Impact of E-Banking on Bank Performance and Customer Satisfaction in Nigeria: Co-Integration and Error Correction Analytic Approach

Peter Chinyere URUAKPA[1], & Onyemachi Maxwell OGBULU[2]
Department of Banking & Finance**,** Abia State University, Uturu, Nigeria.
[1]uruakpa.peter@abiastateuniversity.edu.ng, [2]onyemachi.ogbulu@abiastateuniversity.edu.ng

Veronica Adaku IHEZUKWU[3],
Department of Economics, Abia State University, Uturu, Nigeria
DOI: 10.56201/jafm.vol.11.no4.2025.pg31.51

Abstract
This study examined the impact of e-banking on bank performance and customer satisfaction in the Nigerian banking industry. Knowledge of the relative impact of service quality can propel Deposit Money Banks in Nigeria to focus on the provision of the services that greatly satisfy the banking public. Specifically, the study sought to determine whether there is any significant relationship between ATM, MOB and POS as channels of e-banking respectively and ROA of Deposit Money Banks in Nigeria. Sources of data were both primary and secondary. Secondary data sourced from the CBN Statistical Bulletin and primary data from cross sectional survey instrument distributed to selected bank customers from Imo and Abia States. Data were analyzed using descriptive statistics, regression analysis, Johansen co-integration, error correction model (ECM) and granger causality test. The study finds that ATM negatively but significantly impacts banks performance proxy by ROA; Mobile Banking positively but insignificantly impacts ROA of deposit money banks; and POS negatively but insignificantly relates with ROA of Deposit Money Banks in Nigeria.
The study concludes that e-banking has positively impacted the performance of deposit money banks in Nigeria; providing limitless benefits which are catalytic to economic growth. The positive relationship between e-banking and customer satisfaction is evident going by the level of acceptance of e-banking products by the banking public. The study recommends that banks increase their sensitization of customers towards e-banking products acceptance and improve on service quality delivery as well as provide customers with uninterrupted, reliable and efficient e-banking services in order to satisfy and retain the patronage of the customers.

Keywords: *E-banking, Customer satisfaction, Service quality, Deposit money banks, Co-integration, Error Correction Model.*

1.0 Introduction

The need to serve customers better and reduce the drudgery of waiting in the bank halls led to the adoption of various innovations aimed at cost, risk and waiting time reduction and improvement of market share and customer satisfaction. Customer satisfaction is the term used to measure a customer's perception of a company's products and/or services. It refers to the extent to which customers are happy with the products and/or services provided by a business. It is complex and

holds the key to high patronage and repeat purchase. Technology is making tremendous impact in banks delivery and financial services sector in general. The application of information and communication technology concepts, techniques and policies and implementation strategies to banking services has become too pervasive and indeed a prerequisite for local and global competitiveness in banking industry.

Today, almost all banks are adopting internet banking as a means of enhancing quality of banking services. Internet banking is now being provided by the banking industry to their customers to increase customer satisfaction in banking sector. However, electronic banking, though on the surface appears to bring satisfaction to the customer, thereby enhancing bank profitability, return on asset, return on equity, increased asset quality, return on investment, reduction in risk and cost, however the actual indices of banking performance do not support this claim conclusively.

The broad objective of this study therefore is to examine the impact of e-banking on the performance of banks and customer satisfaction in Nigeria. The methodology adopted for the study involves both time series data and cross-sectional data. The times series data were sourced from CBN Statistical Bulletin for the period 2010-2017; while the second arm of the investigation involves cross-sectional data sourced from a survey of bank customers in Aba, Umuahia and Okigwe to sharpen our results. The data collected is analyzed using descriptive statistics, frequency distributions, factor analysis, ANOVA, regression analysis, Johansen co-integration, error correction mechanism (ECM) and granger causality analysis. The results of the study will be published in peer-reviewed journals and adequately disseminated in conferences and workshops as this would enable both the regulatory authorities in the financial system and bank operators gauge the effectiveness and impact of e-banking products deployed in the system as well as help shape policy formulation to enhance efficiency of the banking system.

1.1 Problem Statement

Nigerian banks have been witnessing tremendous success in delivering a wide range of value-added products and services through e-banking, and there has been evidence of increasing acceptance of e-banking among the banking public. Adagunodo (2002), cited in Oyewole et.al (2013) observe that Nigerian banks have realized that how they can gain competitive advantage over their competitors is through the use of technology (e-banking). Thus, technology now forms the backbone for better results in banking. The benefits of technology are more than three times the cost. For deposit money banks to remain relevant in this technological age, it must continuously innovate to meet the growing aspirations of the ever-demanding customers. One of the benefits banks derive from electronic banking products and services delivery is improved efficiency and effectiveness of their operations so that more transactions can be processed faster and most conveniently, which will ultimately significantly impact the overall performance of the banks. Customer satisfaction is achieved when a potential customer enjoys quick service delivery, has reduced frequency of going to banks physically, has reduced cash handling, etc. Customer satisfaction should encourage greater patronage, and more customers served quickly, leading to fewer queues and fewer crowds in the banking hall.

The experience in the banking industry is a far cry from this expectation. Long queues are still regular occurrence in the banks. Overcrowded halls are regular experiences. Customer satisfaction is expected to translate to improved bank performance by way of enhanced profitability, return on asset, return on equity etc. Several empirical studies have been done on the impact of e-banking on bank performance and customer satisfaction with inconclusive results. For example, Abaenewe,

Ogbulu & Ndugbu (2013), Ogunlowore and Oladele (2014), Ugwueze and Nwezeaku (2016) as well as Yang, Li, Ma, and Chen (2018), in their respective studies observe positive relationship between electronic banking and bank performance, some other researchers like Salihu and Metin (2017) and Al-Smadi and Al-Wabel (2018) find no such positive relationship. The controversy is as yet raging and requires more in-depth and robust research. Hence the justification for this study. The broad objective of this study is to examine the impact of e-banking on bank performance and customer satisfaction in Nigeria.

