E-COMMERCE GROWTH, ONLINE PAYMENT VOLUME AND TAX BASE EFFECTIVENESS IN NIGERIA

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Abstract
The rapid expansion of Nigeria's digital economy has increased electronic commercial transactions, raising questions about its implications for tax mobilisation. This study examined the effect of e-commerce growth and online payment volume on tax base effectiveness in Nigeria over the period 2000–2024, while controlling for GDP growth and inflation. An ex-post facto research design was adopted using annual time-series data obtained from official national and financial databases. The study employed the Autoregressive Distributed Lag (ARDL) approach to estimate the short- and long-run relationships among the variables, following preliminary descriptive, correlation, unit root, and diagnostic analyses. The findings revealed no evidence of a long-run relationship between digital economy indicators and tax base effectiveness. However, in the short run, online payment volume exerted a positive and statistically significant effect on tax base effectiveness, whereas e-commerce growth had no significant influence. The results also showed persistence in tax base performance, suggesting structural rigidities within Nigeria's tax administration. The study concludes that the growth of the digital economy alone is insufficient to strengthen tax mobilisation without complementary institutional and regulatory reforms. It recommends enhancing digital tax administration, strengthening regulatory integration between financial technology platforms and tax authorities, and improving the monitoring of online transactions to expand the tax base and promote sustainable domestic revenue mobilisation in Nigeria.
Keywords: Digital economy; E-commerce; Online payment volume; Tax base effectiveness

1.0 Introduction

The rapid expansion of the digital economy has transformed the way economic activities are conducted worldwide. Advances in information and communication technologies, increasing internet penetration, and the proliferation of digital platforms have accelerated electronic commerce (e-commerce) and online payment systems, enabling businesses and consumers to transact beyond traditional geographical and physical boundaries (Bukht & Heeks, 2017; UNCTAD, 2021). These developments have enhanced market efficiency, promoted financial inclusion, and generated new opportunities for economic growth. More importantly, the increasing use of digital transactions has created electronic records that have the potential to improve tax administration by enhancing transaction traceability, reducing information asymmetry, and strengthening revenue mobilisation (Frost et al., 2021; Ozili, 2022).

Nigeria has emerged as one of Africa's leading digital economies, driven by rapid growth in fintech innovation, smartphone adoption, internet connectivity, and electronic payment infrastructure. The expansion of online marketplaces, mobile banking applications, digital wallets, and payment gateways has substantially increased the volume of electronic transactions across the country (Adeleye et al., 2021; Ozili, 2022). The COVID-19 pandemic further accelerated this digital transformation as businesses and consumers increasingly adopted online platforms for commercial and financial transactions (World Bank, 2021). These developments suggest that digitalisation could broaden the taxable base by making economic activities more visible to tax authorities.
Despite this progress, Nigeria continues to record one of the lowest tax-to-GDP ratios among emerging and developing economies, reflecting persistent weaknesses in tax administration, widespread informality, and limited capacity to capture rapidly expanding digital economic activities within the tax system (IMF, 2023). Although digital transactions generate substantial electronic data that could facilitate tax monitoring and compliance, a significant proportion of online commercial activities still occur through informal digital channels, unregistered businesses, and cross-border platforms that remain largely outside the formal tax net (Aslam & Shah, 2023; Okunogbe, 2023). Consequently, the growth of the digital economy may increase economic activity without necessarily translating into improved tax mobilisation.

Existing empirical evidence provides mixed conclusions regarding the fiscal implications of digitalisation. Some studies argue that digital payment systems improve tax compliance, administrative efficiency, and revenue mobilisation through greater transaction transparency and reduced tax evasion. Others contend that the benefits of digitalisation depend largely on institutional capacity, regulatory effectiveness, and the integration of digital transaction data into tax administration systems. In Nigeria, previous studies have predominantly examined electronic tax administration and tax revenue generation, paying relatively little attention to whether the broader expansion of digital economic activities, particularly e-commerce growth and online payment volume, strengthens the effectiveness of the tax base. Moreover, many existing studies rely on survey or cross-sectional approaches, providing limited evidence on the long-run relationship between digital economy indicators and fiscal outcomes.

These gaps raise an important policy question: does the rapid expansion of Nigeria's digital economy strengthen the country's tax base, or does it merely increase economic activity without corresponding improvements in tax mobilisation? Addressing this question has become increasingly important as governments seek to diversify revenue sources, reduce dependence on oil revenue, and improve domestic resource mobilisation through digital taxation reforms.

