RADICAL INNOVATIONS, BUSINESS COMPETITIVENESS AND DEPOSIT MONEY BANKS IN NIGERIA

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ABSTRACT
Radical innovation fundamentally transforms markets, redefines industries, and alters our daily lives and work. The evolution of banking through innovation enhances payment processing, facilitating a transition from conventional banking practices to digital transformation. This study aims to explore the effects of radical innovations on the competitiveness of Nigerian deposit money banks from Q1 2009 to Q4 2023. The ARDL (autoregressive distributed lag) model was employed to assess long-term relationships. Unit root tests were performed on variables including return on assets, automated teller machines, internet banking, and mobile banking, revealing order one I(1) for the first three and order zero I(0) for point of sale. Co-integration-bound tests confirmed long-term relationships among the variables. The findings indicated that ATMs and mobile banking positively and significantly influence return on assets, while point of sale negatively impacts ROA. The study established a long-term relationship between the variables, with no serial correlation detected, indicating stability. It was concluded that radical innovations such as ATMs, PoS, internet banking, and mobile banking maintain a long-term relationship with Nigerian deposit money banks. Consequently, Nigerian deposit money banks are encouraged to invest in technology and innovative banking solutions to enhance ATM services, point-of-sale systems, internet banking, and mobile banking, thereby reducing customer congestion in banking halls.

Keywords: Deposit money banks, Radical innovation, Business competitiveness, Nigeria, ARDL
JEL Classification: G11, G20, G21, M20, M21

1. INTRODUCTION
In a competitive market, innovation is crucial for companies to maintain leadership and boost profits (Cerulli, 2014). Effective innovation strategies improve organizational performance and address various challenges (Siep, 2010). However, many innovative efforts fail, particularly in service sectors where innovation is often overlooked. Idowu et al. (2019) note that innovation combines creativity and entrepreneurship to create new economic values. Challenges can lead to growth opportunities through product and service innovation. Radical innovation involves significant advancements in technology, business models, or processes that transform industries and society. It introduces groundbreaking ideas that disrupt markets and can lead to revolutionary changes (Jain, 2023). Such innovations fundamentally alter industry components and their interactions (Pratt, 2021). While they can yield high profits, their implementation is risky.

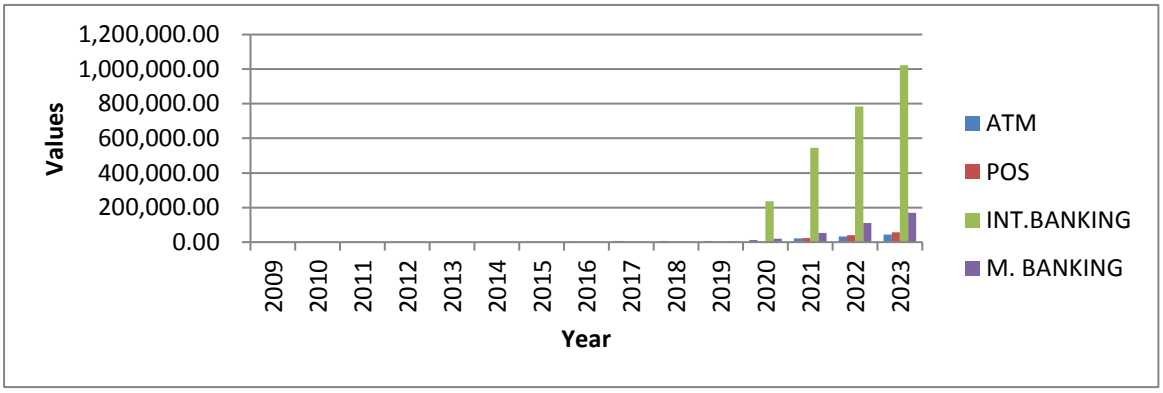
Deposit money banks, including commercial banks and financial institutions, accept transferable deposits like demand deposits and provide loans such as auto loans and mortgages, along with basic investment products. They act as financial intermediaries, channeling funds from savers to borrowers and supporting economic growth through investments and business activities (Raphael and Okologume, 2023). Commercial banks have introduced innovations like mobile banking apps, online banking, ATM networks, credit cards, and debit cards. The rise of alternative financial service providers is making Nigerian deposit money banks to enhance their digital transformation to maintain market share. To improve banking access, the Central Bank of Nigeria has licensed fintech companies like Paga, Quickteller, and Flutterwave to compete with commercial banks. The Nigerian banking sector, valued at over $9 billion, remains profitable, but many rural consumers face challenges due to limited access and affordability, resulting in a lag in technological advancements in banking transactions (Gololo, 2018).

