



A Comparative Analysis of Transaction Costs, Fraud Rates and Customer Adoption of E- Payment Market in Nigeria, 2018-2024

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Abstract

This study examined the influence of electronic fraud and transaction costs on e-payment usage in Nigeria. The study was motivated by the rapid expansion of electronic payment channels alongside persistent concerns about fraud and the cost of digital transactions. Specifically, the study examined the individual effects of electronic fraud rate and actual electronic fraud losses on e-payment usage and assessed the joint influence of electronic fraud rate and electronic transaction costs. The data were obtained from the Central Bank of Nigeria (CBN), Nigeria Inter-Bank Settlement System (NIBSS), and National Bureau of Statistics (NBS). The study adopted an *ex-post facto* research design and relied on secondary quarterly data on e-payment usage, electronic fraud rate, actual fraud losses and transaction costs for the study period. Autoregressive Distributed Lag (ARDL) estimation was employed to examine the relationships among the variables. The findings revealed that electronic fraud rate had a positive but statistically insignificant effect on e-payment usage, while actual electronic fraud losses had a negative but statistically insignificant effect. However, electronic transaction costs exerted a negative and statistically significant effect on e-payment usage ($\beta = -140.4428$; $p = 0.0014$). The joint estimation further showed that electronic fraud rate and transaction costs significantly influenced e-payment usage, with both variables exhibiting negative effects (FR: $\beta = -1,007,724$; $p = 0.0030$; TC: $\beta = -336.8657$; $p = 0.0004$). The study concludes that transaction affordability constitutes a more immediate constraint on aggregate e-payment usage, while fraud becomes statistically consequential when considered jointly with transaction costs. The study recommends an integrated secure-and-affordable payment strategy involving reduced transaction charges, strengthened fraud detection, consumer protection and improved payment-system trust.

Keywords: Transaction cost, Fraud rate, Customer adoption, E- Payment Market

1.0 Introduction

Financial services are essential to economic growth and development because accessibility, availability and affordability of financial products influence individuals' ability to undertake transactions, pursue economic goals and achieve sustainable livelihoods. With the advancement of information and communication technology (ICT), financial technology has transformed the delivery of financial services. The rapid diffusion of digital financial technologies has consequently reshaped financial systems globally, including Nigeria. Electronic payment (e-payment) systems have become an integral component of contemporary financial systems, enabling individuals and businesses to transfer funds and make payments electronically rather than relying predominantly on cash. These systems include mobile banking, internet banking, Automated Teller Machines (ATMs), Point-of-Sale (POS) terminals, USSD and other fintech-enabled platforms. Evidence indicates that expanding e-payment systems improves transaction convenience, speed, accessibility and efficiency while supporting financial inclusion and the transition towards less-cash economies (Oyelami, Adebisi, & Adekunle, 2020). In emerging economies, digital payment infrastructure can further extend formal financial services to underserved populations and reduce geographical and operational limitations associated with conventional banking (Gholami, Ogun, Koh, & Lim, 2010; Oyelami *et al.*, 2020).

Nigeria provides an important context for examining how digital financial transactions are transforming payment systems. The Central Bank of Nigeria (CBN) introduced the cashless policy in 2012 to reduce reliance on physical cash and encourage electronic payments for goods, services and financial transfers. Subsequently, the CBN developed the Payments System Vision 2025 as a strategic framework for strengthening electronic payment adoption, safety, reliability, resilience and financial inclusion in Nigeria (Central Bank of Nigeria [CBN], 2022). The CBN (2024) reported sustained growth in electronic payment channels, particularly instant payments, mobile and POS transactions. The substantial increase in NIBSS Instant Payment transactions between the second half of 2023 and the first half of 2024 further demonstrates the increasing dependence of consumers and businesses on electronic channels (CBN, 2024). E-payment has therefore evolved from a supplementary banking facility into an important component of everyday economic activity.

However, the availability and expansion of electronic payment infrastructure do not necessarily guarantee sustained customer usage. Adoption can be influenced by economic, technological and behavioural factors, including convenience, perceived usefulness, trust, security, accessibility, ease of use and cost. Gholami *et al.* (2010) identified awareness, perceived benefits, reliability, trust, security, accessibility and ease of use as important determinants of e-payment adoption in Nigeria. Oyelami *et al.* (2020) found that convenience, security, safety, trust and social influence were significantly associated with electronic payment adoption among Nigerian consumers. These findings suggest that expanding digital payment infrastructure must be accompanied by conditions that make electronic transactions affordable, secure and reliable.

Transaction cost is therefore an important consideration in digital financial technology usage. Transaction costs include financial charges associated with electronic payments, such as transfer fees, service charges and processing costs. Although individual charges may appear small, repeated costs can become economically significant, particularly for low-income users, micro-enterprises and customers conducting frequent small-value transactions. The CBN's cashless policy recognised the importance of reducing the cost of banking services and providing efficient transaction alternatives as part of the development of Nigeria's payment system (CBN, 2024). Consequently, transaction

costs may influence whether consumers perceive electronic payments as economically attractive alternatives to cash.

Another major concern is electronic payment fraud. The expansion of digital financial services has increased the importance of cybersecurity, consumer protection and user trust. Electronic fraud may involve unauthorised transactions, identity theft, phishing and other cyber-enabled financial crimes (Igudia, 2016). Beyond direct financial losses, repeated exposure to fraud can undermine confidence in digital payment systems. Tade and Adeniyi (2020) demonstrated that electronic banking fraud constitutes an important challenge to trust within Nigeria's emerging cashless ecosystem and that fraud concerns are relevant to decisions regarding the migration to and continued use of electronic banking. Similarly, Nigerian e-payment research identifies security and trust as central considerations in users' adoption decisions (Igudia, 2016; Oyelami *et al.*, 2020).

The interaction between transaction costs and fraud consequently presents an important research and policy concern. Consumers may be attracted to e-payments because of their speed, convenience and accessibility, but these benefits may be weakened when transactions are perceived as costly or insecure. Thus, the availability of payment infrastructure may not automatically translate into effective and sustained usage. This distinction between infrastructure availability and actual utilisation is particularly relevant in Nigeria, where digital payment activity has expanded alongside persistent concerns about transaction charges, fraud and consumer protection.

Although Nigerian literature on electronic payment adoption has expanded, much of it has concentrated on technological and behavioural determinants such as perceived usefulness, ease of use, trust, security, social influence and infrastructure. Other studies have examined electronic fraud as a challenge to the cashless economy. Igudia (2016), for instance, examined factors influencing the adoption and extent of e-payment use among Nigerian SMEs, while Oyelami *et al.* (2020) investigated determinants of e-payment adoption and its relationship with consumer spending. Tade and Adeniyi (2020) focused on electronic fraud and trust within Nigeria's cashless ecosystem. While these studies provide important insights, they do not adequately address how transaction costs and fraud can be jointly examined as constraints on e-payment usage.

Furthermore, existing studies have frequently relied on cross-sectional surveys or examined individual determinants of adoption, with comparatively limited attention to an integrated assessment of transaction costs and fraud within Nigeria's rapidly evolving electronic payment environment. This creates a need for empirical evidence on whether affordability and security concerns have distinct or combined implications for e-payment usage.

Against this background, this study examined the influence of transaction costs and fraud rates on customer adoption of e-payment systems in Nigeria from 2018 to 2024. Specifically, it investigated the influence of transaction costs on e-payment usage, assessed the effect of fraud rates on usage, and examined the combined influence of both factors. The study contributed to digital finance literature by shifting attention from the expansion of electronic payment infrastructure to the economic and security conditions that may determine its effective utilisation.

