PAYMENT SYSTEM AND BANK PROFITABILITY IN NIGERIA

BY

OBASI JESSICA CHIZOBAM
MGS2104756

DEPARTMENT OF FINANCE
FACULTY OF MANAGEMENT SCIENCES
UNIVERSITY OF BENIN
BENIN CITY

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF FINANCE, FACULTY OF MANAGEMENT SCIENCES, UNIVERSITY OF BENIN, BENIN CITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF SCIENCE (B.Sc.) DEGREE IN FINANCE.

NOVEMBER, 2025.

DECLARATION

I, **OBASI JESSICA CHIZOBAM,** hereby declare that this project is undertaken by me in the department of Finance, faculty of Management Sciences, University of Benin, Benin City, Edo State under the supervision of Dr. KASIMU ABUDU

This project has not been previously submitted for the award of bachelor of science degree in Marketing.

All ideas and views are products of my personal research and that of others have been duly referenced, appreciated and acknowledged.

Any litigation or liability arising from the work is to be wholly borne by me and not the supervisor.

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OBASI JESSICA CHIZOBAM **DATE**

CERTIFICATION

We certify that **OBASI JESSICA CHIZOBAM,** with the matriculation number **MGS2104756** submitted this research work to the department of Finance, Faculty of Management Sciences, University of Benin, Benin City.

__________________________ __________________________

Dr. KASIMU ABUDU **DATE**
Project Supervisor

__________________________ __________________________

DR. OMORUYI AIGBOVO **DATE**
Project Coordinator

__________________________ __________________________

DR ANDREW O. IZEKOR **DATE**
Head of Department

DEDICATION

I dedicate this project to God Almighty

ACKNOWLEDGEMENTS

First and foremost, I give all the glory, honor and adoration to the Almighty God for his infinite mercy, grace and strength who has seen me through the successful completion of this project. Without His guidance, wisdom and protection this work wouldn't have been possible.

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ABSTRACT

This study investigated the effect of digital payment systems on the profitability of deposit money banks in Nigeria using quarterly time-series data from 2012Q1 to 2022Q4. Five electronic payment channels such as Automated Teller Machines (ATM), Point of Sale (POS), Web payment platforms, Mobile payment systems, and NIBSS Electronic Fund Transfer (NEFT) were examined. The Fully Modified Ordinary Least Squares (FMOLS) technique was employed to estimate the long-run relationship between digital payment adoption and bank profitability. The empirical findings revealed that ATM and Web payment transaction values exerted a statistically significant and positive influence on bank profitability. In contrast, POS, Mobile payment, and NEFT transaction values showed no significant long-run effect on profitability during the study period. These results suggest that while some digital channels have matured into profit-generating platforms, others remain operationally essential but financially under-optimized. Based on the findings, the study recommends that banks strengthen and expand ATM and Internet banking infrastructure to sustain profitable digital operations. In addition, banks should re-evaluate fee structures, improve service reliability, and increase merchant and customer adoption of POS and mobile payment platforms to unlock profitability potential. Collaboration with regulators and payment stakeholders is also essential to enhance NEFT efficiency, reduce operational costs, and support wider digital financial ecosystem stability. Overall, a balanced multi-channel digital strategy is crucial for long-term profitability and competitive resilience in Nigeria's evolving financial technology landscape.

Keywords: *Digital payment systems, Bank profitability, ATM, POS, Internet banking, Mobile payments.*

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The profitability of banks in Nigeria remains a central concern in financial economics, particularly in light of structural shifts in technology, regulatory changes, and changing consumer behavior. Bank profitability, typically measured through indicators such as Return on Assets (ROA) and Return on Equity (ROE), is a key determinant of banking stability, capital adequacy, and intermediation efficiency (Ahmed, Naala, & Gambo, 2025; Nwankwo & Agbo, 2021). In the Nigerian banking landscape, profitability is influenced by various internal factors (such as operational efficiency, cost management, and asset quality) and external dynamics (including macroeconomic stability, inflation, and financial technology adoption). With increasing competition and customer expectations, banks are now compelled to innovate and optimize service delivery to enhance financial outcomes. Studies by Nwayen, Ukpong, and Uwah (2024), as well as Chukwuekwu (2024), underscore how shifts in banking strategies toward digitization and customer-centric approaches have redefined traditional measures of profitability in Nigeria's financial sector.

Parallel to these profitability concerns is the transformation of Nigeria’s payment system architecture, which has undergone rapid digitization in the past two decades. The Central Bank of Nigeria (CBN) has played a pivotal role in fostering this digital migration through regulatory frameworks that promote cashless policies, financial inclusion, and FinTech collaborations. The contemporary Nigerian payment system includes a wide array of instruments such as mobile payments, Point of Sale (POS) transactions, Automated Teller Machines (ATMs), and web-based payments (Mohammed, Ibrahim, & Muritala, 2022; Ehiedu, Onuorah, & Chienjina, 2023). These innovations, underpinned by advancements in financial technology, aim to improve payment efficiency, security, and customer satisfaction. As noted by Taiwo, Akande, and Adekunle (2024), digital financial services have become essential drivers of operational performance in commercial banks, while concurrently challenging traditional banking norms. The infrastructural expansion of ATMs and POS terminals across Nigeria has notably improved access to banking services, especially in underbanked regions.

The diverse existing payment systems can have varying implications for bank operations. ATMs, for instance, serve as both convenience tools for consumers and cost-intensive infrastructure for banks, resulting in mixed profitability outcomes (Money & Iyoha, 2025; Sopitan et al., 2025). Similarly, mobile payments have rapidly proliferated, driven by smartphone penetration and youth-centric banking habits, and studies show a statistically significant positive relationship with ROA in Nigerian banks (Taiwo et al., 2024; Ilo, Soyebo, & Olaiya, 2024). POS transactions, despite being initially limited by infrastructural bottlenecks, have gained traction, especially in retail and informal markets, contributing positively to revenue streams (Aduku et al., 2025). Web-based transactions, encompassing Internet banking and e-commerce, offer scalable cost advantages but often face barriers such as cybersecurity concerns and uneven broadband access (Ilo et al., 2024; Salawudeen & Suleiman, 2025). Together, these instruments present a complex and evolving set of variables through which Nigerian banks pursue efficiency, revenue growth, and customer acquisition.

The intersection between payment system innovations and bank profitability offers compelling grounds for empirical inquiry. While it is generally observed that digital payment channels improve customer reach, reduce processing times, and lower overhead costs, the actual impact on bank profitability is far from homogenous. Some studies suggest a positive relationship between long-term capital investment in FinTech and profitability, while operational expenditures may offer limited or even negative returns (Ahmed et al., 2025; Abari-Ogunsona et al., 2025). Additionally, evidence indicates that although mobile and internet banking boost financial performance, other channels like ATMs and POS may impose high maintenance costs that offset revenue gains (Money & Iyoha, 2025; Nwankwo & Agbo, 2021). This divergence in findings raises a critical question: under what conditions do payment systems enhance or undermine bank profitability in Nigeria? This question becomes particularly salient considering Nigeria's economic volatility, infrastructural gaps, and regulatory constraints, thus laying the groundwork for a focused study on the effects of various payment systems on the profitability of Nigerian banks.

1.2 Statement of the Research Problem

In the face of a rapidly digitizing global financial ecosystem, Nigeria's banking sector has witnessed a significant transformation in its payment infrastructure, particularly with the integration of electronic payment channels such as Automated Teller Machines (ATMs), Point-of-Sale (POS) terminals, mobile banking, and web-based platforms. This shift, largely driven by regulatory support and technological innovations, has reshaped how banking services are delivered and monetized. Despite these advancements, concerns persist about the true impact of these payment systems on the financial performance of banks, particularly their profitability. Operational costs, cybersecurity vulnerabilities, digital illiteracy, and infrastructural inadequacies continue to obscure the net benefits of electronic payment adoption (Taiwo, Akande, & Adekunle, 2024; Money & Iyoha, 2025). In a developing economy like Nigeria where profit margins are often vulnerable to both market and technological disruptions, the question of whether payment system innovations translate into measurable profitability gains for banks remains empirically unsettled.

Although the theoretical premise suggests that digital payment systems should enhance profitability by reducing transaction costs, increasing customer outreach, and enabling financial inclusion, empirical findings from extant literature remain inconclusive. Some studies have reported a significant positive relationship between electronic payments and profitability metrics such as Return on Assets (ROA) and Return on Equity (ROE). For instance, Mohammed, Ibrahim, and Muritala (2022) and Chukwuekwu (2024) found that mobile payment, POS, and internet banking positively impact financial performance in Nigerian banks. Similarly, Aduku et al. (2025) and Alagbe and Yinus (2025) confirm that POS terminals and ATM usage are significantly linked to improved ROA and overall profitability. Conversely, other researchers such as Ahmed, Naala, and Gambo (2025) and Nwankwo and Agbo (2021) reveal that short-term operational fintech expenditure and some electronic payment instruments like mobile banking yield either insignificant or even negative effects on profitability, often due to high capital and maintenance costs. These divergent results have created a theoretical and empirical gap that warrants further exploration.

Moreover, many of the existing studies have been limited in scope, either by focusing on narrow time frames or by excluding newer data that reflect post-COVID-19 financial dynamics and recent technological upgrades. For instance, Nwankwo and Agbo (2021) concentrated on the period between 2013 and 2017, while Chukwuekwu (2024) examined data from 2011 to 2020. Even Money and Iyoha (2025), although extensive, ended their data coverage in 2023. Similarly, Nwayen, Ukpong, and Uwah (2024) restricted their analysis to the decade spanning 2010 to 2019. These limitations hinder the understanding of evolving trends in electronic payment adoption and their cumulative effect on bank profitability. Therefore, this study intends to fill this gap by examining the period from 2009 to 2024—a broader and more recent time frame that encapsulates key technological reforms, regulatory shifts, and consumer adaptation. By doing so, the study provides a more comprehensive and up-to-date assessment of the relationship between payment systems and bank profitability in Nigeria.

1.3 Research Questions

Based on the above research problem, the following research questions are raised to guide the study:

i. What is the effect of the volume of Automated Teller Machine (ATM) transactions on bank profitability in Nigeria?

ii. How does the volume of Point-of-Sale (POS) transactions influence bank profitability in Nigeria?

iii. What is the relationship between the volume of web payments and bank profitability in Nigeria?

iv. To what extent does the volume of mobile payment transactions impact bank profitability in Nigeria?

1.4 Research Objectives

The broad objective of this study is to examine the effect of payment systems on bank profitability in Nigeria. The specific objectives include to:

i. examine the effect of the volume of ATM transactions on bank profitability in Nigeria;

ii. investigate the influence of the volume of POS transactions on bank profitability in Nigeria;

iii. assess the relationship between the volume of web payments and bank profitability in Nigeria; and

iv. determine the impact of the volume of mobile payment transactions on bank profitability in Nigeria.

1.5 Research Hypotheses

The following hypotheses stated in the null form shall be tested:

i. The volume of ATM transactions has no significant effect on bank profitability in Nigeria.

ii. The volume of POS transactions does not significantly influence bank profitability in Nigeria.

iii. There is no significant relationship between the volume of web payments and bank profitability in Nigeria.

iv. The volume of mobile payment transactions does not significantly impact bank profitability in Nigeria.

1.6 Scope of the Study

This study focuses on examining the effect of payment systems specifically the volume of Automated Teller Machine (ATM) transactions, Point-of-Sale (POS) transactions, web payments, and mobile payments on bank profitability in Nigeria. Geographically, the study is limited to deposit money banks operating within the Nigerian banking sector, with a sample comprising selected commercial banks listed on the Nigerian Exchange Group. The temporal scope spans from 2009 to 2024, a period that captures critical regulatory and technological milestones such as the launch of the CBN's cashless policy in 2012, the acceleration of digital banking adoption post-2015, the COVID-19-induced digital shift beginning in 2020, and the growing fintech integration up to 2024. This timeframe is justified as it reflects both pre- and post-digital transformation phases in the Nigerian banking system, offering a robust basis for analyzing the long-term effects of evolving payment systems on profitability.

1.7 Significance of the Study

This study holds substantial relevance for a wide array of stakeholders within the financial ecosystem, as it offers empirical insights into how different components of the payment system influence bank profitability in Nigeria. The findings are expected to contribute to policy formulation, strategic planning, academic advancement, and financial innovation.

Commercial Bank Managers: This study provides actionable insights for bank executives and operations managers by identifying which payment system channels (ATM, POS, web, and mobile payments) significantly drive profitability. Understanding these dynamics will enable banks to reallocate resources, optimize service delivery, and invest in cost-effective digital infrastructure to enhance financial performance.

Policymakers and Regulators (e.g., Central Bank of Nigeria): The study equips financial regulators with empirical evidence on the implications of payment system expansion for bank profitability. This is particularly relevant in shaping policies that promote financial inclusion, reduce transaction costs, and ensure a stable yet innovative payment ecosystem aligned with national economic goals.

FinTech Companies and Technology Providers: FinTech innovators and digital service providers will benefit from this study by understanding how their platforms and transaction channels contribute to the revenue models of banks. The results can guide partnership strategies, platform development, and the alignment of service offerings with banks' profitability targets.

Investors and Shareholders: By shedding light on how payment system adoption affects bank profitability, this study informs investment decisions. Investors and shareholders can assess the long-term viability of banks' digital strategies and make informed judgments about capital allocation and return expectations.

Academic Researchers and Students: For scholars and students, the study enriches the academic discourse on financial technology and banking performance in emerging economies. It provides a current and data-driven reference for future research, especially in areas related to digital finance, electronic banking, and the economics of innovation in the financial sector.

1.8 Limitation of the Study

A notable limitation of this study lies in the availability and consistency of disaggregated transaction volume data across the four payment system components ATM transactions, POS transactions, web payments, and mobile payments for the entire period spanning 2009 to 2024. In the Nigerian context, the challenge of data reliability is compounded by discrepancies across reporting agencies, irregular updates, and gaps in transaction-level information. To address this, the study relies primarily on secondary data obtained from credible and standardized sources such as the Central Bank of Nigeria (CBN), the Nigeria Inter-Bank Settlement System (NIBSS), and the Nigerian Exchange Group, which offer the most comprehensive and authoritative datasets on banking and electronic payment transactions.

