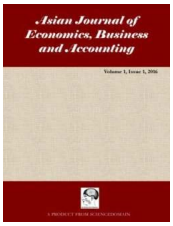

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Financial Innovation and Efficiency on the Banking Sub-sector: The Case of Deposit Money Banks and Selected Instruments of Electronic Banking (2006 - 2014)

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Authors' contributions

This research was carried out in collaboration between both authors. Author ISN conceptualized the study, sourced and organized relevant literature. He wrote the first draft of the manuscript and critically reviewed it thereafter and corrected the grammatical error noticed therein. Author AFA sourced the data, performed the analysis and interpreted the results. Both authors read and approved the final version of the manuscript.

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ABSTRACT

This study evaluates the relationship between financial innovation and bank efficiency as well as the impact of financial innovation on efficiency ratio of deposit money banks in Nigeria from 2006 to 2014. The secondary data covering the period of the study were sourced from the Central Bank of Nigeria statistical bulletin. The unit root test was performed to ensure that the variables were free from stationarity defect linked with almost all time series data due to the nature they were generated. A multiple regression model was developed and estimated to evaluate the relationship

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among the variables concerned. The finding reveals that the value of transaction on Automated Teller Machine (ATM) and Point of Sale (POS) are negatively related with efficiency ratio while web/internet and mobile banking are positively related but only that of web/internet was significantly related. The granger impact assessment depicts that financial innovation products reflected by value of transaction on ATMs, web/internet, POS and mobile banking has no significant impact on efficiency ratio of deposit money banks in Nigeria. However, we found evidence that banks efficiency ratio exerted statistically significant impact on value of transactions on ATMs. In view of the findings, banks should invest more in ATMs and POS platforms as it reduces the operating expenses to net income ratio while ensuring effective utilization of existing web/internet and mobile banking infrastructure rather than acquiring new ones that will gulp a large fraction of their net operating income. Web/internet and mobile banking should be redesigned in such a way that customization will enable customers access all the banking services which would indeed reduce its transaction costs. This calls for dialogue and negotiation with mobile service providers operating in Nigeria.

Keywords: Financial innovation; bank efficiency; mobile banking; web/internet; POS; ATM.

1. INTRODUCTION

In the realities and challenges of today's economic condition, the banking sub-sector should be repositioned to play the strategic role of balancing their performance proxied by return on assets, return on equity and profit before tax among others. With the Nigeria strategic aspiration in patriotic consideration, the banking industry mandate of fund intermediation is the key pillar to the achievement of economic growth of the country as well as achieving the vision 2020 of the Federal Government of Nigeria through enhanced savings and encouragement of Foreign Direct Investment (FDI). In the course of exercising these mandates, a number of challenges manifested among which include the non-performing loans and the lending to one sector mainly the oil and gas sector of the economy which is currently facing volatility and dwindling oil price in the internal oil market, thus impacting negatively on the economy in different ways. The vagaries of this exogenous market and other challenges call for efficient performance of the banks [1].

The use of sophisticated banking technology, paper transaction model, including the application of Information and Communication Technology (ICT) to their banking operation became evident to repositioning Nigeria deposit money banks to an unanticipated improvement in the array of banking products and instruments that are stimulating the customer's need and preference [2]. Financial innovation in the banking sector has been argued to be a force for diversification of product channel systems such as Automated Teller Machines (ATMs), mobile and internet banking. Financial innovative products drive revenue, reduce cost to both banks and customers as customers can access their accounts with their mobile phones [3]. In Ghana, the deployment of financial innovation products have enhanced the performance of the banking sector and customer's as well, customers are efficiently served and profit motive of banks enhanced [4].

Financial innovation has been used by many banks as a formidable strategic variable to out weight any form of competition among the deposit money banks by which banks can improve their performance while simultaneously being able to maintain their effectiveness in the market [5]. Accordingly, bank efficiency is measured by the ratio of quick and easy measures of bank ability to turn resources into revenue. The commonly used efficiency measurement are return on assets, return on equity and interest margin. The developments in the banking sub sector have not only led to the increase in the number of banking institutions but, also the development in level of sophistication with new payment systems and asset alternatives to holding money. This has resulted mainly from technological advancement and increase in competition as the number of institutions increase. Developments in payment systems have started to create close substitutes for hard currency, thus affecting a core part of banking operations [2].

Scholars have investigated the nexus between financial innovation and efficiency of the banking industry for both developed and emerging economies of the world. The results of these studies have empirically lay credence to the positive effect of financial innovation on bank

performance as well as on customer's satisfaction. In the context of Nigeria as an emerging economy, findings on the linkage between financial innovation and efficiency of the banking industry are mixed. [6] noted that the deployment of ATMs terminals have averagely improved the performance of Nigerian banks because, of the alarming rate of ATM fraud. Conversely, the findings of [2] showed that investments in electronic banking services and ATMs do not really improve banks' performance reflected with return on equity in Nigeria. In another emerging economy in Africa, [7] established that bank innovations are statistically and significantly explained profits of commercial banks in Kenya. The great impact of financial innovation on efficiency of commercial banks in Kenya have been confirmed by the studies of [8, 9,10]. This study improved on previous studies by using efficiency ratio as a measure of banks efficiency. Therefore, the objective of this study is to evaluate the relationship between financial innovation and bank efficiency as well as the impact of financial innovation on efficiency ratio of deposit money banks in Nigeria. In line with the objectives, the study developed a hypothesis stated in the null format as:

1. Financial innovation products: ATMs, web/internet, point of sale terminal and mobile banking have no significant impact on efficiency ratio of deposit money banks in Nigeria.