2.0 Conceptual Review

2.1 Electronic Payment Systems

Electronic payment (e-payment) refers to the transfer of monetary value or settlement of financial obligations through electronic channels without the physical exchange of cash. It encompasses technologies that enable individuals, businesses and institutions to initiate, process and receive payments electronically, including internet and mobile banking, Automated Teller Machines (ATMs), Point-of-Sale (POS) terminals, electronic fund transfers, USSD and fintech-enabled applications. E-payment systems have become an important component of contemporary financial systems because they facilitate faster and more convenient transactions while reducing dependence on physical cash (Gholami *et al.*, 2010).

The development of e-payment reflects the wider digitalisation of financial services. Digital platforms allow transactions to be conducted remotely and continuously, reducing the geographical and temporal limitations associated with conventional banking. Ozili (2020) notes that digital finance can improve access to financial services by reducing transaction costs, expanding service availability and facilitating participation in the formal financial system. These benefits are particularly relevant in developing economies, where digital platforms can extend payment services to individuals and businesses facing barriers to conventional banking.

In Nigeria, the evolution of e-payment has been driven by regulatory and technological developments. The Central Bank of Nigeria's cashless policy and subsequent payment-system initiatives have encouraged movement from cash-based transactions towards electronic channels. The expansion of mobile telecommunications, fintech enterprises and instant-payment infrastructure has accelerated this transition. The Payments System Vision 2025 identifies innovation, safety, resilience, interoperability and financial inclusion as important dimensions of Nigeria's modern payment ecosystem (Central Bank of Nigeria [CBN], 2022).

E-payment therefore extends beyond the existence of electronic infrastructure to include the technologies, processes, institutions and users involved in electronically initiated and settled transactions. In this study, e-payment is conceptualised in terms of the use and volume of electronic payment services through channels such as mobile banking, internet banking, POS, USSD and related digital platforms. The concern was on actual customer usage rather than merely the availability of payment facilities.

2.2 Transaction Costs

Transaction cost refers to the costs incurred in undertaking an economic exchange. Transaction cost economics recognises that exchanges involve costs beyond the price of the underlying good or service, including expenses related to searching for information, negotiating, monitoring and completing transactions (Coase, 1937; Williamson, 1985). Within electronic payment systems, transaction costs relate more specifically to the financial and operational costs incurred when initiating or completing digital transactions.

E-payment transaction costs include transfer charges, service fees, processing charges, withdrawal charges and other fees associated with electronic payment services. Although individual charges may appear relatively small, their cumulative effect can become significant for users conducting frequent transactions. Consequently, the cost of digital financial services may influence users' perceptions of the affordability and attractiveness of electronic payment channels.

Transaction cost is particularly relevant to digital financial inclusion because the benefits of electronic payments depend partly on affordability. Where transaction charges are high relative to

users' income or transaction value, consumers may reduce digital transactions or revert to cash. Ozili (2020) argued that reducing transaction costs is one of the potential benefits of digital finance; however, this benefit may be weakened when users face substantial charges for accessing or using digital financial services.

The relationship between transaction costs and adoption can also be explained through perceived value. Consumers are more likely to continue using a payment platform when the benefits of convenience, speed and accessibility outweigh the costs incurred. Conversely, high or unpredictable charges may reduce perceived value and discourage repeated usage. This issue is particularly important for low-income consumers and small businesses that frequently conduct relatively small-value transactions.

For this study, transaction cost is conceptualised as the financial charges borne by customers when conducting electronic payment transactions. It represents an economic constraint that may affect the frequency and extent of e-payment usage. It is operationalised as the representative average regulated charge associated with electronic payment transactions in Nigeria, measured in Nigerian naira per transaction, covering ATM, POS, Internet/Web, USSD, Mobile App and NIP/electronic transfer channels.

2.3 Electronic Payment Fraud

Electronic payment fraud refers to fraudulent activities involving the unlawful acquisition, transfer or manipulation of funds through electronic payment channels. It may include phishing, identity theft, account takeover, unauthorised electronic transfers, payment-card fraud and other forms of cyber-enabled financial deception. The expansion of digital financial services has increased the importance of fraud prevention as a greater proportion of financial transactions are conducted through electronically connected platforms.

The consequences of fraud extend beyond the immediate financial losses suffered by victims. Fraud can undermine confidence in digital financial systems and create perceptions that electronic payment platforms are unsafe. Tade and Adeniyi (2020) show that electronic fraud constitutes an important challenge to trust within Nigeria's cashless ecosystem. This is significant because trust is a fundamental consideration in the adoption and continued use of financial technologies.

Security considerations are also supported by technology-adoption research. Consumers generally assess whether digital platforms adequately protect their financial and personal information before using them. Gholami et al. (2010) identified security and reliability among factors associated with e-payment adoption in Nigeria, while Oyelami et al. (2020) found that security, trust and safety were important considerations in electronic payment adoption among Nigerian consumers.

The expansion of electronic transactions may therefore produce a dual effect. Digitalisation increases convenience and accessibility, but higher transaction volumes may also create more opportunities for cyber-enabled fraud. Such risks may discourage consumers from using electronic payment platforms, particularly where mechanisms for reporting, resolving and compensating fraudulent transactions are perceived as inadequate.

In this study, electronic payment fraud is conceptualised as the incidence or rate of fraudulent activities associated with electronic payment transactions. It is treated as a potential deterrent to customer adoption because actual or perceived exposure to fraud may reduce confidence in digital

payment systems. E-payment fraud is therefore central to determining whether security concerns constitute a significant constraint on sustained e-payment usage in Nigeria.

2.4 Customer Adoption and Usage of E-Payment Systems

Customer adoption refers to an individual's decision to accept, begin using and continue using a particular technology or service. In electronic payments, adoption involves customers' willingness to use digital channels for transferring funds, paying for goods and services and conducting other financial transactions. Adoption is therefore distinct from awareness or availability because a customer may know that a platform exists without actually using it.

Technology adoption is influenced by perceptions of usefulness, convenience, ease of use, security and reliability. The Technology Acceptance Model developed by Davis (1989) identifies perceived usefulness and perceived ease of use as central determinants of technology acceptance. Subsequent research has incorporated other factors, including trust, perceived risk, social influence and facilitating conditions.

In e-payment systems, adoption can therefore be understood as a behavioural outcome arising from users' assessment of the benefits and risks of digital transactions. Oyelami *et al.* (2020) demonstrate that electronic payment adoption can influence consumer spending behaviour, while Gholami *et al.* (2010) identify technological, institutional and user-related factors associated with e-payment adoption in Nigeria. These findings indicated that adoption involves both the decision to use an electronic payment platform and the extent to which it is subsequently utilised.

For this study, customer adoption is operationally reflected in the actual use or volume of electronic payment transactions. This approach distinguishes behavioural usage from mere intention to adopt. Growth in electronic transaction volume indicates increasing utilisation of digital payment channels, although it does not necessarily imply equal adoption across all population groups.

Customer adoption is consequently treated as the dependent concept in this study. The analysis assumes that customer use of e-payment systems may be affected by the economic cost of transactions and security risks associated with fraudulent activities. Examining these relationships helps explain why expanding digital payment infrastructure may not automatically translate into sustained customer usage.

2.5 Interrelationship among the Concepts Reviewed

E-payment systems provide the technological infrastructure through which electronic transactions are conducted, while transaction costs represent the economic burden associated with their use. Electronic payment fraud represents a security-related risk that may affect users' confidence, whereas customer adoption represents the behavioural outcome reflected in actual digital payment usage.

The conceptual relationship suggests that higher transaction costs may reduce adoption by increasing the economic burden associated with electronic payments. Similarly, higher levels of electronic payment fraud may reduce adoption by increasing perceived financial and security risks. Conversely, affordable and secure payment systems may encourage greater and more sustained customer usage.

Thus, customer use of e-payment systems depends not only on the availability and convenience of digital payment infrastructure but also on the affordability and security of transactions conducted

through that infrastructure. The conceptual review consequently establishes transaction costs and electronic payment fraud as important potential constraints on customer adoption and usage of e-payment systems in Nigeria.

