

# Digital Financial Service and Monetary Policy in Nigeria. A Toda-Yamamoto Approach

Dr. Tajudeen IderaAbdulmajeed

Department of Banking and Finance, University of Abuja, Nigeria. [abdulmajeed.idera@uniabuja.edu.ng](mailto:abdulmajeed.idera@uniabuja.edu.ng);  
ORCID: 0000-0002-5661-2570

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## Abstract

*This study examined the digital financial services and monetary policy in Nigeria for the period, 2009-2023. Based on ex-post facto research design, secondary data were obtained from the central bank statistical bulletin. The monetary policy indicator examined is monetary policy rate, while digital financial services was measured with Automated Teller Machines, point of sales web-pay. The quarterly data analyses descriptive statistics, correlation analysis and unit root by employing the Augmented Dickey-Fuller. Finally the Toda-Yamamoto Granger causality techniques was conducted. Empirically, the study indicates that there was no causality flow from Automated Teller Machine, point of sale and web-pay, to monetary policy rate in Nigeria. The study concluded that digital financial services has no connection with monetary policy rate in Nigeria. This implies that to incorporated monetary policy system in Nigeria by linking up the apparatuses of digital financial services other than LOGATM, LOGPOS and logweb-pay may be considered. Therefore, this is need to uphold the digital financial innovations by both the monetary authority, as well as the investors. Also monetary specialist should manage the monetary policy rate properly for it to be attractive and affordable for investors to borrow money from the bank. Finally, the government should employ other measures to support the monetary policy to control the credit creation of deposit money banks.*

**Keywords:** Automated Teller Machine, Digital Financial Services, Monetary Policy, Monetary Policy Rate, Point of Sale, Web-pay

## Introduction

The financial sector plays a crucial role in driving economic growth in any country. Before the emergence of research on digital finance, most studies primarily focused on the positive impact of technological advancements in the financial industry. However, an alternative perspective suggests that these innovations also introduce challenges, as they may lead to insufficient regulation and an increased risk of financial instability (Yue, 2022). In a global context, the progress of any sector within a modern economy is largely reliant on the efficiency and effectiveness of monetary policy instruments. Over the years, Nigeria has implemented various monetary policy strategies aimed at fostering sectoral development and economic expansion within its regulated market system (Gimba, 2022). To influence financial institutions and market interest rates, the country's monetary regulatory authority utilizes the Monetary Policy Rate (MPR) as a guiding tool in line with its

economic objectives for a given period. Consequently, in order to stimulate lending activities, the monetary authority exercises its statutory functions by employing different monetary policy instruments and strategies. These measures directly impact the accessibility, cost, and volume of credit available to productive sectors of the economy (Balogun, 2021).

The conventional obstacles associated with traditional financial methods have been significantly minimized through innovative digital finance, commonly known as financial technology. This transformation has been particularly evident in the provision of financial services through mobile devices and internet-based platforms. As described by Ozili (2020), digital finance encompasses financial services that are accessible via mobile phones, computers (with or without an internet connection), or payment cards that are linked to digital financial systems. The author further emphasized that digital finance enhances the ease of access to

financial instruments and services, offering them at a reduced cost. Moreover, digital credit platforms function as complementary sources to traditional bank credit, addressing credit demands without necessitating physical interaction with banks. These digital financial services not only alleviate credit constraints but also contribute to an increased supply of credit to various economic sectors (Yue et al., 2022).

Despite the rapid advancement of financial technology globally, its adoption in developing nations remains considerably lower than in developed economies. Several factors contribute to this disparity, including insufficient investment in technological advancements, a sluggish rate of digital finance adoption, the lack of government initiatives promoting technological innovation, and a general reluctance among individuals to engage in banking activities without direct interaction with financial institutions (Ozili, 2020). Additionally, the financial sector has struggled to adequately cater to both short- and long-term funding needs of productive industries due to inefficiencies in implementing the Central Bank's monetary policies. Consequently, economic investment growth, technology acquisition, and the recruitment of skilled professionals have been adversely affected (Balogun, 2021).

From the above-mentioned, it is important to evaluate the impact that digital finance service has on monetary policy in Nigeria due to the contests highlighted above and proffer solution to these problems. Empirically, past studies have focused on the effect of digital banking/ financial services on bank's credit, financial inclusion and economic growth (Abdulmajeed, et al., 2024; Babarinde, et al., 2024; Menza, et al., 2024; Manasseh, et al., 2023; Tshuma et al., 2023; Babarinde, 2023; Tiosanna et al., 2023; Asmarani & Wijaya, 2020). However, the study on monetary policy on financial sector development, financial stability, financial sector performance, market interest rates and economic growth (see: Owoeye et al., 2023; Oseni&Oyelade, 2023; Awopegba, et al., 2022; Ifurueze, 2022; Gimba et al., 2022; Abomaye-Nimenibo, 2021; Iwedi&Bekweri, 2023). But

less attention has been given to evaluate digital financial services and monetary policy nexus in Nigeria.

