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Research Article

Digital Payment Channels and SME Contribution to GDP in Nigeria: Quarterly Evidence from Mobile, WEB and POS Transactions, 2012–2025

Gabriel A. Anidiobu PhD[1] & Ekuma O. Okoro PhD[2]

[1] Department of Banking and Finance, Enugu State University of Science and Technology, Ebeano City, Enugu, Nigeria
[2]ESUT Business School, Enugu, Nigeria

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Abstract

This study examined the effect of digital payment channels on small and medium enterprises (SMEs) contribution to gross domestic product (GDP) in Nigeria, focusing on mobile, web and point-of-sale (POS) transactions. Specifically, it assessed the individual long-run effects of mobile banking, web banking and POS transactions on SMEs' contribution to GDP. The study employed quarterly secondary data covering 2012Q1–2025Q4, obtained from the Central Bank of Nigeria (CBN) Statistical Bulletin, and analysed using the autoregressive distributed lag (ARDL) technique. The findings revealed that mobile banking and web banking transactions had positive and statistically significant long-run effects on SMEs' contribution to GDP, with coefficients of 0.8276 ($p = 0.004$) and 0.7438 ($p < 0.001$), respectively. In contrast, POS transactions exerted a negative and statistically significant effect, with a coefficient of −1.8165 ($p < 0.001$). The error correction coefficient of −0.3372 ($p < 0.001$) indicated that approximately 33.72% of short-run disequilibrium was corrected quarterly. The study concluded that digital payment channels have differential implications for SMEs' contribution to GDP, with mobile and web transactions offering greater potential for enhancing their economic contribution. It recommended that the CBN strengthen mobile and web payment infrastructure while promoting affordable, accessible and reliable digital payment services for SMEs. The study contributed to knowledge by providing channel-specific quarterly evidence of the differential long-run effects of digital payment transactions on SMEs' contribution to GDP in Nigeria.

Keywords: Digital Payment Channels; Economic Contribution; Mobile Transactions; Point-of-Sale Transactions; SMES; Web Transactions

Introduction

Small and medium enterprises play an important role in Nigeria's economy through their contributions to production, employment, income generation and the provision of goods and services. The 2021 National Survey of Micro, Small and Medium Enterprises reported that micro, small and medium enterprises (MSMEs) contributed 46.31% of Nigeria's GDP. Micro enterprises accounted for 96.9% of businesses and 87.9% of employment (Small and Medium Enterprises Development Agency of Nigeria [SMEDAN] & National Bureau of Statistics [NBS], 2021). These figures demonstrate the importance of smaller businesses to economic activity and national development. However, the sector continues to face constraints that may limit its productive capacity and contribution to economic growth. One of the major challenges is inadequate access to finance. The International Finance Corporation estimated the unmet demand for MSME finance in Nigeria at approximately ₦13 trillion, based on surveys conducted in 2021 and 2022 (Shah et al., 2022). The World Bank (2025) subsequently reported that fewer than one in twenty Nigerian MSMEs had access to bank credit, while many available loans were costly, short-term and subject to collateral requirements that excluded otherwise viable businesses.

At the same time, Nigeria has experienced substantial growth in digital payment activities. Statistics from the Central Bank of Nigeria (CBN) show that, between January and June 2024, mobile app transfers reached 3.49 billion transactions valued at ₦159.42 trillion. During the same period, internet or web

transfers recorded 11.64 billion transactions valued at ₦825.50 trillion, while POS transactions reached 6.40 billion, valued at ₦85.91 trillion (Central Bank of Nigeria [CBN], n.d.). By the end of June 2024, web transfers accounted for 51.91% of non-cash payment volume, followed by POS transactions at 28.53% and mobile payments at 15.58%. In value terms, web transactions accounted for 52.95%, mobile transactions 10.23% and POS transactions 5.51% (CBN, n.d.). These figures demonstrate the growing importance of digital payment channels in Nigeria's payment system. However, they represent activity across the payment system as a whole rather than transactions conducted exclusively by SMEs.

The expansion of digital payments may have important implications for SME contribution to GDP. Mobile, web and POS channels can make it easier for businesses to receive payments, pay suppliers, serve customers and maintain records of their transactions. These records may also improve the visibility of business cash flows and support decisions on working capital and investment. The International Finance Corporation (IFC, 2025) noted that digital channels and advances in data analytics are creating new opportunities for financial institutions to serve MSMEs. Similarly, evidence from Nigeria indicates that cash-flow-based lending can help financial institutions assess businesses using transaction records rather than relying exclusively on conventional collateral (Gruver et al., 2024). Such developments may support enterprise expansion and productive activity. Nevertheless, increased digital payment activity does not necessarily mean that SMEs are producing more goods and services or contributing a larger share of national output. The extent to which the expansion of mobile, web and POS transactions translates into higher SME contribution to GDP therefore remains an empirical question.

The central problem addressed by this study is the apparent gap between the rapid expansion of digital payment activities and the need to strengthen the contribution of SMEs to Nigeria's economic output. Given the sector's importance to employment and production, any factor that supports or constrains SME performance deserves careful investigation. Digital payment channels may help businesses improve the efficiency of their transactions, reach customers and maintain more reliable financial records. However, the benefits may differ across channels, and increased transaction values may not always be accompanied by corresponding improvements in productive activity. It is therefore important to determine whether changes in mobile banking, web banking and POS transaction values have had measurable long-run effects on SME contribution to GDP in Nigeria.

Existing Nigerian studies have examined digital financial services mainly in relation to SME financing, rather than SME contribution to GDP. Abdulmajeed et al. (2024), using quarterly data from 2009Q1 to 2021Q4, found no causal relationship running from selected digital financial service indicators to SME financing. In contrast, Keremah (2026), using data covering 2009 to 2024, reported a positive long-run relationship between mobile payments and SME financing but a negative relationship between web transfers and SME credit. These findings suggest that the implications of digital financial services may differ across payment channels. However, because the studies focused on financing outcomes, their findings do not directly establish whether digital payment activities affect SMEs' contribution to national output. This distinction provides the motivation for the present study, which examines the long-run effects of mobile banking, web banking and POS transaction values on SME contribution to GDP in Nigeria, using quarterly data from 2012Q1 to 2025Q4.

The broad objective of the study was to examine the effect of digital payment channels on SME contribution to GDP in Nigeria from 2012 to 2025. Specifically, the study sought to assess the long-run effect of mobile banking transaction value on SME contribution to GDP, examine the long-run effect of web transaction value, and determine the long-run effect of Point of Sale (POS) transaction value on SME contribution to GDP in Nigeria.