3.0 Theoretical Framework

This study was anchored on the Technology Acceptance Model (TAM) and Transaction Cost Economics (TCE), with the Perceived Risk/Trust perspective providing a complementary explanation of the fraud dimension.

3.1 Technology Acceptance Model (TAM)

The Technology Acceptance Model was developed by Davis (1989) to explain individuals' acceptance and use of information technology. TAM proposes that technology adoption is primarily determined by perceived usefulness and perceived ease of use. Perceived usefulness refers to the extent to which an individual believes that using a technology will improve performance, while perceived ease of use concerns the extent to which the technology is perceived as effortless to use (Davis, 1989).

The model suggests that perceived ease of use influences perceived usefulness, while both constructs influence behavioural intention and subsequent actual use. In electronic payment systems, customers are more likely to use mobile banking, POS, internet banking and related platforms when they perceive them as convenient, efficient, accessible and easy to operate. However, although digital platforms provide benefits such as speed and convenience, customers also evaluate the costs and risks associated with their use. TAM therefore provides a foundation for explaining e-payment adoption, although its original formulation does not explicitly address transaction charges or electronic fraud.

3.2 Transaction Cost Economics (TCE)

Transaction Cost Economics, principally associated with Coase (1937) and Williamson (1985), explains how costs associated with economic exchanges influence decisions concerning alternative transaction arrangements. Coase (1937) argued that market transactions involve costs, while Williamson (1985) developed the framework to explain how economic actors organise transactions in response to transaction-related costs and risks.

Within electronic payments, transaction costs include transfer charges, processing fees, service charges and other financial costs incurred when conducting digital transactions. TCE suggests that economic actors prefer arrangements that minimise exchange costs. Thus, relatively low transaction charges may increase the attractiveness of e-payment systems, whereas high charges may discourage usage, particularly for frequent or low-value transactions.

3.3 Perceived Risk and Trust Perspective

The Perceived Risk and Trust perspective explains how electronic-payment fraud may influence customer adoption. Digital transactions involve uncertainty concerning financial loss, privacy, unauthorised transactions and security. Perceived risk therefore represents uncertainty and potential negative consequences associated with using a digital payment platform, while trust reflects confidence that the technology, institution or transaction counterpart will perform as expected. These perspectives are therefore relevant because customers require confidence that their funds and personal information are adequately protected.

3.4 Justification for the Integrated Framework

The integrated framework proposed that higher transaction costs reduce the attractiveness and usage of electronic payments; higher electronic-payment fraud increases perceived risk and weaken customer confidence; and customers are more likely to use e-payment systems when they perceive them as useful, convenient and easy to use. This triangulated framework is consistent with empirical evidence that e-payment adoption is shaped by technological, economic, trust and security considerations (Gholami et al., 2010; Igudia, 2016; Oyelami et al., 2020; Tade & Adeniyi, 2020).

4.0 Empirical Review

The empirical evidence relevant to the present study is reviewed under electronic payment adoption and its determinants, trust and security, electronic fraud, transaction costs, and broader e-payment development. The review concludes with the identified gaps that motivate the present study.

4.1 Electronic Payment Adoption and its Determinants

Gholami et al. (2010) examined factors affecting e-payment adoption in Nigeria using the Unified Theory of Acceptance and Use of Technology (UTAUT). Based on survey data from Nigerian respondents, the study found that perceived benefits, effort expectancy, social influence, trust and awareness were important determinants of intention to adopt electronic payment systems. Demographic characteristics were also relevant. The study demonstrated that adoption depends on a combination of technological perceptions and individual characteristics rather than merely on the availability of payment infrastructure.

Igudia (2016) investigated adoption and extent of e-payment use among Nigerian SMEs using primary data from 239 SMEs in Lagos State and logistic regression. The findings showed that perceived benefits, trust, security, firm IT infrastructure, favourable government policy, IT knowledge and education facilitated adoption, whereas perceived complexity and age inhibited it. For the extent of usage, perceived benefits and trust increased usage, while complexity and age affected the breadth of use. The study is relevant because it distinguishes adoption from actual usage. However, it focused on SMEs and survey data collected in 2012, preceding the substantial expansion of Nigeria's fintech and digital-payment ecosystem during 2018–2024. It also did not examine transaction costs and fraud rates as principal explanatory variables.

Oyelami et al. (2020) further examined e-payment adoption in Nigeria using primary and secondary data from 420 consumers across five divisions of Lagos State. Pearson correlation, hierarchical regression and analysis of variance were employed. The findings indicated that convenience, security and safety, trust and social influence were positively associated with e-payment adoption. However, the regression results showed that convenience and security/safety were significant determinants, whereas trust and social influence were statistically insignificant in the specified model. Educational attainment, financial inclusion, income, internet availability and financial infrastructure, including POS and mobile banking, were also relevant. The findings demonstrate that determinants of adoption may vary according to population, measurement and institutional context. The importance of convenience and security provides indirect support for examining transaction costs and fraud as specific dimensions of users' e-payment experience.

4.2 Electronic Payment, Trust and Security

Oni et al. (2022) integrated trust models and task-technology-fit perspectives to examine retail e-payment use in Nigeria. The study surveyed 350 respondents, of whom 258 valid responses were analysed using variance-based structural equation modelling. Task-technology fit and performance expectancy were important influences on usage, while social influence and initial trust were particularly influential in behavioural intention. The study confirms the importance of trust and perceived performance in digital-payment usage. However, its emphasis on behavioural and technological constructs meant that it did not directly examine whether actual electronic fraud incidence affects aggregate customer usage. This distinction is important because perceived risk and actual fraud incidence may produce different empirical outcomes.

4.3 Electronic Fraud and E-Payment Adoption

Tade and Adeniyi (2020) investigated electronic fraud and trust governance within Nigeria's cashless ecosystem using qualitative methods, including in-depth and key-informant interviews with victims of electronic banking fraud and institutional stakeholders. The study identified internal, external and collaborative dimensions of electronic fraud. Participants reported that fraud experiences affected decisions to migrate to and use electronic banking platforms. Weak governance mechanisms also affected trust, although financial institutions had introduced fraud alerts and internal sanctions to strengthen confidence. The study provides strong qualitative evidence of the fraud-adoption relationship, but its qualitative methodology does not establish the statistical magnitude of the relationship between fraud rates and e-payment usage.

Tade (2021) examined the nature of banking fraud in Nigeria using secondary data from the Nigeria Deposit Insurance Corporation for 2015–2019. The study reported increasing fraud attacks on deposit money banks, although monetary losses declined in 2019 compared with 2018. ATM and internet-based transactions were among the platforms experiencing substantial fraud exposure. Similarly, the Central Bank of Nigeria recognised the increasing incidence of electronic fraud accompanying e-payment expansion, leading to the establishment of the Nigeria Electronic Fraud Forum (NeFF) (Central Bank of Nigeria, nd). This institutional evidence reinforces the importance of fraud within Nigeria's digital-payment ecosystem.

Ogoun and Binaebi (2020) examined whether electronic payment platforms accentuated financial crimes in Nigeria using an *ex-post facto* design and secondary CBN and Nigeria Electronic Fraud Forum data. Their OLS results indicated that deployment of electronic payment platforms did not significantly increase financial crimes. This finding challenges the assumption that increasing digital transactions necessarily generate proportionately greater financial crime. More importantly, their direction of analysis differs from the present study: rather than examining whether e-payment causes fraud, the present research investigates whether fraud rates subsequently influence customer e-payment usage.

4.4 Transaction Costs and Electronic Payment Adoption

Aljaradat, Sarkar, and Shukla (2024) examined digital payment solutions and financial inclusion in Nigeria and reported that affordability, network reliability, awareness and ease of use were among the conditions influencing users' experiences with digital payment services. This finding highlights the relevance of cost and accessibility to digital-payment utilisation.