The remainder of this paper is organised as follows: review of related literature (concept of financial innovation and bank efficiency), methodology, results and discussion of findings and conclusion with policy implications.

2. REVIEW OF RELATED LITERATURE

2.1 Concepts Clarifications

2.1.1 Financial innovation, information and communication technology (ICT) and bank efficiency

Financial innovation is primarily a product and organizational innovation which allows cost reduction for banks and/or a service improvement for the industry as a whole [11]. Financial innovation according to [12,13] have been a driving force to the performance of banks because of its potentials to improve the efficiency and profitability of the industry, more especially, its impact on the end users. The works of [12,13] were based on three theories: theory of constraint outcome, theory of application and its outcome and the theory of contestable market. The explanation centred on the fact that financial innovation really contributes to the performance of banks. The question of whether the banks were efficient in their operation is argued by [5] to be simultaneous with improved performance. Bank efficiency which is said to be a measure of banks' ability to turn resources into optimal maximized revenue under the framework of minimized costs against increased revenue. This is sustained using the relevant information and communication technology to drive innovation products. Information and Communication Technology (ICT) refers to technologies utilized by firms, organization, individuals or people to share, distribute and gather information and to communicate same through computer networks. It is represented by the clusters of technologies defined by their functional usage in access to information and communication of which one of them is the internet online banking through which banks perform traditional routine transactions. The uniqueness of internet banking is that it is only accessible to clients using the internet as its delivery channel.

2.2 Selected Financial Innovation Products in Nigeria

2.2.1 Automated teller machine (ATMs)

This are devices that allow a bank customer to access money from his/her account via a cash dispensing machine and the customer's account is automatically debited with same amount withdrawal [14]. This function takes place in the bank premises or designated places created by the banks. This saves customer's time in service delivery and utilized the saved time in other productive activities. ATMs are located in shopping malls, stores, fuel stations, big time eateries and restaurant, hotels, etc. [14] argued that ATMs are cost efficient in yielding higher productivity.

2.2.2 Mobile banking

This refers to the provision of banking service through mobile devices such as smart phones. 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. The benefit of mobile banking include: being the cheapest means of accessing financial services with lower transaction cost, more accessible for less educated, the very poor and less privilege who might feel intimidated in the traditional bank branches and longer openings hours among others [15].

2.2.3 Electronic/Internet banking (E-banking)

This is the use of internet and telecommunication networks to deliver a wide range of valued products and services to banks customers either at home or at the comfort of their offices or over the internet. This internet banking offers online real time traditional banking services [16].

2.3 Theoretical Underpinning

Succinctly and theoretically, this study was governed by two theories. The first is the Schumpeter theory of financial innovation. Schumpeter financial innovation theory argued that technology creates opportunities for new profits and super profits as a result of increased investment by banks or financial institution on products of innovation. The second theory is the resource based theory propounded on the sustainability of competitive advantage based on capabilities and resources [17,18]. Effective performance of the banks on the premises of the resource based theory is customer centric, hence firms strive to: provide superior customer value, achievement of relative lower costs, control of dominant market share and superior financial performance. The competitive advantage grows out of the value of a firm which creates for its buyers and should exceed the firm cost of creating the value [18].

2.4 Related Empirical Studies

Okonkwo et al. [2] empirically examined the impact of Information and Communication Technology and financial innovation on the performance of commercial banks in Nigeria, using conveniently selected eleven Commercial Banks in the country. The study used the banks' annual data and Central Bank of Nigeria facts book over the period 2001 to 2013. The study applied ordinary least square (OLS) in its analysis to ascertain the impact of E-banking services and ATM on the performance of commercial banks in Nigeria. The findings of the study indicate that an increase in banks' profitability performance increases commercial banks' Return on Equity (ROE). Investments in e banking services and ATMs do not really improve banks' performance.

Gakure and Ngumi [7] tried to establish the influence that bank innovations have on profitability of commercial banks in Kenya. Descriptive survey research design was used. The study used multiple linear regression analysis to test the statistical significance of the various independent variables (automated teller machines, debit and credit cards, point of sale terminals, mobile banking, internet banking and electronic funds transfer) on the dependent variable of profit before tax. Profit before tax was measured in Kenya shilling earnings of commercial banks while the influence of innovations was measured on a Likert scale questionnaire. The study results show that bank innovations have a moderate influence on profitability of commercial banks in Kenya. The analysis produced a coefficient of determination of 47.8% which shows the percentage of variations in profitability which is explained by bank innovations.