Additionally, the study employs egression techniques, which assume conditions such as linearity, homoscedasticity, and the absence of multicollinearity and serial correlation. These assumptions may not always hold in real-world datasets, potentially influencing the precision of coefficient estimates. To mitigate these methodological constraints, the study incorporates robust diagnostic and post-estimation tests including the Breusch-Pagan, Durbin-Watson, and Variance Inflation Factor tests to validate model assumptions, enhance reliability, and ensure the robustness of empirical results. While these limitations do not invalidate the findings, they suggest that results should be interpreted with due consideration of contextual data quality and econometric boundaries.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter comprise of conceptual literature, empirical literature, and theoretical literature. The conceptual literature examines some concepts related to the subject matter, the theoretical literature examines some relevant theories related to the topic under study, and the empirical literature examines some previous studies that are closely related to this current study with their findings.

2.2 Conceptual Review

This section provides the conceptualisation of the dependent variable bank profitability (as well as its measures), and the independent variable (payment systems), including its dimensions.

2.2.1 Bank Profitability

Bank profitability refers to the institution's ability to generate sustainable earnings over time, thereby ensuring financial stability, shareholder value, and competitive viability. It is a fundamental dimension of bank performance and is typically assessed through financial metrics that capture the efficiency and effectiveness of income generation from both assets and equity (Bhatia & Gulati, 2021). Key profitability indicators include Return on Assets (ROA), which measures the bank's efficiency in utilising its total assets to produce net income; Return on Equity (ROE), which assesses the returns generated on shareholders' investments; Net

Interest Margin (NIM), reflecting the difference between interest income and interest expenses relative to earning assets; and Earnings per Share (EPS), which denotes profitability on a per-share basis (Akarogbe, Chukwunwike & Ozor, 2024).

These financial metrics are widely adopted due to their quantitative precision and capacity to benchmark performance across institutions and time periods. They offer crucial insights into how effectively a bank is able to convert its resources into profit, maintain cost control, and maximise shareholder returns. However, such indicators have been critiqued for their limited scope, often focusing on short-term profitability while overlooking long-term risk exposure, market dynamics, and the broader socio-economic value banks create (Hughes & Mester, 2014).

Moreover, profitability is increasingly influenced by operational and strategic factors, such as cost management practices, asset quality, capital adequacy, and innovation. Although these are not always captured directly in traditional financial ratios, they play a significant role in shaping profitability outcomes. For instance, inefficiencies in internal processes, inadequate response to technological changes, or shifts in consumer behaviour can subtly erode profit margins even when financial indicators appear stable (Bueno et al., 2024; Famoti et al., 2024).

Therefore, while profitability remains a cornerstone of bank performance measurement, scholars have emphasised the need for a more integrated approach that situates profitability within a broader strategic context. This includes recognising how external pressures such as digital disruption, regulatory changes, and competitive innovations intersect with internal capabilities to influence sustainable profit generation (Muslim, 2024).

2.2.2 Measures of Bank Profitability

In contemporary banking literature, the evaluation of bank profitability is increasingly recognised as a multi-dimensional construct that incorporates financial viability, strategic responsiveness, and operational efficiency (Bhatia & Gulati, 2021). The evolving complexity of the financial ecosystem—driven by digital transformation, intensifying global competition, and dynamic regulatory frameworks—has broadened the analytical scope of profitability assessment in banks. While financial indicators remain the cornerstone of such evaluations, there is growing scholarly consensus that traditional measures should be interpreted within broader institutional and economic contexts. Nonetheless, four principal metrics—Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM), and Earnings per Share (EPS)—continue to serve as foundational tools for assessing the profitability and financial health of banking institutions (Akarogbe, Chukwunwike & Ozor, 2024; Hughes & Mester, 2014).

Return on Assets (ROA) is among the most widely adopted indicators of bank profitability, primarily due to its capacity to capture asset efficiency. It is calculated as the ratio of net income to total assets, offering a size-neutral measure that reflects how effectively a bank utilises its resources to generate earnings. A higher ROA denotes superior management performance and operational efficiency (Bhatia & Gulati, 2021). Crucially, ROA facilitates performance comparisons across institutions of different sizes by neutralising scale-related distortions. However, critics such as Hughes and Mester (2014) argue that ROA does not adequately reflect the underlying risk profile of asset portfolios, especially under volatile economic conditions. Empirical benchmarks suggest that an ROA above 1.5% typically indicates robust profitability, whereas values below 1.0% may signal inefficiencies or heightened exposure to operational risks (Famoti et al., 2024). Additionally, longitudinal analysis of ROA trends can help identify the effects of strategic decisions, economic cycles, or regulatory shifts on profitability.

Return on Equity (ROE) complements ROA by measuring how effectively a bank generates returns for its shareholders. Defined as net income divided by shareholders' equity, ROE is a vital profitability ratio, particularly from an investor's perspective. A high ROE reflects efficient capital utilisation and profitability of equity investment, often translating into improved market valuation (Akarogbe, Chukwunwike & Ozor, 2024). However, ROE is sensitive to capital structure, and a high ratio may stem from increased leverage rather than genuine operational performance. This introduces a trade-off between profitability and financial risk, necessitating caution in interpreting ROE in isolation (Hughes & Mester, 2014). In mature financial markets, a ROE benchmark of 10–15% is commonly used to identify wellperforming banks (Muslim, 2024). Nonetheless, regional variations in regulatory capital requirements and macroeconomic stability may lead to significant deviations from this benchmark.

Net Interest Margin (NIM) is another critical indicator that assesses the core profitability of a bank's intermediation function. It is calculated as the difference between interest income and interest expenses, divided by average earning assets. NIM reflects the bank's ability to manage its interest rate spread effectively, a central component of profitability for traditional depositlending models (Bhatia & Gulati, 2021). A high NIM generally indicates strong asset-liability management and favourable pricing strategies. However, declining margins may suggest increased competition, rising funding costs, or suboptimal credit deployment. As digital banking platforms increasingly diversify income sources through fee-based and non-interest income, the reliance on NIM as a sole indicator of profitability may understate total financial performance (Bueno et al., 2024). Therefore, while still relevant, NIM must be contextualised within a bank's evolving income model and broader market environment.

Earnings per Share (EPS) offers a shareholder-focused metric of bank profitability, expressing net profit allocated per share of outstanding common stock. EPS is commonly used in equity valuation and investment decision-making as it connects internal financial performance to external market expectations. A consistently rising EPS can enhance shareholder value and positively influence stock prices (Akarogbe, Chukwunwike & Ozor, 2024). Nonetheless, EPS is susceptible to distortions arising from changes in capital structure, share repurchases, and non-recurring income, potentially misrepresenting the bank's underlying performance. Moreover, EPS does not directly reflect reinvestment strategies, dividend distributions, or the sustainability of earnings. Despite its limitations, EPS remains a crucial indicator when assessed alongside other profitability metrics such as ROE and price-to-earnings (P/E) ratios (Famoti et al., 2024).

For the purposes of this study, a financial perspective is adopted, with Return on Assets (ROA) selected as the primary measure of bank profitability. ROA offers a consistent, objective, and size-neutral indicator that facilitates comparative analyses across banks. Its focus on asset utilisation aligns with the study's interest in assessing profitability variations in relation to operational and strategic differences among institutions. Moreover, ROA's ability to capture efficiency in income generation makes it particularly suited for environments where bank assets remain the principal drivers of financial performance.

2.2.3 Payment Systems

Payment systems refer to the mechanisms, technologies, and institutional arrangements that facilitate the transfer of monetary value between parties, serving as a foundational element of modern financial infrastructure. These systems include digital platforms and channels such as Automated Teller Machines (ATMs), Point of Sale (POS) terminals, mobile money services, web-based fund transfers, and contactless payments that enhance the speed, security, and convenience of financial transactions (Alt & Huch, 2022). As a key component of the broader financial services ecosystem, payment systems play a critical role in improving the efficiency, accessibility, and inclusivity of banking operations. They represent the most visible and widely adopted technological innovation in many banking sectors, particularly in emerging markets where traditional financial service penetration remains limited (Jalal, Al Mubarak & Durani, 2023).

According to Lavrinenko et al. (2023), payment systems operate at the intersection of financial intermediation and digital innovation, leveraging advanced technologies such as real-time data analytics, cloud infrastructure, artificial intelligence, and application programming interfaces (APIs) to facilitate seamless and secure transaction processing. The Central Bank of Nigeria (CBN, 2020) identifies digital payment services—including ATMs, POS, mobile payments, and online fund transfers—as a major subset of the broader financial innovation agenda, and categorises them under the core areas of financial infrastructure development. Among these, digital payment solutions have emerged as the most significant in Nigeria's banking sector, offering efficient alternatives to cash-based transactions, supporting the national financial inclusion strategy, and reducing the operational costs associated with physical cash handling (Soetan & Mogaji, 2024).

Payment systems are generally characterised by high transaction speeds, scalability, and the ability to function with minimal physical infrastructure—traits that distinguish them from legacy banking systems dependent on physical branches and manual processes (Murinde et al., 2022). In recent years, the role of payment systems in deposit money banks has evolved from being a peripheral service to a strategic enabler of competitive advantage. Mobile banking, USSD payments, QR code systems, and online transfer platforms now form the backbone of customer interaction channels, directly impacting the user experience and perceived service quality (Crouhy, Galai & Wiener, 2021). This evolution has compelled banks to integrate payment technologies into their core operational strategies, influencing decisions around infrastructure investment, customer relationship management, and product development.

While proponents argue that robust payment systems democratise access to financial services by lowering transaction barriers and broadening inclusion—especially for unbanked and underbanked populations (Ediagbonya & Tioluwani, 2023)—others warn of the potential limitations and risks. In particular, the effectiveness of payment systems in enhancing banking outcomes depends on several context-specific factors, including digital literacy, internet accessibility, and the presence of reliable cybersecurity infrastructure (Suryono, Budi & Purwandari, 2020; Ebrahim, Kumaraswamy & Abdulla, 2021). Critics also contend that many digital payment platforms are not inherently innovative but are rather digitised versions of traditional systems, lacking transformative capacity and sometimes introducing systemic vulnerabilities if poorly regulated (Gomber et al., 2018).

Moreover, although payment systems are often credited with enhancing bank performance through operational cost reduction and transaction speed improvements (Soetan & Mogaji, 2024), their actual impact on profitability remains contested. Several studies highlight that unless strategically integrated into broader banking models—with alignment to market readiness and institutional capacity—the benefits of payment systems may remain marginal or even offset by high implementation costs and regulatory compliance burdens (Murinde et al., 2022). Thus, while payment systems constitute a critical innovation in contemporary banking, their profitability implications require nuanced, context-sensitive analysis.

2.2.3.1 Automated Teller Machines (ATM)

Automated Teller Machines (ATMs) are electromechanical devices that allow bank customers to perform transactions such as cash withdrawals, fund transfers, and balance inquiries without human assistance (Badnore & Umarani, 2021). Initially designed to decentralise and automate banking services, ATMs have evolved to offer round-the-clock banking access, reducing congestion in banking halls and enhancing service delivery (Ngiruwonsanga, 2024). As part of the foundational wave of FinTech infrastructure, ATMs continue to serve both urban and semiurban populations. However, critical challenges persist including network disruptions, security breaches such as card skimming, high operating costs, and technical malfunctions, all of which can diminish customer trust and bank efficiency (Ama et al., 2024). While ATMs contribute to improved transactional speed and cost-saving in banking operations, their long-term viability

is being challenged by newer, more flexible mobile and digital banking platforms, necessitating continuous upgrades and tighter cybersecurity controls (Kandpal et al., 2025).

2.2.3.2 Point of Sale (POS) Systems

Point of Sale (POS) systems are electronic terminals that facilitate card-based financial transactions at physical retail and service locations (Obi, 2023). These systems provide a secure and efficient mechanism for real-time payments, reducing the need for cash handling and promoting digital commerce. The adoption of POS systems has expanded with the global push towards cashless economies and financial inclusion (Rui et al., 2023). Despite their functional appeal, POS systems often face operational constraints such as transaction failures, hardware maintenance issues, susceptibility to fraud, and dependency on stable internet connections (Mahathir et al., 2025). Critics also note that the economic benefit of POS technology to banking institutions may be modest without integration into broader digital financial ecosystems or value-added services (Stefanelli & Manta, 2022; Shinkevich, Kudryavtseva & Samarina, 2023). Therefore, while POS systems have redefined payment mechanisms across commercial environments, their success as a FinTech innovation depends on infrastructural support, regulatory protection, and merchant-user synergy.

2.2.3.3 Web Pay (Internet Banking)

Web Pay, commonly referred to as internet banking, involves the use of online banking platforms to facilitate financial transactions such as bill payments, account management, interbank transfers, and loan servicing (Zebedee, 2023). This platform offers customers the flexibility to engage with banking services remotely, enhancing operational efficiency and customer autonomy. Web Pay systems are increasingly viewed as essential tools for digital transformation within the financial services industry. Nevertheless, adoption levels remain uneven, primarily due to challenges related to cybersecurity risks, low digital literacy, poor user experience, and inconsistent internet access (Kitsios, Giatsidis & Kamariotou, 2021). Furthermore, while Web Pay can reduce operational costs for banks, its strategic impact on financial performance may be limited if not supported by robust digital infrastructure, regulatory safeguards, and continuous user education (Chaimaa, Najib & Rachid, 2021). As such, Web Pay exemplifies the dual nature of FinTech offering operational efficiency while exposing banks to new vulnerabilities and competitive pressures.