Against this background, this study examines the effect of e-commerce growth and online payment volume on tax base effectiveness in Nigeria using annual time-series data covering the period 2000–2024. Gross domestic product (GDP) growth and inflation are included as control variables to account for prevailing macroeconomic conditions. The study employs the Autoregressive Distributed Lag (ARDL) modelling framework to estimate both the short-run and long-run relationships among the variables.

This study contributes to the literature in several ways. First, it shifts attention from conventional tax revenue measures to tax base effectiveness, thereby providing a broader assessment of how digital economic activities are translated into sustainable fiscal capacity. Second, it disaggregates digital economy growth into two important dimensions, e-commerce growth and online payment

volume, allowing for a more nuanced understanding of their individual effects on tax mobilisation. Third, by employing annual time-series data spanning 2000–2024 and the ARDL estimation technique, the study provides evidence on both the short-run dynamics and long-run relationships between digital economy indicators and tax base effectiveness in Nigeria. The findings are expected to provide useful insights for policymakers, tax authorities, and financial regulators seeking to strengthen digital tax administration and improve domestic revenue mobilisation in an increasingly digitalised economy.

2.0 Literature Review and Hypothesis Development

The digital economy has emerged as a transformative economic system in which digital technologies, including the internet, mobile networks, digital platforms, and data-driven systems, facilitate the production, distribution, and consumption of goods and services (Bukht & Heeks, 2017; UNCTAD, 2021). Driven by advances in information and communication technologies, expanding internet connectivity, and the widespread adoption of smartphones, the digital economy has reshaped traditional business models by enabling firms to conduct transactions electronically, access wider markets, and operate with lower transaction costs. It comprises three interrelated components: digital production, digital transactions, and digital platforms and infrastructure, all of which underpin modern digital commerce (OECD, 2020; UNCTAD, 2021).

Tax base effectiveness refers to the ability of a country's tax system to convert economic activities into sustainable public revenue by effectively identifying, assessing, and taxing economic transactions (Fenochietto & Pessino, 2021). Unlike tax revenue growth, which reflects increases in tax collections arising from economic expansion, inflation, tax policy changes, or administrative improvements, tax base effectiveness evaluates whether economic activities are adequately incorporated into the tax system and translated into sustainable fiscal outcomes (Gaspar et al., 2020; Mascagni et al., 2021; Fenochietto & Pessino, 2021). This distinction has become increasingly important in developing economies, where informality and weak institutional capacity often prevent economic growth from translating into improved revenue mobilisation (Keen & Slemrod, 2021; Aslam & Shah, 2023).

The literature conceptualises tax base effectiveness through three complementary dimensions: revenue adequacy, efficiency of tax collection, and the breadth and sustainability of the tax base. Revenue adequacy concerns the ability of the tax system to generate sufficient and stable revenue relative to economic activity, while efficiency relates to mobilising revenue with minimal administrative costs and compliance burdens. Breadth and sustainability refer to the extent to which diverse economic activities, including emerging digital transactions, are incorporated into the tax system to ensure long-term fiscal resilience (Gaspar et al., 2020; Keen & Slemrod, 2021; Fenochietto & Pessino, 2021). The digital economy offers opportunities to strengthen these dimensions through improved transaction traceability, although effective regulatory frameworks and the integration of digital transaction data remain essential (OECD, 2022; Okunogbe & Santoro, 2023).

E-commerce represents one of the most significant dimensions of the digital economy and refers to the buying and selling of goods and services through websites, mobile applications, and other digital platforms (UNCTAD, 2021). It encompasses both business-to-consumer (B2C) and business-to-business (B2B) transactions, with the latter accounting for a substantial share of global digital trade. The rapid expansion of e-commerce has increased commercial activity across geographical boundaries and is commonly measured using indicators such as the value of online

transactions, digital marketplace participation, and online payment volumes, particularly in developing economies where fintech and mobile commerce have accelerated digitalisation (Ozili, 2022; Bongomin et al., 2020; UNCTAD, 2021).

Online payment systems constitute the financial backbone of the digital economy by enabling secure, efficient, and traceable electronic transactions through mobile money, digital wallets, internet banking, and payment gateways (Frost et al., 2021). These technologies promote financial inclusion and facilitate participation in digital markets while generating electronic transaction records that improve transparency and provide valuable information for tax monitoring and compliance. Consequently, online payment volume is widely used as a proxy for digital transaction intensity because it reflects the scale of digital economic activity and the potential for strengthening tax administration through improved visibility of taxable transactions (Ozili, 2022; Frost et al., 2021; Okunogbe & Santoro, 2023).

Empirical Review

E-Commerce Growth and Tax Base Effectiveness

This section reviews empirical studies examining how e-commerce growth influences tax revenue mobilisation and tax base effectiveness. The studies are categorised according to their empirical findings into positive and significant effects, negative and significant effects, and statistically insignificant effects.

