“Dynamic effect of financial technology on financial development in Nigeria”

AUTHORS	Innocent Okoi Faithpraise Otosi Enya Emori Joseph Asukwo Ekpenyong Obo Augustine Eba John John

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Innocent Okoi, Ph.D., Senior Lecturer, Faculty of Administration and Management Sciences, Banking and Finance Department, University of Calabar, Nigeria. (Corresponding author)

Faithpraise Otosi, Ph.D., Lecturer, Faculty of Administration and Management Sciences, Business Management Department, University of Calabar, Nigeria.

Enya Emori, Ph.D., Senior Lecturer, Faculty of Administration and Management Sciences, Banking and Finance Department, University of Calabar, Nigeria.

Joseph Asukwo, M.Sc., Lecturer, Faculty of Administration and Management Sciences, Banking and Finance Department, University of Calabar, Nigeria.

Ekpenyong Obo, Ph.D., Senior Lecturer, Faculty of Administration and Management Sciences, Business Management Department, University of Calabar, Nigeria.

Augustine Eba, Ph.D., Lecturer, Faculty of Administration and Management Sciences, Banking and Finance Department, University of Calabar, Nigeria.

John John, Ph.D., Lecturer, Faculty of Administration and Management Sciences, Banking and Finance Department, University of Calabar, Nigeria.

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Innocent Okoi (Nigeria), **Faithpraise Otosi** (Nigeria), **Enya Emori** (Nigeria), **Joseph Asukwo** (Nigeria), **Ekpenyong Obo** (Nigeria), **Augustine Eba** (Nigeria), **John John** (Nigeria)

DYNAMIC EFFECT OF FINANCIAL TECHNOLOGY ON FINANCIAL DEVELOPMENT IN NIGERIA

Abstract

Financial technology has become a top priority and a vital avenue for banking institutions seeking financial development and enhanced services. Financial technology is using a new digital transformation in the financial services industry. The study aims to investigate the dynamic effect of financial technology tools on financial development, examining both the long-run and short-run perspectives. The study used an ex-post facto research design because the data already existed and were retrieved from the Central Bank of Nigeria's statistical bulletin. The Autoregressive Distributed Lag (ARDL) model was employed to examine the impact of financial technology policy tools and financial development from the first quarter to the fourth quarter of 2013–2023. The long-run results revealed that financial technology positively impacted financial development, where a 1% increase in financial technology led to a 20.33% (p-value = 0.4123) increase in financial development, though statistically insignificant. In the short run, financial technology positively impacted financial development, where a 1% increase in financial technology led to a 6.57% (p-value = 0.0053) increase in financial development. The results showed a statistically significant relationship between biometric authentication devices, point of sale, web-based transactions, and mobile banking on money supply to gross domestic product in the short run, suggesting that financial technology drives financial development, enhancing access to financial services, and improving efficiency. Banks should continuously strengthen the adoption of financial technology tools that would promote banks' efficiency.

Keywords fintech, cryptocurrencies, money supply, financial deepening, technology acceptance model, internet infrastructures, biometric authentication devices, facial recognition

JEL Classification G21, 031, 033

INTRODUCTION

Financial technology is the broad use of digital innovation in financial transactions and intermediation processes to benefit organizations, consumers, companies, and business owners within the economy. It aims to enhance the effectiveness of monetary policy in promoting economic growth and development. The evolution of financial technology within the financial system has transformed traditional banking services and automation, enabling the delivery of financial services to a broader range of stakeholders. Customers complete a variety of financial transactions electronically (Boursrih, 2023). Equal access and usage of financial services will broaden the intermediation process of any country and improve economic agents, economic development, and financial inclusion (Kabakova & Plaksenkov, 2018; Resendiz, 2017). The financial technology policy minimizes the cost of bank commercial and digitalized payment services and incorporates financial inclusiveness. Financial technology payment channels and instruments are relevant to the economy because they enhance the soundness of banking service delivery. It also facilitates affordability, easy entrance, sound and reliable banking and financial services

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(Bayero, 2015). Financial technology targets the ugly consequences of daily banking services, including risk-taking in carrying physical cash for transactions, epileptic financial services, high bank charges, and substantial fees associated with informal financial intermediation, as well as reducing exposure to economic loss, inefficiency in cash equivalents, and other corporate governance infractions.

Before the digital transformation in financial services, the Nigerian economic system had been operating traditionally, resulting in poor efficiency. Businesses and organizations performed below par, thus causing the banking industry to become stagnant and ineffective, with many manual banking procedures. Due to the dominant manual processes, financial services such as cheque clearing took months; local and international money transfers also required a very long time. The situation caused lengthy lines, slowed banking hall transactions, and crowded the halls with clients. This led to lost person-hours, hindered economic activity, and decreased the ratio of money supply to GDP.

