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Dynamics of Digitalisation and its Implications on the Nigerian Financial System Performance

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Abstract. This paper examines the impact of digitalisation on the performance of Deposit Money Banks (DMBs) in Nigeria. Using the Dynamic Ordinary Least Squares (DOLS) method, the results revealed that Web pay, and the Nigeria Inter-Bank Settlement System (NIBSS), Instant Payment (NIP) transactions, have a significant and positive impact on the Capital Adequacy Ratio expressed as a percentage of risk-weighted credit of banks' exposure. However, Point of Sale (PoS) and Web payments (Web pay) transactions showed a positive, but insignificant impact on the Liquidity Ratio of banks for the period, indicating that both are sources of liquidity in the financial system, but not significant. Also, NIP showed a positive, but not significant impact on the Asset Quality of banks. Further, an insignificant negative effect of PoS transactions and NIP on the profitability of banks in Nigeria was also established. Importantly, mobile payment transactions exerted a positive, significant impact on banks' profitability during the study period. These findings presuppose those technological innovations in the banking sector of Nigeria's economy are key to the profitability of banks. Therefore, DMBs in Nigeria should continue to leverage technological innovations, using the various digital banking channels, especially, Web pay, NIP, and mobile payments to boost their performance.

Keywords: Digitalisation, Bank Performance, Deposit Money Banks, Fintech, Mobile Payment, Technological Innovation

JEL Classification Codes*:* G21, G28, O31, O33

Introduction

Digitalisation has become a norm in all sectors of most economies of the world, including the financial ecosystem. It is currently changing the landscape of financial investment management all over the world. The use of information, data, artificial intelligence, and machine platforms to evaluate investment opportunities, improve business processes, optimize portfolios, and mitigate risks describes digitalisation. These developments have aided the activities of asset managers, who utilize electronic platforms as pivotal tools to engage in hybrid forms of investment decisions making, with the aim of making profit and enhancing business growth in line with global best practices.

In recent times, business managers have gone beyond human factors or advisory inputs to make their business decision process. The current practice is the use of automated electronic transmission channels for business processes and advisory for decision making, which seamlessly, has created a conducive environment and ease of doing business. Additionally, any technological advancement and automated processes in the financial industry, among which are improvements in financial literacy, support, and guidance, training, and education, alongside simplifying and optimizing financial, wealth and asset management, are now considered to be part of digitalization (Legner et al. 2017).

Despite the obvious shift to digitalized methods of service provision and delivery, it is pertinent to note that some financial institutions still view the entire process of digitalisation as problematic and challenging (Carbó-Valverde 2017). But Abbasi & Weigand (2017) observed

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that information and communication technologies have brought about a boost in the financial sector performance, specifically, the support of banking services, risk management and increase in productivity, and these factors have encouraged financial institutions to increase investments in the process of digitalisation.

Furthermore, the advent of technology has prompted advanced digital transformation, which is not just restricted to tech-savvy businesses, but also, high-tech major established organizations have embarked on digital transformation ventures (Idiegbeyan-Ose, Ilo & Isiakpona 2015; Weill & Woerner 2018; Agboola et al. 2017).

Some policy analysts have perceived digital banking transactions as being volatile, less regulated, and posing a high risk to investors, however, some others dissuade this concern that there exist more advantages than limitations. Most countries are yet to accept the regulation of digital currencies, thus, pressuring most Central Banks to place caution on their citizens to be careful while using the currency for financial transactions.

Over time, the relevance of digital money and electronic payment systems have become increasingly fundamental components of the monetary system. Therefore, impacting the financial system and refining economic activities in various ways, developing new opportunities and challenges for businesses, investors, financial analysts, and policymakers. Its activities promote financial inclusion, and financial intermediation which have a great impact on monetary policies. Earlier studies such as Kuusisto (2017), noted that digitalisation accelerates financial system growth, thus contributing to the growth of Gross Domestic Product (GDP) as well. With the emergence of digitalisation, the banking landscape has experienced some fundamental changes leading to improved performance (Onoire & Okoli 2019) and (Abbasi & Weigand 2017).

A variety of gadgets, such as laptops, tablets, and smartphones, have been widely developed and utilized by organizations in their business operations (Dasgupta & Gupta 2019). While various transmission channels for financial transactions such as Automated Teller Machines (ATM), Point of Sale (PoS) terminals, web payment solutions, internet banking, mobile pay, and instant transfer platforms (USSD, Mcash, Ebills etc.) have also been developed and enhanced to make financial payments more robust and seamless in the Nigerian financial system and other climes. Given the opportunities, digitalisation is placing pressure on different companies and banks to reconsider their existing business models and operating processes and focus on finding potential market opportunities (Bouwman et al, 2020). The swift adoption rate of digitalisation has become imperative for financial institutions and multi-faceted industries globally and in Nigeria, as banks and other financial institutions seek effective ways of delivering efficient payment and banking solutions for their customers.

The above developments notwithstanding, the Nigerian financial system over the years has experienced challenges in achieving profitability, robust asset quality, adequate liquidity ratio, and good capital adequacy ratio, among others, which may have led to the failure of some banks. This anomaly could largely be attributed to inadequate adaptation in technology and innovation in the banking sector, thus leading to their dismal performance.

Given the above light, the specific goal of this study is to examine the impact of e-banking channels (ATM, PoS, Web pay, Mobile pay and NIBSS Instant payment) on the performance of the deposit money banks' (Capital Adequacy Ratio, Asset Quality, Liquidity Ratio and Profitability), employing the Dynamic Ordinary Least Squares (DOLS) Econometric Method for the period Q12010 - Q42021.

This study comes into the limelight amidst the level of technological enhancements in the global financial system and the Nigerian financial system developments. The study explores the gains of achievements, develops new horizons, and assesses the digital space of the Nigerian economy, particularly, the DMBs' performance within the selected years of study.

Further from the above section, the paper also contains Section Two which provides some reviews of the relevant literature, Section Three presents the results and analyses, while Section Four provides a summary and conclusion.

Empirical Literature

Studies have been conducted on digitalisation and its impact on financial system performance in different climes, with a few from Nigeria, given the advancement and growth of digitalisation literature in recent times. Most of these studies employed varied approaches and perspectives yielding diverse findings and conclusions, which are either positive or negative postures.