Simiyu et al. [19] assessed the effect of financial innovations and operationalization on market size while focusing on equity of commercial bank. The study adopted a case design approach and used both questionnaires and interview schedules in data collection. A sample of 200 respondents was drawn from the target population. The key finding was that a significant relationship between the various types of accounts and the assets growth of the bank and on the profitability of the bank. The findings also indicated that there was an effect on the loans issued by the bank on the assets and on the profitability of the bank. Finally, the Correlation indicated no significant relationship between the transaction channels employed and market but a significant relationship between the various market needs and products developed, hence more innovations were recommended to meet the customer need and expand the market size.

Jegede [6] investigated the effects of ATM on the performance of Nigerian banks. Questionnaire was used to collect the data from a convenience sample of 125 employees of five selected banks in Lagos State with interswitch network. The data collected through the questionnaire were analysed statistically by using the Software Package for Social Science (SPSS) and chi-square technique. The results indicate that less than the benefits, the deployment of ATMs terminals have averagely improved the performance of Nigerian banks because of the

alarming rate of ATM fraud. Similarly, ATM service quality is less correlated to security and privacy of users and providers.

Gakure and Ngumi [7] in trying to establish the effects of credit cards, mobile banking, internet banking and agency banking on the financial performance of commercial banks in Kenya. The population of the study consisted of forty four commercial banks that are currently operating in Kenya, The target population was Sixteen banks and at least four members of the management team with representations in the following dimensions; locally incorporated banks, banks incorporated elsewhere but operating in Kenya, banks in which the government has some shareholding and also based on size. Secondary data was collected from the banks for the periods 2008-2012. The study found that some banks in Kenya had adopted some financial innovations such as credit cards, mobile, internet and agency banking. The financial innovations had great impact on the financial performance of these banks.

Cherotich et al. [9] determined the effect of financial innovations on financial performance of commercial banks in Kenya. The study relied on secondary data. It adopted a census where all the 44 banks were used in the study and there was no sampling since the population size was small. The study found out that there is a strong relationship between financial innovations and financial performance. The study concludes that financial innovations positively affect financial performance.

In a study carried out by [20] in Lagos with the population of interest in this study which was made up of 1, 912 questionnaires were distributed and 1, 223 questionnaires returned for analysis. The duration study was from 2008 to 2013. Data collected were analysed using Pearson Correlation Statistics. The findings showed that a positive relationship exists between technology innovation and banks employee's performance. Secondly, the introduction of ICT improves customer satisfaction and retention, these reveals that there is a significant relationship between technology innovations in service delivery.

Kashmari et al. [21] evaluated the impact of financial innovation, which needs a heavy cost in terms of money and time, on the share of each bank in attracting deposit as one of the most important goals and competitive tools of a bank. By using Panel Data-Vector Autoregressive methods (Panel-VAR) and Granger causality test, data of 23 Iranian banks in the 7 years (2007-2013) has been studied. The results showed that based on the Granger Causality Test, the number of ATM machines, POS, Personal Identification Number (PIN) pad, SWIFT system and amount of banking facilities provided by each bank, has causal relation in explaining the increase of the bank's share in attracting deposits; but the Market Share was recognized as the cause of the innovation. Also, the causality direction of deposits' share and the amount of facilities were noticed to be bilateral.

Makur [22] assessed the effect of financial innovation on commercial bank's financial performance as the key players in the banking sector over a period of 5 years in South Sudan. The study used a casual research methodology and studied 16 commercial Banks registered with the central bank of South Sudan for January 2009- December 2013. The findings indicated that return on asset (ROA) recorded a mean of 3.2534 with standard deviation of 1.2548. The average number of daily transactions using ATM for the commercial banks during the study period was 156,547 with standard deviation of 20,51. It was clear that adoption of financial innovation resulted in strong financial results of commercial banks in South Sudan.

Gichungu and Oloko [10] studied the effect of mobile phone banking, ATM banking, online banking and agency banking on the financial performance of commercial banks in Kenya. The target population of this study was all the 43 commercial banks in Kenya. The study was based on secondary data which was collected from the published annual reports for commercial banks spanning five years (2009-2013) during which technological innovations have been intensely invested in by banks. Multiple regression analysis was used to test the relationship between bank innovations and financial performance among commercial banks in Kenya. In addition, the Pearson Product Moment Correlation Coefficient was used to test the direction and magnitude of the relationship between the dependent and independent variables at 95% confidence level and 5% level of significance. The study established that the identified bank innovations, precisely, mobile phone banking, online banking, agency banking and ATM banking had positively impacted on the financial performance of commercial banks in

Kenya over the 5 year period between 2009 and 2013.

