

# Dynamic Linkage(s) between Financial Innovation and Efficiency of Deposit Money Banks in Nigeria

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**Abstract:** The emergence of new technologies, changing customer expectations, and regulatory imperatives, among others, have driven the financial industry into an era where "digital innovations" thrive, culminating in the emergence and growth of innovative products such as agency banking, mobile/internet banking, mobile money, unstructured supplementary service data (USSD), just to name a few. There is increased customers' reliance on e-channels. This has further established the need for banks to engage in financial innovation for relevance, competitiveness, efficiency and growth. This study, therefore, examines the dynamic linkage(s) between financial innovation and the efficiency of deposit money banks (DMBs) in Nigeria. The population of the study comprises the 13 listed DMBs in Nigeria as of 31 December 2021, and these serve as the sample size. The period covered is 48 months -2016 and 2019. Data were collected from the bank's annual reports and Apex bank's statistical bulletin. Descriptive statistics, correlation and autoregressive distributed lag (ARDL) cointegration techniques were used for data analyses. The efficiency of DMBs was estimated using data envelopment analysis (DEA). Findings reveal that financial innovation has forward and backwards dynamic linkages with the efficiency of DMBs in Nigeria.

**Key-Words:** - Financial innovation; Agency Banking; USSD; ARDL; and DEA.

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## 1 Introduction

Over the years the global economy has been greatly interconnected and interwoven. In the same vein financial services have been deeply integrated. In recent times, the financial landscape has been riding upon waves of technological disruptions, [1]. The emergence of new technologies, changing customer expectations, and regulatory imperatives, among others, have driven the financial industry into an era where "digital innovations" thrive, culminating in the emergence and growth of innovative products such as agency banking, mobile/internet banking, unstructured supplementary service data (USSD), "virtual banking", and many more, [2].

The Nigerian financial industry is without a doubt one of the country's most digitally-driven industries. Over the years, DMBs in Nigeria have gradually subscribed to and adopted financial innovation products such as agency banking, mobile/electronic banking, (USSD), etc., as selling points and operational strategies to ensure better service provision, improved customer satisfaction,

and enhance organizational performance in terms of efficiency. They use certain inputs to optimize output. They make an effort to use low input to generate high output and thus achieve a significant reduction in costs and wastes, to realize optimum results, [3], [4]. All of these are a result of advances and improvements in ICT, digitization, improved regulation and heightened customer expectation, among others, [1], [2]. The reality, therefore, is to determine if there is a corresponding effect on organizational performance in terms of the efficiency of the DMBs. As input changes through improved technology and innovation, is there a linkage between output (improved performance/efficiency)? What is the effect of "process and product improvement" on the performance and efficiency of DMBs? Is there any significant effect of digitization (financial innovation) on performance and efficiency? Naturally, the expectation would be that changes and embrace(s) of digital know-how (financial innovation) by banks would lead to increased performance and efficiency. This is a

research question this study is poised to find the answer to.

Financial innovation was one of the inevitable phenomena that resulted from the liberalization of the Nigerian financial sector. While studies exist that investigate the effect of financial innovation on DMBs in Nigeria, only a few have researched its effect on their performance in terms of efficiency. Among them, just a handful have researched agency banking; and none has researched USSD as one of the financial innovation variables because it is new. Besides, most of the studies employ the traditional metrics of performance measurement such as RoI, RoE, RoA, Total Asset, Income and Cost Analyses, (not DEA) in assessing the effect of financial innovation on the performance of DMBs in Nigeria. Data envelopment analysis (DEA) is a nonparametric scientific technique that is used to measure efficiency. It helps to overcome the challenges of using accounting ratios such as RoI, RoA, etc. Besides, this is one study that examines the dynamic linkages between financial innovation and the efficiency of DMBs in Nigeria using bank size as a control variable. The dearth of empirical studies, therefore, mandates this study, which fills this gap in the literature.

Different researchers such as [1], [5], [6], [7], [8], [9], [10], [11], [12], [13], [14], [15], [16], [17], [18], [19], [20] researched financial innovation using different financial innovation variables. None has researched financial innovation using USSD. None of these studies measured performance using efficiency, or the DEA technique. Also, none of the studies used bank size as a control variable. This study is therefore unique as it helps to fill the gap thus identified.