Agboola et al. (2017), examined how digitalisation enhances the performance of commercial banks employing the purposive method and simple random sampling, selecting 370 non-managerial employees from a commercial bank. A self-structured questionnaire served as the primary technique for their data collection, which was examined using SPSS version 25. Their findings included a slightly significant but positive correlation between the process of digitalisation and the performance of commercial banks); the relationship between product innovation and the performance of commercial banks in Nigeria is strongly correlated and positively significant. The study, however, recommends that if appropriately and efficiently executed, the processes of digitalisation technologies will significantly improve deposit money banks' performance in Nigeria.

Rostami (2015) demonstrated CAMELS analysis in the banking industry. In the study, a few pertinent ratios were chosen and computed to examine banking sector performance. An Iranian bank's annual financial reports were the source of the data for this study which was subsequently juxtaposed with reports and various bank statistics. Undoubtedly, trends in measurements, and computations, together with pertinent data reveal essential elements managers require, and the CAMELS rating serves as a reliable tool for banking system performance as it can be used to manage, regulate, and determine from a management accounting perspective.

Siddik et al. (2016) investigated the impact of electronic banking on banks' performance in emerging economies, using empirical data from Bangladesh. It was observed that though electronic banking was gaining relevance and acceptability in Bangladesh, the effect of the e-banking variable on banks' performance was yet to be ascertained. Using Panel data from 13 banks over the period 2003-2013 in Bangladesh and banking parameters such as Return on Assets (ROA), Return on Equity (ROE), and Net Interest Margin (NIM) of Bangladesh banks. The study employed the Ordinary Least Square (OLS) technique, the results observed that e-banking starts to impact positively on the banks' ROE with a two-year time lag, where an observation of a negative contribution was made in the inaugural year of usage. Thus, the study's empirical results are more pertinent for emerging economies such as Bangladesh.

Taiwo & Agwu (2017) examined how electronic banking impacts the effectiveness of Nigerian banks' day-to-day operations; they employed the SPSS using the Pearson Correlation technique to analyse the results. Primary data from the staff of four selected Systematically Important Banks (Guaranty Trust Bank, United Bank for Africa, First Bank of Nigeria, and Ecobank) were used. The result revealed how the implementation of digital banking has increased Nigerian banks' operations efficiency compared to traditional banking periods. Bank strength, income, capital bases, patronage (loyalty of consumers), and profitability all showed this trend. Banks' performance significantly improved after adding new digital transmission channels to their online banking system according to the study.

Ibrahim & Daniel (2019) investigated the impact of E-Banking in the development of the banking sector in Nigeria, using the Pearson product moment correlation coefficient technique. The study revealed that the adoption of banking transactions digitally impacts positively and

negatively on the banking industry in Nigeria. Although electronic banking has immensely developed and improved service delivery significantly, however, it is exposed to fraud and unauthorized access to vital information.

Oniore & Okoli (2019) analysed the impact of electronic banking on the performance of deposit money banks in Nigeria from 2006 to 2017 using time series quarterly data and employing the ordinary least square technique in the analysis. The result showed that all the variables used are appropriately significant over the long term except for the inter-bank transfer variable, which is negatively significant. In their conclusion, e-banking in Nigeria gradually enhances the performance of banks that could boost economic growth in Nigeria. Accordingly, the study recommends banks to use strategic tools in the deployment of the right technology, to achieve their goals and objectives in line with global best practices, given an efficient regulatory framework from the Central Bank of Nigeria (CBN).

Iwedi et al (2022) examined the effect of digitalisation of banking services on the Nigerian economy. The study employed a multiple regression technique in assessing the efficacy of the link between Nigeria's economic performance and its digital banking service channels. The result reveals that WEB pay, and Mobile Pay all display a strong relationship with Nigeria's economic growth. Thus, it implies that the expansion of Nigeria's economy is highly and significantly correlated with the digitization of financial service channels. This further shows that banking clients in Nigeria are accepting the digital system of banking and thus, the paper recommends that banks should continuously increase awareness of the diverse digital platforms available to customers. However, it is suggested that banks encourage customers to embrace digital banking solutions like NIPS, Remita, m-Cash, and E-bills in the contemporary global financial and banking market space.

Do et al (2022) explored how digital transformation affected Vietnamese commercial banks' performance, for 2011 to 2019. They employed the Blundell and Bond GMM system (SGMM) to analyse thirteen (13) joint-stock data of Vietnam-based commercial banks. The models estimated by the SGMM method were subjected to Bayesian analysis to determine their level of robustness. The outcome demonstrates that Vietnamese commercial banks' performance has been positively and significantly impacted by the digital revolution. They also found that digital transformation's positive impact on bank performance rises in tune with the size of banks. Therefore, the pace with which a bank expands impacts the effectiveness of digital transformation.

In conclusion, our literature review shows that most studies in Nigeria employed questionnaire source of data collection method. Based on the foregoing, this paper employed the Dynamic Ordinary Least Square (DOLS), a deviation from the previous papers. Further, the selected dependent and explanatory variables for this study have not been used by previous researchers either in Nigeria or other countries. Significantly, the data set which originated from the CBN databank as well as the Dynamic Ordinary Least Square (DOLS) statistical technique employed in this paper distinguishes this study.

Theoretical Review

In this section, we briefly discuss some theoretical literature in innovation, technology, and financial system performance, which this paper is anchored.

Innovation Diffusion Theory

This theory was postulated by Everett Rogers in 1962 and revised in 1995. He analysed that diffusion is observed as the channel of transmission of innovation over a period between the players in the social system. Meso & Jain (2006) further posited that innovations are introduced, irrespective of their serviceability; it can take time before it can be accepted and implemented. Rogers (1995) posited that four major elements determine how new ideas are

circulated namely, communication, innovation, time channels and social system. He described innovation as a concept, method, or initiative which individuals, groups of individuals, or organizations consider novel. The researcher furthermore investigates the five fundamental stages that make up the process of innovative decision-making, namely, knowledge, decision, persuasion, implementation, and confirmation. Rogers (1995) stated that the innovation-diffusion was an uncertainty process of reduction. He also put forth characteristics, such as relative advantage, complexity, observability, compatibility, and tribality, that helped to reduce doubt about innovation. While compatibility is linked to the process by which an innovation is adopted in accordance with the values and ethics of an organization, and demands of prospective adopters, relative advantage is connected to the ideas that are giving a business a competitive edge. The degree of trial involved in the procedure will determine how much the suggested innovation can be tested. Additionally, the extent of innovation perceptibility is linked to its observability.