Monyoncho [23] determine the relationship between E-Banking technologies and financial performance of commercial banks in Kenya. The study population included all 44 commercial banks licensed by Central Bank of Kenya. Secondary data for a five years period were collected from financial statements of commercial banks in line with the specific variables of the study. Regression analysis was conducted to establish the nature of the relationship. The study revealed that ATM innovations offer financial institutions the opportunity to transform the ATM from a cash dispenser to a customer relationship management tool, helping to enhance loyalty among all customers. Credit cards are being adopted by the banks so as to increase income, and to reduce credit and liquidity risks. Mobile banking is likely to have major impacts on the profitability of commercial banks as business operations get smoothen and that internet banking offers the convenience of conducting most of the banking transactions at a time that suits the customer.

Kamau and Oluoch [5] used correlation research design to examine the causal effect of innovation on commercial banks performance from 2012 to 2015. Purposive sampling was used to select 11 commercial banks which are listed and actively trading in NSE. Secondary data which was collected from the published annual reports for commercial banks spanning four years (2012-2015). Descriptive statistics showed the average commercial banks performance was 23.7%. Correlation analysis showed that ATM banking had the highest influence on commercial bank performance and more ATM and banking services should more availed through use of it. Regression analysis showed that ATM, mobile banking, use of credit and debit cards, internet banking and agency banking all have positive significant influence on commercial banks performance in Kenya.

3. METHODOLOGY

This study on financial innovation and efficiency of deposit money banks performance adopted an ex-post facto research design to establish the relationship between the financial innovation products and efficiency of deposit money banks in Nigeria from 2006 to 2014. The choice of the time frame was to capture the e-payment channels transaction after the consolidation exercise of 2004/2005. After the consolidation programme of 2004/2005, deposit money banks in Nigeria rolled out technologically driven products to stay in the business. The population of the study consisted of twenty three (23) banks licenced by the Central Bank of Nigeria. These banks submit their financial statement to the Central Bank of Nigeria in compliance with regulation and licencing. The Data casing the time frame were sourced from Central Bank of Nigeria Banking Supervision Report and Nigeria Deposit Insurance Corporation annual report of various issues. Bank efficiency was measured with efficiency ratio. Efficiency ratio is the measure of total overhead expenses against operating income. We proxied financial innovation by the value of transaction on the four basic e-payment channels available in Nigeria: ATMs, web/internet, Point of Sale (POS) terminal and mobile banking. The dependent variable is Efficiency Ratio (EFR) while the independent variables are Value of Transaction on Automated Teller Machine (VTATM), Value of Transaction of Web/Internet (VTWEB), Value of Transaction on Point of Sale (VTPOS) terminals and Value of Transaction on Mobile Banking (VTMOB). Monetary Policy Rate (MPR) and Cash Reserve Ratio (CRR) were introduced as control variables of Central Bank of Nigeria capable of affecting banking industry efficiency. The equation representing the algebraic expression of the financial innovation-efficiency model is stated as:

$$EFR = f(VTATM, VTWEB, VTPOS, VTMOB, MPR, CRR) \quad (3.1)$$

Logarithmically transforming the variables in the model for easy interpretation of the coefficients, equation 3.1 now becomes:

$$\begin{aligned} &LogEFR_t \\ &= a_0 + a_1 LogVTATM_t + a_2 LogVTWEB_t \\ &+ a_3 LogVTPOS_t + a_4 LogVTMOB_t + a_5 LogMPR_t \\ &+ a_6 LogCRR_t + \varepsilon_t \end{aligned} \quad (3.2)$$

Where:

EFR_t is Efficiency Ratio of deposit money banks in Nigeria in year t; $VTATM_t$, $VTWEB_t$, $VTPOS_t$, $VTMOB_t$, MPR_t and CRR_t represent value of transaction on Automated Teller Machine, Web/Internet, Point of Sale, Mobile Banking, Monetary Policy Rate and Cash Reserve Ratio respectively in year t; α_0 is the coefficient constant; α_1 - a_6 are the coefficient of independent variables and ε_t is the error term in year t.

4. ANALYSIS OF DATA AND FINDINGS

4.1 Descriptive Statistics of Variables

Table 4.1 shows the descriptive statistic of the variables of interest. Efficiency ratio, value of transaction on automated teller machine, web/internet, point of sale terminals and mobile banking averaged 81.00333, 1291223, 40046.34, 68736.38, 35730.03, 10.05556 and 6.616667 respectively. The maximum values are 181.7700 for EFR, 3679880 for VTATM, 84150 for VTWEB, 312070.0 for VTPOS, 142800.0 for VTMOB, 13.00000 for MPR and 16.250000 for CRR. The minimum values of the series were shown to be 31.77000, 86200.00, 3000.000, 6442.100, 95.00000, 6.00000 and 1.0000 for EFR, VTATM, VTWEB, VTPOS, VTMOB, MPR and CRR respectively. All the variables are positively skewed towards normality as evidenced by the positive sign of the skewness except for MPR. The Jarque-Bera suggests that all the variables are not normally distributed except EFR owing to insignificant level of p-values at 5% level of significance.