Other studies that investigate the dynamic linkage(s) between financial innovation and the efficiency of banks are as follows: [1], [7], [17], [18], [20] assess the effect of financial innovation on the financial performance and found that financial innovation has a positive and significant effect on the efficiency of banks globally. Studies with negative findings include the study of [12], [13], [18], [19],

which concludes that digital financial services offered by fintech have a negative effect on the performance of commercial banks in Kenya, Nigeria and Ghana.

Therefore, the general objective of this study is to examine the effect of financial innovation on the efficiency of DMBs; while the specific objective of the study is to examine the dynamic linkage(s) between financial innovation and the efficiency of DMBs in Nigeria. Financial innovation in this study does not cover digital currency such as eNaira or cryptocurrency. The period of this study covers 4 years, i.e., 48 months from 2016 to 2019. The years and months are chosen because unlike other financial innovations such as ATM and PoS, agency banking and USSD are very current as they were introduced in Nigeria in 2016 and data are only obtained for this period. The study used 48 months and used agency banking and USSD as a proxy for financial innovation while organizational performance is measured with efficiency. The study measured efficiency using DEA which involves using the banks' input and output variables. Descriptive and inferential statistics were used, while correlation and autoregressive distributed lag (ARDL) cointegration techniques were used for data analysis. Findings reveal that financial innovation has forward and backwards dynamic linkages with the efficiency of DMBs in Nigeria. The hypotheses for the study are therefore stated as follows: H<sub>1</sub>: Financial innovation has no significant effect on the efficiency of deposit money banks in Nigeria; H<sub>2</sub>: Bank size has no significant effect on the efficiency of deposit money banks in Nigeria; H<sub>3</sub>: There is no short run, long run dynamic effect of financial innovation on the efficiency of deposit money banks in Nigeria.

## 2 Conceptual Framework

The conceptual framework highlights the connection between the dependent and independent variables as well as the control variable. Figure 1 below clearly depicts this connection.

Figure 1: Conceptual Framework

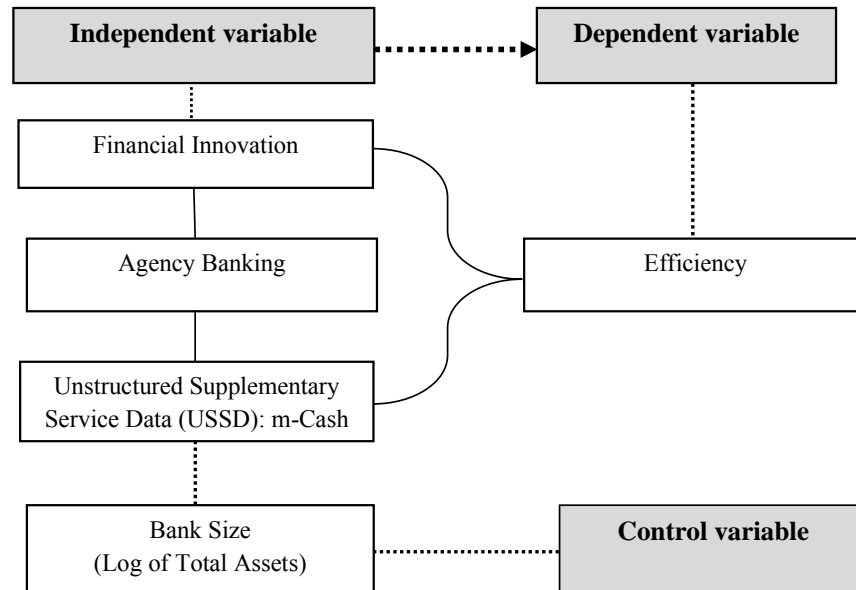


Fig. 1: Conceptual Framework

Source: Researcher's Model of Financial Innovation and Performance (Efficiency)

**Financial Innovation:** Financial innovation is generally marked by the introduction of a new product or a new process in the financial system, [21], [22], [23]. Financial innovation may also involve modifying an existing idea as either a product or a process, [10], [24].