2.2.3.4 Mobile Pay (Mobile Banking)

Mobile Pay refers to financial services accessed and executed via mobile devices, typically through banking apps or USSD codes, enabling users to perform transactions such as money transfers, airtime purchases, bill payments, and account monitoring (Moonde, 2023). Among FinTech innovations, Mobile Pay has emerged as the most transformative, especially in regions with high mobile phone penetration but limited access to traditional banking infrastructure (Anagreh et al., 2024). The appeal of Mobile Pay lies in its convenience, speed, and accessibility, which allow users to interact with financial institutions in real time. However, concerns over data privacy, fraud, platform instability, and exclusion of digitally illiterate populations persist (Hussain, Gupta & Bhardwaj, 2024). Although mobile payment platforms have proven effective in reducing service delivery costs and enhancing financial inclusion, their performance impact is contingent on sustained technological investment, robust cybersecurity measures, and inclusive service design (Mhlanga, 2024). Consequently, Mobile Pay stands at the frontier of banking innovation promising broad transformation while simultaneously demanding strategic, regulatory, and ethical oversight.

2.2.4 Fintech and Bank Profitability

2.2.4.1 Automated Teller Machines (ATM) and Bank Profitability

Automated Teller Machines (ATMs) have historically served as one of the earliest manifestations of financial technology within banking operations, providing customers with 24/7 access to cash withdrawals, balance inquiries, and limited transactional services. From a performance standpoint, ATMs contribute to operational efficiency by reducing the need for in-branch transactions, thereby lowering staff costs and improving service delivery metrics (Badnore & Umarani, 2021; Ngiruwonsanga, 2024). As FinTech infrastructure, ATMs play a strategic role in extending banking services to underserved and geographically remote areas, acting as access points for formal financial services where branch penetration is low. According to Ele, Enang, and Uguru (2023), increased ATM transaction volumes were statistically associated with improved performance indicators, including return on assets (ROA) and earnings per share (EPS), across Nigerian banks. Additionally, Fernando and Dharmastuti

(2021) observed a significant positive relationship between ATM usage and both profitability and market value (Tobin's Q) in Indonesian banks, suggesting that ATMs, despite being traditional in design, remain instrumental in reinforcing customer reach and cost-effective banking.

However, the contribution of ATMs to bank performance is increasingly under scrutiny due to operational constraints, rising maintenance costs, and the advent of more dynamic mobile and web-based banking channels. Several scholars argue that ATMs, while initially revolutionary, now offer diminishing returns unless supported by modernisation and integration into digital ecosystems (Ama et al., 2024; Kandpal et al., 2025). In a study by Akintunde et al. (2024), it was found that FinTech investment in ATM infrastructure only positively influenced ROA when embedded in a broader strategic framework, rather than as isolated technological outlays.

Moreover, empirical findings from Ogbuji, Ologundudu, and Oluyomi (2020) suggest that fully digitised banking platforms, such as Wema Bank's ALAT, yielded stronger performance metrics than earlier ATM-centred innovations. Consequently, while ATMs still enhance operational efficiency and customer accessibility, their long-term contribution to performance is contingent on technological upgrades, cybersecurity resilience, and relevance in an increasingly mobile-first financial landscape.

2.2.4.2 Point of Sale (POS) and Bank Profitability

Point of Sale (POS) systems have emerged as a crucial FinTech tool facilitating seamless, realtime payments at retail and service locations. In banking contexts, POS terminals not only reduce the prevalence of cash-based transactions but also promote merchant engagement and expand transactional revenue streams (Obi, 2023; Rui et al., 2023). The widespread adoption of POS infrastructure has supported central bank initiatives to drive cashless economies and deepen financial inclusion, particularly in urban centres and retail-dense environments. Empirical findings by Ele, Enang, and Uguru (2023) showed that increased POS transaction volume positively correlated with improved bank performance indicators, notably ROA and NIM, reflecting greater transactional throughput and fee-based income. Similarly, the work of Otonne and Ige (2023) confirmed that POS usage significantly enhanced earnings per share (EPS) and other market-based performance metrics when incorporated into a broader digital banking strategy. These findings align with global trends, where POS adoption has been associated with improved customer retention, reduced cost-to-income ratios, and expanded service accessibility.

Nonetheless, the effectiveness of POS systems in enhancing bank performance is moderated by infrastructural limitations, device maintenance costs, transaction failures, and fraud risks. POS terminals are often dependent on consistent internet connectivity and electricity—

challenges that are particularly acute in developing economies (Mahathir et al., 2025). Scholars such as Stefanelli and Manta (2022) note that without integration into value-added service ecosystems (such as loyalty programs or credit scoring), POS systems may offer marginal returns to financial institutions. Furthermore, studies like that of Shinkevich, Kudryavtseva, and Samarina (2023) highlight that many POS implementations are not sufficiently leveraged for data analytics or cross-selling opportunities, limiting their strategic value. In this light, while POS systems undoubtedly support operational performance and revenue diversification, their contribution to long-term profitability and competitive advantage is conditional upon regulatory support, technological investment, and merchant-customer synergy.

2.2.4.3 Mobile Banking and Bank Profitability

Mobile banking, often referred to as Mobile Pay, represents the most transformative dimension of FinTech within the banking sector, particularly in emerging markets with high mobile phone penetration. Through mobile applications and USSD interfaces, banks can offer real-time, customer-centric services that include funds transfer, bill payment, loan applications, and balance monitoring. Empirical evidence strongly supports the performance-enhancing role of mobile banking. For example, Le et al. (2021) found a statistically significant positive relationship between mobile banking adoption and both ROA and ROE across Vietnamese banks, particularly in smaller institutions where mobile platforms filled infrastructure gaps. Likewise, Kiilu (2018), in a longitudinal study of Kenyan banks, demonstrated that mobile banking usage—measured by active user registrations—significantly boosted ROA, suggesting strong links between digital accessibility and income generation. In Nigeria, studies by Otonne, Melikam, and Ige (2023) and Akintunde et al. (2024) similarly found that strategic investment in mobile banking infrastructure positively impacted financial performance indicators, including EPS and cost of service (CoS) efficiency.

Despite these promising outcomes, the deployment of mobile banking platforms is not without its challenges. Data security concerns, platform instability, digital illiteracy, and user resistance—particularly among older and rural populations—can undermine the effectiveness of mobile banking (Hussain, Gupta & Bhardwaj, 2024). Mhlanga (2024) argues that while mobile platforms reduce operational costs and expand customer bases, their impact on longterm profitability hinges on continued technological investment, regulatory oversight, and usercentric design. Furthermore, as noted by Ediagbonya and Tioluwani (2023), mobile banking's success is uneven across regions, often reflecting disparities in internet access and financial literacy. Thus, while mobile banking serves as a powerful performance lever, its efficacy is moderated by contextual factors such as user adoption rates, cybersecurity readiness, and the institutional maturity of banks.

2.2.4.4 Web Banking and Bank Profitability

Web banking, also known as internet banking or Web Pay, enables customers to conduct financial transactions remotely via web-based platforms, including transfers, bill payments, and account management. This channel significantly reduces the need for physical branch interaction, thereby enhancing service convenience and lowering operating costs for banks (Zebedee, 2023). From a performance perspective, internet banking is associated with increased process efficiency and revenue diversification. Empirical evidence by Fernando and Dharmastuti (2021) indicates that internet banking positively impacts ROA and Tobin’s Q in Indonesian banks, particularly where digital strategies are fully integrated into core operations. Moreover, Ele, Enang, and Uguru (2023) found a statistically significant positive relationship between internet banking transaction volume and bank performance in Nigeria, supporting the view that digital channels can enhance both income and market valuation. These findings are echoed by Le et al. (2021), who found that internet banking platforms facilitated customer

retention and fee-based revenue growth, particularly in urban and middle-income demographics.

However, internet banking's contribution to bank performance is constrained by factors such as poor digital infrastructure, cybersecurity vulnerabilities, and uneven digital literacy. Kitsios, Giatsidis, and Kamariotou (2021) argue that inconsistent user experience and lack of customer trust may limit adoption, particularly in markets with prior exposure to service failures or online fraud. In addition, the strategic benefit of Web Pay systems may be diluted when not coupled with complementary services such as online investment platforms or virtual advisory tools (Chaimaa, Najib & Rachid, 2021). Furthermore, the rise of mobile-first platforms has, in some contexts, overshadowed the utility of web-based banking, especially among younger demographics. Hence, while web banking is a vital component of digital transformation, its effect on performance is contingent on continuous innovation, robust cybersecurity mechanisms, and customer-focused design principles.

2.3 Theoretical Literature

Two major theories are prevalently adopted in the study of FinTech and banking: the Technology Acceptance Model and the Innovation Diffusion Theory.

2.3.1 Technology Acceptance Model

On one hand, the Technology Acceptance Model (TAM), developed by Davis (1989), provides a foundational framework for understanding users' acceptance of technology based on two core constructs: perceived usefulness and perceived ease of use. According to the model, individuals are more likely to adopt a new technology if they believe it will enhance their performance and if the system is easy to use (Venkatesh & Davis, 2000). Over time, TAM has been extended to include variables such as attitude, behavioural intention, and actual system use, becoming one of the most cited models in studies on digital financial service adoption (Legris, Ingham &

Collerette, 2003). In the context of banking, TAM has been widely applied to explain the adoption of electronic banking platforms such as ATMs, POS, internet banking, and mobile payments (Pikkarainen et al., 2004; Alalwan et al., 2016). However, critics argue that TAM tends to oversimplify the complex socio-technical processes influencing technology adoption, as it underestimates the roles of trust, security, cultural context, and infrastructural readiness (Bagozzi, 2007; Martins, Oliveira & Popovič, 2014). Despite its limitations, TAM remains highly relevant for evaluating how customers and financial institutions respond to FinTech innovations. In analysing the adoption of ATM, POS, Web Pay, and Mobile Pay technologies in the banking sector, TAM provides useful insight into how user perceptions can drive or hinder effective utilisation, which ultimately impacts bank performance outcomes.

2.3.2 Innovation Diffusion Theory

On the other hand, the Innovation Diffusion Theory (IDT), originally proposed by Rogers (1962) and further expanded in his later works (Rogers, 2003), explains how, why, and at what rate new technologies spread within a social system. The theory categorises adopters into five groups—innovators, early adopters, early majority, late majority, and laggards—and identifies key attributes that influence adoption decisions: relative advantage, compatibility, complexity, trialability, and observability. In financial services research, IDT has been instrumental in understanding the uptake of technological innovations such as mobile banking, internet payments, and other digital financial platforms (Moore & Benbasat, 1991; Lu et al., 2003). Its relevance lies in its ability to contextualise adoption within social and organisational networks, recognising that technology acceptance is not merely an individual decision but also shaped by peer influence, institutional structures, and market readiness (Al-Jabri & Sohail, 2012; Oliveira & Martins, 2011). However, IDT has been criticised for assuming a linear and uniform adoption path and for underestimating the dynamic interplay between regulatory environments, user resistance, and technological evolution (Lyytinen & Damsgaard, 2001). In the context of banking, IDT helps explain how the diffusion of FinTech tools such as POS terminals and mobile payment platforms varies across market segments and how institutional and consumer behaviour interact over time to shape performance implications. As such, it provides a theoretical lens for examining how digital innovations diffuse within financial ecosystems and influence bank competitiveness and efficiency.

2.4 Empirical Review

Bashayreh and Wadi (2021) conducted a panel data analysis on thirteen commercial banks between 2012 and 2018 to assess the impact of FinTech services—specifically ATM, internet banking, and phone banking—on bank performance in Jordan. Using return on equity (ROE) as the dependent variable, alongside GDP growth, bank size, and leverage as controls, the study found a positive and significant relationship between FinTech adoption and bank profitability. Notably, while GDP and bank size positively influenced ROE, financial leverage showed no significant effect. The findings support the argument that digital banking innovations can enhance bank profitability when supported by economic scale and macroeconomic stability.

Kayed et al. (2025) employed panel data regression over a ten-year period (2010–2019) across 13 commercial banks to examine the internal integration of FinTech and its implications for profitability, risk, and stock performance. The study revealed that FinTech development had a significant positive effect on profitability and a negative association with risk-taking, indicating enhanced financial stability. However, the impact on stock return was statistically insignificant. The methodological robustness—through endogeneity and autocorrelation checks—reinforces the conclusion that FinTech improves operational safety and profit generation but may not immediately reflect in market-based performance metrics.

Dasilas and Karanović (2025) applied both static and dynamic panel regression models to data from UK banks (2010–2019) to evaluate the effect of FinTech firms on financial performance.

Their results demonstrated that the entry of FinTech firms significantly boosted bank profitability, with each new FinTech firm associated with an increase of 6.385% in net interest margin (NIM) and 3.192% in yield on earning assets (YEA), relative to sample means. These findings suggest that FinTech competition can drive efficiency and revenue enhancement in interest-based banking activities.

Le et al. (2021) investigated the impact of mobile banking applications on the performance of 22 commercial banks in Vietnam using multivariate panel regression on data spanning 2010 to 2019. The study confirmed a positive relationship between mobile banking adoption and bank performance, with stronger effects observed in smaller banks. Specifically, fee-based income, consumer loans, and market deposits improved significantly with mobile app usage, while GDP per capita and mobile penetration also positively influenced ROE and ROA. This highlights the differential impact of FinTech based on bank size and customer demographics.

Kiilu (2018) employed longitudinal data from 44 commercial banks in Kenya over 30 quarters (2010–2017) to assess the relationship between mobile payment adoption and financial performance. Using OLS regression and correlation analysis, the study found a significant positive association between the number of mobile payment account users and return on assets (ROA), with the strongest predictor being user registration. The T-test confirmed statistical significance at the 0.05 level. These findings suggest that mobile payment infrastructure serves as a key driver of bank performance through customer acquisition and usage.

Fernando and Dharmastuti (2021) examined the impact of four FinTech products—ATM, mobile payment, mobile banking, and internet banking—on bank performance and value in Indonesia, using linear regression and mediation analysis across 23 banks over two years. Results showed that mobile banking, internet banking, and ATM usage significantly enhanced ROA and Tobin's Q, while mobile payment had no statistically significant effect. The study concluded that not all FinTech innovations contribute equally to performance, and some tools may deliver strategic rather than financial value.