Furthermore, the money supply to gross domestic product (GDP) ratio dropped, and the credit provided by commercial banks to the private sector was inadequate, with commercial banks in Nigeria supplying less than 40% of the credits needed by the private sector. Despite the prevalent sensitization of commercial banks, some individuals are still attached to physical cash, particularly the low-income group, the unemployed, and the rural dwellers. On this premise, the study examines the implications of financial technology advancement on financial development in the long and short run.

1. LITERATURE REVIEW AND HYPOTHESES

Financial technology is the use of software and mobile applications to automate and improve traditional forms of finance. In any business environment, a financially driven technological economy is a financial culture where one hardly uses cash for transactional and precautionary motives. Most transactions are made with these contemporary cards: credit cards, debit cards, and direct electronic money transfers between accounts. Any cashless nation does not imply a total dearth of physical cash dealings within the commercialized centers; merely one that is operated upon minimum usage of cash-based transactions. It is the broad use of digital innovation in financial transactions and intermediation processes. Financial technology uses digital tools to create new financial instruments that improve the efficiency and effectiveness of financial transactions and services. It is seen as an organization's process of rolling out novel financial and investment tools to bring about the desired changes in employees' and customers' working environment. It augments an organization's market environment and improves allocative efficiency for growth. Financial innovation delivers value to customers, increases market reach, and fuels business growth using digital tools (Morufu & Taibat, 2012). Financial innovation drives change towards credit cards and online transactions to facilitate the overall banking sector transformation and financial development. Digital financial innovation started long ago with feasible results in industrialized countries like Britain, Canada, Brazil, and many other global communities.

However, developing nations like Nigeria are believed to have been operating a cash-centered economy. In Nigeria, a technology-driven economy is made up of about 63.3% of the people with bank accounts who use automated teller machines, 49.4% of the population with bank accounts use Point of Sales services, 6.9% of people with access to financial services use the internet, and below 12.8% access mobile-enabled financial transactions (Ogbeide, 2019). The recent COVID-19 pandemic has made many financial technology-driven countries more digitalized as banks were coerced to use electronic transactions more than their traditional banking system (Boursrih, 2023). Financial technology has led many Nigerians to embrace operating with cryptocurrency, and some economic agents use platforms such as Paxful and Binance to buy and sell cryptocurrencies. Non-financially included persons have affected many rural dwellers with minimal access to financial technology services (Mboto et al., 2024). Financial technology tools need to be safe, sound, and effi-

cient. Any financial system that is unsafe would be counterproductive and inefficient. This could, in turn, weaken penetration, access, and financial services accessibility and usage, and ultimately affect financial development (Malaguti, 2015).

Financial technology facilitates financial deepening and improves the efficiency of the financial intermediation process. The goal of financial technology is to mitigate some of the untold harmful outcomes arising from the economy's high cash holding rate, unparalleled charges due to unofficial financial intermediation, high risk associated with cash use, fluctuating internet access, ineffective service delivery, fraudulent activities of fraudsters, and corrupt activities. (Bayero, 2015; Ailemen et al., 2018). Financial technology lowers the risk of cash-related crimes, expands service possibilities, improves convenience, and makes credit and banking services more affordable (Yaqub et al., 2013). Equal access and usage of financial services will broaden the intermediation process and improve economic agents, economic development, and financial inclusion (Kabakova & Plaksenkov, 2018; Resendiz, 2017). Financial technology improves financial development depending on the country-level financial performance and financial inclusion. Financial technology could leverage countries well-known for poor financial sector performance or less financial inclusion to improve financial development. Financial technology has evolved to encompass novel technologies, including big data analytics, blockchain, artificial intelligence, machine learning, cloud computing, and the Internet of Things, used to build new models in the financial sector (Lait, 2024). Financial technology has made international transactions affordable and quicker. It has also changed the investment climate by presenting robo-advisory services and low-cost investment options (Bhat, 2019). Financial technology considerably propels the availability and affordability of financial services across all sectors of the economy. It contributes to economic growth and financial development by facilitating capital formation, financial intermediation, capital mobilization, and the financial system in general (Amutabi, 2024; Nazir et al., 2020; Laeven et al., 2015). Financial innovation is crucial in liberalizing the financial system by providing unregulated credit access via digital lending, leading to financial development (Hau et al., 2021). It empowers businesses and individuals by offering innovative services and financial products, ultimately contributing to economic growth and development.