4.2 Diagnostic Test

4.2.1 Serial correlation LM test

The serial correlation LM test the presence of serial correlation in a model. It corrects the deficiency of Durbin Watson regarding autocorrelation. If the p-value of the F-statistic of Breusch-Godfrey serial correlation LM test is not significant at 5% level of significance then there is no autocorrelation among the residuals. On the other hand, if p-value of the F-statistic of Breusch-Godfrey serial correlation LM test is significant at 5% level of significance, autocorrelation exist among the residuals. From Table 4.2a, the p-value of Breusch-Godfrey serial correlation test is insignificant p-value (at 5% significance level) indicating that the variables residuals are not serially correlated. Nevertheless, the Durbin Watson test of autocorrelation in Table 4.4 discloses that the variables are free from autocorrelation problem.

4.2.2 Heteroskedasticity test

In classical linear regression assumption, the variance of the residuals should not increase with fitted values of response or dependent variable. If the p-value of the F-statistic of the heteroskedasticity test is significant at 5% level of significance, disturbances appearing in the population regression are not homoscedastic in nature. Similarly, if the p-value of the F-statistic of the heteroskedasticity test is not significant at 5% level of significance, heteroskedasticity does not exist in the model. The p-values of F-statistics of the model is insignificant at 5% level of significance thus, the model as developed by this study is not associated with heteroskedasticity. Table 4.2b provides an evidence to this claim using the Breusch-Pagan-Godfrey test of heteroskedasticity.

4.2.3 Ramsey Reset specification

The Ramsey Reset Test determines the fitness of the model, whether it was properly specified or not. The null hypothesis of Ramsey Reset specification is that the model is well specified as there is no omitted variables. If the p-value of F-statistic is greater than conventional significance

Table 4.1. Summary of descriptive statistics

	EFR	VTATM	VTWEB	VTPOS	VTMOB	MPR	CRR
Mean	81.00333	1291223.	40046.34	68736.38	35730.03	10.05556	6.616667
Median	71.43000	548600.0	31570.00	20200.00	6650.000	10.00000	3.000000
Maximum	181.7700	3679880.	84150.00	312070.0	142800.0	13.00000	16.25000
Minimum	31.77000	86200.00	3000.000	6442.100	95.00000	6.000000	1.000000
Std. Dev.	41.71084	1302030.	28053.58	103109.7	55424.12	2.533457	5.609479
Skewness	1.636852	0.749747	0.295894	1.724885	1.254457	-0.606903	0.555283
Kurtosis	5.081480	2.146438	1.818057	4.516083	2.794739	2.042715	1.789963
Jarque-Bera	5.643636	1.116394	0.655200	5.324784	2.376294	0.896146	1.011579
Probability	0.049498	0.572240	0.720651	0.069781	0.304786	0.638858	0.603029
Sum	729.0300	11621005	360417.1	618627.4	321570.3	90.50000	59.55000
Sum Sq. Dev.	13918.35	1.36E+13	6.30E+09	8.51E+10	2.46E+10	51.34722	251.7300
Observations	9	9	9	9	9	9	9

Source: Computer output data using E-views 8.0

level of 0.05%, the null hypothesis of correct specification would not be rejected. On the other hand, if the p-value of F-statistic is significant at 0.05, the null hypothesis is rejected. From Table 4.2c, the p-value of F-statistic is insignificant at 5% signifying that our model does not suffer from endogeneity causing biased coefficient estimates.

4.3 Stationarity Test

There is need to consider the time series property of data. This is because non-stationarity of time series data has always been regarded as a problem in empirical analysis. This may lead to incorrect and spurious regression result from which inferences would become meaningless. To avert the occurrence of spurious results, stationarity of data were checked using Augmented Dicky-Fuller (ADF) and Phillips-Perron tests. The essence of the ADF tests is the null hypothesis of non stationarity. To reject this, the ADF statistics must be more negative than the critical values and significant. On the other hand, the Phillips-Perron test differs because it is a robust test for serial correlation and time dependent heteroskedasticities.

4.3.1 Augmented dickey-fuller (ADF) test

The ADF stationarity test was performed at level and first difference. The result in Table 4.3a evidenced the stationarity of all the variables and are not linked stationarity defect of most time series data.

4.3.2 Phillips perron (PP) test

To further confirm the stationarity of the variables, Phillips Perron test was conducted and the result as presented in Table 4.3b indicates that the variables are stationary.

4.4 OLS Relationship

4.4.1 Financial innovation and efficiency of deposit money banks

The regression result in Table 4.4 reveals that value of transaction on ATM, POS and MPR have negative insignificant relationship with deposit money banks efficiency ratio. Mobile banking transaction, transaction performed on web/internet and cash reserve ratio have positive but insignificant relationship with efficiency ratio. The coefficient of the constant is an insinuation that when transaction value on ATM, POS, Web/internet, mobile banking, monetary policy rate and cash reserve ratio are kept constant, deposit money banks efficiency ratio would be 102.90%. A unit increase in the value of transaction on ATMs, POS and MPR decreases efficiency ratio by a factor of 0.00016, 0.00011 and 12.79 respectively. A percentage increase in value of transaction on web/internet, mobile banking and cash reserve ratio lead to a corresponding factor rise in efficiency ratio by 0.002450, 0.000964 and 28.25671 respectively. This findings infer that deployment of more ATMs and POS terminal by deposit money banks reduce the ratio of total overhead expenses to operating income while web/internet and mobile banking channels increases total overhead expenses to operating income. Put differently, deposit money banks investment in ATMs and POS reduces operating expenses but, such is not the case for investment in web/internet and mobile banking. A finding that is worthy of notice is the fact that investment in web/internet infrastructures by banks increases their operating income, however, this is not statistically significant at 5% level of significance.