Fintech enterprises are emerging to tackle these challenges by providing cost-effective payment solutions, rapid loan approvals, and adaptable savings options. From 2014 to 2019, over 200 fintech companies in Nigeria secured more than $600 million, contributing to the $491.6 million raised by technology firms throughout Africa. Despite the difficulties faced in 2024, characterized by reduced funding, stricter regulations, and a challenging macroeconomic environment, Nigeria's fintech sector continued to thrive, achieving a notable 70% growth year-over-year. By 2025, Nigeria boasted more than 430 fintech companies, a significant rise from the 255 firms recorded in 2024.

Competition among Nigerian deposit money banks has increased, requiring innovative strategies to adapt to rapid technological changes (Cainelli, Evangelista, and Savona, 2004). New distribution channels like online and mobile banking have raised the demand for innovation. While improving user access has raised operational costs, it has also increased revenue from existing accounts. To stay competitive, banks must develop new strategies, often leading to higher transaction fees and interest rates (Werner, 2014).. To meet customer expectations and maintain market share, Nigerian banks have introduced cardless banking services, allowing customers to access accounts via their mobile number linked to a bank app, using a one-time PIN and card PIN at ATMs.

A key innovation of Deposit Money Banks is the emergence of Internet and mobile banking, ATMs, and POS systems. According to the CBN's 2017 report, ATMs made up 78.2% of e-payment transactions, followed by POS (14.3%), mobile payments (4.7%), and internet banking (2.8%). The 21st century has seen advancements in self-service banking features.

Fig 1 Values of E-Payment Channels from 2009 to 2023



Sources: CBN, 2023.

From 2009 to 2019, ATMs were the leading electronic transaction channel. From 2020 to 2023, internet banking took the lead, followed by mobile banking, POS, and ATMs. Technological

innovations have boosted competition and revenues for Nigerian banks (Parnell, 2013). Developing innovative strategies is crucial for competitive advantage and marketplace performance (Tidd, 2003). Access to banks is vital for business growth, and some banks focus exclusively on Internet Banking to differentiate themselves (Achour & Benzedrine, 2005).

Electronic banking services like ATMs, point-of-sale systems, mobile banking, and Internet banking significantly impact business competitiveness, especially regarding return on assets. Nigerian banks must adopt these solutions to compete with FinTech firms and international banks. Historical economic downturns have often put banks at the forefront of crises (Kamau & Oluoch 2016). In response, many banks have adopted e-banking to improve operational performance. Recently, deposit money banks have worked to refine their services before delivery to customers, planning to increase prices while adding value. If financial institutions do not keep up with technological advancements, they risk lower productivity, profitability, and customer satisfaction (Ndubuisi-Okolo and Nwatu, 2020). While focusing on service improvement and value addition, neglecting technological innovations may lead to decreased productivity and customer dissatisfaction (Ndubuisi-Okolo & Nwatu, 2020).

