8	1,400	5.0	2.5
2019	Access Bank	2.3	1,600	7.0	3.0
	Zenith Bank	3.1	1,800	8.0	4.0
	First Bank	2.6	1,900	7.0	3.5
	GTBank	3.6	1,700	8.0	4.5
	UBA	2.9	1,500	6.0	3.0
2020	Access Bank	2.4	1,700	8.0	3.5
	Zenith Bank	3.2	1,900	9.0	4.5
	First Bank	2.7	2,000	8.5	4.0
	GTBank	3.7	1,800	9.0	5.0
	UBA	3.0	1,600	7.0	3.5
2021	Access Bank	1.5	2,500	50	30

	Zenith Bank	2.5	3,000	70	40
	First Bank	2.0	2,100	55	35
	GTBank	3.0	2,300	60	40
	UBA	2.4	2,000	60	40
2022	Access Bank	1.6	2,600	60	35
	Zenith Bank	2.6	3,100	80	45
	First Bank	2.1	2,200	65	40
	GTBank	3.1	2,400	75	45
	UBA	2.5	2,100	70	45
2023	Access Bank	1.7	2,700	70	40
	Zenith Bank	2.7	3,200	90	50
	First Bank	2.2	2,300	75	45
	GTBank	3.2	2,500	80	50
	UBA	2.6	2,200	80	50

Appendix 2:
Analysis of the descriptive Statistics

	ROA	**ATM**	**MT**	**POS**
Mean	16.73319	3217.573	219.9755	273.1796
Median	18.00000	3679.880	312.0700	346.4700
Maximum	36.20000	5710.670	515.0100	777.1800
Minimum	0.400000	399.7100	11.03000	1.270000
Std. Dev.	7.376938	2024.663	182.2293	245.9057
Skewness	0.203267	-0.017178	0.123345	0.089485
Kurtosis	2.856635	1.638046	1.478053	21.256666
Jarque-Bera	0.363905	3.634862	4.655306	5.014519
Probability	0.833641	0.162443	0.097524	0.049427
Sum	686.4600	151225.9	10338.85	12839.44
Sum Sq. Dev.	3227.962	1.89E+08	1527546.	2781602.
Observations	15	15	15	15

Source: *E-views 12*

Appendix 3: Analysis of the Correlation Results

	ROS	**ATM**	**MT**	**POS**
ROA	1.000000			
ATM	0.736115	1.000000		

MT	0.646821	0.971899	1.000000	
POS	0.804759	0.959159	0.968903	1.000000

Appendix 4: Analysis of the Hausman Test for Cross-Section Random Effects

Test Summary	Chi-square statistic	Chi-square prob
Cross section random	0.977	0.96

Source: *E-views 12*

Appendix 5: Analysis of the Presentation of Regression Results

Dependent variable: ROA			
Variables	**Panel(A) Panel OLS**	**Panel(B) Random effect**	**Panel (C) GMM**
ATM	0.0041 [0.0547]**	0.0071 [0.0000]*	0.0049 [0.0230]**
MT	-0.0176 [0.4409]	-0.0259 [0.1757]	-0.0339 [0.0359]**
POS	-0.334 [0.0000]*	-0.0221 [0.0332]**	-0.0137 [0.1250]
ROA(-1)			0.7522 [0.0000] *
R-squared	0.6175	0.6091	-
Adjusted R-squared	0.56101	0.5888	-
F-statistics	13.6999	35.9488	-
Prob (f-statistic)	0.000	0.0000	0.000
Durbin-Watson stat	1.6106	1.6615	2.2372
J- Statistics	-	-	2.3100