2.0 Review of Related Literature

2.1 Conceptual Framework: Basic operational concepts in this study are discussed

E-banking: E-banking is the use of electronic and telecommunication networks to deliver a wide range of value-added products and services to bank customers (Steven, 2002). According to Abubakar (2014) electronic banking is the provision of variety of banking services at any point in time other than the banking hall through electronic and mobile platforms. A framework permitting people to perform banking exercises at home by means of the web (investorwords.com.2015). In electronic banking, Information and Communication Technology (ICT) is at the center. It is the automated delivery of new and traditional banking products and services directly to customers through electronic, interactive communication channels. The entire cash flow of most banks is linked to the information system. Electronic banking depends on providing customers, partners and employees with access to information in a controlled and secure way (Soludo, 2005). Various innovative products have been introduced into the banking business to heighten the customer's appreciation level, convenience, and satisfaction, thus soliciting their patronage. Among the services which e-banking offer in the present circumstance are ATM, Electronic fund transfer, Point of sale system, web banking etc.

AUTOMATED TELLER MACHINE (ATM): ATM is an innovation by banks that enable bank customers withdraw money without visiting banking hall; operating 24 hours a day and 7 days a week. It sells recharge cards, transfers funds as well as gives account balance enquiry ATMs are mostly located outside the banking halls, airports, schools, shopping malls, places far away from home, situated in large stores, filling stations, eateries, and hotels. It also has self-supervising operating applications and diagnostic programs and incorporates sophisticated physical and logical security features (Kaplan & Maxwell, 1994, cited in Salami & Ogbeta, 2014, p.5). The ATM is a combined computer terminal with cash vault and record-keeping system in one unit, permitting users to enter a bank's book keeping system with a plastic card containing a personal identification number (PIN). It is accessed by punching a special code number into the computer terminal linked to a bank's computerized records (Rose, 1999).

INTERNET BANKING Internet banking is a real time solution that allows you to access your accounts with no banking test technological innovation. It is accessible 24/7 (24hours a day, 7 days in a week). You may check your balances, view your account statements, and transaction history even for your various accounts. You can also transfer money between your accounts, pay your bills, pay salaries, vendors, contractors, manage requests such as backdraft and cheque book requests, debit/credit cards requests, etc change your password over the internet, and all in a secure manner, view real time transactions, account balances, fund transfer, book for airline tickets, within/interbank, download activity in any format, local money transfer, monitor trade finance

transaction, cheque confirmation, create, amend or cancel standing orders, direct debits, bills payment, etc.
It comprises all banking transactions using a personal computer, connected to the internet via a browser and a token given by your bank. It reduces cost, improves the flexibility of business transactions (Balachandher, 2001). Internet banking helps to manage your account and investments with ease. It personalizes your financial and other commercial transactions. Internet banking has made it possible to deposit or withdraw money irrespective of your location (Okey, 2005). Internet is often the most efficient way to distribute internal corporate information, because producing and distributing paper is usually slower and more expensive than using web based communications.

POINT OF SALE (POS): This is the electronic banking terminal that manages the selling process through an accessible interface for salespersons. POS allows the creation and printing of the transaction receipt. POS is used for card payments, which allows the processing of debit/credit card transactions, cashless transactions, and real-time processing, which authorizes and settles transactions instantly. POS is fast and easy, reduces fraud risk, guarantees efficiency, and increases sales.

2.1.1 Bank Performance

Performance is the bank's profitability as a result of a firm's policies and operations in monetary terms. These results are reflected in the firm's return on investment, return on assets, value-added, capital base, employee performance, and customer loyalty. It's the state or condition of yielding financial profit or gain (Kweyun, 2009). According to Ssejaka (1996), profitability has been the widely used measure of financial performance. Profitability is the excess of income over expenditure, which can be expressed by ratios like gross profit margin, net profit margin, and return on equity. Bank performance is reflected by strong financial performance, sustained profitability, and efficient asset management, prioritizing customer satisfaction and investing heavily in digital banking systems. Some high performing banks in Nigeria like Zenith Bank, Guarantee Trust Bank, Access Bank United Bank for Africa and First Bank of Nigeria have demonstrated these attributes.

2.1.2 Customer Satisfaction

The extent of repeat purchase which a firm experiences, is a measure of satisfaction of the customers. According to Amith (2021), Customer satisfaction is the extent to which customers are happy with the products and/or services provided by a business. Or a term generally used to measure a customer's perception of a company's products and/or services. Today, almost all banks are adopting electronic banking as a means of enhancing service quality of banking services. Banks are providing electronic banking to their customers to increase customer satisfaction in banking services. Nigerian banks are strategically using e-banking services for retaining and attracting large clients. Customer satisfaction theory was propounded by Philip Kotler in 1973 in his book "Marketing Management: Analysis, Planning and Control where he defined customer satisfaction as a person's feeling of pleasure or disappointment resulting from comparing a product's perceived performance or outcome in relation to his or her expectations. Customer satisfaction of products leads a consumer to repeat purchase, appreciation of a product or dropping a certain product in preference to another.

2.2 Theoretical Framework

Technological Innovation Theory states that e-banking is a technological innovation that has transformed the banking industry. It has enabled banks to provide services to customers remotely, improving convenience, speed and accessibility. This theory propounded by Joseph Schumpeter in 1942 opines that technological innovation is a key driver in economic growth and development, and leads to a process of "creative destruction", where new technologies and industries emerge and replace existing. Schumpeter from this theory is interrogating the role of innovation in shaping the economy and the society and the place of entrepreneurship and innovation in driving economic progress. This work anchors on this theory and e-banking innovation have been a key driver of economic growth.

Customer satisfaction Theory suggests that customer satisfaction is a critical factor in determining bank performance. E-banking services that meet customer expectations and needs lead to increased customer satisfaction, loyalty and retention. Customer satisfaction theory was propounded by Philip Kotler in 1973 in his book "Marketing Management: Analysis, Planning and Control where he defined customer satisfaction as a person's feeling of pleasure or disappointment resulting from comparing a product's perceived performance or outcome in relation to his or her expectations. Customer satisfaction of products leads a consumer to repeat purchase, appreciation of a product or dropping a certain product in preference to another.

Bank Performance Theory, also known as CAMELS rating system was developed by the Federal Reserve Board in 1979. CAMELS is an acronym for: Capital adequacy; Asset quality; Management; Earnings; Liquidity and Sensitivity to market risk. A bank is deemed performing if it can attain specific standards or levels prescribed in the CAMELS rating. The theory suggests that e-banking has a significant impact on bank performance. E-banking services can improve bank efficiency, reduce costs and increase customer base, leading to improved bank performance.