The study is relevant to policymakers, financial institutions, SME operators and researchers. For policymakers, the findings provide evidence that may inform decisions on digital payment infrastructure, enterprise development and policies intended to improve the productive capacity of smaller businesses. For financial institutions, the findings may help clarify how developments in different payment channels relate to the broader economic performance of SMEs, complementing their role in assessing business cash flows and financing needs. For SME operators, the findings highlight the importance of considering digital payment channels not merely as means of transferring money but also as tools that may support efficient business operations and expansion. The study also contributes to the empirical literature by extending

the discussion beyond SME financing to the contribution of SMEs to GDP and by providing quarterly, channel-specific evidence from Nigeria for the period 2012–2025.

2. Review Of Literature

Digital Payment Channels

Digital payment channels are electronic platforms through which individuals and businesses make payments and transfer funds without relying exclusively on cash. In Nigeria, these channels include mobile banking, internet or web banking, and Point of Sale (POS) transactions, among others. Their growing use reflects the gradual shift towards electronic payments in the country's financial system. The Central Bank of Nigeria (CBN, 2022) has identified the development of electronic payment systems as an important part of efforts to modernise the payment infrastructure and promote financial inclusion. More recent CBN statistics also show substantial growth in the value of mobile, web and POS transactions, highlighting the increasing importance of these channels in everyday commercial and financial activities (CBN, 2024).

Mobile banking enables users to initiate financial transactions through mobile banking applications, while web banking allows payments and transfers through internet-based banking platforms. POS transactions involve payments processed through electronic terminals at business locations. Each channel provides a different means of conducting transactions and may offer businesses opportunities to receive payments more conveniently, settle obligations promptly and serve customers who prefer electronic payment methods. However, the extent to which these benefits translate into higher business output may depend on the nature of the enterprise, the frequency and value of its transactions, the reliability of digital infrastructure and the way business owners use the available services.

For this study, digital payment channels are measured by the value of transactions through mobile banking, web banking and POS platforms. Transaction value is used because it shows the amount processed, rather than the number of transactions. The three measures are converted to natural logarithms to account for differences in scale and serve as the main explanatory variables.

Digital payments may help SMEs complete sales, reduce cash handling, manage payments and keep records for cash flow and inventory decisions. These benefits may improve sales, efficiency and investment, thereby increasing SME output and its contribution to GDP. However, transaction costs, network or power failures, fraud, limited digital skills and poor management may restrict these gains. Since some digital transactions are unrelated to SME production, their effects must be established through empirical investigation.

Figure 1 illustrates the use of digital payment channels, including mobile banking, web or internet banking, and point-of-sale (POS) services, in business transactions.



Figure 1: Digital Payment Channels: mobile, web and POS transactions and SME contribution to GDP
Source: Authors' illustration (2026)

SME Contribution to GDP

SME contribution to gross domestic product (GDP) refers to the value added generated by small and medium enterprises through their production of goods and provision of services, expressed either as an amount or as a share of national output. It reflects the contribution of these enterprises to economic production rather than the amount of financing available to them. SMEs contribute to economic activity through business operations, employment, income generation, investment and the supply of goods and services to households and other businesses. Their contribution to GDP may increase when enterprises expand production, improve productivity, reach additional customers or make more efficient use of available resources.

In Nigeria, enterprise classification is commonly based on the number of employees and the value of assets, excluding land and buildings. Under the classification reported in the 2021 National Survey of Micro, Small and Medium Enterprises, micro enterprises employ fewer than 10 persons and have assets below ₦5 million; small enterprises employ 10–49 persons and have assets of ₦5 million to less than ₦50 million; while medium enterprises employ 50–199 persons and have assets of ₦50 million to less than ₦500 million (Small and Medium Enterprises Development Agency of Nigeria [SMEDAN] & National Bureau of Statistics [NBS], 2021). These categories provide a basis for distinguishing enterprises according to their size and productive capacity.

The distinction between SMEs and micro, small and medium enterprises (MSMEs) is important in interpreting evidence on the sector's contribution to the economy. MSMEs include micro enterprises as well as small and medium-sized businesses, whereas SMEs, when used to distinguish enterprise sizes strictly, refer to small and medium enterprises without the micro category. The 2021 SMEDAN–NBS survey reported that MSMEs contributed 46.31% of Nigeria's GDP, demonstrating the importance of the broader enterprise sector to national output (SMEDAN & NBS, 2021). However, because this figure covers MSMEs, it should be treated as background evidence rather than assumed to represent the contribution of SMEs alone. For the present study, SME contribution to GDP is measured by the variable SMEF_GDP, according to its stated operational definition and data source.

Despite their contribution to economic activity, smaller businesses in Nigeria face constraints that may limit their ability to expand production and increase their contribution to GDP. Access to finance is one such constraint. Shah et al. (2022), in a report published by the International Finance Corporation (IFC), estimated the unmet demand for MSME finance in Nigeria at approximately ₦13 trillion, equivalent to US$32.2 billion. The report highlighted difficulties accessing formal finance, including inadequate business documentation, weaknesses in credit information infrastructure and shortcomings in debt resolution and loan recovery arrangements. These constraints may restrict the capacity of businesses to acquire equipment, purchase inventory, expand their operations and undertake other productive investments.

The financing challenge is relevant to the present study because the ability of an enterprise to convert business opportunities into higher output may depend partly on the resources available to it. Micro and small enterprises may struggle to satisfy formal lending requirements because of limited financial records or inadequate collateral, while medium-sized enterprises may require larger amounts of funding to support investment and expansion. Although these constraints affect enterprises differently, they illustrate why the availability of digital payment services alone may not be sufficient to improve business performance. Enterprises must also be able to use the opportunities created by digital transactions to support productive activities.

Digital payment channels may influence SME contribution to GDP through several practical mechanisms. First, convenient electronic payment options may help businesses complete sales and receive payments more efficiently. Second, electronic transaction records may improve the monitoring of cash inflows and outflows, making it easier for business owners to plan purchases and manage their working capital. Third, digital payments may facilitate transactions with customers and suppliers beyond the immediate business location, potentially widening market access. Finally, where digital records improve the information available to financial institutions, they may help viable enterprises demonstrate their business activity and obtain financing for productive purposes. The IFC (2025) notes that digital channels, data analytics and new lending approaches are creating opportunities for financial institutions to serve MSMEs that have

traditionally been underserved. This evidence provides useful context for understanding how digital financial services may support enterprise development, although its primary focus is financing rather than SME contribution to GDP.