The purpose of this study is to explore the relationship between digital financial services and monetary policy in Nigeria. In particular, the study aims to achieve the following objectives: to examine the influence of the automated teller machine (ATM) payment system on the monetary policy rate in Nigeria; to analyze the effect of the point-of-sale (POS) payment system on the monetary policy rate; to assess how the web-based payment system impacts the monetary policy rate; to evaluate the role of the exchange rate in shaping the monetary policy rate; and to investigate the effect of interest rates on the monetary policy rate in Nigeria. The study has been structured into five sections. The first section introduces the research, setting the foundation for the discussion. The second section provides a review of relevant literature, focusing on the concepts of digital finance and monetary policy. The methodology adopted in the research is outlined in the third section. In the fourth section, the findings are presented and analyzed. Finally, the study is concluded in the fifth section, where key recommendations are also provided.

## M. Literature Review

### Conceptual Review

#### Digital Finance

Digital finance is recognized as a mechanism that facilitates the transition from conventional financial practices to modern transaction methods, primarily by lowering transaction costs through technological advancements to achieve economies of scale (Yue et al., 2022). The concept has been described by Chukwu and Molokwu (2022) as the electronic provision of both innovative and traditional banking services directly to consumers through various digital channels, including Automated Teller Machines (ATMs), Point of Sale (POS) terminals, Unstructured Supplementary Service Data (USSD), mobile applications, and web-based portals. Further insights into digital finance have been provided by Abdulmajeed et al. (2024), who highlighted its role in technological advancements within the financial sector. It has

been noted that digital finance encompasses a range of financial technology applications that offer investment products, whether in the form of goods or services. According to the author, financial transactions that enable individuals, businesses, and organizations to access payment services, savings, and credit facilities—whether through internet-enabled platforms or offline channels—fall under digital finance, eliminating the necessity for in-person interactions with service providers.

The adoption of digital financial services involves various transaction methods, such as using POS devices, ATMs, online fund transfers, mobile payment applications, and web-based payment systems, all of which link individuals and businesses through digital networks. These networks facilitate quick and convenient financial transactions without requiring physical presence (Agbaeze et al., 2023). Moreover, Babarinde (2023) defined digital finance as financial services that are carried out through digital payment systems utilizing devices like smartphones, computers, and smart cards, with or without an internet connection.

#### **Monetary policy**

Monetary policy encompasses the strategies implemented by a nation's central bank to control the flow of money and credit within the economy. These measures are designed to achieve macroeconomic goals, including economic stability and growth. As Gimba (2022) asserts, monetary policy plays a crucial role in maintaining economic stability by managing the supply, cost, accessibility, and direction of money and credit to align with specific macroeconomic objectives. Similarly, Osakwe et al. (2019) describe monetary policy as a set of measures enforced by a central bank to regulate liquidity, interest rates, and the availability of credit to attain both macroeconomic and microeconomic targets. The authors highlight two primary schools of thought regarding its implementation: monetarists, who advocate for controlling the money supply, and Keynesians, who emphasize interest rate adjustments as a means to foster economic growth.

The execution of monetary policy relies on two key approaches: monetary policy instruments and policy targets. Instruments such as the Cash Reserve Requirement, Monetary Policy Rate (MPR), and Treasury Bills serve as direct mechanisms for guiding banks in their intermediary role. Conversely, policy targets—

including money supply regulation, inflation control, exchange rate stabilization, and interest rate adjustments—act as broader economic frameworks to steer financial stability. For this study, the focus is on the Monetary Policy Rate (MPR) as a key indicator of monetary policy effectiveness. The Central Bank of Nigeria (CBN) employs MPR as a benchmark rate to influence both commercial bank lending rates and deposit rates, thereby ensuring efficiency in financial intermediation. Higher deposit rates encourage saving, while increased lending rates may deter borrowing, ultimately impacting economic activity (Osakwe et al., 2019).

### **Theoretical Review**

#### **Financial Innovations Theory**

Financial Innovations theory propounded by Silber (1975) suggests the financial innovations are genetic to solve certain problem or secure a certain constraints against the attainment of set goals and objectives. Hence, the innovation of new financial technologies, financial instruments, policies, products or services are geared towards the negative effect of certain issues faced by the organisation. Specifically, innovations in financial institutions and practices have enhanced the ability to endure risk, lowered transactions costs, and dodged outmoded regulations (Silber, 1983).

According to Babarinde et al. (2024), financial innovations are established on purpose to ease financial constraints of business and operational activities of firms. Thus, digital financial innovation, in the essence of financial innovations theory, is purposely to solve financial barring through the instrumentality of digital technologies. Therefore, it should be established that, the point of which the financial innovations will impact on micro/macroeconomic proxy will also be read out by the level acceptance and usage of the innovations (Babarinde et al., 2024).