Financial development is the improvement and expansion of a nation's financial institutions, capital markets, regulatory framework, infrastructure, and services to boost the stability, accessibility, and financial infrastructure efficiency of an economy. It is an upsurge of accessibility to financial services, stimulating financial inclusion and sound financial stability, encouraging savings and investment, boosting innovation, and enhancing financial infrastructure. Compared to a country's gross domestic product, it is seen as an improvement and development in financial and non-financial institutions such as banks, bureau de change, and others. Money supply is liquid instruments (cash) and other currencies circulated within a country's economy, while gross domestic product measures aggregate economic output produced within a geographical nation. The supply of money to gross domestic product indicates the nation's overall economic health.

Fintech has made borrowing by bank customers easy within a few minutes and has decreased the cost of borrowing, with more funds available. This is reinforced by the Central Bank of Nigeria, which noted that the growth rate of money stock rose from 30.0% in 2017 to 52.7% in 2022. Nigeria's innovation heritage is marked by a thriving fintech sector that compares favorably to that of Kenya, South Africa, and Malaysia, also key fintech centers in Africa (Effiom & Edet, 2020).

Financial development in growing economies could be driven by remittances, foreign direct investment, and other micro and macroeconomic indices such as inflation, interest rate, and gross domestic product (Joseph et al., 2023; Majeed et al., 2021; Irandoust, 2021). Financial development is the growth and deepening of financial systems, markets, and institutions. It is the bedrock for economic growth as it enhances credit access for people and businesses, facilitating digital financial inclusion. Financial development enhances capital formation, facilitates savings and investments, and contributes to economic stability. Financial development is a catalyst for economic growth by facili-

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tating the efficient allocation of resources, lowering transaction costs, and improving risk management. With the rise of FinTech, attention has shifted toward digital financial development, where innovations serve to bridge gaps in financial inclusion and modernize the financial intermediation process (Sahay et al., 2015; Otosi et al., 2024). Globally, the link between FinTech and financial development has been widely explored. Arner et al. (2016) argued that FinTech innovations significantly enhance service delivery, reduce costs, and expand access to underserved populations. Demirgüç-Kunt et al. (2018) emphasized that digital finance plays a transformative role in financial inclusion across low-income countries. Suri and Jack (2016) found that mobile money adoption in Kenya improved savings behavior and access to credit. Empirical findings from Asia, Latin America, and Europe demonstrate that FinTech innovations positively affect financial development and economic activity. Gabor and Brooks (2017) noted that Asia's FinTech boom has supported domestic credit expansion and deepened financial development. Kou et al. (2021) confirmed that institutional quality and technological readiness are critical to maximizing the developmental impact of FinTech.

Financial technology has changed the financial landscape in the last decade, reshaped social demographic structures, and significantly contributed to financial development in emerging markets (Allen et al., 2021). Financial technology could also contribute to financial development by managing risk, improving access to finance, increasing efficiency, developing innovative financial products and services, and overall job creation and economic growth.

The innovative technology system manages cash deposits and withdrawals, credit authorization, check verification, and cash payment through point-of-sale terminals. These terminals allow businesses to accept card payments for the sale of goods and services on a cash or credit basis, such as lottery tickets, recharge cards, and bill payments. Mobile banking is a variant of online service transactions that predominantly employs cell phones as electronic equipment.

A Biometric authentication device (BAD) is gradually gaining ground in Nigeria, as almost all commercial and microfinance banks have started implementation. The main benefit of a biometric authentication device is that, unlike traditional banking methods, where customers must wait in line for extended periods to withdraw money, a biometric authentication device (BAD) can be used at any time of the day and is not restricted to being located within banking premises. Debit cards are not used; the machine only recognizes and verifies the face and fingerprints of customers who intend to withdraw cash from the automatic teller machine (Ezeamama et al., 2014; Joshi, 2012). Biometric authentication is used in automated teller machines through fingerprint recognition and facial recognition (Tripathi & Nishad, 2020; Jain et al., 2017). Electronic transfers that may be completed online on Personal computers (PCs) and other Android phones are referred to as web-based transactions or e-transfers. Customers of banks who have internet banking subscriptions can conduct simple online banking transactions. Online banking is one way to pay bills and conduct any transaction using personal electronic devices.

The study is anchored on the Technology Acceptability Model (TAM) developed by Fred Davis in Min et al. (2019). The acceptance of novel technology by individuals, organizations, enterprises, and banks is explained by the notion of technological acceptance. This embrace of technology fosters financial development. The hypothesis describes the applicability of technology acceptance theory as a business-friendly model, and users of a new technology accept and perfect its usage within the shortest possible time. The notion is deemed acceptable based on three belief systems: perceived ease of use, perceived utility, and intention to use. Perceived usefulness is predicated on how well the new technology will enhance a given task 24/7 (Mazana et al., 2016). Other concepts from other theories that were used to modify TAM were perceived risk, trust, and social influence to enhance efficiency (Bara et al., 2025). Another theory that backs this Technology Acceptance Model (TAM) is the Unified Theory of Acceptance and Use of Technology (UTAUT) that recently emerged (Baptista & Oliveira, 2015; Le et al., 2020; Venkatesh, 2003). It is worth noting that TAM and UTACUT have common denominators and elements, including perceived usefulness, perceived ease of use, effort expectancy, per-

formance expectancy, trust, social influence, facilitating conditions, and perceived risk (Bara et al., 2025). The relevance of the model is that it has been widely adopted and used by different scholars to demonstrate the success of its performance (Min et al., 2019). There are also numerous confirmed and validated metrics in use. The model is vital in measuring customers' willingness to apply different types of technology at different intervals.