These potential benefits are not automatic. Digital payment channels may facilitate the transfer of money without necessarily increasing the quantity or value of goods and services produced. The extent to which they contribute to higher SME output may depend on whether businesses use them to support additional sales, improve operating efficiency, manage resources more effectively or undertake productive investment. Consequently, an increase in transaction value may coincide with higher, unchanged or lower SME contribution to GDP, depending on prevailing economic conditions and the way businesses use the available payment channels.

For the present study, SME contribution to GDP is the dependent variable, while the values of mobile banking, web banking and POS transactions are the explanatory variables. The study examines whether changes in these digital payment channels have significant long-run effects on SME contribution to GDP in Nigeria, using quarterly data covering 2012Q1 to 2025Q4. Financing remains relevant to the discussion as a possible factor influencing the productive capacity of enterprises, but the study does not treat MSME financing as its outcome variable. Rather, it focuses on whether the expansion of selected digital payment channels is reflected in the contribution of SMEs to national output.

Conceptual Framework of the Study

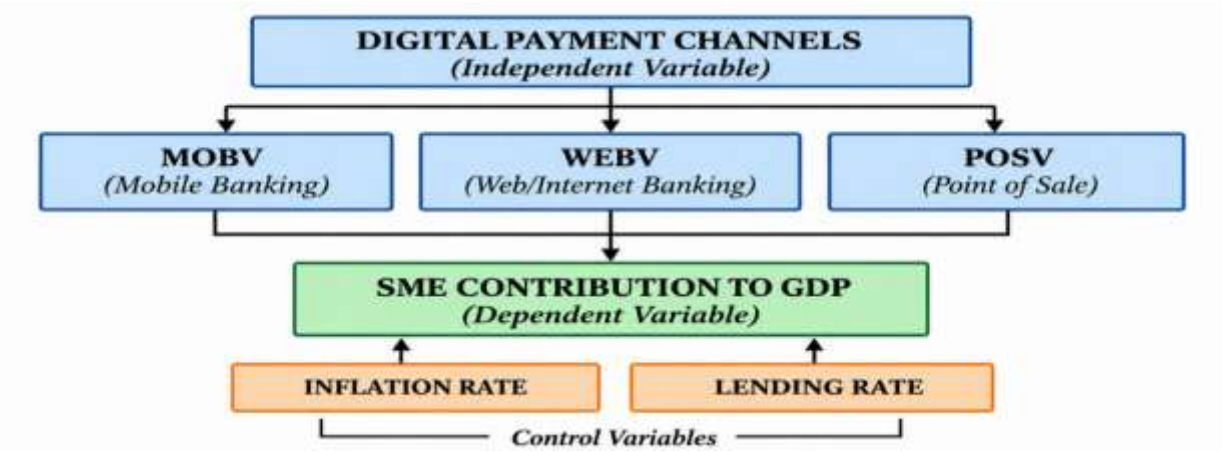


Figure 2: Conceptual Framework of the Study
Source: Developed by the Authors, 2026

The conceptual framework explains how digital payment channels influence the contribution of small and medium-sized enterprises (SMEs) to gross domestic product (GDP) in Nigeria. It identifies mobile banking, web-based payments and point-of-sale (POS) transactions as the explanatory variables, while SME contribution to GDP (SME_GDP) represents the dependent variable. The framework also incorporates inflation and lending rates as control variables because changes in the general price level and the cost of borrowing may affect SME performance independently of digital payment activities. The framework therefore proposes that mobile, web and POS transactions may have individual effects on SME_GDP, while inflation and lending rates are controlled for when estimating these effects.

Theoretical Framework

This study is anchored on Transaction Cost Theory, associated with Coase (1937) and Williamson (1981), and Financial Intermediation Theory, developed by Gurley and Shaw (1960) and discussed by Allen and Santomero (1998). Together, these theories explain how digital payment channels may influence SME contribution to gross domestic product (GDP) through improved transaction efficiency and access to financial resources.

Transaction Cost Theory explains that conducting business involves costs related to making payments, completing transactions and confirming settlements (Coase, 1937; Williamson, 1981). Mobile banking, web banking and Point of Sale (POS) services may reduce the time and effort required to receive payments and settle business obligations, thereby improving operational efficiency. Where these benefits support increased sales, investment and production, digital payments may contribute to higher SME output. However, transaction charges, network failures and fraud risks may limit these benefits.

Financial Intermediation Theory explains how financial institutions channel funds to productive users and how transaction costs and information problems influence financial intermediation (Gurley & Shaw, 1960; Allen & Santomero, 1998). Digital payment records may provide information about business receipts and cash flows, helping financial institutions assess enterprises with limited conventional financial records. Where such information facilitates access to funds for productive investment, SMEs may expand their operations and increase their contribution to GDP. Nevertheless, improved transaction records do not automatically guarantee additional financing or higher output.

Accordingly, the study employed quarterly data from 2012Q1 to 2025Q4 and the ARDL framework to estimate the effects of mobile banking, web banking and POS transaction values on SME contribution to GDP in Nigeria, controlling for inflation and lending rates. Since the payment variables capture national transaction activity rather than SME-specific transactions, the findings reflect the effects of aggregate payment-channel activity on measured SME contribution to GDP, with their direction and magnitude determined empirically.

Empirical Review

Previous empirical studies have examined the implications of digital payments for small-business financing, access to credit and business performance. Their findings generally suggest that electronic transactions can improve the visibility of business activities, provide useful information about cash flows and help financial institutions assess borrowers. However, the effects differ across payment channels, countries and measures of business performance. Importantly, evidence that digital payments improve access to finance does not necessarily establish that they increase SME contribution to gross domestic product (GDP). This distinction provides the basis for examining the effects of digital payment channels on SME contribution to GDP in Nigeria.

In Nigeria, Ukaigwe et al. (2025) examined the effects of financial innovation and financial inclusion on SME financing using data from the Central Bank of Nigeria's Statistical Bulletin and the Autoregressive Distributed Lag (ARDL) technique. Their findings indicated that automated teller machines, mobile payments and loans from rural branches of commercial banks had positive and statistically significant effects on SME financing. POS transactions had a positive but statistically insignificant effect in the short run, becoming significant in the long run. Although the findings suggest that financial innovation can improve the availability of finance to smaller businesses, the study focused on SME financing rather than SME contribution to GDP. It also did not separately examine web banking transaction values. The present study extends this line of inquiry by examining mobile banking, web banking and POS transaction values in relation to SME contribution to GDP in Nigeria.