2.3 Empirical Review

Morufu (2016) focused on the impact of four (ATM, POS, Web/internet, and mobile) e-payment adoption and banks' specific variables on the profitability of the Nigerian Deposit Money banks. Secondary data were collected from annual reports and accounts of ten quoted DMBs between 2005 and 2012. Data were analyzed using panel logistic regression. The result from data analysis shows that when banks adopt e-payment systems, their performance level such as gross margin, profit after tax, return on assets and return on equity changes. This is reflected in the positive association between adoption and gross earnings of banks. Furthermore, adoption of the four e-payment instruments like ATM, WEB, POS and Mobile Banking influenced performance indices measured by return on assets (ROA), gross margin and profit after tax (PAT) of the sampled banks Abaenewa, Ogbulu, and Ndugbu (2013) investigated the profitability performance of Nigerian banks following the full adoption of the electronic banking system. The judgmental sampling method was adopted by utilizing data collected from four Nigerian banks. The profitability performance of these banks was measured in terms of return on equity (ROE) and return on assets (ROA). With the data collected, the pre and post-adoption of e-banking performance was tested the difference of means using a standard statistical technique for an independent sample at a 5% level of significance for performance indicators such as ROA and ROE. The study recommends that bank management from time to time train their customers with regard to electronic banking: its benefits, risk exposure, physical and electronic security to avoid financial loss in the hands of hackers.

The regression model adopted Sulieman and Ahlam-Jebreen (2017) examined the impact of electronic banking services on the customers' loyalty of commercial banks in Jordan. The Electronic banking services represented by (ease of use, usefulness, cost of use, web site design, Privacy and accessibility). The study used random sample of 400 participants while SPSS version17 was used to examine the study hypotheses and achieve its objectives. The study found that there is statistically significant impact of the electronic banking services (Ease of use, usefulness, Web Site Design, privacy) on Customers loyalty of commercial Banks in Jordan. Regarding the dimension of Accessibility, the study indicates that it had insignificant impact on Customers loyalty.

Mawutor (2014) investigated the impact of electronic banking on the profitability of a Bank in Ghana. The methodology was quantitative in nature. In all, 150 questionnaires were administered to the interviewee from the selected branches of the Agricultural Development Bank who are customers, to solicit information concerning the E-banking. All data from the structured self-administered questionnaires were correctly organized. The software that was used for this is, Statistical Package for Social Sciences (SPSS). After testing the hypothesis by using inferential statistics, it was discovered that E-banking does have an impact on the profitability of the Agricultural Development bank. The study revealed that E=banking has a positive effect on ADB's Profitability.

Agboola (2016) in his study on Information and Communication Technology (ICT) in Banking operations in Nigeria using the nature and degree of adoption of innovative technologies; degree of utilization of the identified technologies; and the impact of the adoption of ICT devices on banks, found out that technology was the main driving force of competition in the banking industry. During his study he witnessed increase in the adoption of ATMs, EFT, smart cards, electronic home and office banking and telephone banking. He indicates that adoption of ICT improves the banks' image and leads to a wider, faster and more efficient market. He asserts that it is imperative for bank management to intensify investment in ICT products to facilitate speed, convenience, and accurate services, or otherwise lose out to their competitors.

3.0 Methodology

3.1 Research Design

The study adopts ex post facto research wherein the researcher cannot manipulate the existing variables and an experimental survey research method. The survey method involved using a questionnaire to gather data from the respondents. The Time series data are extracted from the secondary sources from 2010-2017. The data analysis specifies bank performance as a function of e-bank products as follows:

ROE = f (ATM, MOB, POS, WEB)…….(1)
ROA = f (ATM, MOB, POS, WEB)…… (2)
CUP = f (Primary Data)…….(3) and
CWT = f (Primary Data)……(4)
Where ROE= Return on Equity, ROA= Return on Assets – proxy for bank performance
ATM= Automated teller machines, (Vol of ATM system transaction) MOB = Mobile banking usage; POS= Point of sales machines (No of POS terminals WEB = Web based internet banking, CUP = Customer patronage, CWT = Customer waiting time.

For models (1) and (2), time series data will be sourced from the CBN Statistical Bulletin for the period 2010-2017. The data will be analyzed using Unit roots tests, Johansen co-integration, ECM, and Granger causality analysis.

3.2: Sources of Data

Data for models (3) and (4) being cross-sectional survey data were sourced using structured questionnaire administered on a sample of bank customers drawn from the urban areas of Aba, Umuahia and Okigwe. A combination of Stratified and Simple random sampling technique is employed in eliciting responses from our respondents

4.0: Data Analysis

4.1: In this section, data is presented and analyzed on two fronts, secondary and primary, in accordance with the raised hypotheses. This section commences with the secondary data analysis, followed by the distribution features of the questions raised in this study
In this analysis bank performance is assumed to be a function of e-banking products thus:
ROE = f (ATM, MOB, POS, WEB)…….(1)
ROA = f (ATM, MOB, POS, WEB)…… (2)

For stationarity of the variables, the Augmented Dickey-Fuller (ADF) unit root test is used to determine if a long-run relationship exists between the dependent and independent variables in this study; Johansen Cointegration is used. In testing for multicollinearity and global utility of specified models, the correlation matrix and ordinary least squares (OLS) are engaged. Generalized Method of Moments (GMM) and Vector Autoregressive (VAR) were employed in testing the models due to the dynamic nature of the variables.

4.2: Model Specification

Functional form.

Bank Performance = f (E-banking Products) (1)

Model 1

ROA = f (ATM, MOB, POS, and WEB) (2)

Model 2

ROE = f (ATM, MOB, POS, and WEB) (3)

Then, the ***explicit form.***

The GMM explicit form in first difference is.

Model 1

$$ROA = b_0+b_1ROA_{t-1}+b_2ATM +b_3ATM_{t-1}+b_4MOB +b_5MOB_{t-1} + b_6POS + b_7POS_{t-1} + b_8WEB + b_9 WEB_{t-1} +e_{t-1} \quad (4)$$

Model 2

$$ROE = b_0+b_1ROE_{t-1}+b_2ATM +b_3ATM_{t-1}+b_4MOB +b_5MOB_{t-1} + b_6POS + b_7POS_{t-1} + b_8WEB + b_9 WEB_{t-1} +e_{t-1} \quad (5)$$

The reduced VAR model, incorporating ROA, ROA, ATM, MOB, POS and WEB is stated below.