Rickinghall (2022) conducted a multivariate regression analysis on 470 observations from 18 Islamic banks in Malaysia over 15 years (2005–2020) to assess the influence of Islamic FinTech on financial performance. The study revealed a strong positive relationship between Islamic FinTech adoption and both bank profitability and income generation, particularly in small banks. The results underscore the importance of tailored digital tools in niche banking sectors, suggesting that FinTech's performance impact is moderated by bank size and operational model.

Ky, Rugemintwari, and Sauviat (2019) examined the impact of mobile money on bank performance within the East African Community using a panel of 141 banks between 2009 and 2018. Data were sourced from Bankscope and BankFocus, and performance was measured through profitability, efficiency, and stability metrics. The study employed panel regression analysis and found a strong positive association between banks' duration of mobile money involvement and improved financial performance. Further analysis revealed that bank size, deposit mobilisation, and diversification significantly moderated this relationship, suggesting mobile money enhances long-term competitiveness in banking.

Akintunde et al. (2024) investigated the relationship between FinTech expenditure and the financial performance of Nigerian deposit money banks using both primary and secondary data across nine listed banks from 2008 to 2023. The study employed descriptive statistics, ANOVA, and panel regression analysis. The results revealed a statistically significant positive relationship between cost of service (CoS) related to FinTech and return on assets (ROA), indicating that strategic investments in FinTech infrastructure can improve bank profitability when effectively deployed.

Ogbuji, Ologundudu, and Oluyomi (2020) conducted a comparative analysis of Wema Bank's performance under FinTech and traditional operations using the CAMELS model over the 2012–2018 period. Data were obtained from annual reports, and performance was evaluated using descriptive and composite CAMELS ranking. The study found that the digital banking era, represented by ALAT, yielded better performance metrics (e.g., capital adequacy, asset quality, liquidity) than the earlier payment FinTech phase, underscoring the importance of fully digitised platforms over partial or transaction-only systems.

ohn et al. (2024) assessed the impact of FinTech on the performance of deposit money banks and SMEs in Nigeria using secondary data and an Auto-Regressive Distributed Lag (ARDL) model. The study adopted an ex post facto design and revealed that FinTech has a statistically significant positive impact on bank performance. The calculated F-value (1234.17) exceeded the critical value, indicating a robust relationship between FinTech variables and financial outcomes such as return on equity and profitability indicators across firm categories.

Otonne and Ige (2023) explored the influence of FinTech on traditional and market-based performance indicators using financial statement data from selected banks and transactionlevel statistics. Employing econometric modelling and descriptive analysis, the findings showed that increased usage of ATM transactions and other FinTech platforms significantly boosted earnings per share and overall performance. The study concludes that FinTech adoption enhances efficiency, reduces costs, and broadens financial inclusion, though infrastructure and regulatory challenges remain.

Ele, Enang, and Uguru (2023) analysed the effect of specific FinTech tools—ATM, POS, web payments, and mobile banking—on banking service delivery between 2005 and 2022. Using an ex post facto design and estimating with the ARDL technique, the study found that ATM, POS, and internet banking transactions had a statistically significant and positive impact on bank performance at the 5% significance level. Interestingly, online transactions (ONLIT) were found to have a negative impact under specific confidence levels (90%), suggesting variation in tool effectiveness depending on usage context and infrastructure.

Otonne, Melikam, and Ige (2023) assessed the influence of financial technology on the performance of deposit money banks, focusing on UBA and Zenith Bank over the 2012–2019 period. Using quarterly data from the banks' reports and CBN bulletins, the study applied the Autoregressive Distributed Lag (ARDL) technique for estimation. The findings indicated that payment-related FinTech tools exhibited both positive and negative effects on key performance metrics—such as earnings per share (EPS), price-earnings ratio (P/E), return on assets (ROA), and return on equity (ROE). However, the positive effects predominated, suggesting that while some short-term fluctuations may occur, payment FinTech enhances long-term bank profitability and market valuation when strategically adopted.

Mugabe (2022) explored the long-run impact of FinTech on banking sector performance in South Africa using annual data from 2000 to 2018. The study employed the ARDL model and Granger causality tests to investigate whether FinTech firm presence affects performance indicators such as ROA, ROE, NIM, and YEA. The results from the ARDL model showed significant long-run positive relationships between FinTech and ROA, ROE, and YEA (at 1% significance), while NIM was significant only at the 10% level. However, the Granger causality test indicated no predictive relationship between FinTech firm presence and future banking performance. The study concludes that although FinTech plays a role in shaping banking fundamentals, its predictive power for sector-wide outcomes remains inconclusive.

Nwayen, Ukpong, and Uwah (2024) analysed the relationship between FinTech tools and the profitability of five listed deposit money banks over a ten-year period (2010–2019), using secondary data from audited reports and the Central Bank of Nigeria Bulletin. The study applied regression and correlation analyses using SPSS 20. The key finding was that the use of mobile payments and ATMs had statistically insignificant effects on return on assets (ROA), suggesting that despite their widespread adoption, these particular FinTech tools may not directly drive profitability unless integrated into a broader digital banking strategy. This raises questions about the differential impact of specific FinTech channels on financial outcomes.

Table 2.1 Summary of Empirical Studies on FinTech and Bank Performance

S/NO	Author(s)	Year	Topic	Methodology	Findings
1	Bashayreh & Wadi	2021	Impact of FinTech (ATM, Internet, Phone Banking) on Bank Performance in Jordan	Panel data analysis (13 banks, 2012–2018)	FinTech adoption significantly improved ROE; GDP and bank size positively impacted profitability, leverage had no significant effect.
2	Kayed et al.	2025	Internal FinTech Integration and Bank Profitability, Risk & Stock Performance	Panel regression (2010–2019, 13 banks)	FinTech improved profitability and reduced risk; no significant effect on stock returns.
3	Dasilas & Karanović	2025	Entry of FinTech Firms and Bank Performance in the UK	Static and dynamic panel regression (2010–2019)	New FinTech firms increased NIM by 6.385% and YEA by 3.192%; FinTech competition boosted efficiency.
4	Le et al.	2021	Mobile Banking and Bank Performance in Vietnam	Multivariate panel regression (2010–2019, 22 banks)	Mobile banking improved ROA and ROE; greater impact in smaller banks; fee income, loans, and deposits increased.

5	Kiilu	2018	Mobile Payments and Financial Performance in Kenya	OLS regression and correlation (2010–2017, 44 banks)	Mobile payment usage positively correlated with ROA; user registration was

					the strongest performance predictor.
6	Fernando & Dharmastuti	2021	FinTech Products and Bank Performance in Indonesia	Linear regression and mediation analysis (23 banks)	ATM, mobile, and internet banking improved ROA and Tobin's Q; mobile payment had no significant effect.
7	Rickinghall	2022	Islamic FinTech and Performance of Islamic Banks in Malaysia	Multivariate regression (2005–2020, 18 banks)	Islamic FinTech adoption improved profitability and income generation, especially in small banks.
8	Ky, Rugemintwari & Sauviat	2019	Mobile Money and Bank Performance in East Africa	Panel regression (2009–2018, 141 banks)	Mobile money duration positively influenced profitability and efficiency; effects moderated by bank size and diversification.
9	Akintunde et al.	2024	FinTech Expenditure and Financial Performance in Nigeria	Descriptive statistics, ANOVA, panel regression (2008–2023)	FinTech CoS positively influenced ROA; strategic FinTech investment enhances profitability.
10	Ogbuji, Ologundudu & Oluyomi	2020	Traditional vs. FinTech Banking (Wema Bank CAMELS Analysis)	Descriptive analysis using CAMELS (2012–2018)	ALAT (FinTech phase) outperformed traditional banking in all CAMELS indicators.

11	John et al.	2024	FinTech and Performance of Deposit Money Banks and SMEs in Nigeria	ARDL model, ex post facto design	FinTech had a statistically significant positive impact on performance; high F-value confirmed robustness.

12	Otonne & Ige	2023	FinTech Use and Market/Traditional Performance Metrics	Econometric modelling & descriptive analysis	ATM and FinTech usage improved EPS and performance; challenges included infrastructure and regulation.
13	Ele, Enang & Uguru	2023	Effects of ATM, POS, Web, Mobile Banking on Service Delivery	ARDL model, ex post facto design (2005– 2022)	ATM, POS, and web banking had significant positive impact; online transactions had mixed or negative effects.
14	Otonne, Melikam & Ige	2023	FinTech and Performance of UBA and Zenith Bank	ARDL technique, quarterly data (2012–2019)	FinTech tools showed both positive and negative effects on EPS, P/E, ROA, and ROE; overall long-term performance improved.
15	Mugabe	2022	Long-Run FinTech Impact in South Africa	ARDL & Granger causality (2000–2018)	FinTech improved ROA, ROE, and YEA significantly; NIM had limited effect; no causality found for future predictions.
16	Nwayen, Ukpong & Uwah	2024	FinTech Tools and Profitability of Nigerian Banks	Regression & correlation (2010–2019, 5 banks)	Mobile payments and ATM had statistically insignificant effects on ROA; effectiveness depends on strategic integration.

Author's Compilation (2025)

2.5 Identified Research Gaps

Despite the growing corpus of literature examining the relationship between payment systems and bank profitability, empirical findings remain inconclusive and, at times, contradictory. While several studies (e.g., Bashayreh & Wadi, 2021; Dasilas & Karanović, 2025; Le et al., 2021) affirm the positive contributions of specific payment platforms—such as mobile payments, ATMs, and internet banking—on key financial indicators like Return on Assets (ROA) and Return on Equity (ROE), others document limited or even adverse impacts (Fernando & Dharmastuti, 2021; Nwayen, Ukpong & Uwah, 2024). For instance, Kiilu (2018) and Ky et al. (2019) report significant improvements in ROA associated with mobile money innovations in African banking sectors, while Mugabe (2022) identifies a negative correlation between the proliferation of digital payment firms and ROE in the South African context.

Moreover, mixed outcomes have been observed across different profitability metrics. Otonne et al. (2023) and John et al. (2024) report both positive and negative fluctuations in Earnings per Share (EPS), ROA, and ROE depending on the specific payment system under analysis. These inconsistencies suggest that the impact of digital payment channels—such as Automated Teller Machines (ATM), Point of Sale (POS) terminals, web-based payment gateways, and mobile payment platforms—may not be uniform across contexts. Instead, outcomes appear to be mediated by factors such as operational scale, market maturity, technological integration, and bank-specific strategies.

This body of evidence underscores a critical research gap: the lack of a disaggregated, channelspecific empirical approach to evaluating the impact of payment systems on bank profitability. Many existing studies treat payment systems as part of a broader digital transformation or FinTech composite, thereby obscuring the individual effects of each platform. Furthermore, few studies have focused explicitly on ROA as a holistic, size-neutral, and asset-efficiency

metric, despite its relevance in comparative performance evaluation. Given the strategic importance of digital payments in driving operational efficiency and customer engagement, there is a clear need for more targeted investigations that isolate the unique and combined contributions of ATM, POS, Web Pay, and Mobile Pay platforms to bank profitability.

Such an approach would not only advance academic understanding but also provide practical insights for policymakers, regulators, and banking executives seeking to optimise the deployment of payment systems in performance-enhancing strategies. Hence, this study seeks to fill this empirical void by examining the individual and combined effects of key payment channels on bank profitability, using ROA as the principal indicator of financial performance.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter deals with the research design, population and sample of the study, sources of data, theoretical framework and model specification, measurement and operationalization of variable as well as method of data analysis.

3.2 Research Design

The Ex-Post-facto research design will be used in this study, which are particularly applicable in management and social sciences. The use of secondary data in an Ex-Post-facto research design involves the study of responses in the nature of a factor and its effects on individuals; the researcher does not have the ability or opportunity to modify or manipulate the independent variables. This inability to control the independent variables stems from either the variables being fundamentally non-manipulable or their manifestations having already occurred (Agbonifoh & Yomere, 1999).

3.3 Population and Sample of the Study

The population of the study is made up of the entirety of the Nigerian financial sector focusing on the effect of payment systems on bank profitability. The census sampling technique is adopted as a result of the macro-nature of this study. However, data covered is limited to the variables of this study, including ATM, POS, Web Pay, Mobile Pay, and Return on assets.

3.4 Sources of Data

The data to be used for the study is the secondary data which would be directly obtained from Central Bank of Nigerian statistical bulletin and National Bureau of statistics for various years under review.

3.5 Theoretical Framework

This study is anchored on the innovation diffusion theory. This theory was stipulated by Rogers (1962). Theory argues that any institutions aiming to achieve growth must be willing to undertake innovations. This theory posits that there are five key attributes of innovations; improvement of current modes operandi, consistent approach to performance, pre-testing capacity and ease to observe any shortcoming (Frame & Scott, 2021). According to Hirtle, (2015) institutions have capacity to gain competitive advantage and minimize operational costs courtesy of innovations. Further, institutions would easily penetrate new markets and discover alternative means of serving their customers.

3.6 Model Specification

This study shall adapt the model Eguisa and Ulokor (2013). Their model was specified utilizing Return on assets (ROA) as a function of three major financial innovation variables including ATM, POS, and MBS. This study modifies their model by introducing Web Pay.

Their model was specified thus:

$ROA_t = \beta_0 + \beta_1 ATM_t + \beta_2 POS_t + \beta_3 MBS_t + U_i$……………….………………..….……..(3.1)

The modified model which would be used in this study is functionally expressed as follows;

$ROA = f(ATM,POS,WEB,MOB)$………………………………………………...…(3.2)

The econometric form of the model is specified as;

$ROA_t = \beta_0 + \beta_1 ATM_t + \beta_2 POS_t + \beta_3 WEB_t + \beta_4 MOB_t + U_i$……………………..……….(3.3)

Where;

ROA_t = Return on assets at time t

ATM_t = Automated Teller Machine at time t

POS_t = Point of sale at time t

WEB_t= Web pay at time t

MOB_t= Mobile pay at time t

a_o is the mean or intercept

β_1- β_4 are the coefficients of the main independent/explanatory variables of interest.

Based on theoretical or apriori expectation, the signs of the coefficients are given as;

$\beta_1 - \beta_4 > 0$

In other words we expect a positive relationship between the dependent and independent variables.