Fasanmi et al. (2026) examined digital-payment friction and micro-transaction cost efficiency in a Nigerian tertiary institution, drawing on Transaction Cost Economics. The study specifically

considered how digital-payment frictions affect the efficiency of small-value transactions. It reinforces the importance of transaction costs but does not fully resolve whether changes in transaction costs are systematically associated with e-payment usage across Nigeria. Moreover, transaction cost may interact with transaction frequency: a small charge may be insignificant for an occasional high-value transaction but economically meaningful for customers conducting numerous low-value transactions.

4.5 E-Payment Development and Financial Inclusion

Aljaradat et al. (2024), using a game-theoretic approach, also examined the interaction between cybersecurity and digital-payment adoption. The study argued that increasing cybercrime can cause users to reconsider digital-payment channels and, in some circumstances, return to traditional cash-based methods. Although not Nigeria-specific, the evidence provides support for considering fraud and security as potential constraints on digital-payment adoption.

Okonkwo, Obinozie, and Echekoba (2015) examined the effect of ICT and financial innovation on Nigerian commercial-bank performance between 2001 and 2013 using annual bank data and CBN information. Applying OLS, the study examined e-banking services and ATM investment and found that investment in these technologies did not automatically improve bank performance. The authors emphasised efficient utilisation and appropriate institutional policies rather than technology acquisition alone. Although the study focused on bank performance rather than customer adoption, it demonstrates that electronic infrastructure does not necessarily guarantee effective utilisation.

Okonkwo and Uzochukwu (2026) examined electronic transaction channels and financial participation in Nigeria over 2010–2024. Its relevance lies in its contemporary treatment of electronic transaction channels within Nigeria's financial environment, although financial participation differs conceptually from customer e-payment adoption. Similarly, Okonkwo and Pius (2026) examined digital transformation and Nigerian bank profitability, focusing on digital transaction value, AI-driven fraud detection and employee efficiency. The study links digital transaction expansion with technological mechanisms for addressing electronic fraud, but its focus on bank profitability leaves the relationship between fraud management and customer usage unresolved.

Nwankwo, Idachaba, and Eze (2023) examined electronic transactions and Nigerian commercial-bank profitability using e-cheques, ATM, POS, mobile money transfers and web payments as measures of electronic banking payments. Although profitability was the dependent variable rather than customer adoption, the study demonstrates the breadth of electronic transaction channels operating within Nigeria's financial system.

4.6 Gaps in Literature

The reviewed studies reveal important gaps. First, there is a variable gap because relatively limited attention has been given to transaction costs and fraud rates as direct explanatory variables of e-payment usage. Much existing research emphasised perceived usefulness, convenience, trust, security, infrastructure and other behavioural determinants. Second, there is a methodological gap, as several studies rely on cross-sectional surveys or qualitative evidence, while comparatively limited research provides time-series evidence covering Nigeria's rapidly changing digital-payment environment.

This study addressed these gaps by examining transaction costs and electronic fraud simultaneously as potential determinants of customer adoption and usage of e-payment systems in Nigeria over 2018–2024. The approach shifts attention from the conventional question of whether users perceive digital payments as useful or convenient to the more policy-relevant question of whether electronic payments remain sufficiently affordable and secure to sustain customer usage.

5.0. Methodology

This study adopts an *ex-post facto* research design. The study period was 2018 to 2024. The study employed quarterly data, giving 28 observations over 2018Q1–2024Q4. Data were sourced from Central Bank of Nigeria (CBN) Statistical Bulletin, CBN Payments System data and Nigeria Inter-Bank Settlement System (NIBSS). Given the time-series nature of the data, the study employed the Autoregressive Distributed Lag (ARDL) modelling technique.

The theoretical framework suggests that customers are more likely to use electronic payment systems when the systems provide benefits and convenience at acceptable costs and when users perceive the systems as sufficiently secure. Accordingly, the functional relationship is expressed as: $TVEP = f(AFL, FR, TC)$

The econometric model is specified as: $TVEP = \beta_0 + \beta_1AFL + \beta_2FR + \beta_3TC + e$

Where:

TVEP = Aggregate volume of electronic payment transactions (Customer adoption/usage of e-payment)

AFL = Actual Electronic Fraud Loss

FR = Electronic Fraud Rate

TC = Transaction Cost (Average/representative cost or charges associated with electronic payment transactions)

β_0 = Intercept

β_1 = Coefficient of Actual Electronic Fraud Loss

β_2 = Coefficient of Electronic Fraud Rate

β_3 = Coefficient of Transaction cost

The proxy for the transaction cost was computed using the formular: $TC_t = \frac{\sum_{i=1}^n (V_{it} \times C_{it})}{\sum_{i=1}^n V_{it}}$

where:

TC_t = weighted average transaction cost in period t ;

V_{it} = transaction volume of channel i ;

C_{it} = representative charge for channel i .

Note: For the transaction cost components construction, the study applied as follows: ATM (₦35 before 2025 revision); POS (₦0 direct customer charge); Internet (₦50 before 2020; ₦28.33 from 2020); NIP/NEFT (₦50 before 2020; ₦28.33 from 2020); Mobile App (₦50 before 2020; ₦28.33 from 2020); and USSD (₦6.98 from 16 March 2021). The study noted but did not utilize the 2025

CBN revised ATM fees effective 1 March 2025, that introduced ₦100 per ₦20,000 for not-on-us on-site ATM withdrawals and allowing an additional off-site surcharge of up to ₦500. The channel weights were based on CBN e-payment transaction volumes estimated from the official volumes.

The proxy for the electronic fraud rate was computed as:

$$FR_t = \frac{\text{Number of Electronic Payment Fraud Cases}_t}{\text{Electronic Payment Transactions}_t} \times 100$$

6.0 Data Presentation and Analysis

Table 1 showed the computed quarterly datasets for the study: 2018 – 2024.

Table 1: Constructed quarterly datasets for the study: 2018 – 2024

Year	Quarter	TC	TVEP (Million)	FR	AFL
		(₦)		(%)	(₦bn)
2018	Q1	35.841	280	0.001	0.55
2018	Q2	35.841	295	0.001	0.6
2018	Q3	35.841	310	0.001	0.65
2018	Q4	35.841	330	0.002	0.7
2019	Q1	38.114	360	0.002	0.7
2019	Q2	38.114	380	0.002	0.75
2019	Q3	38.114	410	0.002	0.8
2019	Q4	38.114	440	0.002	0.71
2020	Q1	26.374	2200	0.005	2.2
2020	Q2	26.374	2400	0.005	3.1
2020	Q3	26.374	2600	0.006	3.8
2020	Q4	26.374	2945	0.005	2.51
2021	Q1	23.258	3500	0.003	2.9
2021	Q2	23.418	3900	0.003	3.1
2021	Q3	23.418	4200	0.003	3.4
2021	Q4	23.418	4725	0.003	3.37
2022	Q1	23.246	4800	0.003	3.5
2022	Q2	23.246	5200	0.003	3.7
2022	Q3	23.246	5600	0.004	3.9
2022	Q4	23.246	6474	0.003	3.22
2023	Q1	20.913	8000	0.002	4.2
2023	Q2	20.913	9000	0.002	4.5
2023	Q3	20.913	10500	0.002	4.9
2023	Q4	20.913	11230	0.002	4.07
2024	Q1	20.105	10500	0.004	3
2024	Q2	20.105	11920	0.004	4.2
2024	Q3	20.105	12500	0.004	20
2024	Q4	20.105	13000	0.004	25.06

Source: Constructed from available data on Central Bank of Nigeria (CBN) (2024). *Electronic payment statistics*; Nigeria Inter-Bank Settlement System (NIBSS) (2024). *Annual fraud landscape report*; Financial Institutions Training Centre (FITC) (2025). *Quarterly fraud and forgeries report*; and Central Bank of Nigeria (CBN) (2020). *Guide to charges by banks and other financial institutions*.