**Branchless (Direct) Banking:** Banking outside the conventional banking system, or using platforms other than the traditional bank branches is often referred to as branchless banking [9]. It comprises the delivery of financial services using retail agents or other third-party intermediaries. It also involves the use of digital platforms by DMBs (such as mobile banking) as the key point of contact with customers, [9], [19].

**Agency Banking:** Agency banking (otherwise referred to as agent banking) is the delivery of financial services to customers via a third party (agent) on behalf of an authorized deposit-taking financial institution or mobile money operator, [19]. According to [6], agency banking is a form of branchless banking that enables traditional banks to increase their network of branches and services (cost-effectively and efficiently, through authorized agents) into areas, where traditional banking services are difficult to reach, [6].

**Unstructured Supplementary Service Data (USSD):** USSD is a global system for mobile communications

(GSM) protocol that is used for mobile money services, prepaid services, menu-based information services and location-based content services (CBN Bulletin, 2018). With USSD, users interact directly from their mobile phones by making selections from various menus. Unlike an SMS message, during a USSD session, a USSD message creates a real-time connection. This means USSD enables two-way communication of information, [25].

**Performance:** Performance (in the context of an organization) is the practice of measuring the results of a firm's strategies, policies and operations in monetary terms (Bonn et al., 2004). Performance is in two forms: financial performance and non-financial performance, [26]. Performance is a general structure that refers to the enterprise's operations, [3]. Performance can also be seen as a reflection of the productivity and efficiency of members of an enterprise and the enterprise itself, measured in terms of revenue, profit, growth, competitiveness, development, and expansion of the organization, [3]. Some organizations measure performance using market share, growth metrics, expansion, efficiency, survival, number of employees, quality of employees, employee turnover, competitiveness, and capital employed, [26], just to mention a few. In this study, performance is measured using efficiency.

**Efficiency:** Generally speaking, efficiency involves a process that helps to optimize the use of resources

(Zala, 2020). We can say there is efficiency where the least amount of resources (e.g. time and money) is used to achieve the best (most) possible outcomes [10]. Efficiency is defined as a level of performance that describes a process that uses the least amount of inputs to make the foremost significant amount of outputs, [10]. Efficiency relates to any or all inputs employed in producing any given output, including personal time and energy, [27].

*Bank Size:* According to [25] two measures of bank size are mostly found in the literature. They are systemic and absolute bank size. Systemic bank size is measured either as the ratio of gross turnover to total assets, [28], or bank assets as a percentage of the statement of financial position. This is then compared to the industry standard, [29]. A bank's absolute size may be defined as the log of total assets, [28], [29], or the ratio of the bank's total assets to total financial position.

## 2.1 Theoretical Framework

In the course of this study, several theories were reviewed. Kane's theory of regulatory dialectics and the branchless banking theory were found to underpin the study:

*Kane's Theory of Regulatory Dialectics:* Kane developed this theory in 1984, and he sees financial innovation as an institutional response to financial costs created by changes in technology, market needs and political forces, particularly laws and regulations, [30]. Kane describes the interactive regulatory process that follows institutional avoidance and innovation as a dialectical process. Financial innovation in Nigeria is largely driven by the CBN cashless policy instrument encapsulated in its FSS 2020 policy document. This theory is relevant to this study as it highlights some of the reasons behind banks' use of innovation to address requirements of the regulation, ICT, competition, and market forces for efficient performance.

*Branchless Banking:* The branchless banking theories are divided into three groups: bank-led, non-bank-led,

and bank-focused theories, [31]. These theories are very significant and relevant to this study because many financial innovation products ride on the principle of branchless (Direct) banking. The theories mainly seek to explain how financial innovation has given rise to the notion of branchless banking. They explain how branchless banking is conducted, and thus contribute to this study's independent variable [9], [31], [32]. A regulated financial institution delivers financial services and products through a retail agent in the bank-led theory of branchless banking. This is also known as agency banking. The bank generates financial services and products and then distributes them to customers through retail agents. Retail agents deal with customers face-to-face and execute cash-in/cash-out activities in the same way that a teller at a bank's branch would take deposits and process withdrawals [9]. The bank does not need to set up a branch at the agents' location.