Previous research has shown that financial technology impacts economic growth and the performance of banks and firms. Cashless policy correlated positively with cashless payments (mobile cellular subscription, total value of banknotes, cards with e-money function) and bank performance (Jihen, 2023). The impact of automated teller machines on perceived ease of use, transaction cost, and service security was positive and significant, as was user satisfaction in Nigeria (Lasisi & Abubakar, 2014). The study on Nigeria's cashless policy and electronic banking found that electronic banking components of automated teller machines, point of sale, web-based transactions, and mobile transactions do not significantly increase the amount of currency in circulation (Ailemen et al., 2018). Other findings revealed that use of automated teller machines, point of sale, customer satisfaction, customer retention, and turnover with return on assets and return on equity had a high positive correlation between cashless policy and commercial banks' profitability (Akara & Asekome, 2018; Akanbi et al., 2022). Nigeria's interbank payment and agent banking were regressed against real gross domestic product, and the results were positively related to economic growth. In the same vein, another study on financial innovation variables: automated teller machines, mobile banking, internet banking, and point-of-sale terminals had significant positive effects on economic growth (Cynthia & Onyeiwu, 2019).

Furthermore, Ogbeide (2019) regressed cashless policy tools with financial inclusion. The findings revealed that the volume of automated teller machines and the volume of Point of sale had a positive and significant influence on financial inclusion, while web-based transactions revealed an insignificant relationship with financial inclusion in Nigeria. However, few studies on financial innovation and financial development revealed that automated teller machines, web-based transactions, and point-of-sale terminals were positively related to financial deepening in Nigeria, while mobile banking showed an indirect and significant effect on financial development (Enueshike et al., 2025).

The study reviewed some empirical works that have been done on financial technology and financial development in Nigeria and beyond. Consequently, the empirical studies reviewed evolved the following variables: cards with e-money function, accounts ownership at financial institution, mobile cellular subscriptions, total value of banks' notes in circulation, automated teller machine, Point of sale terminals, Nigeria interbank settlement system, agent banking, web based transactions, automated clearing system, bank branches, Africa infrastructure development index, secure internet servers, mobile payment on financial performance and economic growth in Nigeria; and these include: Jihen (2023), Lasisi and Abubakar (2024), Akara and Asekome (2018), Cynthia and Onyeiwu (2019), Chukwunulu (2019), Morufu and Taibat, (2012), Ogbeide (2019), Enueshike et al., (2025), Akanbi et al. (2022), Effiom and Edet (2020), and Amutabi (2024).

In the reviewed literature, some scholars were merely exploratory in that they discussed the benefits, challenges, and consequences of the financial technology policy, as well as whether or not its goals were met (Taiwo et al., 2017; Nguene & Abimbola, 2013; Ezeamama et al., 2014; Baptista & Oliveira, 2015; Bhat, 2019; Yaqub et al., 2013). In addition, some studies on financial technology have been inconclusive, with inconsistent relationships. Currently, no study focuses on the long-term and short-term dynamic effects of financial technology on financial development in Nigeria. Moreover, the study introduced a novel variable, a biometric authentication device, as one of the exogenous variables to measure financial technology. Consequently, the current study determined how to close the gap associated with financial development.

The study aims to investigate the dynamic effect of financial technology tools on financial development, examining both the long and short run. The study is intended to offer solutions to the research hypotheses put forward as follows:

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H1: Biometric authentication devices (BADs) do not have a significant effect on money supply to gross domestic product in Nigeria.

H2: Point of sale (POS) does not have a significant effect on money supply to gross domestic product in Nigeria.

H3: Mobile banking (MB) does not have a significant effect on money supply to gross domestic product in Nigeria.

H4: Web-based transactions do not have a significant effect on money supply to gross domestic product in Nigeria.