Keys: TVEP = Total Volume of E-Payments (Millions of Transactions); FR = Electronic Fraud Rate (%); AFL = Actual Electronic Fraud Loss (₦ Billion); TC = Transaction cost (₦)

Table 2 displayed the descriptive statistics of the input data of the study

Table 2 Descriptive statistics on Computed data: AFL, FR, TC, TVEP

	AFL	FR	TC	TVEP
Mean	4.074643	0.002914	26.85314	4928.536
Median	3.160000	0.002750	23.41840	4050.000
Maximum	25.06000	0.005500	38.11420	13000.00
Minimum	0.550000	0.001200	20.10530	280.0000
Std. Dev.	5.442118	0.001259	6.817592	4288.804
Skewness	3.030823	0.492290	0.737106	0.558949
Kurtosis	11.35643	2.187922	1.866180	1.981763
Jarque-Bera	124.3357	1.900346	4.035320	2.667590
Probability	0.000000	0.386674	0.132966	0.263476
Sum	114.0900	0.081600	751.8880	137999.0
Sum Sq. Dev.	799.6495	4.28E-05	1254.948	4.97E+08
Observations	28	28	28	28

Source: EViews version 10 output data

Table 2 showed the substantial variations in Nigeria's electronic-payment channel over the 28 observations. Actual Amount Lost to Electronic Fraud (AFL) recorded a mean of 4.075 billion naira and standard deviation of 5.442, with values ranging from 0.550 billion naira to 25.060 billion naira. Its high positive skewness (3.031) and kurtosis (11.356), together with a statistically significant Jarque-Bera statistic (124.336; $p < 0.001$), indicated substantial departures from normality and the presence of extreme fraud-loss observations. The Electronic Fraud Ratio (FR) averaged 0.002914, equivalent to approximately 0.291%, and was relatively stable, while its Jarque-Bera probability of 0.387 indicated no significant departure from normality. Transaction Cost (TC) averaged ₦26.853 and ranged from ₦20.105 to ₦38.114, with moderate positive skewness and no significant evidence of non-normality ($p = 0.133$). Total Volume of E-Payments (TVEP) averaged 4,928.536 million and ranged from 280 million to 13,000 million, reflecting considerable variation in electronic-payment activity. Its moderate positive skewness (0.559) and Jarque-Bera probability of 0.263 suggest approximate normality. Thus, the statistics indicated that while electronic-payment activity and transaction costs display relatively regular distributions, actual fraud losses were characterized by considerable concentration and extreme observations.

The summary unit roots results were displayed in Table 3.

Table 3: ADF Unit Root Test Results

Variable	Level: ADF Statistic	Level: p-value	Decision at Level	First Difference: ADF Statistic	First Difference: p-value	Order of Integration
AFL	-3.7575	0.0360**	Non-stationary	-3.7341	0.0101**	I(1)
FR	-2.0409	0.5538	Non-stationary	-4.3902	0.0020***	I(1)
TC	-1.9334	0.6097	Non-stationary	-5.2396	0.0002***	I(1)
TVEP	-1.8988	0.6274	Non-	-4.507	0.0015***	I(1)

			stationary			
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Notes: AFL = Actual Amount Lost to Fraud; FR = Fraud Rate; TC = Transaction Cost; TVEP = Total Volume of E-Payments. ADF = Augmented Dickey-Fuller. * Significant at 10%; ** significant at 5%; *** significant at 1%. Lag length is based on SIC. Probability values are based on MacKinnon (1996) one-sided p-values.

Source: EViews version 10 output.

The ADF results summarized in Table 3 indicated that all four variables were non-stationary at level but become stationary after first differencing. Hence, AFL, FR, TC and TVEP were integrated of order one, I (1). This result established that the variables were suitable for an ARDL framework, provided none is integrated of order two, I (2).

Table 4 showed the ARDL output data of the estimated model one on Electronic Fraud rate.

Table 4: ARDL Output for Model One – Electronic Fraud Rate

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TVEP (-1)	1.0491	0.0383	27.4069	0.0000***
FR	38,276.64	97,688.36	0.3918	0.6988
AFL	-10.5455	28.8456	-0.3656	0.718
C	174.1041	303.1209	0.5744	0.5713

Model statistics:

Statistic	Value
R ²	0.9839
Adjusted R ²	0.9818
F-statistic	469.6882***
Prob. (F-statistic)	0
Durbin-Watson	2.0612
S.E. of Regression	575.4541
AIC	15.6842
Observations	27
Selected Model	ARDL (1,0,0)

Note: *** denotes significance at 1%. Dependent variable: Total Volume of Electronic Payments (TVEP). FR = Fraud Rate; AFL = Actual Amount Lost to Fraud. Model selected using the Akaike Information Criterion (AIC). Sample period: 2018Q2–2024Q4.

Source: EViews 10 output.

Table 4 displayed the ARDL Long-Run and Bounds Test. The ARDL (1,0,0) bounds test was estimated using 27 quarterly observations covering 2018Q1–2024Q4. The computed F-statistic of 5.175 exceeds the upper-bound critical value at the 5% level (3.87) and also exceeds the corresponding finite-sample upper bound for a sample size of 35 observations (4.335). Thus, the null hypothesis of no long-run levels relationship is rejected at the 5% level. Therefore, there was a long-run relationship among total volume of e-payments (TVEP), electronic fraud ratio (FR), and actual amount lost to fraud (AFL).

The estimated long-run coefficients for FR ($-779,357.8$; $p = 0.7171$) and AFL (214.719 ; $p = 0.6685$) were statistically insignificant. Similarly, the short-run coefficients of FR ($38,276.64$; $p = 0.6988$) and AFL (-10.546 ; $p = 0.7180$) were not statistically significant. We conclude that the bounds test confirmed a joint long-run relationship among the variables, but the individual results provided no evidence of statistically significant effects of either fraud ratio or actual amount lost to fraud on total e-payment volume in the estimated period.

The error-correction term was estimated and the conditional regression was positive (0.0491) and statistically significant in the separate ECM specification ($p = 0.0001$), but the ARDL long-run-form output reports its bounds-test t-statistic as 1.283 ($p = 0.2123$), reflecting the distinction between conventional coefficient inference and the non-standard bounds-test distribution. This finding supported the existence of a long-run association but did not establish significant individual short - or long-run effects of the fraud variables on TVEP.

Table 5 Error Correction summary statistics on model one: Electronic Fraud model

Statistics	CointEq(-1)	R ²	Adj R ²	DW	F-Bounds statistic	5% Upper Bound	Observations	P-value
Value	0.0491***	0.102	0.102	2.06	5.1749	3.87	27	1E-04

Source: Extracted from EViews ECM output on model one

Table 5 showed summary results of the Error correction model one estimated. The ARDL (1,0,0) error-correction model, estimated with 27 quarterly observations for 2018Q1–2024Q4, produced a CointEq(-1) coefficient of 0.0491 ($p = 0.0001$). Thus, there was a statistically significant relationship between short-run changes in total e-payment volume and deviations from the long-run relationship. The model records an R² of 0.1017 and a Durbin-Watson statistic of 2.061 , suggesting modest explanatory power for short-run changes and no obvious first-order autocorrelation. The associated F-bounds statistic of 5.175 exceeds the 5% upper-bound critical value of 3.87 , supporting the existence of a long-run levels relationship among total e-payment volume, fraud ratio, and actual amount lost to fraud.

The Ramsey RESET test was also conducted to assess the functional-form specification of the ARDL model. The test produced a t-statistic of 1.410 and an F-statistic of 1.987 , both with a probability value of 0.1726 . Since the probability value exceeds the 5 percent significance level, the null hypothesis of correct model specification cannot be rejected. We concluded that there was no statistically significant evidence of functional-form misspecification or omitted nonlinear terms in the estimated ARDL model. The result therefore provides support for the adequacy of the specified functional form.