#### **Technology Acceptance Model**

The Technology Acceptance Model was established by Davis (1989). The theory declares that the adoption of new information technology systems is dependent on three factors, namely, intent to use, apparent usefulness, and apparent ease of use. The method and intention of management to adopt or use technology like fintech innovation will depend on whether the fintech innovation shadows what is needed and easy to apply (Davis, 1989). This implies that

extent to which people adopt digital technology in accessing and using formal financial services are influenced by these three factors pinpointed in the Technology Acceptance Model. In the same vein, the application or adoption of digital financial technology in the stock market operation will also be affected by the three factors of enunciated in the model: intent to use, the ease of use, and perceived utility of the technology.

### **Monetarist Theory of Monetary Policy**

The monetarist theory of monetary policy, championed by Nobel laureate Friedman (1963), is a macroeconomic perspective that highlights key principles such as long-term monetary neutrality, short-term monetary non-neutrality, the distinction between real and nominal interest rates, and the significance of monetary aggregates in policy formulation. According to the principle of long-term monetary neutrality, any increase of  $Z$  percent in the money supply will, after all necessary adjustments, lead to a corresponding  $Z$  percent rise in the general price level, without influencing real economic variables like consumption, output, or the relative prices of individual goods. While most economists acknowledge the approximate validity of this concept in real-world economies, monetarists emphasize its importance more strongly than any other macroeconomic school of thought. Conversely, short-term monetary non-neutrality exists in economies where price adjustments to changes in the money supply occur gradually. This delay results in temporary effects on real output (GDP) and employment before full equilibrium is reached. Real interest rates, which account for expected inflation when evaluating nominal interest rates, are factored into rational decision-making when individuals balance present and future consumption. However, this distinction was largely overlooked in macroeconomic discussions until monetarists brought attention to its significance in the 1950s. Despite being rooted in Keynesian economic thought, many monetarist propositions have been widely integrated into standard macroeconomic and monetary policy analysis. This acceptance is largely due to the careful differentiation between real and nominal variables, as well as the rejection of a long-term trade-off between inflation and unemployment. Furthermore, contemporary research economists largely support the view that monetary policy is a more effective tool for economic stabilization

compared to fiscal policy. However, proponents of the real-business-cycle theory argue that monetary policy has little to no influence on real economic variables, though this perspective holds only marginal relevance in broader economic discussions.

Due to the emergence of various theoretical frameworks, it becomes necessary to establish that the adoption of financial innovations—particularly those stemming from digital finance or fintech—serves as a connecting factor capable of affecting macroeconomic indicators, especially monetary policy. Furthermore, the extent to which these innovations exert such influence is expected to be reflected in their level of awareness and practical application within the economic system.

### **Empirical Review**

There is drought of study on the connection between digital financial services and monetary policy rate in Nigeria. But, some interrelated and relevant studies were reviewed such as Abdulmajeed et al. (2024) conducted a study to analyze the relationship between digital financial services and the financing of small and medium enterprises (SMEs) in Nigeria, utilizing causal inference over the period from the first quarter of 2009 to the fourth quarter of 2021. The research process involved several preliminary statistical tests, including descriptive statistics, unit root analysis, correlation tests, and cointegration tests, before applying the Granger causality test. The time series data used for the study were sourced from the Central Bank of Nigeria's statistical bulletin.

Findings from the research revealed the presence of a long-term relationship between digital financial services and credit allocation by Deposit Money Banks to SMEs in Nigeria. The causal analysis indicated a one-way causality running from Automated Teller Machine (ATM)-based digital financial services to bank credit for SMEs, whereas no causality was detected between Point of Sale (POS)-based financial services and bank credit. Additionally, both mobile-payment and web-payment digital financial services exhibited unidirectional causality, influencing Deposit Money Banks' credit to SMEs. Based on these findings, the study concluded that digital financial services play a crucial role in facilitating SME financing in Nigeria.

Similarly, research conducted by Babarinde et al. (2024) explored the influence of digital financial transactions on stock market performance in Nigeria, covering the period from January 2012 to December 2021. The study employed the Fully Modified Ordinary Least Squares (FMOLS) regression technique to assess time series data gathered from the Central Bank of Nigeria's Statistical Bulletin, Monthly Economic Reports, and other financial records. Results demonstrated that digital financial transactions conducted through ATMs, POS terminals, mobile platforms, and web-based systems had a significantly positive impact on stock market capitalization in Nigeria. Consequently, the study concluded that digital finance serves as a vital driver in improving stock market performance within the country.

Menza et al. (2024) conducted an analysis on the relationship between financial technology and financial inclusion in Ethiopia during the digital economic era. The study utilized secondary data collected from nine commercial banks over the period from 2015 to 2020. To examine the impact of various explanatory variables on financial inclusion, the researchers applied the random effects model. Findings from the study indicated that digital financial tools such as Automated Teller Machines (ATMs), mobile banking, Point of Sale (POS) terminals, and agent banking had a statistically significant and positive influence on financial inclusion in Ethiopia throughout the study period.