In Kenya, Dalton et al. (2024) investigated the effect of electronic payment technology on business finance through a randomised controlled trial involving small and medium-sized enterprises. The study found that encouraging businesses to adopt electronic payment technology increased access to mobile loans by at least 50%, equivalent to 0.17 standard deviations. However, the intervention had no measurable effect on sales or profits, although it reduced sales volatility and precautionary investment, particularly among smaller enterprises. These findings indicate that digital payments may improve access to finance and help businesses manage short-term financial difficulties without necessarily producing an immediate increase in output. Nevertheless, the study concentrated on mobile money and business financing in Kenya rather than the separate effects of mobile banking, web banking and POS transaction values on SME contribution to GDP in Nigeria.

Deng and Qian (2024) examined the effect of digital payments on the financing constraints of micro-enterprises in China using survey data covering 2020–2022. Their findings showed that digital payments

significantly reduced financing constraints, with stronger effects among enterprises in the growth stage and those operating in western China than among their counterparts in eastern and central regions. The study also found that financial market development strengthened the ability of digital payments to ease financing constraints. These findings suggest that electronic transaction records can improve the information available to lenders and help address difficulties associated with assessing smaller businesses. However, the study focused on micro-enterprise financing constraints rather than SME contribution to GDP and did not separately estimate the effects of mobile banking, web banking and POS transaction values.

In India, Ghosh et al. (2026) examined the role of cashless payment records in lending decisions using loan applications and transaction records from a financial technology lender serving small businesses. The study considered payment methods including internet banking transfers, mobile banking transfers and POS transactions. The findings indicated that businesses with a higher proportion of cashless payments were more likely to obtain loans, received larger approved amounts and faced lower borrowing costs. The results also showed that greater cashless payment activity was associated with a lower likelihood of loan default. The authors attributed these findings partly to the value of transaction records in helping lenders assess business activities and repayment capacity. Although the study directly considered several payment channels examined in the present research, its focus was on lending outcomes among Indian businesses rather than the contribution of SMEs to national output.

Rishabh (2026) investigated the value of payment histories in screening and monitoring small-business loans in India. The study found that payment data improved lenders' ability to assess and monitor borrowers beyond the information available from conventional credit records. Payment histories and credit-bureau information provided complementary insights into borrowers' repayment capacity and willingness to repay. These findings highlight the potential value of reliable transaction records in evaluating business performance and creditworthiness. However, the study concentrated on loan assessment and monitoring rather than the contribution of SMEs to GDP. It therefore provides supporting evidence on one possible channel through which digital payments may benefit businesses but does not directly establish whether higher mobile, web or POS transaction values contribute to increased SME output.

Babina et al. (2025) examined customer access to financial transaction data and the development of financial technology services under open banking arrangements. Drawing on cross-country evidence and firm-level data from the United Kingdom, the study found that open banking enabled small and medium-sized enterprises to establish new lending relationships. The findings suggest that greater access to financial transaction information can improve the ability of businesses to connect with alternative financial service providers and reduce information barriers in lending. Although this evidence is relevant to understanding how digital financial records may support enterprise development, the study focused on open banking, financial technology entry and access to financial services rather than the effects of specific digital payment channels on SME contribution to GDP.

Anidiobu and Okoro (2026) explored the short- and long-run effects of mobile banking (MOB), internet banking (WEB) and point-of-sale (POS) transactions on unemployment in Nigeria from 2012Q1 to 2025Q4. Using quarterly data from official sources, the study applied the autoregressive distributed lag (ARDL) model. Results showed that MOB and POS transactions had positive and significant effects on unemployment, while WEB transactions had negative and significant effects in both periods. The error correction term indicated that 62% of disequilibrium was corrected quarterly. The study recommended targeted credit and digital skills support for small businesses to strengthen employment creation.

At the international level, Galilea et al. (2026) examined the relationship between electronic payments and firms' credit constraints across 101 economies using World Bank Enterprise Surveys data. Their findings indicated that firms receiving payments electronically were generally less likely to face credit constraints. The effects were particularly pronounced among small and young firms and in economies with weaker credit information systems and less developed financial markets. The study suggests that electronic payments can improve the visibility of business transactions and provide an alternative source of information where conventional financial records are limited. However, the study used a broad measure of electronic payments and concentrated on access to external finance rather than SME contribution to

GDP. It did not separately examine the long-run effects of mobile banking, web banking and POS transaction values on SME contribution to GDP in Nigeria.

The national digital payment statistics cover transactions made by SMEs, households and other businesses without distinguishing between them. Consequently, the data do not show the extent to which SMEs account for the recorded mobile, web and POS transactions. This study therefore examines how changes in aggregate digital payment activities relate to SME contribution to GDP in Nigeria, rather than measuring the effects of digital transactions conducted exclusively by SMEs. Although digital payments can improve business transaction records and access to finance, these benefits do not always translate into higher business output. For example, Dalton et al. (2024) found that mobile money improved access to loans among Kenyan SMEs but did not significantly increase their sales or profits. This raises an important question about whether increased use of mobile, web and POS payment channels translates into a higher contribution of SMEs to GDP in Nigeria.

Gap in the Empirical Review

Existing empirical evidence on digital payments focuses mainly on SME financing and credit constraints rather than SME contribution to GDP. Ukaigwe et al. (2025) examined SME financing in Nigeria, while Dalton et al. (2024), Deng and Qian (2024), Ghosh et al. (2026), Babina et al. (2025) and Galilea et al. (2026) investigated financing outcomes or access to financial services in other settings. Although these studies identify potential benefits of digital payments, they do not establish whether increased payment activity translates into higher SME contribution to national output. This study addresses the outcome gap by examining SME contribution to GDP as the dependent variable.

A further payment-channel and contextual gap arises because previous studies generally used broad measures of electronic payments or focused on selected channels and firm-level financing outcomes. The separate effects of mobile banking, web banking and POS transaction values on SME contribution to GDP remain insufficiently established in Nigeria. Moreover, findings from other economies and firm-level studies cannot automatically be generalised to Nigeria's national economic conditions. This study addresses these gaps using quarterly Nigerian data covering 2012Q1–2025Q4.

Methodologically, the study employs the Autoregressive Distributed Lag (ARDL) framework to estimate the short-run and long-run effects of the three payment channels, controlling for inflation and lending rates. Since the explanatory variables represent national transaction activity rather than transactions attributable exclusively to SMEs, the analysis examines how aggregate digital payment activity relates to measured SME contribution to GDP. The study therefore contributes country-specific evidence on an underexplored outcome while distinguishing aggregate payment-channel effects from the direct effects of SME-specific transactions.

Methodology

The study adopted an ex-post facto research design, relying on quarterly secondary data covering 2012Q1–2025Q4. The design was appropriate because the variables were observed as recorded, without manipulation. Data on SME contribution to GDP (SME_GDP), mobile banking, web banking and POS transaction values, and the maximum lending rate were obtained from the CBN Statistical Bulletin and relevant payment system statistics. Inflation data were obtained from National Bureau of Statistics (NBS) Consumer Price Index reports. The data were analysed using the ARDL technique to estimate the short-run and long-run effects of the explanatory variables.