The Breusch-Pagan-Godfrey test was employed to examine whether the residual variance of the estimated ARDL model is constant. The test produced an F-statistic of 1.880 ($p = 0.1611$) and an Obs*R-squared statistic of 5.318 ($p = 0.1500$). Since both probability values exceed the 5 percent significance level, the null hypothesis of homoskedastic residuals cannot be rejected. Of course, the scaled explained SS statistic was 8.701 (p -value of 0.0335) indicating significant. This indicated that there was no significant evidence of heteroskedasticity in the estimated model and suggests that the residual variance is reasonably stable over the study period.

The stability of the estimated ARDL model was examined using the CUSUM test. As shown in Figure 1, the CUSUM statistic remains within the 5 percent critical bounds throughout the sample period. Although the statistic exhibited an upward movement, particularly from 2021 through 2024, it did not cross either the upper or lower critical boundary. This indicated that the estimated parameters were stable over the study period and provided no evidence of significant structural instability in the ARDL model at the 5 percent level.

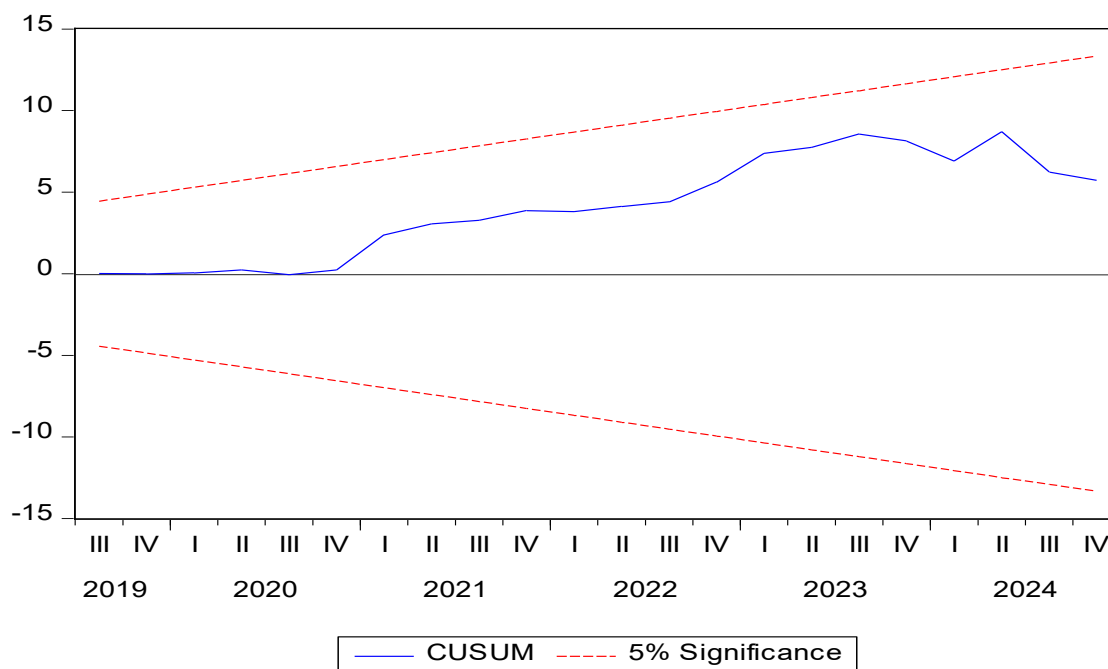


Figure 1: CUSUM test on TVEP, FR and AFL

Source: EViews Version 10 Output data

Table 6 displayed the Model two ARDL: TVEP and TC

Table 6: ARDL Output for Model Two – Electronic Transaction Cost

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TVEP (-1)	1.0117	0.0418	24.1842	0.0000***
TC	-140.4428	38.6644	-3.6324	0.0014***
TC (-1)	110.5298	41.8883	2.6387	0.0147**
C	1,145.99	856.7657	1.3376	0.1941

Model Statistics:

Statistic	Value
R ²	0.9898
Adjusted R ²	0.9884
F-statistic	740.6798***
Prob. (F-statistic)	0
Durbin-Watson	2.1298
S.E. of Regression	459.6
AIC	15.2345
Observations	27

Selected Model	ARDL (1,1)
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Note: ***, ** denote significance at 1% and 5%, respectively. Dependent variable: Total Volume of Electronic Payments (TVEP); TC = Electronic Transaction Cost. Model selected using the Akaike Information Criterion (AIC). Sample period: 2018Q2–2024Q4.

Source: EViews 10 output.

The ARDL (1,1) results summarized in Table 6 showed that electronic transaction cost had a statistically significant short-run effect on e-payment usage. The current-period transaction cost (TC) had a coefficient of -140.4428 and was significant at the 1% level ($p = 0.0014$). This indicated that an increase in electronic transaction costs was associated with a reduction in the volume of electronic payments, holding other factors constant. The negative relationship was consistent with the expectation that higher transaction charges may discourage users from conducting electronic transactions.

However, the lagged transaction cost, TC (-1), had a positive and statistically significant coefficient of 110.5298 ($p = 0.0147$). This suggested that the effect of transaction costs was not confined to the current period. The positive lagged coefficient indicated adjustment or delayed behavioural responses in e-payment activity following changes in transaction costs.

The lagged dependent variable, TVEP (-1), was positive and highly significant (coefficient = 1.0117 ; $p = 0.0000$), demonstrating strong persistence in electronic payment usage. Thus, previous-period e-payment activity was an important determinant of current-period activity.

The model has a very high explanatory power, with an R^2 of 0.9898 and an adjusted R^2 of 0.9884 , implying that approximately 98.98% of the variation in TVEP was explained by the variables included in the model. The overall model was statistically significant, as indicated by the F-statistic of 740.6798 ($p = 0.0000$).

The Durbin-Watson statistic of 2.1298 was close to 2, suggesting no obvious first-order serial-correlation problem. The standard error of regression is 459.60 , while the AIC is 15.2345 .

Thus, the findings indicate that electronic transaction costs had a significant relationship with e-payment usage in Nigeria, with the effect being negative. This provided empirical support for the view that transaction charges constitute an important consideration in electronic payment activity. However, because the lagged cost coefficient is positive and significant, the results also suggest that the response to transaction-cost changes may involve a short-term adjustment process rather than a uniformly negative effect across periods.

To assess the structural adequacy and functional form of the baseline ARDL (1,1) model two, the Ramsey Regression Specification Error Test (RESET) was conducted using the squared fitted values of the dependent variable ($FITTED^2$). The test yielded an F-statistic of 4.8468 ($p = 0.0385$) and a corresponding t-statistic of -2.2015 ($p = 0.0385$). Since the p-value falls below the 0.05 threshold, the null hypothesis of correct model specification is rejected at the 5% significance level. This outcome indicated potential non-linear dynamics or functional form misspecification in levels, suggesting that alternative functional transformations (such as a logarithmic or non-linear ARDL specification) may further improve model specification.

To test for non-constant error variance, the Breusch-Pagan-Godfrey test for heteroskedasticity was conducted. The test yielded an F-statistic of 2.4722 ($p = 0.0872$) and an Obs x R2 statistic of 6.5836 ($p = 0.0864$). Because both main test statistics exceed the conventional 5% significance threshold ($p > 0.05$), the null hypothesis of homoskedasticity cannot be rejected at the 5% level. This confirms that the variance of the error terms remains homoskedastic across observations, ensuring the validity of standard inference procedures for the baseline ARDL (1,1) model two.

Figure 2 displayed the Cumulative Sum of Recursive Residuals (CUSUM) test on the model two.