Numerous researchers have investigated the role of innovative technology in deposit money banks and its influence on business competition in Nigeria. While several studies have assessed the effects of innovations on the competitiveness of Nigerian deposit money banks, there has been a lack of focus on the radical innovations that are propelling the transformation of these banks. Notable studies, including those by Okeke and Ezela (2023), Gbandor, Makwe, and Olushola (2022), Ogundayo, Siyanbola, and Babatayo (2022), Okolo (2023), Ndubuisi-Okolo and Nwatu (2020), Ogege and Boloupremo (2014), Ringim, Razalli, and Hasnan (2011), Bestman and Gwarah (2021), and Atay (2014), have generally concluded that innovations in banking positively impact business competitiveness, although a few have identified significant negative effects. Despite the extensive research on the impact of innovative technology on competitiveness within Nigerian banks, the exploration of radical innovations that drive transformation remains limited. This current study aims to investigate how radical innovations, such as ATMs, POS, mobile, and internet banking, affect the competitiveness of Nigerian banks, specifically in terms of Return on Assets, in the context of competition from FinTec and international players. Consequently, this study seeks to evaluate the influence of these radical innovations on the business competitiveness of Nigerian deposit banks from the first quarter of 2009 to the fourth quarter of 2023, employing the Auto-regressive Distributed Lag (ARDL) model to analyze long-term effects.

2. LITERATURE REVIEW

2.1 Theoretical Literature

In 1988, Greg Yezersky introduced the General Theory of Innovation, which explores the evolution of human-created systems. It asserts that all artificial systems evolve, with each innovation marking a key milestone. Its business applications have been validated through various tests. Innovation is defined as creating new theories to address past shortcomings, exemplified by the evolution of sound storage technologies like phonographs, discs, and MP3s. The theory of innovation diffusion explains how technological advancements spread through social networks in phases: awareness, persuasion, decision-making, implementation, and validation (Kim, 2017). This theory is pertinent to the current analysis, as it illustrates how innovations in finance, communicated via channels like POS, ATM, INTB, and MOB, have improved the operational efficiency of Nigerian banks, ensuring effective service delivery over time.

The competitive dynamic theory, represented by Ken Smith, Walter Ferrier, and Hermann Ndofor (2001), explains how a firm's actions influence competitor responses in an industry. Actions to maintain or gain a competitive edge include pricing changes, unique market

activities, new product launches, or market exits. Based on this theory, the reactions represent the response taken by a rival organization. It is important to note that this theory of competitive dynamics discusses both the firm initiating a competitive move as well as the firm that is reacting to the move. There is a relation between the magnitude, the scope, and the type of actions taken by firms.

The theory of competitive advantage suggests that informed decisions at national, corporate, local, and individual levels benefit all parties. It posits that individuals leveraging others' competitive advantages to enhance their own potential will have abundant job opportunities. The theory suggests that companies should adopt strategies to create high-quality products that can sell at premium prices. This is relevant to the analysis as it highlights the potential for higher profitability, allowing businesses to maintain pricing power and demand. By enhancing their competitive edge, organizations can become sector leaders and remain strong in challenging market conditions.

2.2 Empirical Literature

Folami, Somoye, and Ilo (2024) studied payment innovations in Nigeria's deposit money banks through a systematic literature review. Their findings highlighted key factors influencing these innovations, including bank size, perceived usefulness, regulatory capital, R&D investment, human capital development, asset quality, and ICT investment. Okeke and Ezela (2023) studied the impact of financial innovations like ATMs, POS systems, and mobile banking on Nigeria's deposit money banks from 2006 to 2020, using an ex-post facto design. They found that while POS significantly affected liquidity, ATMs and mobile banking did not. All three innovations were insignificant regarding the loan-to-deposit ratio. Similarly, Gbandor, Makwe, and Olushola (2022) examined financial innovation's effect on deposit money banks from 2009 to 2021, measuring performance by bank assets with the ARDL methodology. Their results showed POS systems performed best, while internet banking was the least effective. Ogundayo, Siyanbola, and Babatayo (2022) reviewed the impact of financial innovation on the return on assets of publicly listed Deposit Money Banks in Nigeria from 2010 to 2022, using an ex-post facto design. They concluded that financial innovation significantly affects return on assets. Okolo (2023) analyzes how financial innovations like ATMs, POS systems, internet banking, and mobile banking affected the financial performance of Nigerian deposit money banks from 2000 to 2021. Using Return on Equity (ROE) and the ARDL model, the study finds that ATMs and internet banking significantly impact ROE, while POS systems and mobile banking do not significantly affect ROE in the short or long term.