3.7 Measurement and Operationalization of Variables

In this study, variables are operationalized based on established empirical literature and contextual relevance to the Nigerian banking sector. The dependent variable—Return on

Assets (ROA)—is adopted as a comprehensive measure of bank profitability due to its efficiency orientation and scale-neutral characteristics. The independent variables include four distinct payment system channels: Automated Teller Machine (ATM), Point of Sale (POS), Web Pay, and Mobile Pay, each measured by the total volume of transactions executed through the respective channels within the period under review.

Table 3.1: Operationalization and Measurement of Variables

S/NO	Item	Variable Type	Measurement	Source
1	Return on Asset (ROA)	Dependent variable	Ratio of net income to total assets	Kiilu (2018); Fernando & Dharmastuti (2021); Nwayen, Ukpong & Uwah (2024)
2	Automated Teller Machine (ATM)	Independent variable	Total volume of transactions carried out on ATMs	Ele, Enang & Uguru (2023); Otonne & Ige (2023)
3	Point of Sale (POS)	Independent variable	Total volume of transactions carried out through POS terminals	Ele, Enang & Uguru (2023); Akintunde et al. (2024)
4	Web Pay	Independent variable	Total volume of transactions carried out through web-based payments	Ele, Enang & Uguru (2023); Ogbuji, Ologundudu & Oluyomi (2020)

5	Mobile Pay	Independent variable	Total volume of transactions carried out through mobile payment apps	Kiilu (2018); Fernando & Dharmastuti (2021); Le et al. (2021)

Source: Author's compilation (2025)

3.8 Method of Data Analysis

In analyzing the impact of payment systems on bank profitability, time series ordinary least squares (OLS) regression analysis will be adopted. This approach is suitable for examining the temporal dynamics of payment systems within the banking sector. The study will conduct unit root tests and cointegration tests, as well as other diagnostics, to ensure the robustness and validity of the results. This method allows for an in-depth understanding of how payment systems influences bank profitability over time.

CHAPTER FOUR

DATA PRESENTATION AND ANALYSIS

The primary aim of this section is to analyse the data used for various estimations in reaching inference for possible policy recommendation for both policy and profitable banking decisions. The results are presented where necessary and duly interpreted based on econometric decision rules. The variables of the study are automated teller machine, point of sales transaction, web payment transaction, mobile payment and NIBSS Electronic Fund Transfer

4.1 Data Presentation

The data for the study are presented in appendix A with other estimation being presented in appendix B. The data presented covers all the variables considered in the study.

4.2 Interpretation of Results

The result of the analyses is interpreted in this section. The estimations are conducted using the EViews 10 software and based on the earlier stated hypothesis of chapter one.

4.2.1 Descriptive Statistics of the Variables.

The result of the descriptive statistic shows that ROE has a mean value of 5.4256 with a median value of 2.2 and a standard deviation value of 6.5573. With a higher standard deviation value, it implied that the series is not normally distributed. In the same vein, AVL has a mean vale that is greater than the value of the standard showing the same non-normal distribution of the data set. The result of the Jarque-Bera statistic also agree to the non-normal distribution of the variables. The statistic for the data set for AVL also revealed that the data set is not found to be normally distributed. This is same for the other variables of PVL, WVL, MVL and EVL.

Table 4.1: Descriptive Statistics

	ROE	AVL	PVL	WVL	MVL	EVL
Mean	5.425682	4846.130	6468.470	100469.6	14594.51	70721.10
Median	2.218750	1597.090	500.4324	64.90693	426.4599	4090.452
Maximum	20.71000	29793.75	36890.71	724004.9	96643.65	460568.1
Minimum	-0.130000	454.7892	1.865365	6.380682	1.081546	2757.682
Std. Dev.	6.557367	7171.257	11405.03	195899.9	26275.21	128208.6
Skewness	1.548751	2.341918	1.574789	1.990254	1.674293	2.132950
Kurtosis	3.787770	7.574519	3.900203	5.905351	4.588501	6.409150
Jarque-Bera	18.72768	78.58500	19.67205	44.52344	25.18333	54.67037
Probability	0.000086	0.000000	0.000053	0.000000	0.000003	0.000000
Sum	238.7300	213229.7	284612.7	4420662.	642158.6	3111728.
Sum Sq. Dev.	1848.960	2.21E+09	5.59E+09	1.65E+12	2.97E+10	7.07E+11
Observations	44	44	44	44	44	44

Source: Estimated from EViews 10, 2025.

4.2.2 Analysis of Correlation Results

The result of the correlation matrix revealed that all the independent variables are negatively related to the dependent variable for which only AVL was found to have significant relationship with ROA. Implying that the value of transaction using the channel of the ATM produces more profit to the banks with the newly introduced charges by the regulatory authorities than the other channels do. the variable AVL was found to have a probability value that is less than the 0.05 level of statistical significance while the probability value for the other variables are found to be higher than the 0.05 level of statistical significance The result of the correlation matrix is presented in table 4.2

Table 4.2: Correlation Matrix

Correlation Analysis: Ordinary
Date: 11/20/25 Time: 10:24
Sample: 2012Q1 2023Q4
Included observations: 44
Balanced sample (listwise missing value deletion)

Correlation Probability	ROE	AVL	PVL	WVL	MVL	EVL
ROE	1.000000 ----					
AVL	-0.306083 0.0433	1.000000 ----				
PVL	-0.265956 0.0810	0.843115 0.0000	1.000000 ----			
WVL	-0.261060 0.0870	0.966950 0.0000	0.935663 0.0000	1.000000 ----		
MVL	-0.267160 0.0796	0.894286 0.0000	0.988318 0.0000	0.966310 0.0000	1.000000 ----	
EVL	-0.272583 0.0734	0.972915 0.0000	0.901435 0.0000	0.991606 0.0000	0.935268 0.0000	1.000000 ----

Source: Estimated from EViews 10, 2025.

4.2.3 Analysis of Unit Root Results

The result of the unit root test shows that only the variable ROE is found to be stationary at level without requiring differencing. WVL, MVL and EVL were found to be stationary after first differencing. But PVL and MVL are found to be stationary after second differencing. Tis implied the need for a cointegration test the application of a cointegrating regression technique.

Table 4.3: Unit Root Results

	Augmented Dickey-Fuller test statistic		
Series	Statistic	Prob.**	Remark
ROE	-3.796365	0.0062	I(0)
PVL	-1.552399	0.1119	
D(PVL)	1.960154	0.9998	
D(PVL,2)	-18.25095	0.0000	I(2)
WVL	3.738074	0.9999	
D(WVL)	-2.534742	0.0127	I(1)
MVL	0.145858	0.7226	I(1)
D(MVL)	1.051989	0.9998	
D(MVL, 2)	-26.19532	0.0000	I(2)
EVL	-2.688108	0.0845	
D(EVL)	-4.341471	0.0073	I(1)

Source: Estimated from EViews 10, 2025.

4.2.4 Analysis of Cointegration Results

The result of the cointegration using the Trace test shows that there is at least four cointegrating equation at the 5% level of statistical significance. This implied that there is a long – run relationship between the dependent variable and the independent variables estimated in the study.

Table 4.4: Cointegration Results – Trace Test

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.961014	261.2480	95.75366	0.0000
At most 1 *	0.747429	131.4660	69.81889	0.0000
At most 2 *	0.647374	76.42349	47.85613	0.0000
At most 3 *	0.430575	34.72963	29.79707	0.0125
At most 4	0.212483	12.20448	15.49471	0.1474
At most 5	0.064095	2.649652	3.841466	0.1036

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: Estimated from EViews 10, 2025.

4.2.5 Analysis of Fully Modified Least Square Results

The result of the regression shows that AVL has significant but negative effect on ROE for the period under consideration, this is because AVL has a probability value that is less than the 0.05 level of statistical significance. A unit change in AVL will result in a 0.28% change ROE of banks in Nigeria. While this shows a very insignificant effect on the probability of banks, the negative effect is concerning as major payment system have also move from cash based to just electronic based transactions. PVL, MVL and EVL were not found to have significant effect on ROE but with the increase in the level of statistical significance to 10%, WVL becomes significant. Implying that WEB payment platform significantly increase the profitability of banks in Nigeria.

The parameter of the regression result revealed that the independent variables are able to account for up to 16.1577% of the systematic variation in the dependent variable with a 4% value of Adjusted R-squared for the model fitness.

Table 4.5: Regression Result

Dependent Variable: ROE
Method: Fully Modified Least Squares (FMOLS)
Date: 11/20/25 Time: 05:48
Sample (adjusted): 2012Q2 2023Q4
Included observations: 42 after adjustments
Cointegrating equation deterministics: C
Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AVL	**-0.002829**	**0.001288**	**-2.196527**	**0.0346**
PVL	-0.001045	0.001357	-0.770400	0.4461
WVL	**0.000272**	**0.000143**	**1.901441**	**0.0653**
MVL	-0.000197	0.000880	-0.223883	0.8241

EVL	-0.000155	0.000147	-1.059836	0.2963
C	12.69005	2.977350	4.262198	0.0001

R-squared	0.161577	Mean dependent var	5.598333
Adjusted R-squared	0.045129	S.D. dependent var	6.664607
S.E. of regression	6.512487	Sum squared resid	1526.849
Long-run variance	118.5102		

Source: Estimated from EViews 10, 2025.

The result of the residual statistic for the model shows that the residual are normally distributed. This provide sufficient evidence for reliance on the inferences from the study for policy statement and business decision. The Residual statistic is provided in figure 4.1

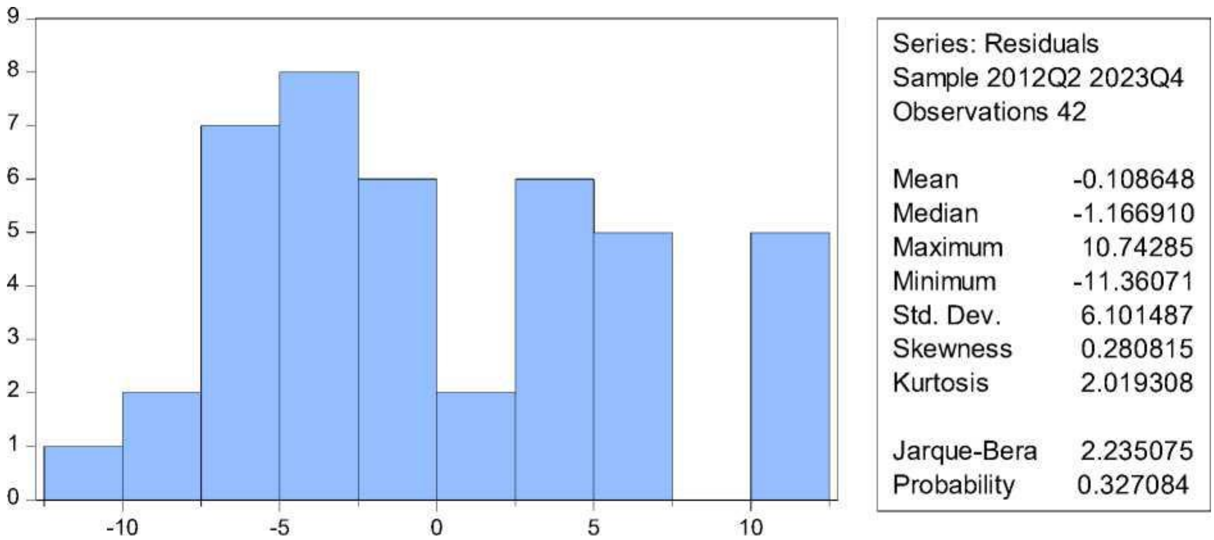

Figure 4.1: Residual of the Model

Source: Author's Estimation from EView 10, 2025.

4.3 Test of Hypotheses

The test of hypothesis is based on the regression result presented in table 4.5. The level of significance is based on 5% and in some cases 10% is considered.

It was stated in the first hypothesis that the value of ATM transaction does not have significant effect on bank profitability in Nigeria. The regression result shows that we do not accept the null hypothesis that the value of ATM transaction does not have significant effect on bank profitability in Nigeria but the alternate hypothesis that the value of ATM transaction have significant effect on bank profitability in Nigeria (Prob. AVL 0.0346 < 0.05).

It was stated in the second hypothesis that the value of POS transaction does not have significant effect on bank profitability in Nigeria. The regression result revealed that we fail to reject the null hypothesis and that hence, the value of POS transactions does not have significant effect on bank profitability in Nigeria (Prob. PVL 0.4461 > 0.05).

It was stated in the third hypothesis that the value of Web pay transactions does not have significant effect on bank profitability in Nigeria. The regression result revealed that we do not accept the null hypothesis that the value of Web pay transactions does not have significant effect on bank profitability in Nigeria. But accept the alternate hypothesis that the value of Web pay transactions have significant effect on bank profitability in Nigeria. (Prob. WVL 0.0653 < 0.10).

The fourth hypothesis is stated that the value of Mobile payment transactions does not have significant effect on bank profitability in Nigeria. The regression result shows that we fail to reject the null hypothesis (Prob. MVL 0.8241 > 0.10).

In the same vein, the last hypothesis is stated you The regression result shows that we fail to reject the null hypothesis (Prob. EVL 0.2963 > 0.05).

4.4 Discussion of Findings

This study examined the relationship between digital payment systems and bank profitability in Nigeria, analyzing five electronic banking channels: ATMs, POS systems, Web payments, Mobile payments, and NIBSS Electronic Fund Transfers. The findings reveal that only ATM and Web payment transaction values significantly affect bank profitability, while POS, Mobile payments, and NEFT showed no significant effects.

Significant Effect of ATM and Web Payments

The significant positive effect of ATM transaction value on bank profitability aligns strongly with empirical evidence. Multiple studies confirm that ATM transactions enhance profitability through improved service accessibility and reduced processing time (Mang et al., 2023; Muhammad, 2023; Aginam, 2024). ATMs generate direct revenue through transaction fees, reduce operational costs by automating routine transactions, and enhance customer convenience through 24/7 access (Idris, 2014). The widespread ATM infrastructure creates network effects that drive transaction volumes, with strategic deployment enabling banks to extend service reach beyond physical branches cost-effectively (Adeoye & Omoregie, 2013).