Model 1

$$ROA_t = \alpha_{01}+\alpha_{11}ROA_{t-1} + \alpha_{21} ATM_{t-1}+\alpha_{31} MOB_{t-1}+\alpha_{41} POS_{t-1}+ \alpha_{51} WEB_{t-1} + U_{t1} \quad (6)$$

$ATM_t = \beta_{02} + \beta_{12} ROA_{t-1} + \beta_{22} ATM_{t-1} + \beta_{32} MOB_{t-1} + \beta_{42} POS_{t-1} + + \beta_{52} WEB_{t-1} + U_{t2}$ (7)

$MOB_t = \Upsilon_{03} + \Upsilon_{13} ROA_{t-1} + \Upsilon_{23} ATM_{t-1} + \Upsilon_{33} MOB_{t-1} + \Upsilon_{43} POS_{t-1} + \Upsilon_{53} WEB_{t-1} + U_{t3}$ (8)

$POS_t = Z_{04} + Z_{14} ROA_{t-1} + Z_{24} ATM_{t-1} + Z_{34} MOB_{t-1} + Z_{44} I\ POS_{t-1} + + Z_{54} WEB_{t-1} + U_{t4}$ (9)

$WEB_t = \partial_{05} + \partial_{15} ROA_{t-1} + \partial_{25} ATM_{t-1} + \partial_{35} MOB_{t-1} + \partial_{45} POS_{t-1} + \partial_{55} WEB_{t-1} + U_{t5}$ (10)

Model 2

$ROE_t = \alpha_{01} + \alpha_{11} ROE_{t-1} + \alpha_{21} ATM_{t-1} + \alpha_{31} MOB_{t-1} + \alpha_{41} POS_{t-1} + \alpha_{51} WEB_{t-1} + U_{t1}$ (11)

$ATM_t = \beta_{02} + \beta_{12} ROE_{t-1} + \beta_{22} ATM_{t-1} + \beta_{32} MOB_{t-1} + \beta_{42} POS_{t-1} + + \beta_{52} WEB_{t-1} + U_{t2}$ (12)

$MOB_t = \Upsilon_{03} + \Upsilon_{13} ROE_{t-1} + \Upsilon_{23} ATM_{t-1} + \Upsilon_{33} MOB_{t-1} + \Upsilon_{43} POS_{t-1} + \Upsilon_{53} WEB_{t-1} + U_{t3}$ (13)

$POS_t = Z_{04} + Z_{14} ROE_{t-1} + Z_{24} ATM_{t-1} + Z_{34} MOB_{t-1} + Z_{44} I\ POS_{t-1} + + Z_{54} WEB_{t-1} + U_{t4}$ (14)

$WEB_t = \partial_{05} + \partial_{15} ROE_{t-1} + \partial_{25} ATM_{t-1} + \partial_{35} MOB_{t-1} + \partial_{45} POS_{t-1} + \partial_{55} WEB_{t-1} + U_{t5}$ (15)

Where U_t are white noises that capture the innovations or shocks to the VAR system.
And finally, the ***Operational form (Apriori Expectation).***
$\boldsymbol{\alpha_1, \alpha_2, \alpha_3 \ and \alpha_4 > 0 < 0}$, are coefficient of ATM, MOB, POS, and WEB. It is expected that E-bank variables will either positively or negatively influence banks' performance.

4.3: Analysis and Discussion

First, the time series plot of the data is shown in figure I below,
Figure 1 below shows that all the variables trended upward and downward, sometimes metering, over the study period, indicating non-stationarity of the variables as expected, except ROE, which recorded a sharp upward trend, and ROA, which trended upwards and maintained a plane movement until the end of the period. In all the variables, there are periods of troughs and peaks.