Technology Acceptance Model (TAM)

This model was postulated by Fred Davis (1989) in his study of technology acceptance model which states that the acceptance of information technology is determined by two fundamental beliefs which are the perceived use of information technology and its perceived usefulness. Hence, in the technology acceptance model, the two criteria are fundamental to the study and a theory of fit for the information management framework. In contrast to the perception of perceived ease of use, which refers to the perception that utilizing a technology application will not require any effort on the part of the user, the perception of assumed simplicity refers to the perception that utilizing information technology applications enhances the user performance. The TAM is a useful, effective, reliable but parsimonious theory that can be used to define a specific technology or information system. Moreover, several studies have suggested extended models for TAM revision. Taylor & Todd (1995) proposed the integrated model of TAM and TPB (named Combined TAM-TPB). Venkatesh & Davis (2000) propounded TAM2 as a novel version of TAM as well. Venkatesh & Jain (2006) postulated the Unified Theory of Acceptance and use of Technology. On the other hand, Lin, C.-H., Shih, H.-Y., & Sher, P. J. (2007) projected the integration of technology readiness and Technology Acceptance Model (TRAM) while Chang (2008) integrated a combined model of Task-technology fit and Technology Acceptance Model.

Model Specification

Based on the theoretical framework briefly discussed earlier, this study is an improvement on Siddik et al. (2016) and Oniore & Okoli (2019), given that more digitalisation instruments (ATM, PoS, WBP, MBP, NIP) and bank performance variables (CAR, LQR, ASQ, PBT) or CAMELS parameters were employed as explanatory and dependent variables, respectively.

Hence, we state the functional forms of the model as below.

$$CAR = f(ATM, PoS, WBP, MBP, NIP) \quad (1)$$

$$LQR = f(ATM, PoS, WBP, MBP, NIP) \quad (2)$$

$$ASQ = f(ATM, PoS, WBP, MBP, NIP) \quad (3)$$

$$PBT = f(ATM, PoS, WBP, MBP, NIP) \quad (4)$$

Where CAR = Capital Adequacy Ratio; LQR= Liquidity Ratio; ASQ= Asset Quality (ratio of non-performing loans to total gross loans); PBT= Profitability.

Therefore, we state the model equation as;

$$CAR_t = a_0 + a_1 ATM_t + a_2 POS_t + a_3 MBP_t + a_4 WBP_t + a_5 NIP_t + \sum_{p=-y}^{n} \emptyset_1 \Delta ATM_{t-y} + \sum_{p=-y}^{n} \emptyset_2 \Delta POS_{t-y} + \sum_{p=-y}^{n} \emptyset_3 \Delta MBP_{t-y} + \sum_{p=-y}^{n} \emptyset_4 \Delta WBP_{t-y} + \sum_{p=-y}^{n} \emptyset_4 \Delta NIP_{t-y} + \sum_t \quad (5)$$

$$LQR_t = a_0 + a_1 ATM_t + a_2 POS_t + a_3 MBP_t + a_4 WBP_t + a_5 NIP_t + \sum_{p=-y}^{n} \emptyset_1 \Delta ATM_{t-y} + \sum_{p=-y}^{n} \emptyset_2 \Delta POS_{t-y} + \sum_{p=-y}^{n} \emptyset_3 \Delta MBP_{t-y} + \sum_{p=-y}^{n} \emptyset_4 \Delta WBP_{t-y} + \sum_{p=-y}^{n} \emptyset_4 \Delta NIP_{t-y} + \sum_t \quad (6)$$

$$ASQ_t = a_0 + a_1 ATM_t + a_2 POS_t + a_3 MBP_t + a_4 WBP_t + a_5 NIP_t + \sum_{p=-y}^{n} \emptyset_1 \Delta ATM_{t-y} + \sum_{p=-y}^{n} \emptyset_2 \Delta POS_{t-y} + \sum_{p=-y}^{n} \emptyset_3 \Delta MBP_{t-y} + \sum_{p=-y}^{n} \emptyset_4 \Delta WBP_{t-y} + \sum_{p=-y}^{n} \emptyset_4 \Delta NIP_{t-y} + \sum_t \quad (7)$$

$$PBT_t = a_0 + a_1 ATM_t + a_2 POS_t + a_3 MBP_t + a_4 WBP_t + a_5 NIP_t + \sum_{p=-y}^{n} \emptyset_1 \Delta ATM_{t-y} + \sum_{p=-y}^{n} \emptyset_2 \Delta POS_{t-y} + \sum_{p=-y}^{n} \emptyset_3 \Delta MBP_{t-y} + \sum_{p=-y}^{n} \emptyset_4 \Delta WBP_{t-y} + \sum_{p=-y}^{n} \emptyset_4 \Delta NIP_{t-y} + \sum_t \quad (8)$$

Where: a_0 = Constant Term; $a_1 - a_4$ = vector of long run multipliers; n and y = Optimal lag length and lead lengths respectively; Δ b = notation of first difference operator; $\sum_t$ = random error term.

The error correction representation of the relationship between the variables are expressed thus;

$$\Delta In(CAR) = \alpha_0 + \sum_{i=1}^{q} \theta_1 \Delta In(CAR)_{t-i} + \sum_{i=1}^{q} \theta_2 \Delta In(ATM)_{t-i} + \sum_{i=1}^{q} \theta_3 \Delta In(POS)_{t-i} + \sum_{i=1}^{q} \theta_4 \Delta In(MBP)_{t-i} + \sum_{i=1}^{q} \theta_5 \Delta In(WBP)_{t-i} + \sum_{i=1}^{q} \theta_5 \Delta In(NIP)_{t-i} + \varphi ECM_{t-1} + e_{1t} \quad (9)$$

$$\Delta In(LQR) = \alpha_0 + \sum_{i=1}^{q} \theta_1 \Delta In(LQR)_{t-i} + \sum_{i=1}^{q} \theta_2 \Delta In(ATM)_{t-i} + \sum_{i=1}^{q} \theta_3 \Delta In(POS)_{t-i} + \sum_{i=1}^{q} \theta_4 \Delta In(MBP)_{t-i} + \sum_{i=1}^{q} \theta_5 \Delta In(WBP)_{t-i} + \sum_{i=1}^{q} \theta_5 \Delta In(NIP)_{t-i} + \varphi ECM_{t-1} + e_{1t} \quad (10)$$