Similarly, Manasseh et al. (2023) explored the role of digital finance and financial inclusion in driving economic growth across nineteen COMESA member states. The study, which relied on annual time series data spanning from 1997 to 2018, utilized the panel Autoregressive Distributed Lag (ARDL) model for analysis. Results confirmed that digital financial services and financial inclusion are fundamental catalysts for economic expansion in the region. Specifically, key predictors of growth included ATM services, mobile transactions, POS terminals, mobile banking, the number of deposit accounts per 1,000 adults, the number of registered mobile money accounts, active mobile money agent outlets, digital card ownership, and financial literacy. Additionally, the study identified a bidirectional causal relationship between digital finance, financial inclusion, and economic growth. Based on these findings, the study recommended that COMESA countries

implement policies aimed at strengthening digital finance and expanding financial inclusion.

Tshuma et al. (2023) examined the impact of digital financial inclusion on the stability of the financial sector. Using the two-step Generalized Method of Moments (GMM) for dynamic panel data analysis, the study focused on twelve selected banking institutions between 2013 and 2023. The research variables included a digital financial inclusion index, the z-score (a measure of bank stability), real GDP, the loan-to-asset ratio, and inflation. The findings demonstrated that digital financial inclusion had a significantly positive effect on banking stability, as measured by the z-score, while economic growth exhibited a marginally positive impact on financial sector stability during the study period.

Babarinde (2023) conducted a study to assess the influence of digital finance on the credit allocation of deposit money banks in Nigeria, covering the period from the first quarter of 2009 to the fourth quarter of 2019. The research utilized Vector Autoregression (VAR), variance decomposition, and Pearson correlation techniques to analyze the relationship between digital financial transactions and bank credit distribution. Findings from the study indicated that no long-term relationship existed between digital finance and credit allocation in Nigerian deposit money banks. However, a strong and positive correlation was observed between digital financial transactions and credit allocation. While POS transaction values exhibited a negative and statistically insignificant impact, ATM and WEBPAY transaction values showed positive but non-significant effects on bank credit allocation. The study ultimately concluded that, despite the lack of a long-run connection, digital finance and bank credit allocation were strongly correlated during the examined period.

Similarly, Tiosanna et al. (2023) investigated the impact of internet and mobile banking on stock prices, considering the role of financial performance among banking institutions listed on the Indonesia Stock Exchange. The study employed descriptive analysis and multiple linear regression techniques to analyze the data. Findings revealed that internet banking had a positive but statistically insignificant effect on stock prices, whereas mobile banking exerted a negative yet significant influence. Additionally, financial performance displayed a positive but non-significant effect on stock prices. When examined collectively, both internet and mobile

banking—through their effect on banking financial performance—were found to have a significant impact on stock prices.

In another study, Owoeye et al. (2023) explored how monetary policy affected the financial performance of Nigerian deposit money banks between 2000 and 2018. Given the nature of the time-series data, the research employed the Autoregressive Distributed Lag (ARDL) regression model to assess the influence of key monetary policy variables. Specifically, the study analyzed the effects of the interest rate (INT) and cash reserve ratio (CRR) on bank financial performance, with secondary data obtained from the Central Bank of Nigeria's Statistical Bulletin. The results demonstrated that both interest rates and the cash reserve ratio significantly influenced the deposit liabilities of Nigerian banks, thereby shaping their overall financial performance.

The influence of monetary and fiscal policies on Nigeria's economic growth was investigated by Oseni and Oyelade (2023) through the examination of various economic indicators. The results indicated that key determinants of economic growth in the country include gross capital formation, the total workforce, the broad money supply, and the lending interest rate. It was observed that while gross capital formation, employment levels, and broad money supply had a significant and positive impact on the gross domestic product (GDP), the lending interest rate exerted a significant but negative effect. Based on these findings, the study concluded that monetary policy plays a more crucial role in driving economic growth compared to fiscal policy. Therefore, policymakers were advised to direct monetary interventions toward sectors with high growth potential.

Similarly, the impact of monetary policy on the financial sector's development in Nigeria between 1981 and 2021 was examined by Iwedi and Bekweri (2023). Financial data used in the study were sourced from the Central Bank of Nigeria and the National Bureau of Statistics. Various econometric methods, including unit root tests, co-integration tests, regression models, and Granger causality tests, were applied in the analysis. The findings revealed that the monetary policy rate and Treasury bill rates negatively influenced financial sector growth. On the other hand, both the exchange rate and inflation rate were identified as having a positive effect on the sector's expansion. As a result, the study

concluded that money supply, monetary policy rate, Treasury bill rates, and exchange rate significantly shaped the financial sector's growth within the study period.