Similarly, web payment transaction value significantly affects bank profitability, supported by research showing positive relationships between internet banking and bank performance (Aginam, 2024). Internet banking dramatically reduces transaction costs by eliminating physical infrastructure needs, enables geographic expansion beyond traditional branches, generates revenue through transaction fees and cross-selling opportunities, and improves operational efficiency through process automation. Online platforms also provide valuable customer data for targeted marketing. These channels represent mature, established revenue models with clear profitability pathways.

Insignificant Effect of POS, Mobile Payments, and NEFT

The insignificant effect of POS transaction value on bank profitability, despite some studies reporting positive relationships (Aginam, 2024), reflects several challenges. POS infrastructure deployment remains inconsistent and urban-concentrated, limiting transaction volumes (Mang et al., 2023; Gbanador, 2023). Transaction fees are shared among multiple stakeholders—banks, payment processors, terminal providers, and merchants—reducing individual bank

benefits. Maintenance costs including network connectivity issues, electricity challenges, and technical support offset revenue generation. Additionally, fraud concerns create costs through chargebacks and dispute resolution, while many POS transactions occur through third-party agents, further diluting bank revenue share.

Mobile payment transaction value's insignificant effect contrasts with substantial literature reporting positive relationships (Okon & Amaegberi, 2018; Abubakar, 2024). This disconnect reflects Nigeria's fragmented mobile money ecosystem with multiple competing platforms operated by banks, telecommunications companies, and fintech startups, diluting transaction volumes and market share. Regulatory constraints create barriers to seamless integration with traditional banking services. Many mobile services are offered at low or zero fees to drive adoption, reducing immediate revenue. Significant infrastructure investments may not yet be recouped through transaction revenues, particularly for banks recently entering mobile banking.

Competition from specialized fintech players has intensified, eroding market share and pricing power. However, this finding should be interpreted cautiously, as mobile payments' long-term trajectory suggests increasing importance as adoption scales and revenue models mature. NEFT transaction value's insignificant effect reflects its role as infrastructure service facilitating interbank transfers rather than direct revenue generation. NEFT fees are modest and shared among multiple participants in the payment chain. Operating as a utility service with heavily regulated and standardized pricing limits profit margins (Aigbovo & Orobator, 2021). Operational costs including systems integration and compliance requirements offset transaction fee revenues. NEFT transactions primarily represent fund location shifts rather than generating new economic activity that would enhance profitability through lending or investment.

These findings underscore the importance of channel-specific analysis in understanding digital banking profitability dynamics. While ATMs and web payments deliver clear profitability contributions through established revenue models and operational efficiency gains, POS, mobile payments, and NEFT face structural challenges, competitive pressures, or immature business models limiting direct financial performance impact. However, insignificant profitability effects should not diminish these channels' strategic importance. They deliver broader benefits including financial inclusion, customer satisfaction, operational efficiency, and competitive positioning that extend beyond immediate profitability and remain strategically critical for long-term banking sector sustainability in Nigeria's increasingly digital financial landscape.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

This study examined the relationship between digital payment systems and bank profitability in Nigeria, analyzing five major electronic banking channels: Automated Teller Machines (ATM), Point of Sale (POS) systems, Web payment platforms, Mobile payment services, and NIBSS Electronic Fund Transfer (NEFT). The findings provide important insights into how different digital payment channels contribute to the financial performance of deposit money banks in Nigeria.

5.1 Summary of Findings

The following are the findings from the empirical analysis of the study:

1. that the value of ATM transaction have significant effect on bank profitability in Nigeria.
2. that the value of POS transaction does not have significant effect on bank profitability in Nigeria.
3. that the value of Web pay transactions have significant effect on bank profitability in Nigeria.
4. that the value of Mobile payment transactions does not have significant effect on bank profitability in Nigeria.
5. that the value of NIBSS Electronic Fund Transfer transactions does not have significant effect on bank profitability in Nigeria.

5.2 Conclusion

This study examined the relationship between digital payment systems and bank profitability in Nigeria, analyzing five major channels. The findings reveal that among these channels, only

ATM and Web payment transaction values demonstrated statistically significant positive effects on bank profitability, while POS, Mobile payment, and NEFT transaction values showed no significant impacts.

The significant positive effects of ATM transactions reflect the maturity and established revenue models of ATM infrastructure in Nigeria. ATMs generate direct fee income, reduce operational costs through automation, and enhance customer convenience, all contributing to improved profitability. Similarly, web payment platforms deliver profitability benefits through cost reduction, service expansion, and operational efficiency gains, particularly for banks with robust online banking infrastructure.

The insignificant effects of POS, mobile payment, and NEFT transactions on profitability suggest these channels face structural challenges, competitive pressures, or immature business models limiting their direct contribution to bank financial performance. POS systems face deployment challenges and cost pressures; mobile payments encounter fragmentation and intense competition; NEFT operates primarily as utility infrastructure with regulated pricing.

However, insignificant findings should not be interpreted as evidence that these channels are unimportant. Rather, they indicate that profitability realization requires strategic refinement, operational optimization, and potentially longer time horizons for investment returns to materialize. The broader benefits of digital payment systems—including financial inclusion, customer satisfaction, operational efficiency, and competitive positioning—extend beyond immediate profitability impacts and remain strategically critical.

The findings have important implications for bank management and policymakers. Banks should continue investing in and optimizing ATM and web banking infrastructure given their demonstrated profitability contributions. Simultaneously, strategic attention should focus on enhancing the profitability potential of POS, mobile payments, and NEFT through improved business models, cost management, and service innovation. A balanced digital channel strategy recognizing both immediate profitability contributors and long-term strategic assets is essential for sustainable banking sector performance in Nigeria's increasingly digital financial landscape.

5.3 Recommendations

Based on the empirical findings, this study offers the following recommendations for banks, regulators, and policymakers:

1. Optimize ATM Infrastructure and Services

Given the significant positive effect of ATM transactions on bank profitability, banks should expand and optimize their ATM networks strategically. Banks should invest in modern, reliable ATM equipment with enhanced security features and multi-functionality including bill payments and fund transfers. Strategic placement should focus on high-traffic locations and underserved areas to maximize transaction volumes. Banks should implement dynamic fee structures that balance revenue generation with customer affordability while exploring partnerships to expand ATM access points through shared networks. Regular maintenance schedules and proactive monitoring systems should be established to minimize downtime and enhance service reliability.

2. Strengthen Internet Banking Platforms

The significant positive effect of web payment transactions on profitability indicates that banks should prioritize investment in robust, user-friendly internet banking platforms. Banks should develop comprehensive online services including account management, payments, investments, and loan applications. Security infrastructure must be strengthened through multifactor authentication, encryption, and fraud detection systems to build customer trust. User experience should be optimized through intuitive interfaces, fast loading times, and mobile-

responsive design. Banks should conduct aggressive digital literacy campaigns to expand the internet banking user base, particularly targeting younger demographics and tech-savvy professionals. Continuous platform upgrades incorporating customer feedback and emerging technologies will maintain competitive advantage.

3. Re-evaluate and Enhance POS Business Models

To improve the profitability contribution of POS transactions, banks should reevaluate their POS business models and operational strategies. Banks should analyze cost structures comprehensively to identify and eliminate inefficiencies in POS deployment, maintenance, and transaction processing. Revenue optimization should explore innovative fee structures, value-added services such as loyalty programs, and strategic partnerships with merchants and payment processors. Terminal quality and reliability must be improved through regular maintenance, technology upgrades, and efficient replacement cycles. Agent network expansion into rural and underserved areas can increase transaction volumes while promoting financial inclusion. Security concerns must be addressed through enhanced fraud prevention mechanisms, dispute resolution processes, and comprehensive agent training programs.

4. Develop Comprehensive Mobile Banking Strategies

Despite the current insignificant effect of mobile payments on profitability, banks should recognize mobile banking's strategic importance and long-term potential. Banks should invest in developing feature-rich, secure mobile banking applications with seamless integration with core banking systems. Revenue models should be refined by balancing adoption incentives with sustainable fee structures and exploring value-added services such as bill payments, airtime purchases, and merchant payments. Strategic partnerships with telecommunications companies and fintech firms can expand market reach and enhance service offerings. Customer education programs should promote mobile banking adoption and safe usage practices. Fraud prevention mechanisms must be continuously strengthened through advanced authentication methods, transaction monitoring, and rapid incident response capabilities. Banks should also explore opportunities in the Payment Service Bank framework to expand mobile financial services reach.

5. Leverage NEFT for Ecosystem Benefits

While NEFT transactions may not directly drive profitability, banks should leverage this infrastructure for broader ecosystem benefits and competitive positioning. Banks should optimize NEFT operations to minimize processing costs while maintaining service quality, reliability, and regulatory compliance. Integration with other digital channels should be enhanced to provide seamless customer experiences and reduce friction in fund transfers. Banks should explore opportunities to develop value-added services around NEFT infrastructure, such as automated recurring payments, instant transaction notifications, and integrated account management tools. Collaborative approaches within the banking sector can improve overall NEFT system efficiency, reduce per-transaction costs, and enhance settlement processes. Banks should also engage with NIBSS and regulatory authorities to advocate for system improvements that benefit the entire banking ecosystem.

6. Implement Balanced Digital Channel Strategy

Banks should adopt holistic digital banking strategies that balance immediate profitability with long-term competitive positioning and market development. Portfolio management should assess each digital channel's contribution to profitability, market share, customer satisfaction, brand positioning, and strategic objectives. Resource allocation should be data-driven, informed by rigorous analysis of channel performance, customer preferences, and competitive dynamics. Banks should pursue continuous innovation, experimenting with emerging technologies such as blockchain for secure transactions, artificial intelligence for personalized services and fraud detection, and biometric authentication for enhanced security. Regular performance monitoring systems should track key metrics across all digital channels including transaction volumes, revenue generation, cost efficiency, customer satisfaction, and market penetration to inform timely strategy adjustments and investment decisions.

5.4 Suggestions for Further Study

Future research should employ longitudinal panel data designs to track how digital payment channels' profitability contributions evolve over time as technologies mature, adoption scales, and business models develop. This approach would be particularly valuable for understanding when mobile payments and POS systems transition from cost centres to profit contributors.

Future research should conduct detailed cost-benefit analyses disaggregating both revenue streams and cost structures (infrastructure investment, operational costs, maintenance, fraud prevention) for each digital payment channel. This would provide clearer understanding of net profitability contributions and identify specific cost drivers that banks can optimize.

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APPENDIX A: DATA FOR THE STUDY

	Return on Equity	ATM Value of Transactions	POS Value of Transactions	Web Value of Transactions	Mobile Payment Value of Transactions	NIBSS Electronic Fund Transfer Value of Transactions
	ROE	AVL	PVL	WVL	MVL	EVL
2012Q1	2.2000	454.7892	1.865365	6.380682	1.081546	3447.136
2012Q2	6.8275	483.2455	8.738110	6.933116	4.926689	3398.260
2012Q3	11.4550	499.7126	14.74928	7.534602	7.260329	3287.936
2012Q4	16.0825	546.9116	22.65556	10.71896	18.24077	3526.700
2013Q1	20.7100	611.2582	26.28496	11.36867	22.87857	3439.456
2013Q2	20.6175	675.0880	30.94148	9.359096	28.91565	3298.689
2013Q3	20.5250	729.2297	43.14587	12.30203	33.92431	3527.227
2013Q4	20.4325	813.3631	60.64403	14.28653	57.07861	4041.946
2014Q1	20.3400	784.0535	67.46780	16.60499	66.35992	3845.406
2014Q2	16.0025	852.3553	70.25199	14.13317	74.15706	3511.496
2014Q3	11.6650	1027.924	78.00143	18.93588	86.47695	3658.969
2014Q4	7.3275	1015.545	96.35052	24.36958	119.4734	3600.709
2015Q1	2.9900	3970.252	448.5125	91.58129	442.3538	13087.09
2015Q2	2.2100	4224.723	526.1335	101.7761	520.9897	13461.51
2015Q3	1.4300	4479.193	603.7545	111.9708	599.6256	13835.94
2015Q4	0.6500	4733.663	681.3755	122.1656	678.2616	14210.37
2016Q1	-0.1300	1069.990	144.7603	31.69218	135.2422	2757.682
2016Q2	0.4025	1134.496	163.7120	26.27595	168.2846	3041.714
2016Q3	0.9350	1246.799	189.9470	30.76359	223.0574	5460.301
2016Q4	1.4675	1536.849	260.5772	43.62861	230.3132	3325.106
2017Q1	2.0000	1502.057	285.9773	46.57401	260.5894	3087.021
2017Q2	2.0500	1544.229	324.1315	37.09280	295.2361	3963.298
2017Q3	2.1000	1558.755	364.5499	45.57765	239.3560	3757.188
2017Q4	2.1500	1832.551	435.1544	55.35217	306.8174	4138.958
2018Q1	2.2000	1568.949	474.7313	60.74235	329.1158	3869.845
2018Q2	2.2250	1603.166	543.6255	53.25561	410.5659	3579.123
2018Q3	2.2500	1591.014	650.4066	69.07151	498.0817	3581.993
2018Q4	2.2750	1716.957	714.3454	221.5315	592.9377	3581.993
2019Q1	2.3000	1539.266	633.8057	107.6448	810.1057	24167.24
2019Q2	2.1675	1699.163	749.8183	116.2584	1155.639	25182.93
2019Q3	2.0350	1622.926	856.8633	120.5669	1428.112	26181.89
2019Q4	1.9025	1651.253	964.2659	133.6675	1687.109	29690.50
2020Q1	1.7700	18199.66	4727.077	392340.2	14987.74	NA
2020Q2	1.6775	18957.48	9659.162	430515.1	24542.87	NA
2020Q3	1.5850	19715.30	14591.25	468690.0	34098.01	NA
2020Q4	1.4925	20473.12	19523.33	506864.8	43653.14	NA
2021Q1	1.4000	21230.93	24455.42	545039.7	53208.27	410171.5
2021Q2	1.5250	24085.21	28600.51	604694.8	67686.73	426970.3
2021Q3	1.6500	26939.48	32745.61	664349.9	82165.19	443769.2
2021Q4	1.7750	29793.75	36890.71	724004.9	96643.65	460568.1
2022Q1	1.9000	6137.169	7486.281	174817.2	23687.72	137735.1
2022Q2	2.2125	6501.973	8377.803	192024.2	25966.84	123326.1
2022Q3	2.5250	9672.326	10284.98	194375.1	30693.86	103676.5
2022Q4	2.8375	10336.56	14886.74	222443.4	30773.69	112629.3
2023Q1	3.1500	7165.564	23284.14	229246.0	42312.66	161296.9
2023Q2	3.2350	7467.002	25160.72	232928.1	54743.41	136839.3