$$\Delta In(ASQ) = \alpha_0 + \sum_{i=1}^{q} \theta_1 \Delta In(ASQ)_{t-i} + \sum_{i=1}^{q} \theta_2 \Delta In(ATM)_{t-i} + \sum_{i=1}^{q} \theta_3 \Delta In(POS)_{t-i} + \sum_{i=1}^{q} \theta_4 \Delta In(MBP)_{t-i} + \sum_{i=1}^{q} \theta_5 \Delta In(WBP)_{t-i} + \sum_{i=1}^{q} \theta_5 \Delta In(NIP)_{t-i} + \varphi ECM_{t-1} + e_{1t} \quad (11)$$

$$\Delta In(PBT) = \alpha_0 + \sum_{i=1}^{q} \theta_1 \Delta In(PBT)_{t-i} + \sum_{i=1}^{q} \theta_2 \Delta In(ATM)_{t-i} + \sum_{i=1}^{q} \theta_3 \Delta In(POS)_{t-i} + \sum_{i=1}^{q} \theta_4 \Delta In(MBP)_{t-i} + \sum_{i=1}^{q} \theta_5 \Delta In(WBP)_{t-i} + \sum_{i=1}^{q} \theta_5 \Delta In(NIP)_{t-i} + \varphi ECM_{t-1} + e_{1t} \quad (12)$$

Where: Δ = first difference notation; α_0 = constant parameter; θ_1 - θ_5 = dynamic coefficients of the explanatory variables; ECM = error correction mechanism lagged for one (1) period; ϕ = error correction coefficient which measures the speed of adjustment.

Note: The deposit money banks' (DMBs) was employed as proxy for financial system, while the CAMELS parameters were used as variables for the financial system performance.

Data Description

Automated Teller Machine (ATM) describes the liquidity (cash) volume in the Automated Teller Machine (ATM) space, which is used for financial transactions. Transactions are carried out by withdrawing cash from machines and transferring funds to other platforms using a debit or credit card with the aid of the automated machine. This channel reduces over-the-counter cash withdrawals in banks; however, there are limits to the amount that can be withdrawn for each volume of transaction to ensure seamless regulation and control.

Point of Sale (POS) refers to a device used in the execution of a financial transaction (payment) at the point of sale (purchase). This is typically done or completed electronically using a machine known as a point of sale (POS) terminal.

Web pay: The volume of transactions done through the webpage channel is defined by the performance of the web pay with the aid of the internet. It also known as internet banking. Unlike other digital channels that accept payments for goods and services and cashback, the webpage accepts salary payments and other online transactional settlements in addition to the aforementioned.

Mobile pay refers to a financial transaction (payment) performed online utilizing mobile electronic devices such as tablets, mobile phones, laptops, or any other mobile electronic device. It is a robust transmission channel for digital payment.

NIP is an online real-time Electronic Funds Transfer (EFT) platform that is account-based. NIBSS (Nigeria Interbank Settlement System) Instant Payments (NIP) is a reliable person-to-person, person-to-business, and business-to-business funds transfer service that provides beneficiaries with instant value. It enables financial institutions to offer online real-time services. It is used for both retail and big-ticket transactions. Hence described as a major digital banking transmission channel.

Results and Discussion

Descriptive statistics was used to provide insight into the distribution of each variable during the data analysis.

Descriptive Statistics

Table 1 below outlines the descriptive statistics of mean distribution, standard deviation and normal distribution for the variables.

Table 1: Summary of Descriptive Statistics

	CAR	LQR	ASQ	PBT	POS	ATM	MBP	WBP	NIP
Mean	15.678	46.672	7.550	379.40	301.29	637.69	356.12	6101.2	6876.1
Median	15.478	45.425	5.982	352.90	106.05	500.37	79.41	13.29	4342.5
Maximum	19.589	96.612	15.13	898.16	2089.08	1889.94	2161.8	46645.	30261.
Minimum	10.481	36.570	2.959	60.57	1.46	156.16	0.510	2.030	146.56
Std. Dev.	2.250	9.391	4.131	237.33	531.59	506.45	547.87	12728.	7534.5
Jarque-Bera	1.764	678.18	5.297	2.953	78.81	12.255	33.886	25.719	19.753
Probability	0.414	0.0000	0.07	0.228	0.000	0.002	0.0000	0.0000	0.000
Obs	40	40	40	40	40	40	40	40	40

Source: Researcher's computation using E-views 12

The descriptive statistics for the variables demonstrate that the average values of capital adequacy ratio, liquidity ratio, and asset quality of banks are: 15.7, 46.7 and 7.6 percent, respectively, for the study period. The results also showed that profitability averaged 379.40 billion, while the value of POS, ATM, mobile payment, and web payment transactions stood at an average of 301.29, 637.69, 356.12 and 6101.2 billion naira, respectively. In addition, the transactions through the Nigerian Inter Bank Settlement System transfer option averaged 6876.1 billion naira during the study period. The standard deviations showed that capital adequacy ratio, ATM transactions, liquidity ratio, asset quality and profitability clustered around their respectively mean values. However, the observations for POS, mobile payment, web payment and NIP transactions do not gather around their mean values, provided their standard deviation are greater than the corresponding average values. The results further show

that capital adequacy and asset quality are normally distributed, while the other variables are not.

Unit Root Test Results

The unit root test was carried out using the Augmented Dickey Fuller (ADF) method.

Table 2. Results of the Augmented Dickey Fuller (ADF) Test

Variable	Level	First difference	Probability	Decision
Asset Quality	-1.926782	-3.728302	0.0305	I(1)
LATM	-3.479099	-7.229642	0.0534	I(1)
CAR	-2.702280	-5.896395	0.0001	I(1)
LInternet	-1.856046	-8.028230	0.0000	I(1)
Liquidity ratio	-3.172214	-6.518856	0.0000	I(1)
Lmobilepay	-3.294640	-9.266114	0.0000	I(1)
Lnips	-2.527052	-5.607947	0.0003	I(1)
Lpbt	-1.915518	-11.58493	0.0000	I(1)
Lpos	-3.074219	-5.623860	0.0002	I(1)

Source: Authors Estimation using E-views 12

The ADF unit root reveal that none of the variables in the model remained stationary at points where the probability value of their ADF statistic is more than 0.05. Therefore, the entirety of the variables' unit root null hypothesis cannot be rejected at the 5% level. Consequently, the variables were modified using first differencing, and it was discovered that they were stationary at first difference, suggesting that they are integrated at order one [(1)]. Given the results, the variables are considered to represent the first stationary difference process. The evidence of stationarity at first difference is akin to the findings of Akinkunmi (2017); Attari & Javed (2013) and Okolo, Edeme & Emmanuel (2018). More specifically, the evidence of the ADF unit root test necessitated the use of the Johansen cointegration test method.