2. METHODOLOGY

The study adopts an ex-post facto research design, which is appropriate for examining causal relationships using historical data without manipulating any independent variables. In view of the dynamic nature of this study, the unrestricted standard Autoregressive Distribution Lag (ARDL) analytical technique was adopted. The design facilitates the investigation of how financial technology (FinTech) adoption influences financial development in Nigeria over time. The source of data collection was the Central Bank of Nigeria's statistical bulletin, which has been issued over the years. The study or researchers have not used the data in previous publications. The study utilized quarterly data from 2013 (2013Q1) to the fourth quarter of 2023 (2023Q4). The value of biometric authentication device (BAD) transactions was determined by the frequency with which this device was mentioned in the annual financial report. The study used content analysis to measure Biometric authentication device (BAD) transactions. The corporate annual report of commercial banks was analyzed, and a dichotomous method was followed to mark each disclosure issue as "1" if it appears to have disclosed the issue and "0" otherwise. Therefore, the econometric model after the Ordinary Least Squares (OLS) dynamic is specified in the following econometric equation in line with the regression, thus:

$$logMSGDP = b_0 + b_1 logBAD + b_2 logPOS + b_3 logMB + b_4 logWBT + e_t, \quad (1)$$

where *MSGDP* – Money supply to gross domestic product (measures the velocity of money and an indicator of liquidity), *BAD* – Value of biometric authentication device transactions (measures reliability, security, performance, and user experience), *POS* – Point of sales (measures the value of POS transactions), *MB* – Mobile banking (measures the value of mobile transactions), *WBT* – Web-based transactions (measures the value of online based transactions), e_t – Stochastic error term.

Theoretically, financial technology tools are expected to positively impact financial development in Nigeria. That a priori expectations should be greater than one. The study adopted the autoregressive distributed lag (ARDL) model to investigate the relationship and impact of financial technology tools on financial development in Nigeria. The study designed the ARDL technique for appraisal, which is formulated as follows:

$$\begin{aligned} \Delta LogMSGDP_t &= b_0 + \sum_{k=1}^{n} b_1 \Delta LogBAD_t \\ &+ \sum_{k=1}^{n} b_2 \Delta LogPOS_t + \sum_{k=1}^{n} b_3 \Delta LogMB_t \\ &+ \sum_{k=1}^{n} b_4 \Delta LogWBT_t + a_1 \Delta LogBAD_t - k \\ &+ a_2 \Delta LogPOS_t - k + a_3 \Delta LogMB_t - k \\ &+ a_4 \Delta LogWBT_t - k + e_1. \end{aligned} \quad (2)$$

The unit root test was also used to determine whether the series under investigation was stationary. The augmented Dickey-Fuller (ADF) unit root was used as a pre-test approach.

3. RESULTS

Table 1 shows descriptive statistics using a numerical approach to analyze the quantitative measures characterizing the data. The procedure measures the central tendency, such as the mean and median. It also measures the variability. The mean (0.330197) and median (0.312453) of money supply to gross domestic product (MSGDP) and biometric authentication device {BAD} with mean and median of 344335.8 and 385436.9, respectively, coincide, giving way to a symmetrical distribu-

Table 1. Descriptive statistics analysis

	MSGDP	BAD	POS	WBT	MB
Mean	0.330197	344335.8	123836.9	19756.34	168024.1
Median	0.312453	385436.9	86085.18	11518.96	69478.19
Maximum	0.468037	494894.8	322147.2	85096.79	474096.3
Minimum	0.231254	152814.5	6571.239	2339.774	5719.643
Std. Dev.	0.070322	103875.1	108124.4	18432.62	179277.8
Skewness	0.488381	–0.346726	0.533878	1.445060	0.759601
Kurtosis	1.943383	1.707360	1.776677	5.425436	1.803468
Jarque-Bera	3.105757	3.227688	3.954935	21.35330	5.609498
Probability	0.211638	0.199121	0.138419	0.000023	0.060522
Sum	11.88709	12396087	4458127	711228.3	6048866
Sum Sq.					
Dev.	0.173082	3.78E+11	4.09E+11	1.19E+10	1.12E+12
Observations	36	36	36	36	36

tion, while that of Point of Sale (POS), web-based transactions (WBT), and mobile banking (MB) transactions was positively skewed. The distribution was normal, with kurtosis values of approximately 2.0, except for web-based transactions, with the value of 5.425436. The variables MSGDP, POS, WBT, and MB were positively skewed, while BADs were negatively skewed. The distribution confirms its suitability for generalization.

The multicollinearity test in Table 2 was carried out to mitigate the problem of unstable parameter estimates that could cause difficulties in assessing the effect of exogenous variables on regressant variables. The correlation coefficient of the relationship between the ratio of money supply to gross domestic product (MSGDP) and biometric authentication device (-0.586779), Point of sale (–0.386323), web-based transactions (-0.438892), and mobile banking transactions (–0.347882) was negative and significant with corresponding probabilities less than 5%, respectively. The correlation coefficient of the relationship between biometric authentication devices with a point of sale (0.683515), web-based transactions (0.611104), and mobile banking transactions (0.689504), with corresponding probability values of 0.0000, 0.0000, 0.0000, respectively, was positive and significant. The same relationship exists in point-of-sale web-based transactions and mobile banking transactions.