## 3 Methodology

This study uses the ex-post facto research design. This is because the study tries to find out the cause-and-effect relationship between the variables whose occurrence has already taken place. The data has already manifested and cannot be manipulated. According to [31], [32] Ex-post facto research design is a systematic empirical inquiry in which the researcher does not directly control the variables because their manifestations have already occurred and they are inherently not manipulated. The population of the study comprises the 13 DMBs listed on the Nigeria Exchange Group (NGX) as of December 2021, and they also serve as the sample size. Data were analyzed using descriptive and inferential statistics, as well as the ARDL cointegration technique. Input (total asset) and output (turnover) data were extracted for banks' Annual Reports for the period. DEA was used to determine banks' efficiency.

Table 1. Measurement of the Variables

| Variables            | Measures  | Authors                |
|----------------------|---|------------------------|
| Bank Size            | The natural logarithm of total assets is used as a proxy for bank size (ln SIZE), in line with Salehi et al. (2012) | [25], [27], [28], [29] |
| Financial innovation | Agency Banking (volume and value); and USSD (volume and value)  | [5] and [17]           |
| Performance          | Efficiency  | [26]                   |
| Efficiency           | Input and Output  | [13], [18], [22]       |
| Input (4)            | Total assets (current and non-current assets)   | Self-Measurement       |
| Output (4)           | Turnover (gross)  | Self-Measurement       |

Source: Author' Compilation (2022)

The study adopted a pre-test analysis of correlation and unit root test using the Augmented Dickey-Fuller (ADF) test. After analyzing the unit root test, a decision to use ARDL was determined.

### 3.1 Model Specification

Model:

$$EFF = \beta_0 + \beta_1 VAUSSD_{i,t} + \beta_2 VAAGBA_{i,t} + \beta_3 BS_{i,t} + \epsilon_{i,t} \dots 1$$

Where:

|        |   |                         |
|--------|---|-------------------------|
| EFF    | = | Efficiency              |
| VAUSSD | = | Value of USSD (m-cash)  |
| VAAGBA | = | Value of agency banking |

The model specification follows the established theoretical framework. It aids to establish the dynamic linkage (s) between financial innovation and performance in terms of the efficiency of DMBs in Nigeria. The model used is represented and summarized below:

|                     |   |  |
|---------------------|---|--|
| BS                  | = | Bank size  |
| $\beta_0$           | = | Constant   |
| $\beta_1 - \beta_3$ | = | Beta coefficient that measures the sensitivity of independent variables to changes in the dependent variable |
| $\epsilon$          | = | Error Term   |

## 4 Results and Discussion

### Descriptive Statistics and Test Results

Table 2 shows a summary of the statistical methods employed in this empirical study. The mean value of efficiency (EFF) has the lowest mean value of 1.2774, while the mean value of (USSD) has the greatest mean value of 620277, as shown in the table. The value of USSD (VAUSSD) and Bank size (BS) have mean values of 8.94 and 2.516 respectively. The

table's values for skewness and kurtosis were also used to help with the analysis. The skewness of the histogram is used to determine symmetry, while the tail shape of the histogram is used to determine kurtosis. As a result, all of the variables are positively biased except efficiency. Kurtosis, on the other hand, comes in three varieties: mesokurtic, platykurtic, and leptokurtic. As can be seen from the table, all of the variables in the distribution have a positive kurtosis value, indicating that the distribution is leptokurtic. See Table below.