Additionally, the relationship between the monetary policy rate (MPR) and market interest rates in Nigeria was explored by Awopegba et al. (2022). The non-linear autoregressive distributed lag (NARDL) model and threshold regression techniques were utilized, with monthly data spanning from January 2002 to December 2019. Findings from the threshold regression model suggested that the impact of MPR on short-term interest rates (SINT) and long-term interest rates (LINT) became more significant when MPR exceeded the estimated thresholds of 11% and 13%, respectively. Furthermore, results from the nonlinear ARDL model indicated that an increase in MPR led to a positive effect on both short-term and lending interest rates, whereas a decline in MPR resulted in a negative effect. However, while the negative impact on LINT was minimal, its effect on SINT was statistically insignificant. Ultimately, the study reinforced the concept of price downward stickiness, supporting the notion that MPR adjustments are less effective when reductions occur.

The influence of monetary policy instruments on the performance of Nigeria's financial sector was investigated by Ifurueze (2022). The findings demonstrated the presence of a long-term relationship between monetary policy instruments and financial institutions' output. While these instruments were found to exert a significant short-term impact, no substantial long-term effect was observed in the insurance sector. Similarly, the banking sector showed no long-run effects from monetary policy instruments. However, in the case of money market institutions, a positive and significant short-term influence was identified, though no long-term effects were noted. Consequently, the study concluded that monetary policy instruments significantly affect financial sector performance in the short run but lack long-term significance.

The relationship between monetary policy and financial sector development in Nigeria over the period from 2007 to 2020 was explored by Gimba et al. (2022). Monthly time-series data were sourced from the Central Bank of Nigeria's Statistical Bulletin, incorporating variables such as credit to the private sector as the dependent variable, while liquidity ratio, interest rate, and

cash reserve ratio were used as independent indicators representing monetary policy. The results indicated a significant impact of monetary policy on financial sector development. It was concluded that liquidity ratio, cash reserve ratio, and interest rate played a crucial role in determining credit availability to the private sector.

A comparative analysis of Nigeria’s monetary policy and financial stability between 1990 and 2015 was conducted by Abomaye-Nimenibo (2021). Data collection was carried out through questionnaire distribution, and the Pearson Product Moment Correlation Coefficient (PPMCC) method was applied to test the formulated hypotheses. The study contributed to an improved understanding of the link between monetary policy and financial stability in Nigeria. The findings highlighted that regulatory authorities, particularly the Central Bank of Nigeria (CBN), play a vital role in maintaining financial system stability. Moreover, it was revealed that the effectiveness of monetary

**M. Methodology**

A retrospective (ex-post facto) research design was utilized in this study. The data, which were derived from secondary sources, were readily accessible for collection. Quarterly time-series data spanning from the first quarter of 2009 (2009Q1) to the fourth quarter of 2023 (2023Q4) were obtained from the Central Bank of Nigeria’s 2023 Statistical Bulletin. For the analysis of data, various statistical techniques were employed. Descriptive statistics, correlation analysis, and unit root tests were conducted to examine the stationarity of the time-series data. The Augmented Dickey-Fuller (ADF) test was specifically applied to determine the highest order of integration within the dataset. Additionally, to establish the causal relationship

policy in Nigeria is largely dependent on its independence from government deficit financing. Additionally, the restructuring of financial institutions was identified as essential for sustaining a stable and competitive financial sector, which is necessary for the efficient transmission of monetary policy.

An assessment of digital technology (fintech) and its impact on stock returns of retail banks listed on the Indonesia Stock Exchange between 2016 and 2018 was conducted by Asmarani and Wijaya (2020). Monthly data covering the period from January 2016 to October 2018 were obtained from Crunchbase and Investing. Fintech was analyzed as an independent variable, represented by fintech funding frequency and fintech funding value. The study employed the Fama-French Three-Factor Model along with panel data regression techniques. Empirical findings suggested that fintech had no statistically significant impact on the stock returns of retail banks listed on the Indonesia Stock Exchange.

between digital financial services and the monetary policy rate in Nigeria, the Toda-Yamamoto (1995) causality test was performed to identify the direction of causality.

**Model Specification**

The economic model adopted in this study aligns with the framework developed by Abdulmajeed et al. (2024), which empirically examined the causal connection between digital financial services and small and medium-sized enterprises’ (SMEs) access to financing in Nigeria. This analysis, utilizing the Toda-Yamamoto procedure, covered the period from 2009Q1 to 2021Q4. The econometric model applied in the current study, as discussed in the preceding section, is specified below:

$$SME_{it} = \beta_0 + \beta_1 APM_{t-1} + \beta_2 POS_{t-1} + \beta_3 WPS_{t-1} + \beta_4 M-PAY_{t-1} + \epsilon_{it} \dots \dots \dots \text{equ (1)}$$

Where:

- SMEs= Small and Medium Enterprises Scales
- ATM= Automated Teller Machine Payment System
- POS = Point of Sales Payment System
- WPS = Web Payment System
- M-PAY= Mobile Money Payment System
- $\epsilon_{it}$  = Stochastic Error Term;
- $\beta_0$ = Intercept for Estimation.
- $\beta_1 - \beta_4$  = Coefficient of Independent Variables
- $\Sigma$  = summation

P = Optimal lag

However, this study adapted the earlier model by replacing Small and Medium Enterprises Scales (SMEs) with Monetary Policy Rate (MPR) in Nigeria as the dependent variable. On the other hand, Automated Teller Machine Payment System (ATM), Web Payment System (WPS), Point of Sales System (POS). In addition, Interest Rate (INT) and Exchange Rate (EXR) used as control variables.

The econometric model for this study is specified as:

$$MPR_t = \beta_0 + \beta_1 ATM_{t-1} + \beta_2 W-POS_{t-1} + \beta_3 W-PAY_{t-1} + \beta_4 INT_{t-1} + \beta_5 EXR_{t-1} + ECM_{t-1} \dots \text{equ (2)}$$

Where;

MPR= Monetary Policy Rate

ATM= Automated Teller Machine Payment System

POS= Point of Sales System

W-PS = Web Payment System

INT= Interest Rate

EXR= Exchange Rate

$\epsilon_t$  = Stochastic Error Term;

$\beta_0$  = Intercept for Estimation.

$\beta_1 - \beta_5$  = Coefficient of Independent Variables

$\sum$  = summation

P = Optimal lag

## M. DATA ANALYSIS AND INTERPRETATION OF RESULTS

### Descriptive Statistics

The descriptive statistics for the variables of the study are presented in Table 1.

**Table 1: Descriptive Statistics**

	MPR	ATM	POS	W PAY	EXR	INT
Mean	12.15833	2235.175	3159.135	42814.42	280.1188	15.72717
Maximum	18.75000	10336.56	35080.18	356094.3	899.8900	18.98000
Minimum	6.000000	62.59000	1.870000	3.370000	146.8800	11.20000
Std. Dev.	3.010211	2616.782	7258.691	84120.30	159.4824	2.149798
Skewness	-0.256835	1.420707	2.936352	2.001393	1.897590	-0.807445
Kurtosis	3.471945	4.025732	11.02840	6.137231	7.280457	2.490881
Jarque-Bera	1.216470	22.81440	247.3597	64.66129	81.81427	7.167678
Probability	0.544311	0.000011	0.000000	0.000000	0.000000	0.027769
Observ	60	60	60	60	60	60

**Source:** Authors' analysis using e-view 10 output

Table 4.1 describes the variables involved for this study. The descriptive statistics results show that the mean of Monetary Policy Rate (MPR), Automated Teller Machine (ATM), Point of Sale System (POS), Web Payment System (W-PAY), Exchange Rate (EXR) and Interest Rate (INT) was ₦12.1583billion, ₦2235.17billion, ₦3159.135billion, ₦42814.4billion, ₦280.118 billion and ₦15.7271billion respectively. The maximum of all variables of interest (MPR ATM, POS, W-PAY, EXR and INT) were ₦18.7500billion, ₦10336.5billion, ₦35080.18billion, ₦356094billion,

₦899.890billion and ₦18.9800billion, respectively. In dissimilarity, their minimum was ₦6.00000billion, ₦62.5900billion, ₦1.870000billion, ₦3.37000, ₦146.880 and ₦11.2000 respectively.

Comparatively, the standard deviation indicate that the values of ₦2616.78, ₦7258.691, ₦84120.30 variables (ATM, POS, W-PAY) were evidently not dispersed far above the average values except of that value ₦3.010211, ₦159.482 and ₦2.14979 (MPR, EXR and INT) were dispersed far below the average. The table further reveals that the variables (ATM, POS, W-PAY

and EXR) are positively skewed and suggest that the variable is normally distributed. While MPR and INT are negative. Table 4.1 further reveals that the variables (MPR ATM, POS, W-PAY and EXR) with Kurtosis values 3.47194, 4.02573, 11.02840, 6.13723 and 7.28045 are fat or platykurtic. While INT with Kurtosis values of 2.49088 respectively are peak or leptokurtic. The analysis results on Jarque-Bera (JB) tests revealed that variables (ATM, POS, W-PAY,

EXR and INT with JarqueBera statistic of values 1.216470, 22.81440, 247.3597, 64.66129, 81.81427 and 7.167678 respectively with Probabilities value of 0.000011, 0.000000, 0.000000, 0.000000, 0.027769 were abnormally distribution since their p-values are less than 5% level of significance. In contrast, the variable MPR with probably value 0.544311 is normally distributed since their p-values are greater than a 5% level of significance.