Cointegration Tests

The Johansen cointegration test was conducted to ascertain if a long-run relationship exists between the variables as shown in Table 3. Thus, the cointegration tests were carried out at a 5% level of significance after the evidence of discoveries of the ADF unit root test, and the outcomes are presented thus.

Table 3: Johansen cointegration test for capital adequacy model

Series: CAR LOG(POS) LOG(ATM) LOG(MBP) LOG(WBP) LOG(NIP)				
Lags interval (in first differences): 1 to 1				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.820561	136.5115	95.75366	0.0000
At most 1 *	0.503161	71.23053	69.81889	0.0384
At most 2	0.464285	44.64994	47.85613	0.0970
At most 3	0.360787	20.93216	29.79707	0.3619
At most 4	0.096851	3.926469	15.49471	0.9094
At most 5	0.001459	0.055482	3.841465	0.8138
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**

None *	0.820561	65.28094	40.07757	0.0000
At most 1	0.503161	26.58059	33.87687	0.2865
At most 2	0.464285	23.71778	27.58434	0.1449
At most 3	0.360787	17.00569	21.13162	0.1717
At most 4	0.096851	3.870987	14.26460	0.8727
At most 5	0.001459	0.055482	3.841465	0.8138

Source: Researcher's computation using E-views 12
Note: * shows rejection of the hypothesis at the 0.05 level

The Johansen cointegration test results presented in Table 4, show evidence of two cointegrating equations from the trace test, which indicates that at least two of the variables can adjust to long run equilibrium position. Similarly, the results show that one cointegrating equation exist from the maximum eigenvalue test. This finding indicates that capital adequacy ratio has long run relationship with the underlying indicators of digitalisation. It, therefore, provided the basis for the estimated dynamic least squares.

Table 4: Johansen cointegration test for liquidity ratio model

Series: LQR LOG(POS) LOG(ATM) LOG(MBP) LOG(WBP) LOG(NIP)				
Lags interval (in first differences): 1 to 1				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.752637	133.8073	95.75366	0.0000
At most 1 *	0.657575	80.72519	69.81889	0.0052
At most 2	0.401821	40.00052	47.85613	0.2225
At most 3	0.325016	20.47362	29.79707	0.3913
At most 4	0.135482	5.537101	15.49471	0.7494
At most 5	0.000130	0.004922	3.841465	0.9431
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.752637	53.08214	40.07757	0.0010
At most 1 *	0.657575	40.72467	33.87687	0.0065
At most 2	0.401821	19.52689	27.58434	0.3748
At most 3	0.325016	14.93652	21.13162	0.2934
At most 4	0.135482	5.532180	14.26460	0.6737
At most 5	0.000130	0.004922	3.841465	0.9431

Source: Researcher's computation using E-views 12
Note: * shows rejection of the hypothesis at the 0.05 level

From Table 4, two cointegrating equations exist from the trace test. This finding provided the basis for rejecting the null hypothesis of no cointegration. Concurrently, the maximum eigenvalue test results show two cointegrating equations evidence, indicating that liquidity ratio has a long run relationship with POS, ATM, mobile, internet and NIP digital transactions.

Table 5: Johansen cointegration test for asset quality model

Series: ASQ LOG(POS) LOG(ATM) LOG(MBP) LOG(WBP) LOG(NIP)				
Lags interval (in first differences): 1 to 2				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.692209	127.0777	95.75366	0.0001

At most 1 *	0.591759	83.47937	69.81889	0.0028
At most 2 *	0.468394	50.33118	47.85613	0.0287
At most 3	0.339713	26.95261	29.79707	0.1028
At most 4	0.265180	11.59460	15.49471	0.1774
At most 5	0.005224	0.193811	3.841465	0.6598
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.692209	43.59835	40.07757	0.0193
At most 1	0.591759	33.14819	33.87687	0.0609
At most 2	0.468394	23.37857	27.58434	0.1579
At most 3	0.339713	15.35801	21.13162	0.2646
At most 4	0.265180	11.40078	14.26460	0.1352
At most 5	0.005224	0.193811	3.841465	0.6598

Source: Researcher's computation using E-views 12
Note: * denotes rejection of the hypothesis at the 0.05 level

From Table 5 above, the results of the trace test demonstrated that there exists three cointegrating vectors in the model. Similarly, the model has two cointegrating equations, as evidenced by the results of the maximum eigenvalue test. To this end, at a 5% confidence level, the null hypothesis of no cointegration is rejected, thus, the variables in the model are cointegrated. It, therefore, followed from the results that asset quality has a long run equilibrium relationship with the underlying digitalisation indicators (POS, ATM, mobile, internet and NIP digital transactions).

Table 6: Johansen cointegration test for profitability model

Series: LOG(PBT) LOG(POS) LOG(ATM) LOG(MBP) LOG(WBP) LOG(NIP)				
Lags interval (in first differences): 1 to 1				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.697457	132.3610	95.75366	0.0000
At most 1 *	0.634655	86.93086	69.81889	0.0012
At most 2 *	0.491675	48.66813	47.85613	0.0418
At most 3	0.353328	22.95605	29.79707	0.2482
At most 4	0.154806	6.391251	15.49471	0.6493
At most 5	1.69E-06	6.42E-05	3.841465	0.9959
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.697457	45.43017	40.07757	0.0114
At most 1 *	0.634655	38.26274	33.87687	0.0140
At most 2	0.491675	25.71208	27.58434	0.0851
At most 3	0.353328	16.56480	21.13162	0.1936
At most 4	0.154806	6.391186	14.26460	0.5635
At most 5	1.69E-06	6.42E-05	3.841465	0.9959

Source: Researcher's computation using E-views 12
Note: * signifies rejection of the hypothesis at the 0.05 level

The trace test results revealed evidence of three cointegrating vectors in the model. Simultaneously, the maximum eigenvalue test results demonstrated that within the model, two cointegrating equations exist. Consequently, at a 5 per cent level of confidence, the null

hypothesis of no cointegration is rejected, revealing cointegration of the variables. Thus, it implies that profitability has a long run relationship with digitalisation of the banking services. A long run relationship is thus established among the variables, providing a basis for estimating the cointegrating regression model using the dynamic least squares method.