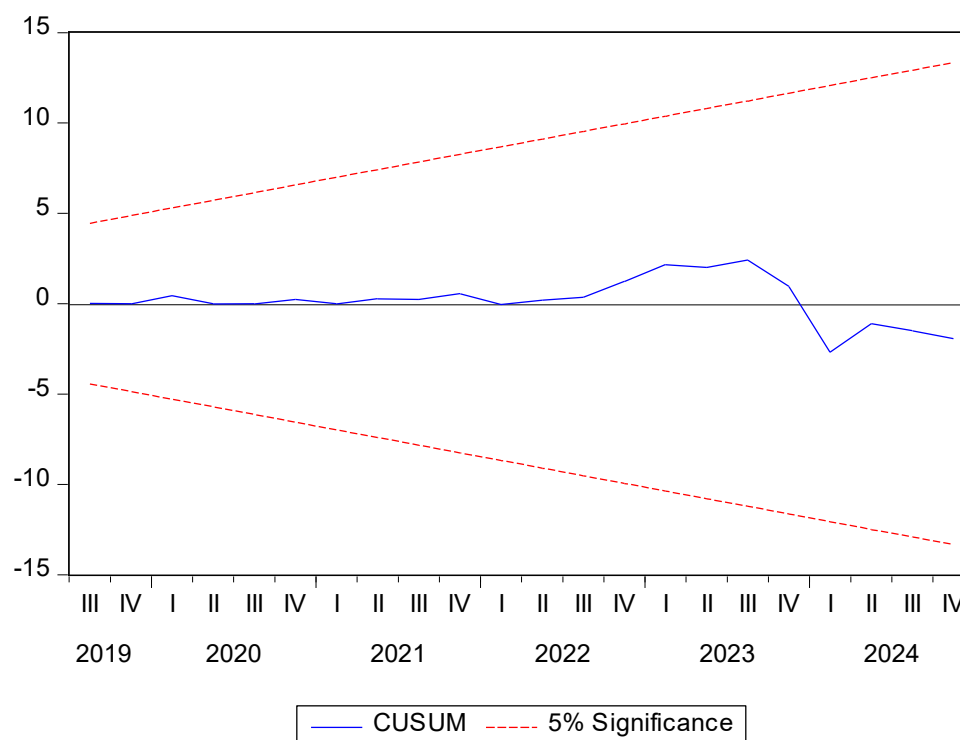


Figure 2 CUSUM tests on ARDL (1,1) model 2.

Source: EViews version 10 output data

To evaluate the structural stability of the short- and long-run coefficients in the estimated ARDL (1,1) model, the Cumulative Sum of Recursive Residuals (CUSUM) test proposed by Brown, Durbin, and Evans (1975) was applied. As illustrated in Figure 2, the plot of the CUSUM statistic remains fully bounded within the pair of straight 5% critical value lines across the entire sample timeline (2019Q3 – 2024Q4). This confirms that the model coefficients were structurally stable over time and that the estimated parameters were reliable for policy evaluation and statistical inference.

Table 7 showed the ARDL output data of the estimated model three on the combined effect of Electronic Fraud and Transaction cost on electronic payment adoption rate.

Table 7: ARDL Output for Model Three – Electronic Fraud Rate and Transaction Cost

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TVEP (-1)	0.0388	0.32	0.1211	0.9062
TVEP (-2)	0.4649	0.3287	1.4146	0.1908
TVEP (-3)	0.5137	0.2667	1.9265	0.0862*
AFL	48.1774	31.0995	1.5491	0.1558
FR	-10,07,724.00	2,50,247.90	-4.0269	0.0030***

FR (-4)	-3,31,193.40	1,67,568.20	-1.9765	0.0795*
TC	-336.8657	62.249	-5.4116	0.0004***
TC (-4)	199.059	65.5637	3.0361	0.0141**
C	8,404.67	2,946.91	2.852	0.0190**

Model Statistics:

Statistic	Value
R ²	0.996
Adjusted R ²	0.9897
F-statistic	159.3296***
Prob. (F-statistic)	0
Durbin-Watson	1.8766
S.E. of Regression	420.9296
AIC	15.192
Observations	24
Selected Model	ARDL (3,0,4,4)

Note: ***, ** and * denote significance at 1%, 5% and 10%, respectively. Dependent variable: Total Volume of Electronic Payments (TVEP); AFL = Actual Amount Lost to Fraud; FR = Electronic Fraud Rate; TC = Electronic Transaction Cost. Model selected using Akaike Information Criterion (AIC). Sample period: 2019Q1–2024Q4.

Source: EViews 10 output.

The ARDL (3,0,4,4) results in Table 7 indicated that electronic fraud rate and transaction cost jointly had statistically significant effects on e-payment usage. The current electronic fraud rate (FR) had a large negative and statistically significant coefficient of $-1,007,724$ ($p = 0.0030$), indicating that higher fraud rates are associated with lower e-payment usage when transaction costs and other model components are controlled for. This provided evidence that increased exposure to electronic fraud may undermine users' engagement with electronic payment platforms.

Similarly, the transaction cost (TC) had a negative and statistically significant coefficient of -336.87 ($p = 0.0004$). This indicated that higher electronic transaction costs are associated with a reduction in TVEP. The fourth lag of transaction cost, however, was positive and significant (199.06 ; $p = 0.0141$), suggesting that the effect of transaction costs may change over time.

The fourth lag of fraud rate was negative and weakly significant at the 10% level ($-331,193.4$; $p = 0.0795$), providing some evidence of a delayed negative association between fraud and e-payment usage. AFL was positive but statistically insignificant ($p = 0.1558$), indicating that the actual monetary amount lost to fraud did not independently explain TVEP in this specification.

The model had a very high explanatory power, with $R^2 = 0.9960$ and adjusted $R^2 = 0.9897$. The overall model was statistically significant ($F = 159.3296$; $p < 0.001$), while the Durbin-Watson statistic of 1.8766 was reasonably close to 2, suggesting no strong evidence of first-order serial correlation.

Thus, the results indicated that fraud rate and transaction cost were important short-run correlates of e-payment usage when considered jointly, with both current-period effects being negative and statistically significant. The findings therefore provided empirical support for the hypothesis that

electronic fraud and transaction costs constitute important constraints on e-payment usage in Nigeria.

To determine whether a long-run equilibrium relationship exists among TVEP, AFL, FR, and TC the Pesaran, Shin, and Smith (2001) F-bounds test was estimated under Case 2 (restricted constant and no trend). As reported in Table 8, the computed F-statistic of 4.7951 exceeds the upper bound I(1) critical value of 3.67 at the 5% significance level under asymptotic distributions (N=1000), as well as the finite-sample I(1) critical value of 4.306 (N=30). Thus, the null hypothesis of no levels relationship is rejected at the 5% significance level, confirming the existence of a long-run cointegrating vector among the variables.

Although the F-bounds test established cointegration, the estimated long-run level coefficients $\beta_{AFL} = -2763.80$, $p = 0.8676$; $\beta_{FR} = 82,265,820$, $p = 0.8600$; $\beta_{TC} = 8264.31$, $p = 0.8661$ were statistically insignificant. This indicated that the functional relationship between TVEP and its determinants operated predominantly through dynamic short-run impact channels and dynamic quarterly corrections rather than direct static level adjustments.

Table 8: Summary Table of ARDL Bounds Test for Cointegration: TVEP, AFL, FR, and TC

Test Statistic	Value	Significance Level	I (0) Bound	I (1) Bound	Decision
F-Statistic	4.795	10%	2.37	3.2	Reject Ho
		5%	2.79	3.67	Reject Ho
		1%	3.65	4.66	Reject Ho
Finite Sample (N=30)		5%	3.272	4.306	Reject Ho

Note. $k = 3$ regressors. $p < .05$. Selected model is ARDL (3, 0, 4, 4). Null hypothesis H_0 : No levels relationship. Critical values sourced from Pesaran et al. (2001) for Case 2 (restricted constant, no trend) and Narayan (2005) for finite samples.