A stationarity test was conducted using the Augmented Dickey-Fuller unit root test in Table 3. The money supply to gross domestic product, bio-

Table 2. Multicollinearity test results

Covariance Analysis: Ordinary
Correlation
Probability

Observations	MSGDP	BAD	POS	WBT	MB
MSGDP	1.000000				
	– 36				
BAD	–0.586779	1.000000			
	0.0002	–			
	36	36			
POS	–0.386323	0.683515	1.000000		
	0.0199	0.0000	–		
	36	36	36		
WBT	–0.438892	0.611104	0.669655	1.000000	
	0.0074	0.0000	0.0000	–	
	36	36	36	36	
MB	–0.347882	0.689504	0.673786	0.682126	1.000000
	0.0376	0.0000	0.0000	0.0000	–
	36	36	36	36	36

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Table 3. Excerpts from Augmented Dickey-Fuller (ADF) unit root test

Variables	At Level	At 1st Difference	Order of integration	Significant at 0.05
MSGDP	–2.2921	–4.9682***	1(1)	0.0067
BAD	–2.1842	–7.0684***	1(1)	0.0003
POS	–3.3733***	–	1(0)	0.0000
WBT	–1.3766	–6.5301***	1(1)	0.0189
MB	–1.8996	–5.7409***	1(1)	0.0000

Note: TEST OF CRITICAL VALUES: 1% = –3.6394, 5% = –2.9511***, 10% = –2.6143.

metric authentication device, web-based transactions, and mobile banking transactions were non-stationary at their levels. Nevertheless, when subjected to further testing, they became stationary at their first difference, making it possible to reject the null hypothesis.

From the ARDL cointegrating and long-run results in Table 4, the estimates indicated that the independent variables (BAD, POS, WBT, and MB) collectively have an insignificantly negative long-run impact on Nigeria's money supply to gross domestic product (MSGDP). A one % increase in BAD, WBT, and MB will lead to a 2.268, 0.426, and 1.412% decrease in MSGDP. The result is inconsistent with economic theory. The results also showed that POS had a positive, albeit insignificant, relationship with MSGDP. Conversely, a percentage increase in point-of-sale (POS) transactions is expected to result in a 2.48% increase in Nigeria's MSGDP ratio relative to the money supply. This relationship was shown to be statistically insignificant over the long run at the 5% significance level. This result is relevant to economic theory, showing that a 1% increase in POS led to an increase in MSGDP by 2.489%, ceteris paribus. In another development, the joint effects of financial technology tools will result in a 20.33 % increase in Nigeria's money supply to gross domestic product (M2 GDP). In the long run, results suggest that over time, the relationship between financial technology and financial development may not be strong, as there could be limited penetration of financial technology, that is, inaccessibility, unaffordability, and digital literacy might contribute to this weak result over this period. This also implies that despite increased online transactions within this period, many individuals or groups might have remained excluded from formal financial services. Mobile banking might not be reaching underserved populations effectively.

Table 5 showed that the value of the intercept being 6.57 explained that the ratio of money supply to gross domestic product (MSGDP) in Nigeria will increase by 6.57 % when all other exogenous variables (BAD, POS, WBT, and MB) are held constant; however, the intercept value of 6.57 was found to be statistically significant at the 5% level. The results also showed that the ARDL model as a whole has a very high fit with an R-squared value of 0.9128 (91.28 %), or roughly 92%. Similarly, the high F-statistic value of 7.57 indicated that the model is statistically significant since the F-computed is more than the F-table value. This explains the overall importance of explanatory variables (BAD, POS, WBT, and MB) in explaining the short-run fluctuations in the money supply to gross domestic product (MSGDP) ratio in Nigeria. This further revealed that taking cogni-

Table 4. ARDL cointegrating and long-run dynamic results

Endogenous Variable: D(LMSGDP) Case 1: Restricted Constant and No Trend				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LBAD	–2.268084	2.597298	–0.873247	0.3984
LPOS	2.488526	1.498239	1.660967	0.1206
LWBT	–0.425638	0.458909	–0.927501	0.3706
LMB	–1.417815	0.811147	–1.747913	0.1040
C	20.32924	23.99803	0.847121	0.4123

Note: EC = LMSGDP – (–2.2681*LBAD + 2.4885*LPOS –0.4256*LWBT –1.4178*LMB +20.3292).