Table 2. Descriptive Statistics Results

|              | EFF       | VAUSSD   | VAAGBA   | BS       |
|--------------|-----------|----------|----------|----------|
| Mean         | 1.277423  | 62027752 | 8.94E+11 | 2.516592 |
| Std. Dev.    | 0.493452  | 50750315 | 8.49E+11 | 0.342307 |
| Skewness     | -0.047235 | 1.207014 | 0.682392 | 2.338479 |
| Kurtosis     | 1.965503  | 4.103824 | 1.912541 | 8.701889 |
| Observations | 48        | 48       | 48       | 48       |

Source: Author's Computation, (2022)

Table 3. Unit Root Test

| Variables | Level                   |                          | first difference        |                          | Order in integration |
|-----------|-------------------------|--------------------------|-------------------------|--------------------------|----------------------|
|           | Augmented Dickey-Fuller | MacKinnon Critical Value | Augmented Dickey-Fuller | MacKinnon Critical Value |                      |
| EFF       | -6.3183***              | -3.5777***               | -                       | -                        | 1(0)                 |
| VAUSSD    | -3.16298***             | -3.57772***              | -                       | -                        | 1(0)                 |
| VAAGBA    | -                       | -                        | -8.66108***             | -3.58115***              | 1(1)                 |
| BS        | -7.42405***             | -3.57772***              | -                       | -                        | 1(0)                 |

Source: Author's Computation, (2022)

**Result of Unit Root Test:** Augmented Dickey-Fuller unit root are respectively reported in Table 3.

From the Augmented Dickey-Fuller unit root table above (Table 3), it could be seen that the value efficiency (EFF), the value of USSD (VAUSSD), and the value of bank size (BS) are all non-stationary series in level form except the value of agency banking (VAAGBA). Meaning all the variables are of order 0 except the value of agency banking which is of order 1. This justifies the reason to embark on the ARDL estimation.

**Estimation of the ARDL Model for EFF:** This hypothesis is rejected because the result shows the existence of both short-run and long-run dynamic effects of financial innovation on the efficiency of

DMBs in Nigeria. The result of the hypothesis is presented in the Figure below (Figure 2) showing the model criteria selection graph and Table 4 showing the bound test, after which the estimation was broken down into its short-run and long-run components as well as the speed of adjustment to equilibrium in the case of disequilibrium.

**Model Selection – Criteria Graph for EFF Model:** The best 20 models, among which the overall best is automatically chosen for the estimation of the ARDL EFF Model is exhibited in Figure 2 below.

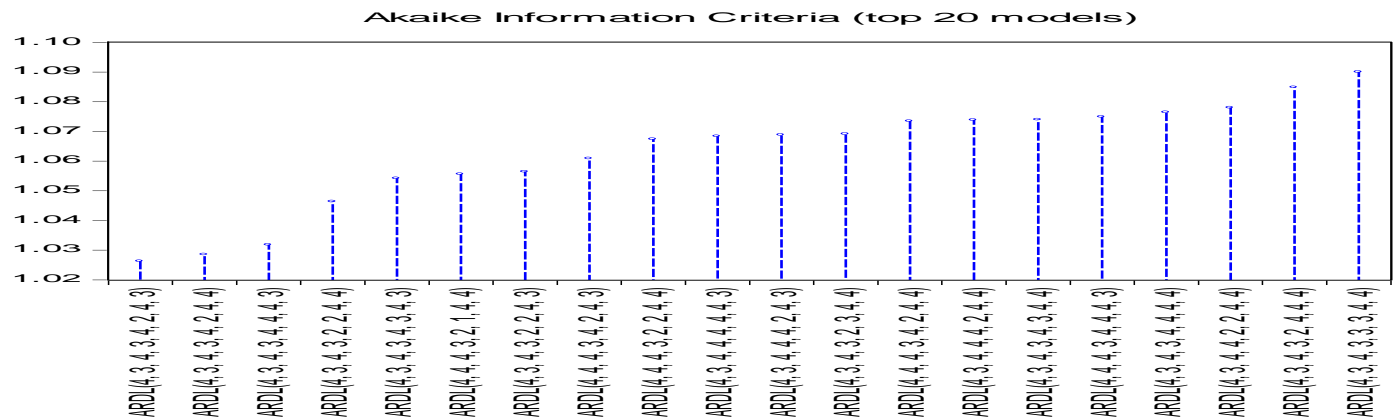


Fig. 2: Model Selection – Criteria Graph for Model for EFF

Source: Computed by the Researcher, (2022)

Figure 2 above gives the values of the Akaike information criterion for the estimated ARDL model. The purpose is to see clearly that the model that minimizes the AIC is chosen given the maximum lag selected.