Model Estimation

Given that the variables have shown the existence of a long run relationship in each of the models, the cointegrating regression models were estimated using the DOLS method. Results are outlaid in Tables 7-10.

Table 7: DOLS results for capital adequacy model

Dependent Variable: CAR				
Method: Dynamic Least Squares (DOLS)				
Fixed leads and lags specification (lead=1, lag=1)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(POS)	-6.752933	2.281046	-2.960454	0.0092
LOG(ATM)	-18.39302	3.193169	-5.760117	0.0000
LOG(MBP)	-0.133369	1.298869	-0.102681	0.9195
LOG(WBP)	2.775194	0.434809	6.382556	0.0000
LOG(NIP)	11.45766	5.065737	2.261796	0.0380
C	56.64602	16.81799	3.368181	0.0039
R-squared	0.922476	Mean dependent var		15.56834
Adjusted R-squared	0.825571	S.D. dependent var		2.244957
S.E. of regression	0.937599	Sum squared resid		14.06548
Long-run variance	0.606295	Prob. (Jarque-Bera.Stat.)		0.4404
F-statistic	38.7864	Prob(F-stat.)		0.0000

Source: Researcher's computation using E-views 12

The results show that POS transaction has a significant negative impact on capital adequacy ratio during the study. This finding is contrary to the theoretical expectation which predicts that digitalisation of banking service has the potential of boosting banking sector performance, it predicts that POS does not have direct relationship with banks' accessible capital adequacy, stated as proportion of risk-weighted credit of banks 'exposure. The results also show that ATM transaction contributed negatively to capital adequacy ratio. This finding also contradicted the a priori expectation but could be attributed to increasing cost of providing and maintaining ATM services across the country, which has adversely affected the performance of banks. However, it also predicts that ATM service does not have direct relationship with banks' available capital adequacy, expressed as percentage of risk-weighted credit of banks 'exposure. In addition, the results show that web payment transaction and the Nigerian Inter Bank Settlement System transfer option have positive and significant effects on capital adequacy ratio. As observed from the estimated parameters, 1 percent increase in web payment transaction increased capital adequacy ratio by 2.775 percent. At the same time, capital adequacy ratio increased by 11.457 percent following 1 percent increase in NIBSS transfer.

The significant positive contributions of web payment transaction and the NIBSS transfer to capital adequacy ratio highlighted the important role they play in enhancing the performance of the Nigerian banking services industry. This discovery corroborated with the results of Agboola et al (2014) and Taiwo & Agwu (2017) which showed evidence of the positive contributions of digitalisation of financial (banking) services to banks' operational efficiency.

The outcome further shows that the R-squared is 0.92247, which indicates that 92.25 percent of the total variations in capital adequacy ratio are jointly explained by the underlying indicators of digitalisation. There is also evidence of joint significance of the entire as observed from the "p" (probability) value of the F-statistic, lower than 0.05.

It is also observed from the probability value (0.4404) of the Jarque-Bera statistic that a normal distribution of the residuals exists at 5 percent level. These findings authenticate the statistical reliability of the estimated model.

Table 8: DOLS results for liquidity ratio model

Dependent Variable: LQR				
Method: Dynamic Least Squares (DOLS)				
Fixed leads and lags specification (lead=1, lag=1)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(POS)	27.57446	28.26662	0.975513	0.3438
LOG(ATM)	-24.39756	39.56960	-0.616573	0.5462
LOG(MBP)	-3.345626	16.09553	-0.207861	0.8380
LOG(WBP)	3.058812	5.388136	0.567694	0.5781
LOG(NIP)	-30.81344	62.77438	-0.490860	0.6302
C	334.8811	208.4077	1.606856	0.1276
R-squared	0.709664	Mean dependent var		46.75427
Adjusted R-squared	0.346743	S.D. dependent var		9.724424
S.E. of regression	7.859696	Sum squared resid		988.3973
Long-run variance	93.10299		Prob. (Jarque-Bera.Stat.)	0.3488
F-statistic	1.5244		Prob(F-stat.)	0.2376

Source: Researcher's computation using E-views 12

As observed from Table 8, POS and web payment transactions have positive but insignificant effects on the liquidity ratio during the study period. This finding suggests that although POS and web payment transactions are associated with the hypothesized positive coefficients, they are not significant but are efficient sources of promoting the liquidity of the banking sector in Nigeria.

On the other hand, ATM transactions and mobile payment were found to exert insignificant negative effects on liquidity ratio. At the same time, the results showed evidence of insignificant negative effect of Nigerian Inter Bank Settlement System transfer on liquidity ratio which does not conform to the predictions of the underlying financial sector digitalisation and technology innovation theory. In sum, the results revealed that the digitalisation of banking services has mixed (negative and positive) effects on liquidity ratio during the study period. This finding is consistent with the results of the previous studies by Ibrahim and Daniel (2019) which highlighted that electronic banking has both negative and positive impact in the Nigerian banking sector.

The explanatory variables are associated with an impressive explanatory power as the R-squared (0.70966) revealed that they account for 70.97 percent of the total variations in liquidity. The probability value (0.3488) of the Jarque-Bera statistic further demonstrated that a normal distribution of the residuals exists at 5 percent level of confidence. This finding provided appreciable empirical evidence for the statistical reliability of the estimated liquidity ratio model.

Table 9: DOLS results for asset quality model

Dependent Variable: ASQ				
Method: Dynamic Least Squares (DOLS)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(POS)	-2.780045	3.435696	-0.809165	0.4240
LOG(ATM)	8.585392	5.517121	1.556136	0.1289
LOG(MBP)	-5.648390	2.474853	-2.282313	0.0288
LOG(WBP)	-1.634876	0.717333	-2.279104	0.0291
LOG(NIP)	12.60327	7.013904	1.796898	0.0812
C	-104.9569	38.39653	-2.733500	0.0099
R-squared	0.613941	Mean dependent var		7.550055
Adjusted R-squared	0.557167	S.D. dependent var		4.130632
S.E. of regression	2.748757	Sum squared resid		256.8927
Long-run variance	19.59861		Prob. (Jarque-Bera.Stat.)	0.8365
F-statistic	4.16896		Prob(F-stat.)	0.0046

Source: Researcher's computation using E-views 12

The estimated dynamic cointegrating regression model for asset quality results show that, there exists an insignificant negative effect of POS transactions on asset quality for the period. It was also found that the effect of ATM transactions on asset quality is positive and statistically insignificant at 5 percent level. Although this finding aligns with the theoretical expectation, it is not significant in boosting the level of asset quality in the Nigerian banking sector. In addition, evidence of negative and significant effects of mobile and web payment transactions on asset quality was established from the results. The results show that 1 percent increase in mobile payment transaction is associated with 5.65 percent increase in asset quality. Similarly, asset quality decreases by 1.63 percent as a result of 1 percent increase in the web payment transaction.