Model Specification

The model was adapted from Ukaigwe et al. (2025), who examined SME financing in Nigeria using selected financial innovation indicators. However, the present study differs by using SME contribution to GDP as the dependent variable and examining mobile banking, web banking and POS transaction values, while controlling for inflation and the maximum lending rate. The functional relationship is expressed as:

Equation (1): Functional Model

$SME_GDP_t = f(LMOBVAL_t, LWEBVAL_t, LPOSVAL_t, INF_t, MLR_t)$

The corresponding econometric model is specified as:

Equation (2): Econometric Model

$$SME_GDP_t = \beta_0 + \beta_1 LMOBVAL_t + \beta_2 LWEBVAL_t + \beta_3 LPOSVAL_t + \beta_4 INF_t + \beta_5 MLR_t + \varepsilon_t$$

where SME_GDP represents SME contribution to GDP; LMOBVAL, LWEBVAL and LPOSVAL denote the natural logarithms of mobile banking, web banking and POS transaction values, respectively; INF represents the inflation rate; MLR denotes the maximum lending rate; β_0 is the intercept; β_1–β_5 are the coefficients to be estimated; ε_t is the error term; and t denotes the quarterly observation. The transaction values are expressed in natural logarithms to accommodate differences in scale, while inflation and the maximum lending rate remain in their original percentage forms.

ARDL Model and Bounds Test

Following Pesaran, Shin and Smith (2001), the unrestricted error-correction representation of the ARDL model is expressed as:

Equation (3): ARDL Bounds-Testing Model

$$\Delta Y_t = \alpha_0 + \Sigma_{i=1}^{p-1} \alpha_i \Delta Y_{t-i} + \Sigma_j \beta_{1j} \Delta LMOBVAL_{t-j} + \Sigma_j \beta_{2j} \Delta LWEBVAL_{t-j} + \Sigma_j \beta_{3j} \Delta LPOSVAL_{t-j} + \Sigma_j \beta_{4j} \Delta INF_{t-j} + \Sigma_j \beta_{5j} \Delta MLR_{t-j} + \lambda_0 Y_{t-1} + \lambda_1 LMOBVAL_{t-1} + \lambda_2 LWEBVAL_{t-1} + \lambda_3 LPOSVAL_{t-1} + \lambda_4 INF_{t-1} + \lambda_5 MLR_{t-1} + \varepsilon_t$$

where Y_t represents SME_GDP, Δ denotes the first-difference operator, α_0 is the intercept, α_i and β_{kj} are short-run coefficients, λ_0–λ_5 are coefficients on the lagged level variables, and ε_t is the error term. The first summation runs from $i = 1$ to $p - 1$, while each subsequent summation runs from $j = 0$ to $q_k - 1$, according to the selected lag order for the corresponding explanatory variable. The differenced terms capture short-run changes, while the lagged level terms provide the basis for testing a possible long-run relationship.

The bounds-test hypotheses are specified as follows:

Null hypothesis (H_0):

$$\lambda_0 = \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = 0$$

Alternative hypothesis (H_1):

At least one $\lambda_i \neq 0$.

The null hypothesis states that no long-run relationship exists among SME contribution to GDP, digital payment channels, inflation and the maximum lending rate. It is rejected when the calculated F-statistic exceeds the upper critical bound. If the statistic falls below the lower bound, the null hypothesis is not rejected; a statistic between the two bounds produces an inconclusive result. The bounds-testing procedure is appropriate only when none of the variables is integrated of order two, I(2).

Long-run Model

Where the bounds test establishes a long-run relationship, the long-run equation is expressed as:

Equation (4): Long-run relationship

$$Y_t = \theta_0 + \theta_1 LMOBVAL_t + \theta_2 LWEBVAL_t + \theta_3 LPOSVAL_t + \theta_4 INF_t + \theta_5 MLR_t + u_t$$

where θ_0 is the intercept, θ_1–θ_5 represent the long-run coefficients, and u_t is the error term. These coefficients are derived from the estimated ARDL model and indicate the long-run effects of the explanatory variables on SME contribution to GDP, holding the other variables constant. Because the payment variables are logged while the dependent variable remains in levels, the payment coefficients represent level-log effects rather than elasticities.

Short-Run Error-Correction Model

Where a long-run relationship is confirmed, the short-run dynamics are estimated using the error-correction model:

Equation (5): Error-correction model

$$\Delta Y_t = \alpha_0 + \Sigma_{i=1}^{p-1} \alpha_i \Delta Y_{t-i} + \Sigma_j \beta_{1j} \Delta LMOBVAL_{t-j} + \Sigma_j \beta_{2j} \Delta LWEBVAL_{t-j} + \Sigma_j \beta_{3j} \Delta LPOSVAL_{t-j} + \Sigma_j \beta_{4j} \Delta INF_{t-j} + \Sigma_j \beta_{5j} \Delta MLR_{t-j} + \psi ECT_{t-1} + \varepsilon_t$$

The summation limits follow the selected ARDL lag orders defined above. ECT_{t-1} is the lagged error-correction term, while ψ measures the speed of adjustment towards long-run equilibrium. A negative and statistically significant ψ indicates that deviations from the long-run relationship are corrected over time. Its magnitude indicates the proportion of the preceding quarter's disequilibrium corrected within the current quarter.

Description of Variables in the Model

Table 1: Description of Model Variables

Variable	Measurement	Data source	Role	A priori expectation
SME_GDP	SME contribution to GDP, measured using the series reported in the CBN Statistical Bulletin	CBN Statistical Bulletin	Dependent variable	—
LMOBVAL	Natural logarithm of mobile banking transaction value	CBN payment system statistics	Explanatory variable	Positive (+)
LWEBVAL	Natural logarithm of web banking transaction value	CBN payment system statistics	Explanatory variable	Positive (+)
LPOSVAL	Natural logarithm of POS transaction value	CBN payment system statistics	Explanatory variable	Positive (+)
INF	Quarterly headline inflation rate (%)	NBS Consumer Price Index reports	Control variable	Negative (−)
MLR	Maximum lending rate (%)	CBN Statistical Bulletin	Control variable	Negative (−)

Source: Authors' compilation from CBN and NBS publications

Method of Data Analysis

The analysis commenced with descriptive statistics to summarise the variables. Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) tests were then used to examine their stationarity properties and establish that none was integrated of order two, I(2). The appropriate ARDL lag structure was selected using the Akaike Information Criterion (AIC), followed by the bounds test for a long-run relationship. Where a long-run relationship was confirmed, the long-run coefficients and short-run error-correction estimates were examined. Diagnostic tests assessed residual serial correlation, heteroskedasticity and normality, while CUSUM and CUSUMSQ tests examined parameter stability. The findings were interpreted in line with the study objectives and hypotheses.