*Cointegrating Bound Testing for ARDL EFF Model:* Table 4 below, highlights the bound testing for cointegration for EFF. Test statistics (K), F-statistics and the Critical values for EFF are all depicted in the table.

As presented in Table 4, the parameter k simply equals total variables minus one which is 7. Cointegration is tested on EFF Model using the measure of organizational performance proxy by efficiency as the dependent variable. The findings reveal that the *F*-statistic is higher than both the lower

and upper bound critical value at 1%, 2.5%, 5% and 10%, levels of significance using restricted intercept and no trend in all the specifications. The findings, therefore, suggest the presence of cointegration among the measure of organizational performance proxy by efficiency (EFF), the value of USSD (VAUSSD), the value of Agency Banking (VAAGBA) and bank size (BS). Based on the results, the null hypothesis of no cointegration is rejected. Therefore, this implies that the measure of organizational performance proxy by efficiency (EFF), the value of USSD (VAUSSD), the value of Agency Banking (VAAGBA) and bank size (BS) are all bound by a long-run relationship in Nigeria. The study, therefore, moves on to the estimation of the short-run and long-run situations as presented by the tables to follow (Tables 5 and 6).

*Table 4: The Bound Test for Co Integration*

|                       | EFF        |             |
|-----------------------|------------|-------------|
| Test Statistics (K)   | 7          |             |
| F-Statistics          | 3.727665   |             |
| Critical Value Bounds | I(0) Bound | I (1) Bound |
| 10%                   | 2.03       | 3.13        |
| 5%                    | 2.32       | 3.5         |
| 2.5%                  | 2.6        | 3.54        |
| 1%                    | 2.96       | 3.26        |

*Source: Authors' Computation, (2022).*

*ARDL Short run Estimates for Model EFF*

Table 5. Summary of Estimation for Short run (Speed of Adjustment) ARDL Model for EFF

| Models    | Variable    | Coefficient | Std. Error | t-Statistic | Prob.  |
|-----------|-------------|-------------|------------|-------------|--------|
| EFF Model | CointEq(-1) | -0.295177   | 0.675095   | -0.437238   | 0.0007 |

*Source: Authors' Computation, (2022).*

Table 6. Summary of the Estimation of the Long run ARDL Model for EFF

| Variables | Coefficient | Std. Error | t-Statistic |
|-----------|-------------|------------|-------------|
| VAUSSD    | 0.435198    | 0.562011   | 0.774358*** |
| VAAGBA    | 0.234176    | 0.982340   | 0.238385*** |
| BS        | 0.657376    | 0.244063   | 2.693468*** |
| C         | 2.988700    | 0.719680   | 4.152819*** |

*Source: Authors' Computation, (2022).*

The short-run cointegrating form of the model is presented in Table 5, in which the coefficient of the error correction model for all eight specifications is presented. The coefficient of the Error Correction Mechanism (ECM-speed of adjustment) is negative as expected and significant at a 5% level. The coefficients suggest that over 29% of the short-run disequilibrium is corrected in the long-run equilibrium in each of the eight specifications.

*ARDL Long-run Estimates for Model EFF:* Table 6 below shows the details of the long-run estimates for the model.

Table 6 presents the long-run coefficients of the three specifications estimated using the ARDL approach. The findings for EFF model specification give the long-run impact of financial innovation on the organizational performance of DMBs using efficiency proxy measures. From the table, the study found the coefficient of the value of USSD (VAUSSD), the value of Agency Banking (VAAGBA) and bank size (BS) are positively significant with organizational performance proxy by efficiency.