Table 4.2a. Serial correlation LM test result

F-statistic	0.007897	Prob. F(1,1)	0.9436
Obs*R-squared	0.070514	Prob. Chi-Square(1)	0.7906

Source: Computer output data using E-views 8.0

Table 4.2b. Breusch-pagan-godfrey heteroskedasticity test result

F-statistic	0.400161	Prob. F(4,4)	0.8376
Obs*R-squared	4.909991	Prob. Chi-Square(4)	0.5554
Scaled explained SS	0.313500	Prob. Chi-Square(4)	0.9994

Source: Computer output data using E-views 8.0

Table 4.2c. Ramsey reset specification result

	Value	df	Probability
t-statistic	0.134496	1	0.9149
F-statistic	0.018089	(1, 1)	0.9149
Likelihood ratio	0.161347	1	0.6879

Source: Computer output data using E-views 8.0

The Adjusted R-squared depicts that 59.20% variations in efficiency ratio of deposit money banks in Nigeria was as result of combined changes in value of transaction on ATM, POS, web/internet, mobile banking, monetary policy

rate and cash reserve ratio. The F-statistics of 2.93 denotes that financial innovation products jointly and insignificantly explained the changes in efficiency ratio over the period studied as evidenced by p-value of 0.28. The Durbin Watson value suggests the variables are not serially correlated. This is further confirmed by the Breusch-Godfrey serial correlation test in Table 4.2a.

4.5 Financial Innovation Impact on Bank Efficiency

To assess the significant impact of financial innovation products on bank efficiency, this study carefully and unambiguously applied the granger causality impact assessment test and the outcome summarized in Table 4.5. From Table 4.5, financial innovation products expressed by value of transaction on ATMs, web/internet, POS and mobile banking has no significant impact on efficiency ratio of deposit money banks in Nigeria. However, the granger causality test reveals the presence of a unidirectional relationship at 5% significance level between efficiency ratio and value of transactions on ATM where the causality was found to flow from deposit banks efficiency ratio to ATMs transaction value. This is to say that rather than financial innovation products having significant impact on banks efficiency, it is banks efficiency ratio that exert significant and statistically significant impact on value of transactions on ATMs. Thus, net operating income is a determinant factor to investment in ATMs infrastructure by banks: the higher the net operating income, the greater the deployment of ATMs and associated maintenance cost thereof. This is in line with findings of [2] that investment in ATMs by deposit money banks in Nigeria does not improve the wealth of shareholders. This result refutes the findings of [6] that the deployment of ATMs terminals have averagely improved the performance of Nigerian banks because of the alarming rate of ATM fraud. None of the control variables exerted significant impact on efficiency of Nigeria banking industry within the period studied.

Table 4.3a. ADF test result

Variables	ADF Test Statistic	Test critical value at 1%	Test critical value at 5%	Order of integration /remark
EFR	-4.131730 (0.02)**	-4.582648	-3.320969	1(0)/Stationary
VTATM	-4.846099 (0.00)*	-3.007406	-2.021193	1(1)/Stationary
VTWEB	-4.684007 (0.01)*	-4.803492	-3.403313	1(1)/Stationary
VTPOS	-5.554041 (0.01)*	-3.007406	-2.021193	1(1)/Stationary
VTMOB	-4.398911 (0.01)*	-3.007406	-2.021193	1(1)/Stationary
MPR	-2.959328 (0.02)**	-2.937216	-2.006292	1(1)/Stationary
CRR	-3.423100 (0.00)*	-3.109582	-2.043968	1(1)/Stationary

Source: Computer Output using E-view 8.0.

Note: The optimal lag for ADF test is selected based on the Akaike Info Criteria (AIC), p-values are in parentheses where (*) and (**) denotes significance at 1% and 5% respectively

Table 4.3b. PP test result

Variables	PP Test statistic	Test critical value at 1%	Test critical value at 5%	Order of integration /Remark
EFR	-11.57355 (0.00)*	-2.937216	-2.006292	1(1)/Stationary
VTATM	-5.517945 (0.00)*	-3.007406	-2.021193	1(1)/Stationary
VTWEB	-4.634069 (0.00)*	-2.937216	-2.006292	1(1)/Stationary
VTPOS	-4.554041 (0.02)**	-3.007406	-2.021193	1(1)/Stationary
VTMOB	-5.055984 (0.00)*	-3.007406	-2.021193	1(1)/Stationary
MPR	-2.544668 (0.02)**	-2.937216	-2.006292	1(1)/Stationary
CRR	-2.930166 (0.02)**	-3.007406	-2.021193	1(1)/Stationary

Source: Computer Output using E-view 8.0.