Source: Extracted from ARDL Bounds Test for cointegration EViews version 10 output data

To check for potential higher-order residual serial correlation in the multivariate **ARDL(3,0,4,4)** model, the Breusch-Godfrey Serial Correlation LM test was conducted up to the second lag. The test yields an F -statistic of 0.6698 ($p = 0.5418$) and an Obs $\times R^2$ statistic of 3.8550 ($p = 0.1455$). Because both p -values exceed the 5% significance level, the null hypothesis of no serial correlation cannot be rejected. This confirms that the residuals were free from higher-order autocorrelation, validating the efficiency of standard error estimates for hypotheses testing.

To verify the linear functional specification of the multivariate **ARDL(3,0,4,4)** model, the Ramsey Regression Specification Error Test (RESET) was also conducted using the square of the fitted dependent variable ($FITTED^2$). The test produced an F -statistic of 3.6735 ($p = 0.0916$) and a corresponding t -statistic of -1.9166 ($p = 0.0916$). Because the p value exceeds 5% significance threshold ($\alpha = 0.05$), the null hypothesis of correct functional form specification cannot be rejected. This demonstrates that adding the additional dynamic explanatory variables (AFL and FR) successfully addresses functional form issues observed in restricted specifications, confirming the linear model structure is statistically adequate for inference.

To test the assumption of constant error variance in the multivariate ARDL (3,0,4,4) specification, the Breusch-Pagan-Godfrey test for heteroskedasticity was performed across the 14 regressors. The

test generated an F -statistic of 0.5072 ($p = 0.8770$), an Obs $\times R^2$ statistic of 10.5848 ($p = 0.7183$), and a Scaled Explained SS statistic of 2.9185 ($p = 0.9992$). Because all p -values exceed the 5% significance cutoff, the null hypothesis of homoskedasticity cannot be rejected. This confirms that the error terms were homoskedastic, establishing the reliability and statistical efficiency of the estimated standard errors.

7.0 Hypothesis Testing and Discussions

Hypothesis One: Electronic Fraud Rate has no significant effect on E-payment Usage in Nigeria

The results in Table 4 showed that electronic fraud rate (FR) recorded a positive coefficient of 38,276.64 ($p = 0.6988$). Since the p -value exceeds the 5% significance level, the null hypothesis is not rejected. Thus, electronic fraud rate had a positive but statistically insignificant effect on e-payment usage in Nigeria. Similarly, actual fraud losses (AFL) recorded a negative coefficient of -10.5455 ($p = 0.7180$) and were statistically insignificant. The results therefore provide no statistical evidence that either the incidence of electronic fraud or the monetary value of fraud losses significantly influenced aggregate e-payment usage during the period examined.

This finding suggested that the expansion of electronic payments may have been driven more by factors such as convenience, accessibility, technological diffusion and increasing acceptance of digital payment channels. It was consistent with the broader expansion of e-payment activities reported by the Central Bank of Nigeria (2024). However, it differs from Tade and Adeniyi (2020), who found from qualitative evidence that experiences of electronic fraud affected customers' decisions to adopt or migrate to electronic banking platforms. The difference may reflect the level of analysis: their study focused on users' experiences, perceptions and adoption decisions, whereas the present study examines aggregate relationships between measured fraud indicators and overall e-payment usage. The negative but insignificant AFL coefficient suggests that monetary fraud losses may exert some downward pressure on usage, although the evidence is insufficient to establish a systematic deterrent effect.

Hypothesis Two: Electronic Transaction Costs have no significant effect on E-payment Usage in Nigeria.

Table 6 indicated that electronic transaction costs (TC) recorded a negative coefficient of -140.4428 ($p = 0.0014$). Since the p -value is below 5%, the null hypothesis was rejected. Electronic transaction costs therefore had a negative and statistically significant effect on e-payment usage in Nigeria. This finding indicated that users were sensitive to the financial cost of conducting digital transactions and that transaction charges can constitute a constraint on the expansion and deepening of electronic payments.

The result was consistent with the economic logic of electronic-payment adoption: when transaction costs increase, users may reduce transaction frequency, consolidate payments, switch to less expensive channels or, where feasible, revert to cash. The finding was also consistent with Ozili (2021), who identified socioeconomic, infrastructural and security considerations as important to sustainable electronic banking adoption. The significant negative coefficient therefore provides evidence that affordability remains an important consideration in Nigeria's increasingly digitalised payment environment.

Hypothesis Three: Electronic Fraud Rates and Electronic Transaction Costs have no significant influence on E-payment Usage in Nigeria

Table 7 showed that the combined model produced a negative and statistically significant coefficient for electronic fraud rate ($-1,007,724$; $p = 0.0030$) and electronic transaction cost (-336.8657 ; $p = 0.0004$). Accordingly, the null hypothesis was rejected. The results indicated that fraud rate and transaction costs jointly had significant negative influences on e-payment usage in Nigeria.

The negative FR coefficient suggested that, when transaction costs and other model components were considered, increases in electronic fraud rates were associated with reductions in e-payment usage. This contrasts with the insignificant effect observed in the individual fraud model, suggesting that the influence of fraud may become more evident when examined alongside the broader cost environment of electronic payments. Increased exposure to fraud may weaken confidence in digital-payment platforms and encourage more cautious transaction behaviour, consistent with the importance of trust and perceived security identified by Tade and Adeniyi (2020).

The significant negative coefficient of TC reinforced the finding under Hypothesis Two. It indicated that higher transaction costs reduce e-payment usage even when fraud-related factors were incorporated into the model. Users may respond to higher charges by reducing transaction frequency, consolidating transactions, selecting alternative payment channels or reverting to cash where available.

These findings portray e-payment development in Nigeria as involving a balance between the benefits of digital transactions and the costs and risks associated with their use. While convenience, accessibility and technological diffusion may support continued adoption, transaction affordability and fraud exposure constitute important constraints on e-payment usage, particularly when considered jointly.

8.0 Conclusion

This study concludes that electronic fraud rate and actual fraud losses individually had no significant effect on e-payment usage, suggesting that fraud had not substantially constrained aggregate adoption. However, transaction costs exerted a significant negative effect, indicating that affordability remains an important determinant of usage. When fraud rate and transaction costs were considered jointly, both exerted significant negative influences on e-payment usage. Thus, sustained e-payment growth in Nigeria requires an integrated approach that combines affordable transaction charges, effective fraud prevention, consumer protection and strengthened trust in digital payment systems.

9.0 Recommendations

1. The Nigerian payment-system stakeholders should prioritise fraud resilience rather than fraud-driven restriction of e-payment adoption by strengthening real-time transaction monitoring, anomaly detection, multi-factor authentication and automated fraud alerts. They should also continue to collaborate especially on information sharing on emerging fraud patterns.
2. Nigerian payment-system regulators and service providers should prioritise the reduction and rationalisation of electronic transaction costs across payment channels, particularly for

low-value and frequent transactions. The CBN, banks, fintechs and payment-system operators should regularly review their transaction charges, eliminate unnecessary fees, promote transparent pricing, and encourage lower-cost digital payment alternatives. Such a cost-efficiency approach would make electronic payments more affordable, particularly for low-income users, small businesses and micro-transactions, thereby supporting broader and sustained digital-payment adoption and financial inclusion in Nigeria.

3. The Central Bank of Nigeria (CBN), banks, fintechs and payment-system operators should adopt an integrated “secure-and-affordable payments” strategy that simultaneously reduces electronic fraud exposure and transaction costs. Thus, the payment providers should reduce avoidable transaction charges, particularly for low-value transactions and financially vulnerable users, while investing in real-time fraud detection, stronger authentication, rapid fraud reporting and customer-protection mechanisms. The intent should be to increase transaction volume, and to create an electronic-payment environment in which users perceive digital payments as affordable, secure and trustworthy.

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Data availability

No datasets were generated or analyzed during the current study.

Declarations

Ethics approval and consent to participate

Not applicable. This study did not involve human or animal subjects.

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Competing interests

The authors declare that they have no competing interests.

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