2023Q3	3.3200	6361.693	26822.05	278864.6	54280.40	159135.6
2023Q4	3.4050	7218.336	35080.18	356094.3	68463.61	189064.7

APPENDIX B: ESTIMATION OUTPUT

UNIT ROOT

Null Hypothesis: ROE has a unit root
Exogenous: Constant
Lag Length: 9 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.796365	0.0062
Test critical values:	1% level	-3.610453	
	5% level	-2.938987	
	10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(ROE)
Method: Least Squares
Date: 11/20/25 Time: 05:27
Sample (adjusted): 2014Q3 2024Q1
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ROE(-1)	-0.161123	0.042441	-3.796365	0.0007
D(ROE(-1))	0.504015	0.112021	4.499279	0.0001
D(ROE(-2))	0.062623	0.056931	1.099986	0.2807
D(ROE(-3))	0.062623	0.056931	1.099986	0.2807
D(ROE(-4))	-0.162503	0.057084	-2.846718	0.0082
D(ROE(-5))	0.133757	0.055330	2.417444	0.0224
D(ROE(-6))	0.065439	0.045461	1.439441	0.1611
D(ROE(-7))	0.065439	0.045461	1.439441	0.1611
D(ROE(-8))	-0.336831	0.045381	-7.422224	0.0000
D(ROE(-9))	0.212134	0.048389	4.383896	0.0001
C	0.377983	0.104030	3.633418	0.0011

R-squared	0.976993	Mean dependent var	-0.320833
Adjusted R-squared	0.968776	S.D. dependent var	1.220376
S.E. of regression	0.215643	Akaike info criterion	0.002363
Sum squared resid	1.302056	Schwarz criterion	0.471572
Log likelihood	10.95393	Hannan-Quinn criter.	0.170711
F-statistic	118.9025	Durbin-Watson stat	2.024952
Prob(F-statistic)	0.000000		

Null Hypothesis: PVL has a unit root
Exogenous: None
Lag Length: 9 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.552399	0.1119
Test critical values:	1% level	-2.627238	
	5% level	-1.949856	
	10% level	-1.611469	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PVL)
Method: Least Squares
Date: 11/20/25 Time: 05:38
Sample (adjusted): 2014Q3 2023Q4
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PVL(-1)	-0.676447	0.435743	-1.552399	0.1318
D(PVL(-1))	0.847235	0.550889	1.537940	0.1353
D(PVL(-2))	1.094975	0.528953	2.070080	0.0478
D(PVL(-3))	0.871301	0.468020	1.861676	0.0732
D(PVL(-4))	0.668415	0.421904	1.584284	0.1244
D(PVL(-5))	1.012953	0.375755	2.695779	0.0117
D(PVL(-6))	0.644979	0.288361	2.236712	0.0334
D(PVL(-7))	0.319568	0.232907	1.372083	0.1809
D(PVL(-8))	-7.356429	1.110693	-6.623279	0.0000
D(PVL(-9))	12.07085	1.591476	7.584691	0.0000

R-squared	0.877450	Mean dependent var	921.3140
Adjusted R-squared	0.838059	S.D. dependent var	5614.855
S.E. of regression	2259.524	Akaike info criterion	18.50463
Sum squared resid	1.43E+08	Schwarz criterion	18.93557
Log likelihood	-341.5880	Hannan-Quinn criter.	18.65796
Durbin-Watson stat	2.163128		

Null Hypothesis: D(PVL) has a unit root
Exogenous: Constant
Lag Length: 8 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.960154	0.9998
Test critical values:	1% level	-3.615588	
	5% level	-2.941145	
	10% level	-2.609066	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PVL,2)
Method: Least Squares
Date: 11/20/25 Time: 05:39

Sample (adjusted): 2014Q3 2023Q4
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PVL(-1))	0.961377	0.490460	1.960154	0.0600
D(PVL(-1),2)	-1.988615	0.463042	-4.294677	0.0002
D(PVL(-2),2)	-1.735025	0.422758	-4.104061	0.0003
D(PVL(-3),2)	-1.605813	0.386671	-4.152917	0.0003
D(PVL(-4),2)	-1.606057	0.350502	-4.582160	0.0001
D(PVL(-5),2)	-1.190017	0.305023	-3.901402	0.0005
D(PVL(-6),2)	-0.997503	0.272488	-3.660722	0.0010
D(PVL(-7),2)	-1.037957	0.243414	-4.264153	0.0002
D(PVL(-8),2) C	-9.693686	0.792631	-12.22976	0.0000
	595.5961	469.7242	1.267970	0.2153

R-squared	0.932235	Mean dependent var	217.2459
Adjusted R-squared	0.910454	S.D. dependent var	7652.410
S.E. of regression	2289.930	Akaike info criterion	18.53136
Sum squared resid	1.47E+08	Schwarz criterion	18.96231
Log likelihood	-342.0959	Hannan-Quinn criter.	18.68469
F-statistic	42.79932	Durbin-Watson stat	1.815263
Prob(F-statistic)	0.000000		

Null Hypothesis: D(PVL,2) has a unit root Exogenous: Constant, Linear Trend
Lag Length: 7 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-18.25095	0.0000
Test critical values:	1% level	-4.219126	
	5% level	-3.533083	
	10% level	-3.198312	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PVL,3)
Method: Least Squares
Date: 11/20/25 Time: 05:40
Sample (adjusted): 2014Q3 2023Q4
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PVL(-1),2)	-15.29571	0.838077	-18.25095	0.0000
D(PVL(-1),3)	13.20219	0.804401	16.41246	0.0000
D(PVL(-2),3)	12.29277	0.760049	16.17365	0.0000
D(PVL(-3),3)	11.45419	0.709356	16.14731	0.0000
D(PVL(-4),3)	10.56085	0.656318	16.09106	0.0000
D(PVL(-5),3)	10.02550	0.615755	16.28165	0.0000

D(PVL(-6),3)	9.644396	0.591710	16.29918	0.0000
D(PVL(-7),3)	9.192785	0.600829	15.30016	0.0000
C	-1759.937	1044.504	-1.684951	0.1031
@TREND("2012Q1")	107.0054	36.52352	2.929766	0.0067

R-squared	0.979649	Mean dependent var	173.7062
Adjusted R-squared	0.973107	S.D. dependent var	13027.59
S.E. of regression	2136.392	Akaike info criterion	18.39256
Sum squared resid	1.28E+08	Schwarz criterion	18.82350
Log likelihood	-339.4586	Hannan-Quinn criter.	18.54588
F-statistic	149.7600	Durbin-Watson stat	1.957836
Prob(F-statistic)	0.000000		

Null Hypothesis: WVL has a unit root Exogenous: None

Lag Length: 8 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		3.738074	0.9999
Test critical values:	1% level	-2.625606	
	5% level	-1.949609	
	10% level	-1.611593	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(WVL)
Method: Least Squares
Date: 11/20/25 Time: 05:41
Sample (adjusted): 2014Q2 2023Q4
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
WVL(-1)	0.250984	0.067143	3.738074	0.0008
D(WVL(-1))	-0.154134	0.112303	-1.372491	0.1801
D(WVL(-2))	-0.131086	0.111325	-1.177509	0.2482
D(WVL(-3))	-0.159759	0.111133	-1.437546	0.1609
D(WVL(-4))	-0.129153	0.111267	-1.160744	0.2549
D(WVL(-5))	-0.145069	0.111495	-1.301118	0.2031
D(WVL(-6))	-0.188974	0.111164	-1.699948	0.0995
D(WVL(-7))	-0.210999	0.110289	-1.913144	0.0653
D(WVL(-8))	-1.729093	0.223034	-7.752596	0.0000

R-squared	0.674908	Mean dependent var	9130.198
Adjusted R-squared	0.588217	S.D. dependent var	112145.5
S.E. of regression	71964.16	Akaike info criterion	25.40490

Sum squared resid	1.55E+11	Schwarz criterion	25.78880
Log likelihood	-486.3955	Hannan-Quinn criter.	25.54264
Durbin-Watson stat	1.991427		

Null Hypothesis: D(WVL) has a unit root
Exogenous: None
Lag Length: 8 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.534742	0.0127
Test critical values:	1% level	-2.627238	
	5% level	-1.949856	
	10% level	-1.611469	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(WVL,2)
Method: Least Squares
Date: 11/20/25 Time: 05:41
Sample (adjusted): 2014Q3 2023Q4
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(WVL(-1))	-1.419222	0.559908	-2.534742	0.0169
D(WVL(-1),2)	0.743350	0.450969	1.648340	0.1101
D(WVL(-2),2)	0.754494	0.433092	1.742110	0.0921
D(WVL(-3),2)	0.727349	0.416252	1.747374	0.0912
D(WVL(-4),2)	0.738321	0.395461	1.866987	0.0720
D(WVL(-5),2)	0.728451	0.375178	1.941613	0.0620
D(WVL(-6),2)	0.681748	0.351563	1.939190	0.0623
D(WVL(-7),2)	0.617873	0.322545	1.915617	0.0653
D(WVL(-8),2)	-0.730530	0.314024	-2.326352	0.0272

R-squared	0.803176	Mean dependent var	2032.425
Adjusted R-squared	0.748880	S.D. dependent var	162336.0
S.E. of regression	81349.68	Akaike info criterion	25.65430
Sum squared resid	1.92E+11	Schwarz criterion	26.04214
Log likelihood	-478.4316	Hannan-Quinn criter.	25.79229
Durbin-Watson stat	2.159480		

Null Hypothesis: MVL has a unit root

Exogenous: None
Lag Length: 9 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.145858	0.7226
Test critical values:	1% level	-2.627238	
	5% level	-1.949856	
	10% level	-1.611469	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(MVL)
Method: Least Squares
Date: 11/20/25 Time: 05:42
Sample (adjusted): 2014Q3 2023Q4
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MVL(-1)	0.055065	0.377524	0.145858	0.8851
D(MVL(-1))	0.566636	0.524044	1.081275	0.2888
D(MVL(-2))	0.107707	0.399284	0.269750	0.7893
D(MVL(-3))	0.182973	0.357770	0.511427	0.6131
D(MVL(-4))	0.004427	0.307495	0.014396	0.9886
D(MVL(-5))	-0.310947	0.301293	-1.032044	0.3109
D(MVL(-6))	0.321021	0.332917	0.964266	0.3432
D(MVL(-7))	0.043181	0.256641	0.168255	0.8676
D(MVL(-8))	-6.950179	0.569220	-12.21001	0.0000
D(MVL(-9))	7.797150	1.463263	5.328603	0.0000

R-squared	0.957170	Mean dependent var	1799.722
Adjusted R-squared	0.943403	S.D. dependent var	13643.96
S.E. of regression	3245.901	Akaike info criterion	19.22911
Sum squared resid	2.95E+08	Schwarz criterion	19.66005
Log likelihood	-355.3530	Hannan-Quinn criter.	19.38243
Durbin-Watson stat	2.051848		

Null Hypothesis: D(MVL) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 8 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.051989	0.9998
Test critical values:	1% level	-4.219126	
	5% level	-3.533083	
	10% level	-3.198312	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(MVL,2)
Method: Least Squares
Date: 11/20/25 Time: 05:43
Sample (adjusted): 2014Q3 2023Q4
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(MVL(-1))	0.501835	0.477034	1.051989	0.3021
D(MVL(-1),2)	-0.953208	0.425947	-2.237855	0.0337
D(MVL(-2),2)	-0.842323	0.396619	-2.123759	0.0430
D(MVL(-3),2)	-0.658875	0.368545	-1.787776	0.0850
D(MVL(-4),2)	-0.650675	0.345991	-1.880615	0.0709
D(MVL(-5),2)	-0.955898	0.326483	-2.927867	0.0069
D(MVL(-6),2)	-0.655540	0.289229	-2.266513	0.0316
D(MVL(-7),2)	-0.625299	0.261967	-2.386934	0.0243
D(MVL(-8),2)	-7.417234	0.420166	-17.65310	0.0000
C	-2883.867	2047.788	-1.408284	0.1705
@TREND("2012Q1")	168.0020	91.27059	1.840703	0.0767

R-squared	0.982079	Mean dependent var	373.0371
Adjusted R-squared	0.975442	S.D. dependent var	19486.34
S.E. of regression	3053.694	Akaike info criterion	19.12329
Sum squared resid	2.52E+08	Schwarz criterion	19.59733
Log likelihood	-352.3425	Hannan-Quinn criter.	19.29195
F-statistic	147.9646	Durbin-Watson stat	2.206581
Prob(F-statistic)	0.000000		

Null Hypothesis: D(MVL,2) has a unit root Exogenous: Constant, Linear Trend
Lag Length: 7 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-26.19532	0.0000
Test critical values:	1% level	-4.219126	
	5% level	-3.533083	
	10% level	-3.198312	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(MVL,3)
Method: Least Squares
Date: 11/20/25 Time: 05:43
Sample (adjusted): 2014Q3 2023Q4
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(MVL(-1),2)	-10.90751	0.416391	-26.19532	0.0000
D(MVL(-1),3)	9.400680	0.406631	23.11846	0.0000
D(MVL(-2),3)	8.972409	0.385851	23.25354	0.0000
D(MVL(-3),3)	8.696303	0.358013	24.29048	0.0000
D(MVL(-4),3)	8.402911	0.326152	25.76382	0.0000
D(MVL(-5),3)	7.782506	0.286972	27.11942	0.0000
D(MVL(-6),3)	7.420779	0.257254	28.84609	0.0000
D(MVL(-7),3)	7.057974	0.245239	28.78003	0.0000
C	-4367.841	1487.258	-2.936842	0.0066
@TREND("2012Q1")	247.3464	51.49492	4.803316	0.0000

R-squared	0.993652	Mean dependent var	385.4657
Adjusted R-squared	0.991611	S.D. dependent var	33404.09
S.E. of regression	3059.506	Akaike info criterion	19.11083
Sum squared resid	2.62E+08	Schwarz criterion	19.54177
Log likelihood	-353.1057	Hannan-Quinn criter.	19.26415
F-statistic	486.9565	Durbin-Watson stat	2.002754
Prob(F-statistic)	0.000000		

Null Hypothesis: D(MVL,2) has a unit root Exogenous: Constant, Linear Trend
Lag Length: 7 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-26.19532	0.0000
Test critical values:	1% level	-4.219126	
	5% level	-3.533083	
	10% level	-3.198312	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(MVL,3)
Method: Least Squares
Date: 11/20/25 Time: 05:43
Sample (adjusted): 2014Q3 2023Q4
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.