Data and Analysis

The results of the two preliminary (pre-estimation) tests are presented below.

Table 2: Descriptive Statistics Results

Variable	Obs.	Mean	Median	Std. Dev.	Minimum	Maximum	Skewness	Kurtosis	JB	Prob.
SMEF_GDP	56	13.288	13.280	0.870	12.090	16.060	1.635	3.147	41.497	0.000
LMOB	56	17.892	17.976	2.537	12.265	21.932	-0.065	-0.799	1.662	0.436
LWEB	56	17.962	16.711	3.803	12.833	23.000	0.145	-1.795	7.282	0.026
LPOS	56	18.168	18.314	2.840	11.684	22.207	-0.161	-1.030	2.782	0.249
INF	56	15.943	14.450	6.889	8.100	33.200	1.082	0.671	10.941	0.004
LEND	56	28.071	28.295	2.320	23.100	31.610	-0.399	-0.70	2.702	0.259

Source: Authors' computation (2026)

Table 2 presents 56 quarterly observations covering 2012 Q1 to 2025 Q4. SME contribution to GDP averaged 13.29%, ranging from 12.09% to 16.06%, indicating relatively little variation over the period. The mean logged transaction values were 17.89 for mobile, 17.96 for web and 18.17 for POS transactions, with web transactions recording the greatest variation. Inflation averaged 15.94%, while the lending rate

averaged 28.07%. Overall, digital payment transactions showed varying levels of activity, while SME contribution to GDP remained relatively stable.

Table 3: Augmented Dickey Fuller (ADF) Unit Root Test Results

Variable	ADF Statistic at Level	Prob.	ADF Statistic at 1st Difference	Prob.	Order of Integration
SME_GDP	-2.114	0.239	-5.860	0.000	I(1)
LMOB	0.623	0.988	-3.952	0.002	I(1)
LWEB	-0.582	0.875	-8.001	0.000	I(1)
LPOS	-2.568	0.100	-8.560	0.000	I(1)
INF	-1.134	0.701	-7.261	0.000	I(1)
LEND	-2.132	0.232	-7.214	0.000	I(1)

Source: Authors' Computation (2026)

Table 3 presents the ADF unit root test results. The findings show that all variables were non-stationary at level but became stationary after first differencing at the 5% significance level. Thus, SME_GDP, LMOB, LWEB, LPOS, INF and LEND were all integrated of order one, I(1). Since none was integrated of order two, I(2), the variables satisfy the stationarity requirement for applying the ARDL bounds testing approach.

ARDL Bounds Cointegration Test

The ARDL bounds test was conducted to determine whether a long-run relationship exists between digital payment channels and SME contribution to GDP in Nigeria.

Table 4: ARDL Bounds Test for Cointegration

Test Statistic / Significance Level	Value / Lower Bound I(0)	Upper Bound I(1)
F-statistic	13.486	
Number of explanatory variables (K)	5	
Observations used	52	
10% significance level	2.134	3.231
5% significance level	2.462	3.627
1% significance level	3.159	4.450

Source: Authors' Computation (2026)

Table 4 presents the ARDL bounds test results. The calculated F-statistic of 13.486 exceeds the 5% upper bound of 3.627. The null hypothesis of no long-run relationship is therefore rejected. This confirms the existence of a long-run relationship among SME contribution to GDP, mobile banking transactions, web transactions, POS transactions, inflation and lending rate. The result provides a basis for examining the long-run and short-run effects of the explanatory variables using the ARDL model.

Estimation Procedure

The estimation procedure allows the study to examine both the immediate and delayed effects of digital payment activities on SME contribution to GDP. The use of quarterly data and the selected ARDL model helps capture how changes in mobile, web and POS transactions, as well as inflation and lending rates, affect SME contribution over time.

1. Long-run Estimates

Table 5: Long-Run ARDL Estimates

Variable	Coefficient	Std. error	t-statistic	p-value	Decision at 5%
Constant	7.0434	0.9920	7.100	<0.001	Significant
LMOB	0.8276	0.2666	3.104	0.004	Positive; significant
LWEB	0.7438	0.0725	10.255	<0.001	Positive; significant
LPOS	-1.8165	0.3110	-5.840	<0.001	Negative; significant
INF	-0.0091	0.0165	-0.549	0.587	Not significant
LEND	0.4027	0.0398	10.124	<0.001	Positive; significant

Source: Authors' computation from the supplied quarterly dataset.

Note: The transaction variables are in natural logarithms; SME_GDP, INF and LEND are in levels. Standard errors and p-values are based on the estimated long-run coefficients and their delta-method standard errors.

$$SME_GDP = 7.043 + 0.828 \times LMOB + 0.744 \times LWEB - 1.817 \times LPOS - 0.009 \times INF + 0.403 \times LEND$$

The long-run estimates show that mobile banking transactions (0.828) and web transactions (0.744) have positive and statistically significant coefficients. POS transactions have a negative and statistically significant coefficient (-1.817). Inflation has a negative but statistically non-significant coefficient, while lending rate has a positive and statistically significant coefficient (0.403). These results indicate that the three payment channels do not have the same estimated long-run effect on SME contribution to GDP.

The findings imply that digital payment channels have different long-run effects on SME contribution to GDP in Nigeria. While mobile and web transactions appear to support SME contribution to national output, the negative POS coefficient suggests that increased POS activity does not necessarily translate into improved SME performance, possibly due to operational costs and service challenges. The results therefore highlight the need for policies that promote reliable, affordable and efficient digital payment services, while addressing the challenges associated with POS transactions.

2. Short-run Estimates

Table 6: Short-Run ARDL Estimates

Variable / lag	Coefficient	Std. error	t-statistic	p-value
ΔSME_GDP(-1)	0.0575	0.0526	1.093	0.283
ΔLMOB	0.1852	0.0923	2.006	0.054
ΔLMOB(-1)	-0.0501	0.0748	-0.669	0.508
ΔLMOB(-2)	-0.1210	0.0728	-1.663	0.106
ΔLWEB	0.0838	0.0260	3.220	0.003
ΔLWEB(-1)	0.3549	0.0500	7.099	<0.001
ΔLPOS	-0.3896	0.0904	-4.310	<0.001
ΔLPOS(-1)	-0.1382	0.0889	-1.554	0.130
ΔLPOS(-2)	0.1227	0.0663	1.849	0.074
ΔINF	0.0125	0.0061	2.063	0.048

Variable / lag	Coefficient	Std. error	t-statistic	p-value
ΔINF(-1)	0.0125	0.0069	1.816	0.079
ΔINF(-2)	0.0146	0.0065	2.244	0.032
ΔLEND	0.1256	0.0260	4.831	<0.001
ΔLEND(-1)	-0.0942	0.0274	-3.432	0.002
ΔLEND(-2)	-0.0587	0.0257	-2.287	0.029

Source: Authors' computation from the supplied quarterly dataset.