The significant negative contributions of mobile and web payment transactions to asset quality contrasted with the findings of Iwedi et al (2022), which revealed that WEB pay and Mobile pay are strongly and significantly associated with economic growth in Nigeria. However, the results showed that NIBSS Instant Payment (NIP) has a positive but insignificant effect on asset quality. This finding could be attributed to the long queue and unstable network that characterize the service which undermine its effectiveness in improving asset quality in the banking sector. The R-squared indicates that 61.39 percent of the systematic variations in asset quality are collectively explained by changes in underlying indicators of digitalisation of banking services in Nigeria. It is also evident from the probability value (0.8365) of the Jarque-Bera statistic that the residuals are normally distributed at 5 percent level. This provides the empirical basis for the statistical reliability of the model.

Table 10: DOLS results for profitability model

Dependent Variable: LOG(PBT)				
Method: Dynamic Least Squares (DOLS)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(POS)	-0.022453	0.352386	-0.063717	0.9496
LOG(ATM)	0.619324	0.565870	1.094464	0.2814
LOG(MBP)	0.653621	0.253836	2.574972	0.0145
LOG(WBP)	-0.170378	0.073574	-2.315729	0.0267
LOG(NIP)	-0.564204	0.719389	-0.784282	0.4383
C	4.338769	3.938183	1.101718	0.2783

R-squared	0.549244	Mean dependent var		5.712739
Adjusted R-squared	0.482957	S.D. dependent var		0.724657
S.E. of regression	0.521069	Sum squared resid		9.231455
		Prob. (Jarque-Bera.Stat.)		0.3642
Long-run variance	0.206174		Prob(F-stat.)	0.0000

Source: Researcher's computation using E-views 12

The results show a negative and insignificant effect of POS transaction and NIBSS Instant Payment on profitability of banks in Nigeria. This result conflicted with Taiwo & Agwu (2017)'s findings which revealed that an introduction of novel digital transmission channels into electronic banking operations considerably improved banks' performances in Nigeria. On the other hand, mobile payment transaction was revealed to exert a positive and significant impact on Nigeria's banking sector profitability during the study period. This finding provides appreciable fact on the effectiveness of mobile payment in promoting profitable growth of the Nigerian banking sector. The significant positive contribution of mobile payment to profitability corroborated with the findings of Oniore & Okoli (2019) which showed that e-banking has gradual positive impacts on performance of banks in Nigeria.

These results reveal that innovations in technology in the banking sector in Nigeria through mobile payment is a prerequisite for profitability. However, evidence on a negative and significant effect of web payment transaction on profitability was also established from the results. This finding could be attributed to increasing incidence of fraud associated with internet banking which tends to undermine its effectiveness in promoting the profitable growth of banks in Nigeria. The R-squared (0.5492) showed that the 54.9% of the changes in profitability result from variations in the explanatory variables. The probability values of the F-statistic in addition, revealed that the entire model is statistically significant which authenticates the statistical reliability of the model. Additionally, the probability value (0.3642) of the Jarque-Bera statistic revealed a normal distribution of the residuals at a 5 percent level. This finding offered more empirical evidence for the reliability of the model for forecast and policy formulation.

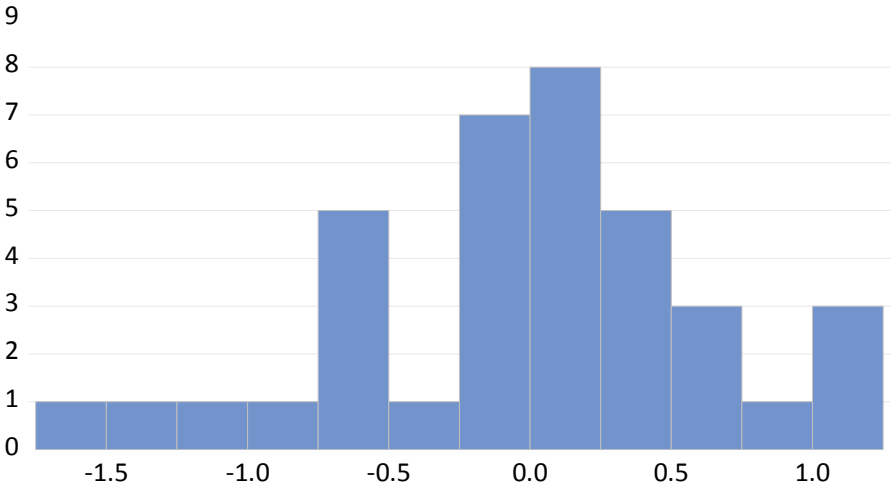
Post Estimation Results

Null Hypothesis = H_0 : Residuals are not normally distributed

Alternative hypothesis = H_1: Residuals are normally distributed

If the p value is lower than 0.05 or 5% then the null hypothesis is rejected and the alternative hypothesis is accepted. If the P value exceeds 0.05 or 5%, then the null hypothesis is accepted, which implies that the data series is normality distributed.

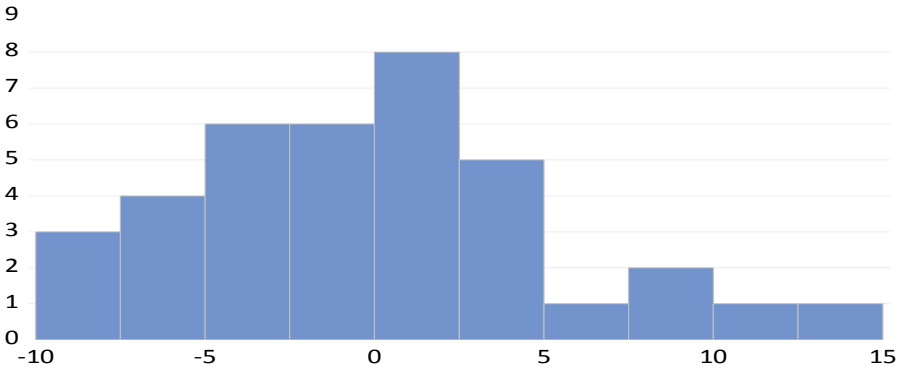
Normality Test Result CAR Model



Series: Residuals	
Sample 2012Q3 2021Q3	
Observations 37	
Mean	1.56e-14
Median	0.069254
Maximum	1.039694
Minimum	-1.595970
Std. Dev.	0.625066
Skewness	-0.511036
Kurtosis	3.138767
Jarque-Bera	1.640163
Probability	0.440396