Ibekwe (2021) examined the impact of financial innovation on Nigerian deposit banks using ex-post facto secondary data from 2006 -2019. The study adopted the OLS method and found that automated teller machines, mobile banking, and point-of-sale systems positively affect return on assets, while internet banking has a negative impact. Overall, financial innovation enhances the performance of commercial banks in Nigeria. Kolapo et al. (2021) assessed the performance of Nigerian banks through strategic marketing innovation by surveying 1,200 employees and 300 customers from eight major banks out of 21 banks. The study used primary data and adopted the fitted regression based model. Results indicate that marketing innovation significantly boosts customer satisfaction. Bestman and Gwarah (2021) studied the impact of technological changes on deposit money banks in River State, Nigeria, surveying 96 staff from 16 banks. The findings indicate a positive correlation between ICT use and organizational growth. Similarly, Akani and Tony-Obiosa (2020) analyzed the effects of financial innovation on profitability in Nigerian banks from 2009 to 2017. The study adopted the panel OLS regression model for analysis. Their panel data regression revealed that return on equity

negatively correlated with ATMs and electronic fund transfers, while internet and mobile banking showed positive correlations.

Onwuala (2019) studied the link between technological innovation and competitive advantage at Deposit Money Banks in Port-Harcourt, Nigeria, using a sample of 143 from 223 employees across 21 banks. The findings indicate significant advantages for these banks. Additionally, Idowu et al. (2019) explored the impact of financial technology on Nigeria's banking sector, revealing that fraud risk and transaction costs significantly influence the adoption of innovations, with ATMs being the most utilized. Jude (2019) analyzes the profitability of Internet banking among banks in the Turkish Republic of Northern Cyprus, addressing key aspects of profitability and cost efficiency using data from 22 retail banks. The study finds that banks utilizing Internet banking saw increased asset returns. Similarly, Njogu (2019) examines the impact of electronic banking on the profitability of Kenyan commercial banks from 2009 to 2013. The analysis indicates a strong positive correlation between financial performance and the use of electronic banking channels.

3. METHODOLOGY

3.1: Theoretical Framework

The framework is based on the General Theory of Innovation, which treats all innovation types as systems. A system's evolution depends on its performance functions relative to resource connections and customer investments. The Coefficient of Freedom, derived from this relationship, reflects value—higher values indicate greater worth.

$$C_{Freedom} = \frac{\sum Functions}{\sum Connections} \qquad 3.1$$

3.1 The Model

An extensive use of autoregressive and distributed lag models is prevalent in econometric analysis. This method is used to determine long-term and short-term relationships between variables using autoregressive distributed lags (ARDLs). It does not matter if the variables in the study are purely I(0) or I(1), the ARDL approach is used regardless of the order of integration.

The general ARDL *(p q)* will be considered

$$y_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \phi_i y_{t-1} + \beta' x_t + \sum_{i=0}^{q-1} \beta^{*\prime} \Delta x_{t-1} + \mu_t \qquad 3.2$$

Equation 3.2 will be formulated as follows.

$$\Delta y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \Delta y_{t-i} + \sum_{i=0}^{p} \beta_j \Delta x_{1t-j} + \sum_{i=0}^{p} \gamma_k \Delta x_{2t-k} + \phi_0 y_{t-1} + \phi_1 x_{1t-1} + \phi_2 x_{2t-1} + \varepsilon_t$$