Table 5. ARDL short-run dynamic results

Endogenous Variable: LMSGDP
Method: ARDL
Dynamic regressors (4 lags, automatic): LATM LPOS LWBT LMB
Selected Model: ARDL(1, 4, 4, 3, 2)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LMSGDP(-1)	0.676618	0.125182	5.405060	0.0001
LBAD	0.108150	0.474556	0.227898	0.8233
LBAD (-1)	0.763346	0.440217	1.734020	0.1065
LBAD (-2)	–1.237578	0.486699	–2.542798	0.0245
LBAD (-3)	0.630506	0.534718	1.179137	0.2595
LBAD (-4)	–0.997883	0.448015	–2.227342	0.0442
LPOS	–1.414704	0.766395	–1.845921	0.0878
LPOS(-1)	1.103486	0.645337	1.709936	0.1110
LPOS(-2)	1.837874	0.709250	2.591293	0.0224
LPOS(-3)	–1.409395	0.614194	–2.294708	0.0390
LPOS(-4)	0.687485	0.361419	1.902184	0.0795
LWBT	–0.122389	0.076673	–1.596236	0.1344
LWBT(-1)	–0.026114	0.086860	–0.300641	0.7684
LWBT(-2)	–0.258066	0.121556	–2.123016	0.0535
LWBT(-3)	0.268925	0.109003	2.467129	0.0283
LMB	–0.197773	0.254495	–0.777121	0.4510
LMB(-1)	0.061432	0.253581	0.242257	0.8124
LMB(-2)	–0.322155	0.234117	–1.376045	0.0021
C	6.574118	8.176688	0.804007	0.0053
R-squared	0.912877			
Adjusted R-squared	0.792246			
S.E. of regression	0.088426			
F-statistic	7.567509			
Prob(F-statistic)	0.000307			

zance of the overall exogenous variables of financial technology, there was a remarkable improvement in financial development. That is, in the short run, there could be enhanced security, reduced fraud, and increased financial inclusion in the use of Biometric authentication devices and point-of-sale terminals.

Furthermore, web-based transactions have increased online transactions and the expansion of digital platforms. In the short run, mobile transactions have increased financial inclusion and accessibility and have made mobile transactions affordable in Nigeria. Moreover, an insignificant positive effect was observed in the current period, the previous lagged period, and the previous three lagged periods of BAD transactions; however, a significant negative impact was observed in the previous two lagged periods and the previous four lagged periods of BAD transactions on the money supply to gross domestic product (MSGDP) ratio in Nigeria in the short run. In the same vein, the ARDL short-run estimates showed that variations in the current lagged periods of the POS transactions showed that changes in the current POS had a negative and insignificant effect on MSGDP. The previous lagged period had a positive and insignificant effect on MSGDP. In contrast, the two lagged periods of POS transactions had a significant positive effect, whereas the previous three lagged periods had a significant adverse effect. On the other hand, the previous four lagged periods had an insignificant positive effect on the MSGDP ratio in Nigeria in the short run.

Web-based transactions in the current period had an insignificant negative effect; the previous two lagged periods of WBT had a negative but significant relationship with MSGDP. Finally, a closer look at the ARDL short run estimates revealed that changes in the recent period and the previous two lagged periods of mobile banking transactions (MB) had an insignificant negative effect and while the previous period of mobile banking transactions (MBT) had an insignificant negative effect on the ratio of money supply to Gross domestic product in Nigeria in the short run.

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4. DISCUSSION

There was a marginal improvement in financial development by 6.57% in the short run, as this may have improved financial development in Nigeria. In contrast, the long run revealed that financial technology positively impacted financial development, as a 1% increase in financial technology led to a 20.33% increase in financial development, though statistically insignificant. The results revealed that fluctuations in BAD transactions significantly affected the degree of financial development in Nigeria in the short term. That is, using BAD for cash transactions without necessarily moving physical cash has facilitated financial development in Nigeria. The implication is that facial recognition and fingerprints have reduced identity theft and fraud, increasing trust in the financial system. This is supported by Ezeamama et al. (2014) and Joshi (2012).

The findings also revealed that differences in POS transactions significantly affected the degree of financial development in Nigeria in the short run. This implies an increase in electronic payment, financial inclusion (more people use POS), and an increase in the intermediation process within the financial system. It was discovered that the value of POS transactions significantly influences financial development from city centres to rural areas. This finding agreed with the study of Enueshike et al. (2025) and Ogbeide (2019). The findings revealed that fluctuations in MB transactions do not significantly impact the degree of financial development in the long run, while MB transactions significantly affect financial development in the short run. That is, mobile banking in Nigeria enhances financial services and is financially inclusive to the underserved population in the short run. It makes financial services more accessible and convenient for users in the short run. The findings agree with Ogbeide (2019), who used primary data to examine the impact of cashless transactions on financial development in Nigeria. The findings revealed that WBT impacts Nigeria's financial technology sector in the short run. This means that WBT drives growth, innovation, and accessibility in the financial system, improving the financial services of businesses and other organizations. This is in tandem with Cynthia and Onyeiwu (2019).