Note: Δ denotes a quarterly change; (-1) and (-2) denote one-quarter and two-quarter lags, respectively. P-values use the residual degrees of freedom of the estimated model. Source:

In the short run, current and one-quarter lagged changes in web transactions have positive and statistically significant coefficients. The current change in POS transactions has a negative and significant coefficient, while its lagged changes are not significant at the 5% level. The mobile transaction coefficients are not significant at the 5% level; the current-quarter coefficient is marginally significant at the 10% level ($p = 0.054$). Current inflation and its two-quarter lag are positive and significant at 5%, while its one-quarter lag is significant only at 10%. Lending rate has a positive current-quarter coefficient, followed by negative and significant coefficients at the first and second lags.

Error Correction Mechanism

Table 7: Error Correction Term

Term	Coefficient	Std. error	t-statistic	p-value
ECT(-1)	-0.3372	0.0618	-5.456	<0.001

Authors' computation from the supplied quarterly dataset.

The error correction coefficient is negative (-0.3372) and statistically significant ($p < 0.001$). This confirms that the model adjusts towards its long-run equilibrium after a short-run disturbance. The coefficient indicates that approximately 33.7% of the previous quarter's deviation from equilibrium is corrected in the current quarter.

Diagnostic Tests

The following diagnostic tests were conducted to assess the reliability and stability of the selected ARDL model.

Table 8: ARDL Diagnostic Test Results

Diagnostic test	Test statistic	Probability	Decision at 5%
Breusch-Godfrey LM (4 lags)	4.131	0.389	No serial correlation
Breusch-Pagan-Godfrey	26.197	0.199	No heteroskedasticity
Jarque-Bera	0.341	0.843	Residuals are normal
ARCH LM (4 lags)	2.763	0.598	No ARCH effect
CUSUM	0.300	0.99999	Parameters are stable

Source: Authors' computation from the supplied quarterly dataset

Based on the results shown in Table 8, the diagnostic results show that the model has no evidence of serial correlation or heteroskedasticity, while the Jarque-Bera and ARCH tests confirm that the residuals are normally distributed and have no ARCH effect. The CUSUM test also indicates that the model

parameters are stable over the study period. Overall, the results suggest that the model satisfies these diagnostic requirements.

Discussion of Long-Run Findings

The long-run ARDL estimates reveal that mobile banking and web transaction volumes have positive and statistically significant effects on SME contribution to GDP in Nigeria, while POS transaction volume has a negative and significant effect. Inflation has a negative but insignificant coefficient, whereas lending rate has a positive and significant coefficient. These findings indicate that the contributions of digital payment channels to SME economic activity differ across payment methods. They also provide mixed support for the study's a priori expectations, which anticipated positive effects for the three payment channels and negative effects for inflation and lending rate.

Mobile Banking Transactions

Mobile banking transactions have a positive and statistically significant coefficient of 0.8276 ($p = 0.004$). This finding agrees with the expected positive sign and suggests that increased mobile banking activity is associated with higher SME contribution to GDP in the long run. Mobile banking can support business operations by facilitating payments, reducing transaction delays, improving access to financial services and making it easier for businesses to receive and transfer funds. It also generates transaction records that may improve the visibility of business cash flows and support access to finance

The finding is consistent with Ukaigwe et al. (2025), who reported a positive and significant long-run effect of mobile payments on SME financing in Nigeria. Similarly, Osei-Tutu and Taylor (2024), using firm-level data across 16 Sub-Saharan African countries, found that mobile money adoption improved firm innovation through better liquidity and access to trade credit and bank loans. Keremah (2026) also reported a positive long-run association between mobile payments and SME financing in Nigeria. These studies support the view that digital financial services can strengthen business activities and contribute to SME development.

However, the positive effect should not be interpreted as evidence that mobile transactions automatically translate into higher business output. Konte and Tetteh (2023) found no robust direct effect of mobile money use on firm productivity across 14 African countries, although combining mobile money with access to traditional financial services improved productivity. Similarly, Tiwasing et al. (2024) found that although Kenyan businesses using mobile money were more likely to introduce product and process innovations, their overall performance was not significantly better than that of non-users. Dalton et al. (2023) also found that electronic payment technology improved access to mobile loans among Kenyan SMEs but did not produce an immediate increase in sales and profits. These differences suggest that the benefits of mobile banking depend partly on whether businesses can translate improved payment access and financial information into productive investment and expansion. The present finding therefore provides support for the contribution of mobile banking to SME economic activity in Nigeria, while recognising that its benefits may depend on complementary financial and business conditions.

Web Transactions

Web transactions have a positive and statistically significant coefficient of 0.7438 ($p < 0.001$). This result agrees with the expected positive sign and indicates that increased web transaction activity is associated with higher SME contribution to GDP in the long run. Internet-based banking facilitates payments between businesses, customers and suppliers, supports online commercial activities and enables transactions across geographical locations. These benefits can improve business efficiency and widen access to markets.

The finding is consistent with the broader evidence of Effiom and Edet (2022), who found that financial innovation, including web or internet banking, contributed positively to SME productivity in Nigeria. It is also relevant to the CBN's (2024) report that internet transfers accounted for 51.91% of electronic payment transaction volume as at June 2024, making web transfers the most widely used channel among

the reported retail electronic payment methods. This demonstrates the growing importance of internet-based transactions in Nigeria's payment system.

Nevertheless, the finding differs from Keremah (2026), who reported a negative association between web transfers and SME credit in Nigeria. The difference may partly reflect the outcome variables examined. The present study focuses on SME contribution to GDP, whereas Keremah examines access to SME credit. Increased web transactions may support business sales, payments and commercial activities without necessarily increasing demand for, or access to, formal bank loans. Furthermore, the CBN's aggregate web transaction statistics include transactions beyond the SME sector. Consequently, the present positive finding should be understood as evidence of an association between national web transaction activity and SME contribution to GDP rather than proof that all recorded web transactions originate from SMEs.