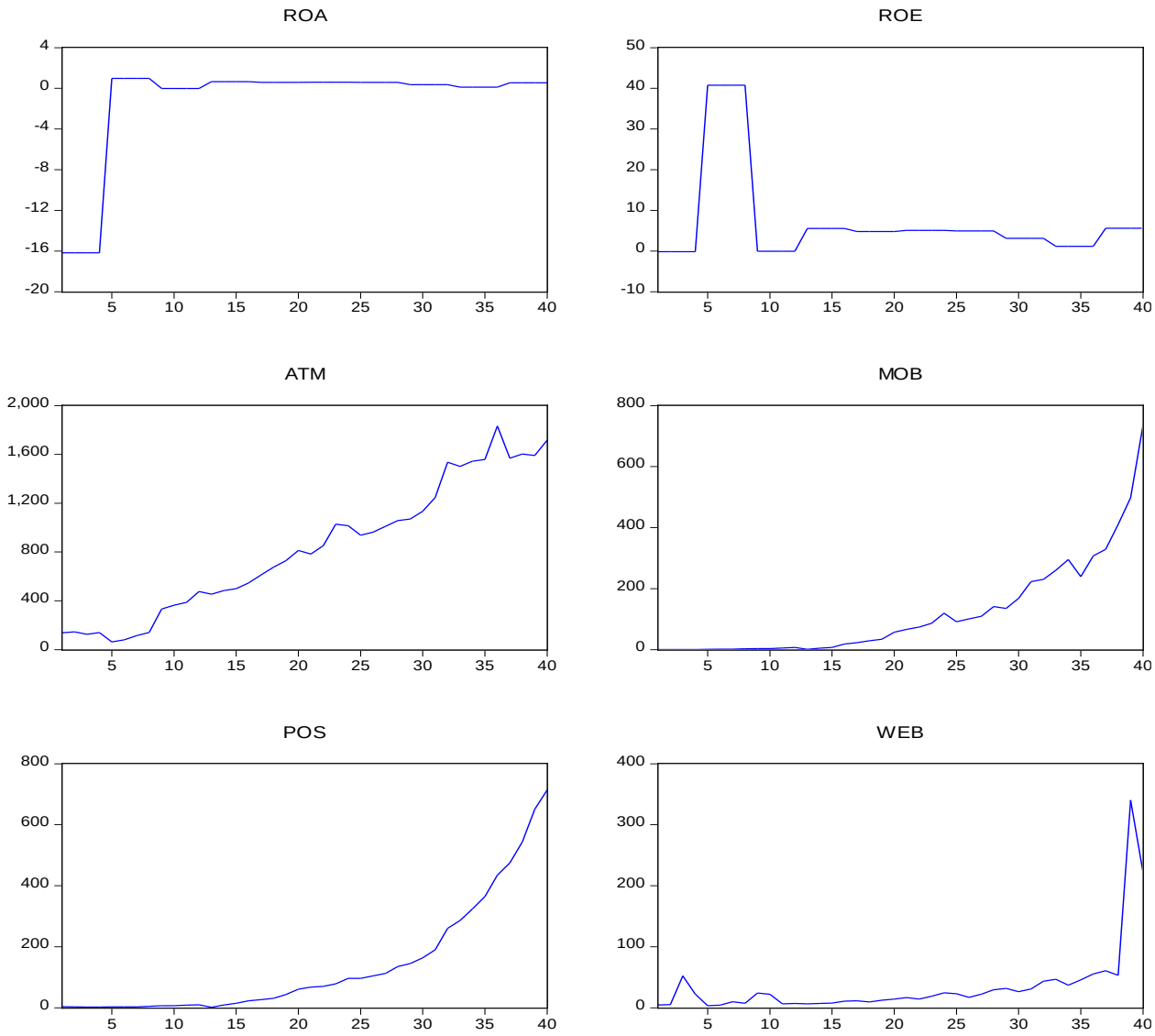

***Figure 1: the time series of* ROA, ROE, ATM, MOB, POS, and WEB**

Table 1 shows the summary of statistics that describe the distributional features of all the data. The variables recorded average of the following: -1.17%, 7.07%, 821.98%, 120.57%, 139.40% and 35.15% for ROA, ROE, ATM, MOB, POS, and WEB respectively, suggesting that ATM fluctuates more than other e-banking variables. The risk (standard deviation) inherent in each of the variables are 5.07, 11.57, 540.46, 162.5, 190.94 and 60.83 for ROA, ROE, ATM, MOB, POS, and WEB respectively. These also suggest that ATM is the most volatile with bank performance. All the variables, except ROA are positively skewed. All the variables, except ATM showed Kurtosis greater than 3, suggesting leptokurtic distribution, while ATM is less than 3, suggesting platykurtic distribution. Jarque-Bera normality distribution test statistical probability values show that all the variables, ATM has abnormal distribution while ATM is normally distributed.

Descriptive Statistics

***Table I: Descriptive Statistics of* ROA, ROE, ATM, MOB, POS and WEB**

	ROA	ROE	ATM	MOB	POS	WEB
Mean	-1.175250	7.075680	821.9898	120.5794	139.4074	35.15481
Median	0.566250	4.865000	798.7083	61.71927	64.05592	20.47294
Maximum	0.977500	40.74500	1832.551	736.4880	714.3454	340.3872
Minimum	-16.18000	-0.173200	62.59000	0.060000	1.865365	3.370000
Std. Dev.	5.072371	11.57303	540.4649	162.5099	190.9479	60.83055
Skewness	-2.652795	2.487454	0.234505	1.881660	1.614312	3.989086
Kurtosis	8.067792	7.576405	1.847508	6.765036	4.637084	19.00951
Jarque-Bera	89.71965	76.15532	2.580347	47.23012	21.84009	533.2593
Probability	0.000000	0.000000	0.275223	0.000000	0.000018	0.000000
Sum	-47.01000	283.0272	32879.59	4823.175	5576.297	1406.192
Sum Sq. Dev.	1003.429	5223.469	11391989	1029969.	1421984.	144313.9

Global Utility Test:

In the macroeconomic analysis, it is pertinent to check the global utility or usefulness of the specified models. To achieve this, the researchers applied correlation matrix and ordinary least square.

Multicollinearity Test

Table 2 and 3 below show the summary of correlation of the variables. The range of correlations between ROA, ATM, MOB, POS, and WEB; ROE, ATM, MOB, POS, and WEB indicate that the variables are not linearly correlated, though that of MOB and POS are close to unity in both models, Therefore, the researchers have enough evidence to announce no presence of multicollinearity in the model.

Tables 2 and 3: Correlation Matrix

Model 1

	ROA	ATM	MOB	POS	WEB
ROA	1.000000	0.409590	0.240198	0.230900	0.075114
ATM	0.409590	1.000000	0.850973	0.860686	0.516162
MOB	0.240198	0.850973	1.000000	0.977850	0.780896
POS	0.230900	0.860686	0.977850	1.000000	0.779384
WEB	0.075114	0.5161627	0.780896	0.779384	1.000000

Model 2

	ROE	ATM	MOB	POS	WEB
ROE	1.000000	-0.386630	-0.195947	-0.194637	-0.1207802
ATM	-0.386630	1.000000	0.850973	0.860686	0.516162
MOB	-0.195947	0.850973	1.000000	0.977850	0.780896
POS	-0.194637	0.860686	0.977850	1.000000	0.779384
WEB	-0.120780	0.516162	0.780896	0.779384	1.000000

Tables 4 and 5 below show the Ordinary Least Square (OLS) estimated model for the relationship between e-banking variables and performance of banks. From the tables Durbin-Watson statistics are 0.865740 and 0.813136, showing presence of autocorrelation, thus cannot be used for further analysis and policy formulation.

Table 4 and 5: Ordinary Least Square (OLS) Methods

Model 1

Dependent Variable: LNROA				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNATM	-0.402628	0.243677	-1.652305	0.1101
LNMOB	0.747433	0.376337	1.986074	0.0573
LNPOS	-0.961804	0.416033	-2.311844	0.0287
LNWEB	0.216253	0.181659	1.190436	0.2442
C	2.342972	1.291982	1.813471	0.0809
R-squared	0.501972	F-statistic		6.803451
Adjusted R-squared	0.428190	Prob(F-statistic)		0.000636
		Durbin-Watson stat		0.865740

Model 2

Dependent Variable: ROE				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
ATM	-0.022797	0.007116	-3.203791	0.0029
MOB	0.017805	0.050872	0.350002	0.7284
POS	0.045577	0.045408	1.003732	0.3224
WEB	-0.067082	0.051708	-1.297308	0.2030
C	19.67212	3.989765	4.930646	0.0000
R-squared	0.258848	F-statistic		3.055938
Adjusted R-squared	0.174144	Prob(F-statistic)		0.029248
		Durbin-Watson stat		0.813136

Stationarity Test:

Due to the peculiarities of the time series, this is a statistical valid procedure that assists to determine the best estimation method for the data. To do this the popular Augmented Dickey Fuller (ADF) unit root test is used as shown below. Table 6 below reveals the summary of stationary test for both level and first difference data. The results show all the variables are not integrated at level, rather they are differenced once to be stationary in the critical values.