3.3

Where ε_t is a random disturbance term

3.2 Model Specification

$ROA = f(ATM, PoS, INTB, MOB)$ 3.4

Where ROA = Return on Asset a proxy of on Business competitiveness for deposit money banks andRadical Innovations Proxy (ATM = Automated Teller Machine, PoS = Point of Sales, INTB = Internet Banking, MOB = Mobile Banking)

The data generating process for equation 3.4 is defined in econometric from as

$$ROA_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta ROA_{t-i} + \sum_{i=0}^{p} \alpha_{2i} \Delta ATM_{t-i} + \sum_{i=0}^{p} \alpha_{3i} \Delta PoS_{t-i} + \sum_{i=0}^{p} \alpha_{4i} \Delta INTB_{t-i} + \sum_{i=0}^{p} \alpha_{5i} \Delta MOB_{t-i} + \beta_1 ROA_{t-1} + \beta_2 ATM_{t-1} + \beta_3 PoS_{t-1} + \beta_4 INTB_{t-1} + \beta_5 MOB_{t-1} + \varepsilon_{t.} \quad 3.5$$

Equation 3.5 is used to capture the objective

Return on Assets: Return on Assets (ROA) indicates the competitive position of Nigerian deposit banks by reflecting profitability relative to total assets. Investors use ROA to gauge how effectively banks generate profit from their resources, assessing their competitive advantage through innovative practices.

ATM: The ATM is a key innovation for banks, allowing them to compete with FinTechs and international banks to boost profitability. This device dispenses cash and provides services to customers who verify their identity with a PIN, marking a significant advancement in commercial banking.

PoS: This represents yet another aspect of radical innovation, enabling businesses to process customer payments and monitor sales, serving as a metric for radical innovation within commercial banks.

Internet Banking: Internet Banking is a major innovation, allowing customers to access their accounts and banking information online, marking a significant advancement in commercial banking.

Mobile Banking: Mobile Banking is a major innovation that uses mobile phones for financial transactions, allowing instant fund transfers between customers. It sets a standard for radical innovations by commercial banks.

3.3 Diagnostic/Estimation Techniques

Unit root test: Dicky and Fuller suggest augmenting their test procedure with additional lagged terms of the dependent variable to address autocorrelation. Below is the equation for the ADF form.

$$\Delta y_t = a_0 + \lambda y_{t-1} + a_{2t} + \sum_{i=1}^{p} \beta_i \Delta y_{t-1} + \mu_t \quad 3.6$$

From the stationary test if the variables are significant, the variable series is stationary and with no unit root. As a result of the significant test, the null hypothesis will be accepted.

The Autoregressive Distributed Lag (ARDL) (Bound test): ARDL models use OLS for both stationary and non-stationary time series and can be transformed into a dynamic error correction model, integrating short-run dynamics with the long-run equilibrium of the ECM without losing information about the long-run.

The ARDL model is given as

$$\Delta y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \Delta y_{t-i} + \sum_{i=0}^{p} \beta_j \Delta x_{1t-j} + \sum_{i=0}^{p} \gamma_k \Delta x_{2t-k} + \phi_0 y_{t-1} + \phi_1 x_{1t-1} + \phi_2 x_{2t-1} + \varepsilon_t \quad 3.7$$

Stability Test

Pesaran and Pesaran (1997) highlighted the importance of short run dynamics in evaluating long run coefficient stability, while Broen et al. (1975) introduced the CUSUM and CUSUMSQ tests for this purpose.

Data Source

The study used quarterly data from 2009Q1 to 2023Q4. The annual data used in this study are gotten from the bulletin of the Central Bank of Nigeria (CBN, 2023) and converted to quarterly with the help of Eview 10

4. FINDINGS AND DISCUSSION OF RESULTS

4.1: Table 1 Unit root test

Variables	ADF (5%)	Level diff	First diff	Order of Integration
ROA	-3.500495	-2.761801	-7.404564	I(1)
Log ATM	-3.500495	-2.726558	-3.830032	I(1)
Log POS	-3.493692	-3.543225		I(0)
Log INTB	-3.493692	-1.875615	-7.691404	I(1)
Log MOB	-3.508508	-0.117937	-3.618213	I(1)

Authors' computation Using E-views 10

Table 4.1 indicates that the return on assets (ROA), ATM, internet banking (INTB), and mobile banking (MOB) series have a unit root, while point of sales (POS) does not. This allows for the estimation of the ARDL model based on I(0) and I(1) integration.