### Correlation Analysis

Correlation Probability	LOGMPR	LOGATM	LOGPOS	LOGW-PAY	LOGEXR	LOGINT
MPR	1.000000 -----					
ATM	0.589818 0.0000	1.000000 -----				
POS	0.623627 0.0000	0.755118 0.0000	1.000000 -----			
W_PAY	0.567766 0.0000	0.902545 0.0000	0.924780 0.0000	1.000000 -----		
EXR	0.708897 0.0000	0.818812 0.0000	0.882095 0.0000	0.877923 0.0000	1.000000 -----	
INT	-0.332406 0.0095	-0.792972 0.0000	-0.450867 0.0003	-0.662019 0.0000	-0.600131 0.0000	1.000000 -----

**Source:** Authors' analysis using e-view 10 output

Based on the correlation analysis presented in Table 4.2, a positive correlation was observed among all the variables, with the exception of LOGMPR, which exhibited a negative correlation with LOGINT.

### Unit Root Tests

The results of the Augmented Dickey-Fuller test statistic

Table 2: Augmented Dickey-Fuller (ADF) unit root tests

<i>Variables</i>	<i>Augmented Dickey-Fuller test statistic</i>	<i>ADF Critical at 5%</i>	<i>Probability Value</i>	<i>Inference</i>
LOGMPR	-4.477720	-2.913549	0.0006	I(1)
LOGATM	-3.300332	-2.916566	0.0197	I(1)
LOGPOS	-5.066197	-3.496960	0.0007	I(2)
LOGW-PAY	-4.746786	-3.493692	0.0017	I(1)
LOGEXR	-3.913404	-3.490662	0.0177	I(1)
LOGINT	-3.674355	-3.492149	0.0325	I(1)

**Source:** Author's computation using Eviews 10.

The stationarity test results for the six variables analyzed in this study, as presented in Table 2, were obtained using the Augmented Dickey-Fuller (ADF) test. The findings indicated that the Monetary Policy Rate (MPR), Automated Teller Machine (ATM), Web Payment System (W-PAY), Exchange Rate (EXR), and Interest Rate (INT) achieved stationarity at their first

differences. However, the Point of Sale (POS) system variable attained stationarity at the second difference. Consequently, the variables were classified as I(1) and I(2) series. This suggests that all variables are appropriately suited for further analysis. Therefore, the application of the Toda-Yamamoto test is deemed both relevant and suitable for this study.

### VAR Lag Order Selection Criteria

Table 4 contains the VAR lag order selection criteria.

**Table 4: VAR Lag Order Selection Criteria**

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-2214.399	NA	1.11e+27	79.29998	79.51698	79.38411
1	-1894.987	558.9719	4.49e+22	69.17810	70.69712	69.76702
2	-1818.768	117.0510	1.12e+22	67.74170	70.56273	68.83541
3	-1757.575	80.86221	5.10e+21	66.84195	70.96499	68.44044
4	-1672.032	94.70814*	1.10e+21*	65.07256*	70.49761*	67.17584*

**Source:** Author's computation using Eviews 10. \* indicates lag order selected by the criterion.

The optimal lag length for the Toda-Yamamoto-Dolado-Lütkepohl Granger causality model was determined through the Vector Autoregression (VAR) lag order selection criteria, as presented in Table 4. Various selection metrics, including the modified likelihood Ratio (LR) criterion, Finite Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz

Information Criterion (SC), and Hannan-Quinn Information Criterion (HQ), indicated that a lag length of four was most suitable. This assessment plays a crucial role in defining the appropriate lag intervals for endogenous variables, ensuring accuracy in the estimation process of the Toda-Yamamoto-Dolado-Lütkepohl Granger causality model.

### Toda-Yamamoto Causality Test

To determine causality between digital financial services and monetary policy rate in Nigeria, the

Toda-Yamamoto causality test was practically applied to the time series data and the results are described in table below