Tables 6: Augmented Dickey Fuller Unit Root Test

Variables	Max lag	LEVEL			1st DIFFERENCE			Remark
		ADF Stat/Prob.	Critical Values		ADF Stat/Prob.	Critical Values		
			5%	10%		5%	10%	
ROA	7	-0.978034 (0.2862)	-1.952473	-1.610211	-4.623628 (0.0001)	-1.960171	1.607051	@1(1)
ROE	7	-0.518490 (0.4835)	-1.952473	-1.610211	-5.196152 (0.0000)	-1.953381	-1.609798	@1(1)
LnATM	9	1.685535 (0.9757)	-1.949609	-1.611593	-5.576367 (0.0000)	-1.949856	-1.611469	@1(1)
LnMOB	9	0.897972 (0.8979)	-1.949609	-1.611593	-6.167503 (0.0000)	-1.949856	-1.611469	@1(1)
LnPOS	9	1.704404 (0.9767)	-1.949609	-1.611593	-6.954918 (0.0000)	-1.949856	-1.611469	@1(1)
LNWEB	9	0.338636 (0.7781)	-1.949609	-1.611593	-6.728102 (0.0000)	-1.949856	-1.611469	@1(1)

Cointegration and Long run Relationship Test:

It is necessary to know if there exist equilibrium relationships between the variables; ROA, ATM, MOB, POS, and WEB; ROE, ATM, MOB, POS, and WEB as shown below; Tables 7 and 8 below show that unrestricted rank tests (Trace and Maximum Eigenvalue) have 3 and 2 cointegrating equations respectively for model 1; and 4 and 3 cointegrating equations for model 2. These are sufficient evidence to show that long run relationship exists between the dependent variable bank performance proxied by ROA and ROE and independent variables; e-banking variables (ATM, MOB, POS, and WEB).

Tables 7 and 8: Johansen Cointegration Test

Model 1

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.900713	123.3106	69.81889	0.0000
At most 1 *	0.642496	58.63784	47.85613	0.0035
At most 2 *	0.493370	29.83680	29.79707	0.0495
At most 3	0.281036	10.79751	15.49471	0.2243
At most 4	0.054160	1.559086	3.841466	0.2118
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.900713	64.67277	33.87687	0.0000
At most 1 *	0.642496	28.80104	27.58434	0.0348
At most 2	0.493370	19.03928	21.13162	0.0957
At most 3	0.281036	9.238427	14.26460	0.2668
At most 4	0.054160	1.559086	3.841466	0.2118

Model 2

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.639429	103.3134	69.81889	0.0000
At most 1 *	0.508535	64.55084	47.85613	0.0007
At most 2 *	0.432254	37.55701	29.79707	0.0052
At most 3 *	0.331898	16.04590	15.49471	0.0413
At most 4	0.018768	0.719980	3.841466	0.3961
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.639429	38.76257	33.87687	0.0121
At most 1	0.508535	26.99382	27.58434	0.0594
At most 2 *	0.432254	21.51111	21.13162	0.0442
At most 3 *	0.331898	15.32592	14.26460	0.0339
At most 4	0.018768	0.719980	3.841466	0.3961

***Relationship between* ROA, ATM, MOB, POS, and WEB; ROE, ATM, MOB, POS, and WEB**

It can be recalled that OLS exhibits unsatisfactory global utility and was therefore abandoned. For that the researchers moved ahead to determine the relationship between performance of banks e-banking variables with General Method Moments (GMM).

General Methods Moment:

Due to the dynamic nature of the variables, the researchers also adopted the General Method Moments (GMM). Table 9 and 10 reveal the estimation of the model using Generalized Method of Moments (GMM). J-statistics has coefficients of 3.493294 and 0.998375 with probability values of 0.478899 and 0.910042 respectively for model 1 and model 2, which show the models are significant and good to establish Relationship between ROA, ATM, MOB, POS, and WEB, ROE, ATM, ATM, MOB, POS, and WEB. The tables also reveal as follows; in model 1, ATM has a negative and significant relationship with banks' performance proxied by ROA whereas other variables insignificant impact banks' performance. In model 2, ATM and WEB are significantly related with banks' performance proxied by ROE, whereas MOB and POS insignificantly relate with ROE.

Tables 9 and 10: General Methods Moment

Model 1

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNATM	-0.357855	0.125205	-2.858158	0.0081
LNMOB	0.517349	0.376862	1.372781	0.1811
LNPOS	-0.661798	0.447820	-1.477822	0.1510
LNWEB	0.170759	0.140572	1.214741	0.2350
C	1.935704	0.806805	2.399222	0.0236
R-squared	0.453241	J-statistic		3.493294
Adjusted R-squared	0.372240	Prob(J-statistic)		0.478899
		Instrument rank		9

Model 2

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNATM	-1.399422	0.078980	-17.71868	0.0000
LNMOB	0.480519	0.250329	1.919548	0.0655
LNPOS	-0.442629	0.286816	-1.543250	0.1344
LNWEB	0.382965	0.055351	6.918786	0.0000
C	9.738444	0.516175	18.86654	0.0000
R-squared	0.840594	J-statistic		0.998375
Adjusted R-squared	0.816978	Prob(J-statistic)		0.910042
		Instrument rank		9

Error Correction and Long run Causality Test

The analysis in tables 11 and 12 reveal that error correction equation (CointEq1) has coefficient of -0.720690 and t-statistic of -2.57859 for model 1 and -1.020686 and -2.77661 respectively for model 2. That means error correction parameter is negative and significant respectively, satisfying the apriori expectation (condition), hence, significant. The speed of adjustment is 72% and 102% respectively. The cointegration already established is confirmed. That means short term errors can be corrected in the long run with annual speed of adjustment 72% and 102%.

Tables 11 and 12: Vector Error Correction Estimates

Model 1

Error Correction:	D(LNROA)	D(LNATM)	D(LNMOB)	D(LNPOS)	D(LNWEB)
CointEq1	-0.720690	-0.006629	0.444997	0.102121	-0.019484
	(0.45654)	(0.09490)	(0.14035)	(0.10054)	(0.27942)
	[-1.57859]	[-0.06985]	[3.17058]	[1.01568]	[-0.06973]

Model 2

Error Correction:	D(LNROE)	D(LNATM)	D(LNMOB)	D(LNPOS)	D(LNWEB)
CointEq1	-1.020686	-0.120989	0.404845	0.070716	0.287466
	(0.57451)	(0.12024)	(0.21662)	(0.13462)	(0.33418)
	[-1.77661]	[-1.00619]	[1.86894]	[0.52528]	[0.86021]

4.4: Test of Hypotheses

Eight of the Ten hypotheses of this research are tested using relevant econometric tools. They are restated here as follows:

Hypothesis 1: There is no significant relationship between ATM and ROA of deposit money banks in Nigeria.