POS Transactions

POS transactions have a negative and statistically significant coefficient of -1.8165 (p less than 0.001). This finding is contrary to the expected positive sign, which was based on the understanding that POS services make payments easier, reduce cash-handling difficulties and improve the efficiency of business transactions. The negative coefficient suggests that increased POS transaction volume does not necessarily correspond with higher SME contribution to GDP in the long run.

This result differs from Ukaigwe et al. (2025), who reported a positive and statistically significant long-run effect of POS terminals on SME financing in Nigeria. Similarly, Ogunsuyi and Tejumade (2021), examining SMEs in Lagos State, found that POS services helped increase sales, reduce payment delays and improve business income. The difference may reflect variations in the periods examined, the methods employed and the measures used to assess SME performance. While these earlier studies focused more directly on SME financing or the experiences of individual businesses, the present study uses aggregate national transaction volumes and SME contribution to GDP.

Several factors may help explain the negative finding. POS transactions may involve operational costs, transaction charges, unreliable network services and occasional transaction failures, all of which can reduce the benefits businesses obtain from the technology. These concerns are not merely theoretical. The CBN issued a dual-connectivity requirement for POS transactions in December 2025 to address service interruptions and reduce downtime in the payment system (John, 2025). Similarly, Siame and Chibesa (2026), examining electronic payment adoption among MSMEs in Zambia, found that merchant charges influenced businesses' payment choices and their willingness to use electronic payment services.

However, these possible explanations should not be treated as causes established by the present regression. The negative coefficient may also reflect the fact that aggregate POS activity covers transactions across different businesses and consumers, rather than transactions specifically associated with productive activities of SMEs. Increased POS use may therefore reflect a greater volume of payments without a corresponding increase in SME value added. This finding calls for closer attention to the quality, cost and reliability of POS services, rather than assuming that increased terminal usage automatically improves SME performance.

Inflation

Inflation has a negative but statistically insignificant coefficient of -0.0091 ($p = 0.587$). Although the negative sign agrees with the expected relationship, the result does not provide sufficient evidence to establish a significant long-run effect of inflation on SME contribution to GDP. Rising prices ordinarily increase the cost of raw materials, transportation, energy and other business inputs, thereby reducing the resources available for production and expansion. Inflation can also weaken consumers' purchasing power and reduce demand for SME products and services.

The negative direction is consistent with Keremah (2026), who reported an adverse association between inflation and SME financing in Nigeria. However, the lack of statistical significance in the present study

may reflect differences in the outcome measured, the period examined and the other variables included in the model. It may also indicate that inflation's influence on SME contribution to GDP operates through other factors, including production costs, lending conditions and household demand. The result should therefore not be interpreted to mean that inflation is unimportant to SMEs. Rather, it indicates that its independent long-run contribution was not statistically established in the estimated model.

Lending Rate

Lending rate has a positive and statistically significant coefficient of 0.4027 (p less than 0.001). This finding is contrary to the expected negative sign because higher lending rates ordinarily increase borrowing costs and discourage SMEs from obtaining loans for working capital, investment and business expansion. The positive coefficient indicates that higher lending rates are associated with increased SME contribution to GDP in the long run, after accounting for the other variables in the model.

This result differs from Keremah (2026), who found that interest rates had no significant long-run effect on SME financing in Nigeria. The unexpected positive result in the present study should be interpreted cautiously. It does not establish that higher borrowing costs improve SME performance. Rather, it may reflect other economic developments occurring alongside changes in lending rates, such as changes in aggregate economic activity, credit conditions, inflationary expectations and business financing patterns. It may also reflect the influence of factors not explicitly included in the model.

The Nigerian financing environment provides an important context for interpreting this finding. The World Bank (2025) reported that fewer than one in twenty Nigerian MSMEs had access to formal bank credit, while available loans were often short-term and costly, with collateral requirements excluding many otherwise viable businesses. This suggests that the expansion of SME activities does not necessarily depend entirely on formal bank borrowing. Some businesses may rely on retained earnings, personal savings, informal credit and other sources of finance. The positive lending rate coefficient should therefore be treated as an empirical association requiring further investigation, rather than evidence that higher interest rates encourage SME growth.

The findings show that digital payment channels have differing long-run effects on SME contribution to GDP in Nigeria. Mobile and web transactions have positive and significant effects, while POS transactions have a negative and significant effect. Inflation has a negative but insignificant effect, whereas lending rate has a positive and significant effect, contrary to expectation. This suggests that the contribution of digital payments to SME activity depends on the channel used and prevailing economic conditions.

These findings reflect the financing and infrastructure challenges facing Nigerian SMEs, as highlighted by the World Bank (2025) and CBN initiatives to strengthen payment systems. Post-sample conditions also remained challenging, with inflation at 14.63%, food inflation at 19.59% and the monetary policy rate at 23% in September 2026 (NBS, 2026; CBN, 2026). These figures fall outside the study period. The findings therefore support policies that improve payment reliability, reduce operating costs and expand access to affordable credit, while addressing the specific challenges of each payment channel.

Conclusion and Recommendations

The study concludes that mobile banking and web transactions contribute positively to SME contribution to GDP in Nigeria, while POS transactions have a negative effect, indicating that the contribution of digital payment channels to SME economic activity depends on the payment method and the conditions under which it operates.

Based on the findings of the study, the following recommendations are proposed to strengthen the contribution of digital payment services to SME economic activities in Nigeria. Deposit money banks and financial technology providers should expand mobile banking services to SMEs, particularly those in rural and underserved communities. This should be achieved through affordable transaction charges, simplified business account registration, reliable mobile applications, improved network coverage and practical digital banking training for SME operators. These measures would encourage wider adoption and enable

SMEs to use mobile banking more effectively for business payments, fund transfers and financial management.

Second, banks and payment service providers should strengthen web-based payment facilities to support transactions between SMEs, customers and suppliers. This can be achieved through affordable online business payment platforms, secure payment systems, prompt transaction settlement and integration of web banking with business accounting and record-keeping applications. Targeted training should also be provided to help SME operators use these services for online sales, supplier payments and transactions beyond their immediate locations. Such measures would improve business efficiency and enable SMEs to benefit more fully from internet-based commercial activities.

Third, the Central Bank of Nigeria, deposit money banks and payment service providers should address the operational challenges that may limit the benefits of POS transactions to SMEs. Practical measures should include strengthening network connectivity, enforcing dual connectivity requirements, ensuring transparent transaction charges, improving the prompt reversal of failed transactions and reducing delays in the settlement of payments. Regular monitoring of POS operators and effective channels for resolving transaction complaints should also be instituted. These measures would reduce payment disruptions and operating costs, making POS services more beneficial to SME operators.

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