**Table 5: Toda-Yamamoto Test of Causality between Digital Financial Services and Monetary Policy Rate in Nigeria**

<b>Toda-Yamamoto Causality Test</b>					
<b>Dependent variable: LOGMPR</b>			<b>Dependent variable: LOGATM</b>		
<b>Excluded</b>	<b>Chi-sq</b>	<b>Prob.</b>	<b>Excluded</b>	<b>Chi-sq</b>	<b>Prob.</b>
LOGATM	8.716999	0.1209	LOGMPR	3.892469	0.5650
LOGPOS	4.124495	0.5316	LOGPOS	15.45577	0.0086
LOGW_PAY	5.469635	0.3613	LOGW_PAY	4.923096	0.4253
LOGEXR	3.414554	0.6364	LOGEXR	8.337643	0.1386
LOGINT	9.154476	0.1031	LOGINT	25.91667	0.0001
<b>Dependent variable: LOGPOS</b>			<b>Dependent variable: LOGW_PAY</b>		
<b>Excluded</b>	<b>Chi-sq</b>	<b>Prob.</b>	<b>Excluded</b>	<b>Chi-sq</b>	<b>Prob.</b>
LOGMPR	23.53159	0.0003	LOGMPR	6.218036	0.2856
LOGATM	16.64058	0.0052	LOGATM	13.34526	0.0203
LOGW_PAY	20.98509	0.0008	LOGPOS	14.33209	0.0136
LOGEXR	25.17763	0.0001	LOGEXR	4.085544	0.5372
LOGINT	16.75690	0.0050	LOGINT	39.30752	0.0000
<b>Dependent variable: LOGEXR</b>			<b>Dependent variable: LOGINT</b>		
<b>Excluded</b>	<b>Chi-sq</b>	<b>Prob.</b>	<b>Excluded</b>	<b>Chi-sq</b>	<b>Prob.</b>
LOGMPR	11.76211	0.0382	LOGMPR	8.082981	0.1517
LOGTM	30.81544	0.0000	LOGATM	2.758330	0.7372
LOGPOS	15.78639	0.0075	LOGPOS	3.154522	0.6762
LOGW_PAY	6.381628	0.2708	LOGW_PAY	1.778269	0.8789
LOGINT	10.24962	0.0685	LOGEXR	0.174099	0.9994

**Source: Authors' computation (2025).**

This test is meant to define if digital finance variables (LOGATM, LOGPOS and LOGW-PAY) provide significant empirical information about monetary policy rate in Nigeria. Causality ascends when index of digital finance cause monetary policy rate or vice versa. According to the results in table 5 present Toda-Yamamoto causality result, the test reveals that, Automated Teller Machine transactions (LOGATM) had no causality with monetary policy rate in Nigeria (LOGMPR) ( $F=8.716999$ ;  $p>0.1209$ ). Similarly Point of Sale transaction (LOGPOS) was free from causality with monetary policy rate in Nigeria (LOGMPR) ( $F=4.124495$ ;  $p>0.5316$ ) during the study period. Also, web-pay (LOGW\_PAY) had no causal relation with monetary policy rate in Nigeria (LOGMPR) ( $F=5.469635$ ;  $p>0.3613$ ). In the same vein, exchange rate (LOGEXR) had no causality relationship with monetary policy rate in Nigeria (LOGMPR) ( $F=3.414554$ ;  $p>0.6364$ ). Finally, interest rate (LOGINT) had no causality affiliation with monetary policy rate in Nigeria (LOGMPR) ( $F=9.154476$ ;  $p>0.1031$ ). The study establish no causality running from any of the three digital financial services (LOGATM,

LOGPOS, and LOGWPAY) and control variable (LOGEXR and LOGINT) to monetary policy rate in Nigeria during the study period. This aligns with the findings of Abdulmajeed, et al. (2024) who found no causality running from any of the four digital financial services (LOGATM, LOGPOS, LOGMPAY, and LOGWPAY) to small and medium scale enterprises' financing in Nigeria in the study period.

Moreover, the result of this study fails to verdict with Davis's theory of technology acceptance model. The theory affirms that the adoption of new information technology systems is dependent on intent to use, apparent usefulness, and apparent ease of use. The method and intention of management to adopt or use technology like fintech innovation will depend on whether the fintech innovation shadows what is needed and easy to apply. The extent to which people adopt digital technology in accessing and using formal financial services are influenced by these three factors identified in the Technology Acceptance Model. This implies that digital financial services did not have significant influence on monetary policy rate in Nigeria and

thus could not help in moderating monetary policy rate that deals with the discretionary control of money supply by monetary authority (CBN) and fiscal authority in an attempt to attain the desired economic goals in Nigeria.

## 5. Conclusion and Recommendations

The causal link between digital financial services and the monetary policy rate in Nigeria over the period from 2009Q1 to 2023Q4 was examined in this study. The digital financial services analyzed included transactions conducted through Point-of-Sale (POS) systems, Automated Teller Machines (ATMs), and web-based payment platforms. The monetary policy rate was utilized as the measure of monetary policy. To determine the direction of causality, the Toda-Yamamoto causality test was applied. The findings revealed that no causal relationship existed between Automated Teller Machine transactions, POS transactions, or web-pay transactions and the

monetary policy rate in Nigeria. Consequently, the study concluded that digital financial services do not influence the monetary policy rate in the country.

This suggests that integrating the monetary policy system in Nigeria may require exploring digital financial service mechanisms beyond Automated Teller Machines (ATMs), Point-of-Sale (POS) systems, and web-based payment platforms. Therefore, it is essential for both monetary authorities and investors to actively promote and sustain innovations in digital finance. Additionally, monetary policymakers should ensure that the monetary policy rate is effectively managed to enhance its appeal and affordability, thereby encouraging investors to access bank loans. Lastly, the government should implement supplementary strategies to strengthen monetary policy, ensuring better regulation of credit creation by deposit money banks.

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