However, the findings of this study challenge the studies conducted by Lasisi & Abubaka (2014), Bayero (2015), Taiwo et al. (2017), Laith et al. (2024), Joseph et al. (2023), and Resendiz (2017), where it was discovered that financial innovation may not have promoted financial development significantly. In summary, the primary determinant of financial growth is incorporating financial technology or innovation through Biometric authentication devices, Point of sale, mobile banking, and web-based transactions. This is in tandem with the economic theory of technology acceptability, which posits a positive relationship between financial technology and financial development; the more financial innovation tools are used, the higher the financial development within the economy.

CONCLUSION

The study aims to investigate the dynamic effect of financial technology tools on financial development, examining both the long and short run. It was discovered that the long-run money supply to gross domestic product (MSGDP) equation revealed that biometric authentication devices, point of sale, web-based transactions, and mobile transactions were statistically insignificant. However, financial development improved by 20.33%, suggesting that financial technology tools are vital in driving financial development in Nigeria. The negligible impact could be attributed to poor internet infrastructure or power, inadequate supply of point-of-sale devices, and insufficient mobile applications of some commercial banks. Moreover, in the short run, according to the ARDL model, the relationship between biometric authentication device transactions and financial development (MSGDP) in Nigeria over the previous two lagged periods was significant at the 5% level.

Additionally, the relationship between financial development and point-of-sale transactions, as well as web-based transactions, over Nigeria's previous two lagged periods was also found to be statistically significant at the 5% level in the short run. Lastly, the relationship between mobile banking

and financial development over the previous two lagged periods was statistically significant at the 5% level. Conclusively, financial technology has gained prominence through biometric authentication devices, Point of sale, web-based transactions, and mobile banking in Nigeria. Though there was a marginal improvement in financial development by 6.57%, this may have improved financial development in Nigeria. The result is, therefore, compatible with the economic theory of the technology acceptance model that fosters economic deepening or financial development. The study shows that financial technology may have improved financial development marginally for the study period in Nigeria in the short run. The long-run results revealed that financial technology positively impacted financial development. A 1% increase in financial technology led to a 20.33% increase in financial development, though statistically insignificant. The positive coefficient and relationship suggest that fintech could catalyze financial development. Therefore, banks must continuously strengthen financial technology tools to bring sound, reliable, and resilient banking services to induce financial development in Nigeria. The Central Bank of Nigeria should stimulate the acceptance of mobile banking among the financially excluded, since it has been identified as one of the primary drivers of financial development.

The policy implementation of this study is that Nigeria, as a nation with improved financial technology, could leverage and strengthen innovative financial policies that will drive financial development. Policymakers in banks should solve recurrent machine malfunctions that may cause unrecognition of facial and fingerprints, as reported by customers; non-functional machines, long waiting lines, limited ATMs, excessive charges, and insufficient funds in ATMs. The issue of Internet banking security should be addressed by implementing appropriate technologies such as strong firewalls, cloud technology, and filters, as is done in industrialized countries. Customers will gain confidence in its use, resulting in increased adoption and financial development. The regulatory bodies and the Nigerian financial system should improve digital infrastructure, develop open banking infrastructure, create a favorable regulatory framework, and license and permit due processes for financial technology organizations. Since financial technology is the future fruit of banks that drives digital transformation, other studies should investigate other determinants of financial technology in developing economies like Nigeria.

AUTHOR CONTRIBUTIONS

Conceptualization: Innocent Okoi, Faithpraise Otosi.
Data curation: Innocent Okoi, Faithpraise Otosi, Ekpenyong Obo, Augustine Eba.
Formal analysis: Innocent Okoi, Enya Emori, Joseph Asukwo, John John.
Funding acquisition: Innocent Okoi, Faithpraise Otosi, Enya Emori, Joseph Asukwo, Ekpenyong Obo, Augustine Eba, John John.
Investigation: Innocent Okoi, Joseph Asukwo.
Methodology: Innocent Okoi, Enya Emori, Ekpenyong Obo.
Project administration: Innocent Okoi, Faithpraise Otosi, Augustine Eba, John John.
Resources: Innocent Okoi, Enya Emori, Ekpenyong Obo, Augustine Eba.
Software: Innocent Okoi, Ekpenyong Obo, John John.
Supervision: Innocent Okoi, Faithpraise Otosi, Joseph Asukwo, Ekpenyong Obo.
Validation: Innocent Okoi, Faithpraise Otosi.
Visualization: Innocent Okoi, Joseph Asukwo.
Writing – original draft: Innocent Okoi, Faithpraise Otosi, Enya Emori, Joseph Asukwo.
Writing – review & editing: Innocent Okoi, Enya Emori, Ekpenyong Obo, Augustine Eba, John John.

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