Source: Researcher's computation on EViews 12

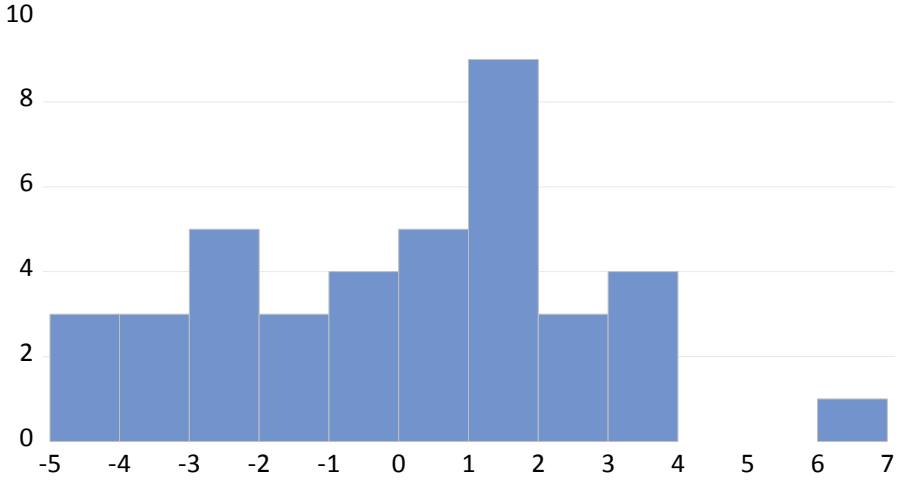
Normality Test Result for Liquidity Ratio Model



Series: Residuals	
Sample 2012Q3 2021Q3	
Observations 37	
Mean	-1.02e-14
Median	-0.040421
Maximum	14.34989
Minimum	-8.879588
Std. Dev.	5.239798
Skewness	0.575774
Kurtosis	3.200837
Jarque-Bera	2.106529
Probability	0.348797

Source: Researcher's computation on EViews 12

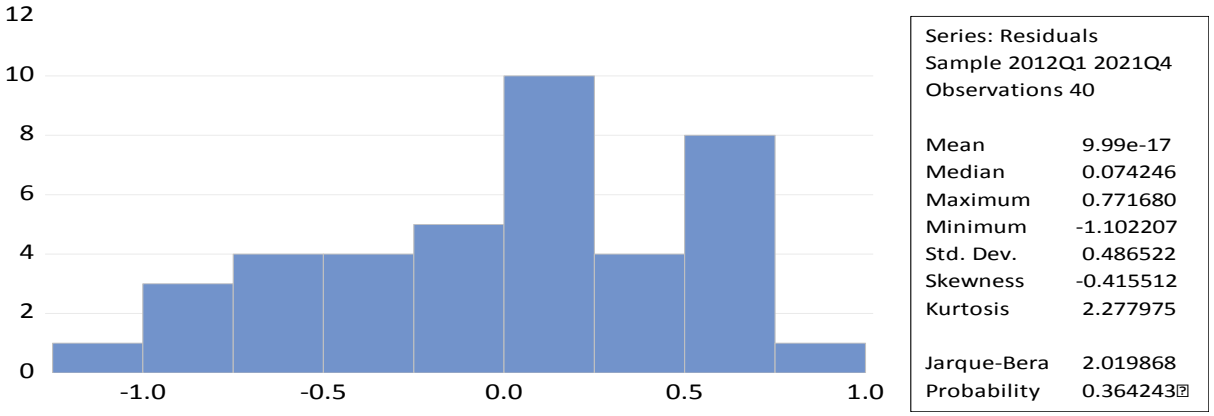
Normality Test Result for Asset Quality Model



Series: Residuals	
Sample 2012Q1 2021Q4	
Observations 40	
Mean	-1.53e-15
Median	0.274937
Maximum	6.758427
Minimum	-4.256172
Std. Dev.	2.566514
Skewness	0.163388
Kurtosis	2.672172
Jarque-Bera	0.357090
Probability	0.836487

Source: Researcher's computation on EViews 12

Normality Test Result for Profitability Model



Source: Researcher's computation on EViews 12

Conclusion and Recommendations

Conclusion

This study investigated digitalisation dynamics and its implications for the Nigerian financial system performance. The Dynamic Ordinary Least Squares (DOLS) results revealed that Web pay and NIBSS Instant Payment (NIP) transactions have positive significant impact on Capital Adequacy Ratio, which presupposes that Web pay, and NIP have positive relationship with banks' available capital, stated as a proportion of risk-weighted credit of banks' exposure. Hence, indicating that digitalisation of banking services has potential of boosting banking sector performance. However, PoS and Web pay transactions showed positive but insignificant effects on the liquidity ratio of banks for the period, indicating that both PoS and Web pay, though sources of liquidity to the financial system do not significantly influence the liquidity of banks in Nigeria.

Similarly, NIP showed a positive but insignificant effect, hence, favorable but negligible impact on asset quality of banks. Further, a negative and insignificant effect of PoS transaction and NIP on profitability of banks in Nigeria was established. Likewise, Web pay, NIP and mobile payments transaction were found to exert positive and significant effect on banking sector performance in the study period. This finding's reveal that technology dynamics within the banking sector in Nigeria through Web pay, NIP as well as mobile payments, are prerequisites for profitability for the Nigeria's DMBs.

Policy Recommendation

This paper therefore, recommend that Deposit Money Banks in Nigeria should continue to leverage on technology, especially the Web Payments, NIP and Mobile Payments digital banking channels, as these will further boost their performance. Proliferation of these digitalisation tools in the banking and related sectors will further deepen financial inclusion in Nigeria, vis-à-vis, enhance the performance of the financial system in Nigeria.

Statements and Declarations

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Competing Interests

The authors have no relevant financial or non-financial interests to disclose.

Data Availability Statements

The datasets generated and analysed during the current study are not publicly available due the fact that they constitute an excerpt of research in progress but are available from the corresponding author on reasonable request. The author confirms that all data generated or analysed during this study are included in this published article.

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