*Model Diagnostic Result*

In other to test for the diagnostic test in the study, the result can be obtained from table 7 below:

Table 7. Residual Diagnostic Test and Stability Diagnostic Test Result

| <b>Residual Diagnostic Test Result</b>  |   |                           |                    |
|---|---|---------------------------|--------------------|
|   | <b>Tests</b>                                | <b>F-statistic</b>        | <b>Probability</b> |
| <b>EFF Model</b>                        | Breusch-Godfrey Serial Correlation LM Test: | 1.759643                  | 0.2404             |
|   | Heteroskedasticity Test: ARCH               | 0.934348                  | 0.5912             |
| <b>Stability Diagnostic Test Result</b> |   |                           |                    |
|   | <b>Tests</b>                                | <b>F-statistic Values</b> | <b>Probability</b> |
| <b>FDCPS Model 1</b>                    | Ramsey RESET Test                           | 3.141618                  | 0.1143             |

*Source: Authors Computation (2022).*



From the table above, the Breusch-Godfrey Serial Correlation LM test for the model reveals that there is no presence of serial correlation judging from the F-Statistics and the probability values which are greater than 0.05. Also, the heteroskedasticity ARCH LM test for the model reveals that there is no heteroscedasticity problem judging from the F-Statistics and the probability values which are greater than 0.05. However, the stability test result using the Ramsey RESET test shows that the model was very stable considering the probability value that was greater than 5%.

## 4.2 Discussion of Findings

Empirical findings from the bound test confirm the existence of a long-run cointegration relationship between the variables. The result of the long-run ARDL estimates revealed that the value of transactions on agency banking and USSD exert a positive and significant impact on the efficiency of DMBs in Nigeria in the long run. It also reveals a dynamic short-run positive linkage between financial innovation and the efficiency of DMBs in Nigeria. The study also reveals that bank size has a dynamic linkage with efficiency. The findings of this study are in line with the findings of [1] whose study reveals that financial innovation influenced financial performance positively and it is significant at 5 per cent. Also, the findings of this study are in agreement with those of [17], [18] which reveals that financial innovation (mobile money) has forward and backward linkages with banks' performance in Nigeria. Besides the findings of this study are in line with those of Jingquin et al (2019) who found a positive and significant effect of financial innovation on the performance of commercial banks in Africa. However, this study is not in line with the findings of [6], [14], [31] who found that there is a negative and insignificant effect of financial innovation on performance in terms of efficiency of DMBs in Nigeria.

## 5 Conclusion

Based on the empirical results and findings, this study concludes that there is a causal relationship between financial innovation (agency banking and USSD) and banks' efficiency. Hence the study concludes that financial innovation has forward and backward linkages with the efficiency of DMBs in Nigeria. This implies that DMBs should invest in financial

innovation strategies and ICT in their quest to improve performance. The value of the transaction has a dynamic short-run and long-run positive and significant effect on efficiency. Bank size also has a positive and significant effect on the efficiency of DMBs in Nigeria.

## 5.1 Recommendation

The study recommends that DMBs should seek collaboration with relevant stakeholders to promote awareness, acceptance, usage and more investment in financial innovation (especially agency banking and USSD) to increase efficiency. They should continue to increase the value of transactions since it is positive and can increase efficiency. There should be continuous and sustained investment in ICT and human capital development to further deepen and cement the dynamic linkages between financial innovation and efficiency. DMBs should seek collaboration and partnership with relevant stakeholders to achieve positive increases in this regard. They should harness opportunities and synergies around the issue of financial innovation, drive customer satisfaction, and embrace more branchless (Direct/Virtual) banking and regulatory dialectics.

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### Authors Declaration

#### *-Availability of Data and Materials*

All data generated and analyzed during this study are included in this article. The datasets generated and analysed during the current study are not publicly available due to privacy clauses from the Central Bank of Nigeria (CBN) but the companies' Annual reports are available from the banks' websites. Data sharing does not apply to this article as no datasets were generated. Some of the data that support the findings of this study are available from Google scholar but restrictions apply to the availability of these data, which were used under license, and so are not publicly available. Data are however available from the authors upon reasonable request and subscription to the journal.

### Competing Interests

The authors declare that they have no competing interests.

### Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

MA is responsible for the main work; Prof HA is the course supervisor and reviewer of the articles; while DR MT analyses, interpreted data and performed major critique. All authors read and approved the final manuscript.

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