4.2 The ARDL Co-integration Bound test

If the F-statistic exceeds the upper I(1) bound, co-integration exists; reject the null hypothesis. If the F-statistic falls below the lower I(0) bound, no co-integration exists; accept the null hypothesis.

Table 2: ARDL Co-integration Bound test

Levels Equation				
Case 3: Unrestricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LATM	14.75062	1.244675	11.85098	0.0000
LPOS	-10.44835	0.818491	-12.76538	0.0000
LINT_BANKING	0.339547	0.170727	1.988832	0.0540
LM_BANKING	3.391061	0.748296	4.531709	0.0001
EC = ROA - (14.7506*LATM -10.4484*LPOS + 0.3395*LINT_BANKING + 3.3911*LM_BANKING)				
F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	104.4309	10%	2.45	3.52
K	4	5%	2.86	4.01
		2.5%	3.25	4.49
		1%	3.74	5.06
Actual Sample Size	52		Finite Sample: n=55	
		10%	2.578	3.71
		5%	3.068	4.334
		1%	4.244	5.726

			Finite Sample: n=50	
		10%	2.614	3.746
		5%	3.136	4.416
		1%	4.306	5.874
t-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-20.93129	10%	-2.57	-3.66
		5%	-2.86	-3.99
		2.5%	-3.13	-4.26
		1%	-3.43	-4.6

Source: Estimation by the Researchers by Using E-views 10

Table 4.2 shows the bond test for long-term relationships. The F-statistic of 104.4309 exceeds the Pesaran 5% critical upper bound of 3.52, allowing us to reject the null hypothesis (H0) in favor of the alternative (H1). This indicates a long-term relationship between radical innovations (ATM, POS, INTB, MOB) and bank competitiveness, as measured by return on assets (ROA). We will use the error correction model (ECM) to estimate long-term effects. Results indicate that ATM and Mobile banking positively and significantly influence ROA, enhancing the profitability of Nigerian deposit banks. Conversely, Point of Sale (PoS) systems negatively impact ROA, reducing profitability, while Internet banking shows no statistically significant effect on ROA.

4.3: Error Correction Model (Long Run Estimation)

Table 3: Dependent variable: D (ROA)

ECM Regression				
Case 3: Unrestricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-72.44345	3.073304	-23.57184	0.0000
D(LATM)	-10.42724	0.989967	-10.53292	0.0000
D(LATM(-1))	-23.76857	1.380379	-17.21887	0.0000
D(LATM(-2))	-23.76857	1.380379	-17.21887	0.0000
D(LATM(-3))	-23.76857	1.380379	-17.21887	0.0000
D(LPOS)	-5.896058	0.714430	-8.252809	0.0000
D(LPOS(-1))	3.837086	0.647056	5.930072	0.0000
D(LPOS(-2))	3.837086	0.647056	5.930072	0.0000
D(LPOS(-3))	3.837086	0.647056	5.930072	0.0000
CointEq(-1)*	-0.948668	0.039490	-24.02329	0.0000
R-squared	0.948458	Mean dependent var		-0.029615
Adjusted R-squared	0.937413	S.D. dependent var		5.239507
S.E. of regression	1.310790	Akaike info criterion		3.550178
Sum squared resid	72.16312	Schwarz criterion		3.925417
Log likelihood	-82.30462	Hannan-Quinn criter.		3.694036
F-statistic	85.87374	Durbin-Watson stat		1.794761
Prob(F-statistic)	0.000000			

Source: Estimation by the Researchers by Using E-views 10

CointEq(-1) shows a coefficient estimate of -0.948668, indicating that 94.87% of disequilibrium movements are corrected within one period. The high t-statistic of -24.02329 confirms the coefficient's significance, suggesting a long-run relationship between the competitiveness of Nigerian deposit money banks and their radical innovation. A Durbin-Watson statistic of 1.794761 indicates no serial or autocorrelation.