D(MVL(-1),2)	-10.90751	0.416391	-26.19532	0.0000
D(MVL(-1),3)	9.400680	0.406631	23.11846	0.0000
D(MVL(-2),3)	8.972409	0.385851	23.25354	0.0000
D(MVL(-3),3)	8.696303	0.358013	24.29048	0.0000
D(MVL(-4),3)	8.402911	0.326152	25.76382	0.0000
D(MVL(-5),3)	7.782506	0.286972	27.11942	0.0000
D(MVL(-6),3)	7.420779	0.257254	28.84609	0.0000
D(MVL(-7),3)	7.057974	0.245239	28.78003	0.0000
C	-4367.841	1487.258	-2.936842	0.0066
@TREND("2012Q1")	247.3464	51.49492	4.803316	0.0000

R-squared	0.993652	Mean dependent var	385.4657
Adjusted R-squared	0.991611	S.D. dependent var	33404.09
S.E. of regression	3059.506	Akaike info criterion	19.11083
Sum squared resid	2.62E+08	Schwarz criterion	19.54177
Log likelihood	-353.1057	Hannan-Quinn criter.	19.26415
F-statistic	486.9565	Durbin-Watson stat	2.002754
Prob(F-statistic)	0.000000		

Null Hypothesis: EVL has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.688108	0.0845
Test critical values:	1% level	-3.596616	
	5% level	-2.933158	
	10% level	-2.604867	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EVL)
Method: Least Squares
Date: 11/29/25 Time: 17:34
Sample (adjusted): 2012Q2 2023Q4
Included observations: 42 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EVL(-1)	-0.155977	0.058025	-2.688108	0.0104
C	6104.170	8447.844	0.722571	0.4741

R-squared	0.153008	Mean dependent var	-4639.606
Adjusted R-squared	0.131833	S.D. dependent var	51766.14
S.E. of regression	48233.35	Akaike info criterion	24.45194
Sum squared resid	9.31E+10	Schwarz criterion	24.53468

Log likelihood	-511.4907	Hannan-Quinn criter.	24.48227
F-statistic	7.225924	Durbin-Watson stat	2.091138
Prob(F-statistic)	0.010423		

Null Hypothesis: D(EVL) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.341471	0.0073
	10% level	-3.198312	
Test critical values:	1% level	-4.219126	
	5% level	-3.533083	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EVL,2)
Method: Least Squares
Date: 11/20/25 Time: 05:44
Sample (adjusted): 2012Q4 2023Q4
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EVL(-1))	-1.096655	0.252600	-4.341471	0.0001
D(EVL(-1),2)	0.045607	0.173776	0.262449	0.7946
C	8118.625	18371.92	0.441904	0.6614
@TREND("2012Q1")	-637.2656	704.8936	-0.904059	0.3723

R-squared	0.521128	Mean dependent var	440.7674
Adjusted R-squared	0.478874	S.D. dependent var	77421.31
S.E. of regression	55889.71	Akaike info criterion	24.79945
Sum squared resid	1.06E+11	Schwarz criterion	24.97183
Log likelihood	-467.1895	Hannan-Quinn criter.	24.86078
F-statistic	12.33337	Durbin-Watson stat	2.047833
Prob(F-statistic)	0.000013		

COINTEGRATION

Date: 11/20/25 Time: 10:26
Sample (adjusted): 2012Q3 2023Q4
Included observations: 40 after adjustments
Trend assumption: Linear deterministic trend Series: ROE AVL PVL WVL MVL EVL
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.961014	261.2480	95.75366	0.0000
At most 1 *	0.747429	131.4660	69.81889	0.0000
At most 2 *	0.647374	76.42349	47.85613	0.0000
At most 3 *	0.430575	34.72963	29.79707	0.0125
At most 4	0.212483	12.20448	15.49471	0.1474
At most 5	0.064095	2.649652	3.841466	0.1036

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.961014	129.7820	40.07757	0.0000
At most 1 *	0.747429	55.04250	33.87687	0.0000
At mo	0.647374	41.69386	27.58434	0.0004
At most 3 *	0.430575	22.52515	21.13162	0.0316
At most 4	0.212483	9.554825	14.26460	0.2428
At most 5	0.064095	2.649652	3.841466	0.1036

Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

ROE	AVL	PVL	WVL	MVL	EVL
0.003277	7.96E-05	0.000236	6.23E-06	-0.000112	-2.23E-05
-0.001662	0.000155	-0.000806	-1.09E-05	0.000550	-3.24E-05
-0.021629	-0.000551	-0.000976	1.40E-05	0.000342	1.62E-05
0.076234	0.000844	7.17E-05	1.75E-05	-0.000100	-6.01E-05
0.164853	2.25E-05	-5.64E-05	-4.70E-05	0.000138	5.04E-05
0.033835	0.000406	-0.000645	-0.000153	0.000570	0.000150

Unrestricted Adjustment Coefficients (alpha):

D(ROE)	-0.066040	0.025784	-0.104229	-0.156724	-0.463200	0.052197
D(AVL)	1274.290	-2176.725	358.2747	-1602.551	201.7332	-8.416468
D(PVL)	1564.933	-2529.199	-838.6493	-2029.195	288.7657	-49.11956
D(WVL)	34425.40	-47546.89	-12220.93	-34569.34	5233.117	441.4085
D(MVL)	3033.186	-7390.733	-1440.942	-4595.926	670.3978	64.58878
D(EVL)	23377.77	-27966.43	-8184.644	-16917.50	2054.414	-1366.402

1 Cointegrating Equation(s): Log likelihood -1924.578

Normalized cointegrating coefficients (standard error in parentheses)

ROE	AVL	PVL	WVL	MVL	EVL
1.000000	0.024301	0.072088	0.001902	-0.034235	-0.006818

	(0.01064)	(0.01568)	(0.00162)	(0.00951)	(0.00183)

Adjustment coefficients (standard error in parentheses)

D(ROE)	-0.000216
	(0.00061)
D(AVL)	
	4.175531 (2.06920)
D(PVL)	5.127894
	(2.57344)
D(WVL)	
	112.8034 (45.6501)
D(MVL)	
	9.938993 (6.55090)
D(EVL)	76.60313
	(25.1542)

2 Cointegrating Equation(s): Log likelihood -1897.057

Normalized cointegrating coefficients (standard error in parentheses)

ROE	AVL	PVL	WVL	MVL	EVL
1.000000	0.000000	0.157224	0.002862	-0.095381	-0.001397
		(0.02190)	(0.00226)	(0.01347)	(0.00256)
0.000000	1.000000	-3.503340	-0.039498	2.516173	-0.223082
		(0.75788)	(0.07833)	(0.46612)	(0.08864)

Adjustment coefficients (standard error in parentheses)

D(ROE)	-0.000259	-1.25E-06
	(0.00069)	(3.3E-05)
D(AVL)	7.793908	-0.236898
	(1.83971)	(0.08745
D(PVL)	9.332189	-0.268546
	(2.37238)	(0.11277
D(WVL)	191.8408	-4.649837
	(40.8226)	(1.94050
D(MVL)	22.22463	-0.907350
	(5.56002)	(0.26430
D(EVL)	123.0918	-2.485793
	(21.5779)	(1.02571

3 Cointegrating Equation(s): Log likelihood -1876.210

Normalized cointegrating coefficients (standard error in parentheses)

ROE	AVL	PVL	WVL	MVL	EVL
1.000000	0.000000	0.000000	-0.014322	0.010903	0.042048
			(0.01023)	(0.02298)	(0.01232)
0.000000	1.000000	0.000000	0.343404	0.147889	-1.191152
			(0.26609)	(0.59806)	(0.32063)
0.000000	0.000000	1.000000	0.109296	-0.676007	-0.276328
			(0.06969)	(0.15662)	(0.08397)

Adjustment coefficients (standard error in parentheses)

D(ROE)	0.001995	5.62E-05	6.53E-05

	(0.00410)	(0.00011)	(0.00024)
D(AVL)	0.044691	-0.434245	1.705775
	(10.8967)	(0.28701)	(0.63939)
D(PVL)	27.47156	0.193402	3.226278
	(13.7870)	(0.36313)	(0.80899)
D(WVL)	456.1706	2.081753	58.37523
	(239.099)	(6.29761)	(14.0298)
D(MVL)	53.39114	-0.113644	8.078850
	(32.7252)	(0.86194)	(1.92023)
D(EVL)	300.1196	2.022510	36.04688
	(124.870)	(3.28894)	(7.32708)

4 Cointegrating Equation(s): Log likelihood -1864.947

Normalized cointegrating coefficients (standard error in parentheses)

ROE	AVL	PVL	WVL	MVL	EVL
1.000000	0.000000	0.000000	0.000000	-0.006885	0.002516
				(0.00112)	(0.00021)
0.000000	1.000000	0.000000	0.000000	0.574399	-0.243257
				(0.07284)	(0.01349)
0.000000	0.000000	1.000000	0.000000	-0.540261	0.025362
				(0.01731)	(0.00321)
0.000000	0.000000	0.000000	1.000000	-1.242006	-2.760292
				(0.94544)	(0.17513)

Adjustment coefficients (standard error in parentheses)

D(ROE)	-0.009953	-7.62E-05	5.41E-05	-4.89E-06
	(0.01465)	(0.00019)	(0.00024)	(4.7E-06)
D(AVL)	-122.1248	-1.787435	1.590859	0.008623
	(32.3631)	(0.41742)	(0.52600)	(0.01048)
D(PVL)	-127.2230	-1.520045	3.080768	-0.009923
	(40.9321)	(0.52795)	(0.66527)	(0.01325)
D(WVL)	-2179.203	-27.10852	55.89632	-0.043159
	(715.841)	(9.23302)	(11.6346)	(0.23172)
D(MVL)	-296.9767	-3.994433	7.749283	-0.001136
	(99.2366)	(1.27997)	(1.61290)	(0.03212)
D(EVL)	-989.5766	-12.26259	34.83375	0.039981
	(384.161)	(4.95496)	(6.24378)	(0.12435)

5 Cointegrating Equation(s): Log likelihood -1860.170

Normalized cointegrating coefficients (standard error in parentheses)

ROE	AVL	PVL	WVL	MVL	EVL
1.000000	0.000000	0.000000	0.000000	0.000000	-0.000346
					(2.9E-05)
0.000000	1.000000	0.000000	0.000000	0.000000	-0.004449
					(0.00387)
0.000000	0.000000	1.000000	0.000000	0.000000	-0.199253 (0.00658)

0.000000	0.000000	0.000000	1.000000	0.000000	-3.276661
					(0.07519)
0.000000	0.000000	0.000000	0.000000	1.000000	-0.415754
					(0.01262)

Adjustment coefficients (standard error in parentheses)

D(ROE)	-0.086312	-8.66E-05	8.02E-05	1.69E-05	-6.24E-05
	(0.03028)	(0.00017)	(0.00021)	(8.9E-06)	(0.00011)
D(AVL)	-88.86859	-1.782903	1.579484	-0.000849	-1.028210
	(74.3496)	(0.41593)	(0.52449)	(0.02175)	(0.27596)
D(PVL)	-79.61918	-1.513558	3.064486	-0.023481	-1.609390
	(93.9341)	(0.52549)	(0.66264)	(0.02748)	(0.34865)
D(WVL)	-1316.510	-26.99095	55.60125	-0.288864	-29.98939
	(1642.17)	(9.18659)	(11.5844)	(0.48036)	(6.09507)
D(MVL)	-186.4598	-3.979372	7.711482	-0.032612	-4.342338
	(227.829)	(1.27452)	(1.60718)	(0.06664)	(0.84561)
D(EVL)	-650.9010	-12.21644	34.71791	-0.056478	-18.81562
	(883.452)	(4.94220)	(6.23215)	(0.25843)	(3.27903)

Not used
Dependent Variable: ROE
Method: Least Squares
Date: 11/20/25 Time: 05:21
Sample (adjusted): 2012Q1 2023Q4
Included observations: 48 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.845357	1.462450	6.048314	0.0000
AVL	-0.001605	0.000671	-2.393932	0.0211
PVL	-0.000862	0.000628	-1.373090	0.1768
WVL	6.35E-05	3.25E-05	1.951275	0.0576
MVL	0.000236	0.000293	0.806423	0.4244

R-squared	0.201204	Mean dependent var	5.109479
Adjusted R-squared	0.126897	S.D. dependent var	6.361109
S.E. of regression	5.943818	Akaike info criterion	6.500913
Sum squared resid	1519.146	Schwarz criterion	6.695830
Log likelihood	-151.0219	Hannan-Quinn criter.	6.574572
F-statistic	2.707751	Durbin-Watson stat	0.251430
Prob(F-statistic)	0.042537		