Note: In determining the truncation lag for PP test, the spectral estimation method selected is Bartlett kernel and Newey-West method for Bandwidth, p-values are in parentheses where (*) and (**) denotes significance at 1% and 5% respectively

Table 4.4. OLS Regression for financial innovation and deposit money bank efficiency dependent variable: Efficiency ratio

Variable	Coefficient	Std. error	t-statistic	Prob.
C	102.9030	81.39403	1.264257	0.3335
VTATM	-0.000159	9.08E-05	-1.754129	0.2215
VTWEB	0.002450	0.000782	3.133560	0.0885
VTPOS	-0.000107	0.000230	-0.467066	0.6864
VTMOB	0.000964	0.000658	1.465928	0.2803
MPR	-12.76933	11.07593	-1.152891	0.3681
CRR	28.25671	17.10322	1.652128	0.2403
R-squared	0.898010	Mean dependent var		81.00333
Adjusted R-squared	0.592041	S.D. dependent var		41.71084
S.E. of regression	26.64141	Akaike info criterion		9.454289
Sum squared resid	1419.530	Schwarz criterion		9.607686
Log likelihood	-35.54430	Hannan-Quinn criter.		9.123259
F-statistic	2.934967	Durbin-Watson stat		1.628073
Prob (F-statistic)	0.275825			

Source: Computer output data using E-views 8.0

Table 4.5. Granger causality result financial innovation and efficiency of bank

Null hypothesis	Obs	F-Statistic	Prob.	Remarks
VTATM does not Granger Cause EFR	7	0.06175	0.9418	No Causality
EFR does not Granger Cause VTATM		50.9150	0.0193	Causality
VTWEB does not Granger Cause EFR	7	0.52123	0.6574	No Causality
EFR does not Granger Cause VTWEB		2.17369	0.3151	No Causality
VTPOS does not Granger Cause EFR	7	1.27311	0.4399	No Causality
EFR does not Granger Cause VTPOS		0.49399	0.6693	No Causality
VTMOB does not Granger Cause EFR	7	0.11006	0.9009	No Causality
EFR does not Granger Cause VTMOB		3.06411	0.2461	No Causality
MPR does not Granger Cause EFR	7	0.30595	0.7657	No Causality
EFR does not Granger Cause MPR		4.14363	0.1944	No Causality
CRR does not Granger Cause EFR	7	0.15838	0.8633	No Causality
EFR does not Granger Cause CRR		1.22107	0.4502	No Causality

Source: Computer analysis using E-views 8.0

4.6 Test of Hypothesis

4.6.1 Decision criteria

If the F-statistic in Granger causality test is less than 0.05, the null hypothesis is rejected. On the other hand, if the F-statistic in Granger causality test is greater than 0.05, the null hypothesis is accepted.

The granger impact assessment result in Table 4.5 (above) established that the hull hypothesis that financial innovation products: ATMs, web/internet, point of sale terminal and mobile banking has no significant impact on efficiency ratio of deposit money banks in Nigeria is accepted. This is evidenced on the insignificant at 5% level of significance p-values of the F-statistic for financial innovation products.

5. CONCLUSION, IMPLICATION OF FINDINGS AND RECOMMENDATIONS

5.1 Conclusion

Financial innovation products: ATMs, POS, web/internet and mobile banking and its impact on efficiency of deposit money banks is indisputable despite the associated risk of frauds that have consistently trailed e-payment platforms in Nigeria. After the banking consolidation programme of 2004/2005, activities of deposit money banks in Nigeria rose up to aligning with their foreign counterparts in achieving competitive advantage through the use of technologies. The finding of this study revealed that infrastructural investments in ATMs and POS and banks efficiency ratio are negatively related that is, value of transaction on

ATMs and POS reduces total operating expenses to net income ratio. Furthermore, financial innovation products have no significant impact on efficiency ratio of deposit money banks in Nigeria rather, it is the efficiency ratio that determines the investment in ATMs infrastructures. Therefore, we conclude that efficiency ratio determines the deployment of information technology and communication banking products in Nigeria.

5.2 Implication of Findings

The positive nexus between web/internet transaction, mobile banking and efficiency ratio gives preference to ATMs and POS channels as cost effective and efficient for banks. Therefore, banks should invest more in ATMs and POS platforms as it reduces the operating expenses to net income ratio while ensuring effective utilization of existing web/internet and mobile banking infrastructure rather than acquiring new ones that will gulp a large fraction of their net operating income. Web/internet and mobile banking should be redesigned in such a way that customization will enable customers access all the banking services which would indeed reduce its transaction costs. This calls for dialogue and negotiation with mobile service providers operating in Nigeria.