From the GMM Table 9, ATM has a coefficient of -0.367 and a probability value of 0.0081 which is significant at 5% level. This shows that ATM negatively but significantly relates with bank performance proxy by ROA.

Hypothesis 2: MOB has no significant relationship with ROA of deposit money banks in Nigeria.

The GMM table 9 reveals that MOB has a coefficient of 0.157349 and probability value of 0.1811. There is insignificant relationship with ROA. The null hypothesis is accepted that there is no relationship between MOB and with bank performance proxy by ROA.

Hypothesis 3: POS has no significant relationship with ROA of deposit money banks in Nigeria.

As evidence shows in the GMM Table 9 model 2, POS parades a coefficient of -0.442679 and probability value of 0.1344, which shows that POS has an an insignificant relationship with ROA at a 5% significant level. Therefore, we accept the null hypothesis that there is no significant relationship between POS and ROA of deposit money banks in Nigeria.

Hypothesis 4: WEB has no significant relationship with ROA of deposit money banks in Nigeria.

From the GMM Table 9, result show that WEB coefficient is 0.170759 with a probability value of0.2350 which shows that the null hypothesis is accepted, implying that WEB has no significant relationship with ROA of deposit money banks in Nigeria.

Hypothesis 5: ATM does not influence ROE of banks in Nigeria

From Table 10, ATM has coefficient of -1.399422 with probability value of 0.0004 which is highly significant at 5% level, confirming that ATM negatively and significantly relates to ROE, which means the null hypothesis is not accepted. Hence, we have enough reason to say that ATM significantly relates with ROE.

Hypothesis 6: There is no significant relationship between MOB and ROE of deposit money banks in Nigeria.

Results of the GMM Table 10 shows that MOB has a coefficient of 0.480519 with a probability value of 0.0655 which is insignificant at 5% level. MOB insignificantly relates with ROE, suggesting that MOB does not have significant relationship with ROE within the scope of the study.

Hypothesis 7: There is no significant relationship between POS and ROE of deposit money banks in Nigeria.

Table 10 shows that POS has no significant relationship with ROE. This is because POS has a coefficient of -0.442629 and a probability value of 0.1344, which is insignificant at the 5% level. Based on this result, the null hypothesis, which says that there is no significant relationship between POS and ROE, is accepted.

Hypothesis 8: WEB does not affect ROE of deposit money banks in Nigeria.

As shown from GMM Table 10, WEB has a coefficient of 0.382965 and a probability value of 0.0000 which is highly significant at 5% level. This is enough reason not to accept the null hypothesis that WEB does not have significant relationship with ROE.

Hypotheses 9 and 10 are tested using primary data model

Hypothesis 9: There is no significant relationship between e-banking and customer patronage of deposit money banks in Nigeria.

Objective: To ascertain the nature of the relationship between e-banking (proxied with SPEED OF SERVICE DELIVERY) and customer patronage (proxied with customer usage of mobile banking services).

Derivative Hypotheses Outputs

Table 4.2.4: Parameter Estimates

		Estimate	Std. Error	Wald	Df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	[SPODEL = 1.00]	-.964	.571	2.846	1	.092	-2.084	.156
	[SPODEL = 2.00]	.190	.531	.128	1	.720	-.851	1.232
	[SPODEL = 3.00]	1.336	.604	4.883	1	.027	.151	2.520
Location	[MOBAN=1.00]	3.457	1.230	7.896	1	.005	1.046	5.869
	[MOBAN=2.00]	.096	.776	.015	1	.901	-1.425	1.618
	[MOBAN=3.00]	0[a]	.	.	0	.	.	.

Link function: Logit.

a. This parameter is set to zero because it is redundant.

Table 4.2.4 only Mobil banking lnd to be statistically significant with probability value of 0.005. The null hypothesis which states that there is no significant relationship between e-banking (proxy

by speed of service delivery and customer patronage (proxy by customer usage of e-banking services) was rejected and the alternative hypothesis accepted.

Table 4.3.4 Parameter Estimates

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	[WAITTIME = 1.00]	17.392	1.139	232.995	1	.000	15.159	19.626
	[WAITTIME = 2.00]	20.242	.944	459.319	1	.000	18.391	22.093
Location	[FUNTRANS=1.00]	-.570	1.015	.315	1	.575	-2.560	1.420
	[FUNTRANS=2.00]	.639	.902	.501	1	.479	-1.129	2.406
	[FUNTRANS=3.00]	0[a]	.	.	0	.	.	.
	[AUTM=1.00]	17.450	1.078	262.264	1	.000	15.338	19.562
	[AUTM=2.00]	10.177	.750	78.234.	1	..067	20.177	20.177
	[AUTM=4.00]	0[a]	.	.	0	.	.	.

Link function: Logit

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.

Hypotheses 10: There is no relationship between e banking (proxy by fund transfer and ATM) and Customer assessment of waiting time (Waiting Time) in Deposit Money Banks in Nigeria.

From Table 4.3.4 and tested with ordinal regression, it was found that only ATM had a probability value of 0.000. This is highly significant; hence the null hypothesis is rejected and the alternative hypothesis which says that there is a significant relationship between e-banking (proxy by ATM Fund transfer and Customer waiting time, accepted.

4.5 Discussion of Findings

Findings show mixed results in the relationship of the variables as ATM transactions, Mobile banking, Web transactions, POS, electronic fund transfer etc exert mixed levels of influence on bank performance in the period under study. In our model 1, only ATM was found to have a significant relationship with bank performance, leading to the rejection of the null hypothesis. Results show that MOB, POS, and WEB had insignificant relationships with ROA, leading to the acceptance of the null hypothesis. This finding supports the findings of Abaenewa, Ogbulu and Ndugbu (2013) who affirmed that e-banking has not significantly improved the returns on assets (ROA) of Nigerian banks. In our model 2, only ATM had a negative but significant relationship

with ROE. This is so because ATM is the major instrument used by customers of deposit money banks. MOB and POS had an insignificant relationship with ROE.