4.4 Stability test

Fig 2

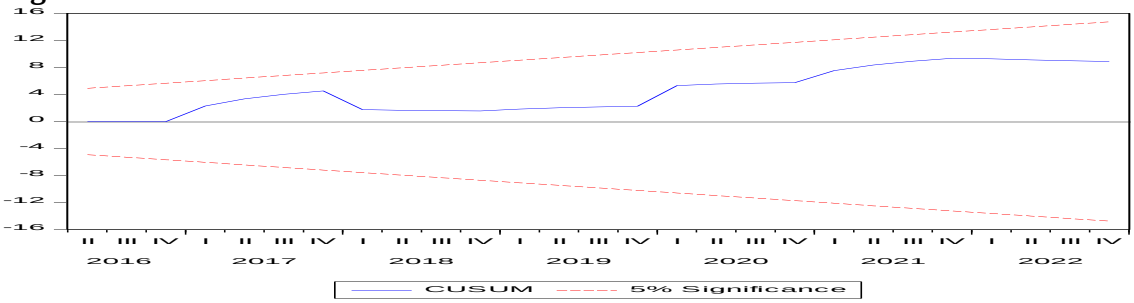


Fig 2 shows that the blue line lies between the 5% significant boundary so we can say the model is stable.

Discussions

The study reveals a strong link between the competitiveness of Nigerian deposit money banks and radical innovations such as ATMs, POS, internet, and mobile banking, positively affecting their long-term performance. Research indicates that financial innovations enhance the performance of both established and new banks (Ibekwe, 2021; Asidok & Micheal, 2018; Njogu, 2019, Okeke and Ezela (2023) Gbandor, Makwe, and Olushola (2022), Ogundayo, Siyanbola, and Babatayo (2022), Okeke and Ezela (2023); Additionally, findings support the positive relationship of internet/mobile banking and ICT investments with return on equity and customer satisfaction, aligning with studies by Balogun (2016) and others. However, this contrasts with Adaora et al. (2018) and Prena & Singh (2011), who found a negative impact of technology on small banks' market share. Notably, fraud at POS adversely affects interest income, unlike fraud at ATMs, mobile banking, and web platforms, which does not impact return on assets.

5. CONCLUSIONS AND POLICY DIRECTIVES

This research analyzed the impact of radical innovation on the competitive landscape of Nigerian deposit money banks using the Autoregressive Distributed Lag (ARDL) model. Data from the Central Bank of Nigeria (CBN, 2022) covering Q1 2009 to Q4 2023 was utilized. The results indicated a strong link between radical innovation and the performance of these banks, suggesting a long-term relationship among ATMs, POS systems, mobile banking, and internet banking, enhancing their competitiveness against Fintech institutions and improving customer satisfaction compared to earlier methods like cashbooks and checks.

Based on the findings, the study directs that:

(1) Nigerian deposit money banks should launch a strong campaign to educate clients about their services, especially ATM, PoS, and mobile banking. They must maintain the financial system's integrity while promoting innovation to lower costs and increase profitability.

(2). Improving service quality and responsiveness to customer issues, such as lost cards and fraud, is crucial for enhancing bank performance.

(3). Additionally, Nigerian deposit money banks should invest in technology to improve access to ATM, PoS, mobile, and internet services. They need to focus on effectively utilizing these innovative financial services.

(4). Finally, both Nigerian deposit money banks and the central bank should collaborate to educate customers about these innovations and expand service networks, including regular training on ATM usage, benefits, risks, and security measures to prevent hacking-related financial losses.

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