5.3 Recommendations

Against the backdrop of the findings and implications, the study further recommended that firstly, the Central Bank of Nigeria should mount impeccable entity to track fraudsters beyond what is currently in place. Secondly, target of efficiency ratios to be prescribed for deposit money banks. Thirdly, in lie with International Bank Payment (IBP) investment ratio on ATM and POS be prescribed for deposit money banks for strict compliance and finally, Central Bank of Nigeria to factor deposit money banks efficiency ratio performance along with bank performance.

CONTRIBUTION TO KNOWLEDGE

This contributes to existing literature on the financial innovation and efficiency in the banking industry by using up to date data and applying all the electronic payment channels available in Nigeria. The inclusion of monetary policy rate and cash reserve ratio also help to ascertain the effect of Central Bank of Nigeria major monetary policy instruments on efficiency of the banking industry with regard to the consolidation exercise of 2004/2005.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Emefeile GI. The financial services industry agenda for a new Nigeria. A keynote address presented at the 9th annual banking and finance conference of the Chattered Institute of Bankers of Nigeria (CIBN); 2016.
2. Okonkwo VI, Obinozie HE, Echekoba FN. The effect of information communication technology and financial innovation on performance on Nigerian commercial banks (2001 – 2013). European Journal of Business and Management. 2015;7(22): 162-171.
3. Abubakar A, Rasmaini BT. The impact of information and communication technology (ICT) on bank performance and customer's service delivery in the banking industry. International Journal of Latest Trends in Finance and Economic Science. 2012; 2(1):25-36.
4. Joshua A. Technological innovations and banking: An evaluation of customers' perceptions. Academic Leadership Online Journal. 2010;8(4):51-63.
5. Kamau DM, Oluoch J. Relationship between financial innovation and commercial banks performance in Kenya. International Journal of Social Sciences and Information Technology. 2016;2(4): 34-47.
6. Jegede CA. Effects of automated teller machine on the performance of Nigerian banks. American Journal of Applied Mathematics and Statistics. 2014;2(1):40-46.
7. Gakure R, Ngumi P. Do bank innovations influence profitability of commercial banks in Kenya? Prime Journal of Social Science. 2013;2(3):237-248.
8. Muiruri JK, Ngari JM. Effects of financial innovations on the financial performance of commercial banks in Kenya. International Journal of Humanities and Social Science. 2014;4(7):51-57.
9. Cherotich KM, Sang W, Shisia A, Mutung'u C. Financial innovations and performance of commercial banks in Kenya.

International Journal of Economics, Commerce and Management. 2015;3(5): 1242-1265.

10. Gichungu ZN, Oloko MA. Relationship between bank innovations and financial performance of commercial banks in Kenya. International Journal of Education and Research. 2015;3(5):443-456.
11. European Central Bank (ECB). Structural change and growth prospects in Asia-challenges to central banking; 2003. Available:http://www.ecb.europa.eu (Accessed 25th July, 2016)
12. Silbert W. The process of financial innovation. American Economic Review. 1975;73(2):131-161.
13. Kane EJ. Accelerating inflation, technological innovation and the decreasing effectiveness of banking regulation. Journal of Finance. 1981;36(2): 355-367.
14. Ojukwu RM, Sujuyigbe AS. The impact of electronic banking on human resources performance in the Nigerian banking industry. International Journal of Eecomomic Research. 2012;3(2):61-69.
15. Fatokun D. Viable agent banking and mobile payment system in Nigeria. Central Bank of Nigeria Bullion. 2013;36(3):70-79.
16. Bradley L, Stewart K. Delphi study of Internet banking. MCB UP Limited. 2003; 272-281.
17. Barney J. Firm resources and sustained competitive advantage. Journal of Management. 1991;17(1):99-120.
18. Peteraf A, Bergen M. Scanning dynamic competitive landscapes: A market based and resourced based framework. Strategic Management Journal. 2003; 24:309-323.
19. Simiyu RS, Ndiang'ui PN, Ngugi CC. Effect of financial innovations and operationalization on market size in commercial banks: A case study of equity bank, Eldoret branch. International Journal of Business and Social Science. 2014; 5(8):227-249.
20. Ilo, JVC, Ani WU, Chijoke NS. Impact of technological innovation on delivery of banking services in Nigeria. 14th International Conference on Economics, Education and Humanities, Indonesia. 2014;162-168. Available:http://dx.doi.org/10.15242/ICEHM.ED1214048.\
21. Kashmari A, Nejad AGH, Nayebyazdi A. Impact of electronic banking innovations on bank deposit market share. Journal of Internet Banking and Commerce. 2016; 21(1):1-12.
22. Makur PM. The effects of financial innovation on the financial performance of commercial banks in South Sudan. A research project submitted in partial fulfilment of the requirements of the degree of master of business administration. School of Business, The University of Nairobi; 2014.
23. Monyoncho LN. Relationship between banking technologies and financial performance of commercial banks in Kenya. International Journal of Economics, Commerce and Management. 2015;3(2): 748-815.

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