The insignificant impact made by other e-bank channels is because little or nothing is known about them by the banking public. E-banking proxy by the speed of service delivery had a significant relationship with customer bank patronage. This finding led to rejecting the null hypothesis and accepting the alternative. This finding supports the view of Ajagbe (2013) who observed that e-banking has positively impacted on the bank's human resource performance in terms of improved efficiency and effectiveness of service delivery by their workforce, even as it has enhanced customer satisfaction. There is a significant relationship between e-banking and customer waiting time. This finding is supported by the observations of Worku, Tilahun, and Tafa (2016), who noted that e-banking has reduced customer waiting time, improved customer satisfaction, and reduced the frequency of bank halls for banking services. No doubt, e-banking has improved bank performance in core areas of profitability, efficiency and service delivery, with even higher opportunity to expand e-banking service in the city. However, the level of penetration in the society has not yet been ascertained.

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

i. E-banking has influenced bank performance dimensions, including increased productivity, efficiency, reliability, service quality, and customer satisfaction, which leads to strong patronage and enhanced profitability.
ii. There is a positive correlation between customer satisfaction and e-banking availability, reliability and convenience
iii. Among the e-banking channels, ATM, POS, and Internet banking are the most frequently used by customers, while other channels are not quite known by the banking public, hence their insignificant impact on the economy.
iv. That ATM and WEB banking are insignificantly related to bank performance proxied by ROE. There is a positive correlation between e-bank services and customer waiting time.
v. The adoption of e-banking services, though useful in its entirety has not improved ROA and ROE.
vi. There is a non-penetration of adopting e-banking in the hinterland.

5.2 Conclusion

E-banking has positively impacted on the performance of Deposit money banks in Nigeria; providing limitless benefits which are catalytic to economic growth. Bank credit and deposit performance have improved due to usage of e-banking products like ATM, POS, WEB, mobile banking etc. It is only the banks that can recognize and adopt the electronic driven power in e-banking and re-engineer the customers' value towards e-banking products that will stand the taste of time in the present world.

5.3 Recommendations

I. Banks should increase their advertising in sensitizing customers towards e-banking products, improve service

quality, efficiency, and infrastructure avoid out-of-service," temporarily unable to dispense cash syndrome," and provide services that will draw the patronage of rural dwellers using thrift collectors, market men and women, and small-scale entrepreneurs.

2. Banks should provide customers with uninterrupted, reliable, and continent-wide e-banking services to satisfy and retain their customers and increase their patronage.

3. Banks to enhance capacity building and developing new e-bank products through training and retraining of staff. Diversification of e-banking products will create wider markets in the banking space with attendant customers craving satisfaction.

4. Banks should engage in serious e-bank education as a business policy. This will guarantee the penetration of e-banking products into the hinter land and eventually grow the economy as the society will be saturated with literate people.

5. Bank management that are slow in innovation adoption should, as a matter of fact, move in and adopt various innovations in their operations in order to attract customer loyalty and boost their profitability.

6. Bank regulators and Policy makers should also review policies related to the promotion of innovation adoption and transfer of technology.

REFERENCES:

Abaenewe, Z. C., Ogbulu, O. M. & Ndugbu, M. O. (2013). Electronic banking and bank performance in Nigeria, *West African Journal of Industrial and Academic Research,* 6 (1): 170-186.

Abubakar, A. (2014), Effect of electronic banking on growth of deposit money banks in Nigeria. European Journal of Business Management. 6(33):79-89.

Adekannbi, J. O. (2018). Factors influencing customer satisfaction and loyalty to internet banking services among undergraduates of a Nigerian university, *Journal of Internet Banking and Commerce,* 23(1):1-21.

Akingbola, A.A. (2006), Electronic payment system and tele-banking services in Nigeria. Journal of internet banking 1(3): 13-28

Al-Smadi, M. & Al-Wabel, S. (2011), The impact of e-banking on the performance of Jordanian banks, *Journal of Internet Banking and Commerce,* 16(2), pp. 1-10

Gomachab, R. & Maseke, B. F. (2018). The impact of mobile banking on customer satisfaction: Commercial banks of Namibia, Journal *of Internet Banking and Commerce,* 23(2): 1-18

Morufu, O (2016), E-payment adoption and profitability performance of deposit money banks in Nigeria, *International Journal of Information Technology*. 4(3): 1-9.

Ogbulu, O. M. (2000). Electronic banking in Nigeria: Conceptual issues and impact on the Nigerian banking system, *African Journal of Applied and Theoretical Economics (AJATE),* Department of Economics, University of Port Harcourt, 4(2): 214-228.

Ogunlowore, A. J. & Oladele, R. (2014). Analysis of electronic banking and customer satisfaction in Nigeria, *European Journal of Business and Social Sciences,* 3(3), 14-27.

Olanipekun, W.D., Brimah, A.N & Ajagbe, S.T. (2013). Role of electronic banking in enhancing human resource performance and customer satisfaction: Evidence from Guaranty Trust Bank Plc, Nigeria, *International Journal of Business and Behavioural Sciences*. 3(4): 36-44

Olori, W. O. & Waribugo, S. 2016). A comparative study of the perceived efficiency of automated teller machines and human teller platforms in Nigerian banks, *European Journal of Business and Innovation Research,* 4(4): 48-59.

Ovia, J. (2001). Internet banking practice and potentials in Nigeria, *Institute of Chartered Accountants of Nigeria*, Lagos.

Oyewole, O. S., Abba, M., Gambo, E. J., & Abam, A. I. (2013). E-banking and bank performance: Evidence from Nigeria, *International Journal of Scientific Engineering and Technology,* 2(8): 766-771.

Salihu, A. & Metin, H. (2017). The impact of services, assurance and efficiency in customer satisfaction on electronic banking services offered by the banking sector, Journal *of Internet Banking and Commerce,* 22(3), pp. 1-12.

Soludo, C (2005), Keynote address delivered at the inauguration of the National Monetary Policy committee of the Central bank of Nigeria head office, Abuja.

Steven, A. (2016), Information system for formation of e-business: New Jersey,

Ugwueze, A. C. & Nwezeaku, N. C. (2016). E-banking and commercial bank performance in Nigeria: A cointegration and causality approach, *International Journal of e-Education, e-Management and e-Learning,* 6(3): 175-185.

Worku, G., Tilahun, A., & Tafa, M. A.(2016) Impact of electronic banking on customers' satisfaction in Ethiopian industry (The case of customers of Dashen and Wogagen banks in Gondar City). *Journal of Business & Financial Affairs.* 5(2): 1-18

Yang, S., Li, Z., Ma, Y., & Chen, X. (2018). Does electronic banking really improve bank performance? *International Journal of Economics and Finance,* 10(2): 82-94.

ACKNOWLEDGEMENT: The funding for the research that generated this paper was provided by TETFUND under Institution Based Research (IBR) Fund intervention.