Apeti (2023) investigated the impact of mobile money adoption on tax revenue performance in developing countries using panel data from 104 developing economies covering 1990–2019. The study employed entropy balancing and weighted least squares regression techniques to address potential selection bias and endogeneity issues. The results revealed that the expansion of digital financial services significantly increased tax revenue mobilisation across developing countries. The findings suggest that digital transaction systems improve transaction traceability and reduce opportunities for tax evasion, thereby expanding the effective tax base. The study concluded that governments in developing economies can improve revenue mobilisation by integrating digital payment data into tax administration systems (Apeti, 2023).

Omodero (2025) examined the implications of digital payment systems on tax revenue collection efficiency in Nigeria. The study adopted a time-series research design and utilised regression analysis to assess the relationship between digital payment adoption and tax revenue performance. The findings indicated that digital payment systems significantly improved tax revenue collection by increasing transaction transparency and facilitating electronic tax payments. The study concluded that the adoption of digital payment infrastructure strengthens tax base effectiveness by enabling tax authorities to monitor economic transactions more efficiently (Omodero, 2025).

Ndalu and Igwe (2022) analysed the effect of electronic tax payment systems on tax revenue generation in Nigeria. Using econometric analysis of secondary data obtained from the Federal Inland Revenue Service, the study found that electronic tax payment platforms significantly enhanced tax revenue performance. The results indicated that digital payment systems improve compliance and reduce leakages associated with manual tax collection processes. The study recommended that tax authorities expand digital payment platforms to strengthen tax base effectiveness and revenue mobilisation (Ndalu & Igwe, 2022).

Abubakari (2024) examined the impact of electronic transaction taxation on revenue mobilisation in developing countries with a focus on Ghana's electronic levy system. Using policy evaluation

and econometric modelling, the study found that the introduction of electronic transaction taxes reduced digital transaction volumes and negatively affected economic participation in digital markets. The study concluded that poorly designed digital transaction taxes may discourage electronic commerce and reduce the potential tax base by driving transactions back into informal cash-based systems (Abubakari, 2024).

Kraus (2025) analysed the taxation of e-commerce and digital businesses in European digital markets using panel regression techniques. The findings revealed that heavy taxation of digital enterprises significantly reduced e-commerce participation and digital business formation. The study concluded that excessive digital taxation policies may negatively affect digital economic growth and ultimately reduce the overall taxable economic base (Kraus, 2025). UNCTAD (2024) conducted a cross-country analysis of the fiscal implications of e-commerce growth in developing economies. The report indicated that although digital trade increases economic activity, many developing countries experience difficulty capturing tax revenue from online commerce due to regulatory gaps and cross-border digital transactions. The study found that the rapid expansion of e-commerce without adequate tax frameworks can lead to erosion of the domestic tax base (UNCTAD, 2024).

Ogbonna et al. (2022) examined the relationship between electronic tax payment systems and tax revenue generation in Nigeria using regression analysis of fiscal data obtained from government revenue agencies. The results revealed a weak positive but statistically insignificant relationship between digital tax payment adoption and overall revenue generation. The authors concluded that while digital payment systems improve administrative processes, their effect on revenue mobilisation may remain limited without broader institutional reforms and improved enforcement mechanisms (Ogbonna et al., 2022). Apalowowa, Oladele, and Deji-Oyeleye (2024) investigated the relationship between digitalisation of tax services and corporate tax compliance in Nigeria using survey data obtained from Federal Inland Revenue Service staff. The study employed regression analysis and found that some digital tax service variables did not significantly influence compliance levels. The authors concluded that technological adoption alone may not significantly influence tax revenue unless supported by taxpayer awareness and effective enforcement mechanisms (Apalowowa et al., 2024).

Santoro, Prichard, and Mascagni (2024) analysed the role of digital payment systems in improving tax administration in developing countries. The study used comparative policy analysis across several African countries and found that although digital payments increase transaction visibility, the effect on tax revenue mobilisation is sometimes insignificant where tax authorities lack the institutional capacity to utilise digital transaction data effectively. The authors concluded that digitalisation alone does not automatically translate into improved tax base effectiveness (Santoro et al., 2024). Therefore, we hypothsised thus:

H_{01}: E-commerce growth has no significant effect on tax base effectiveness in Nigeria.

Online Payment Volume and Tax Base Effectiveness

This subsection reviews empirical studies on how online payment volume, digital payments, and closely related proxies such as mobile money usage influence tax revenue mobilisation, tax compliance, and tax base effectiveness. Because the literature does not always use the exact phrase "online payment volume," many studies operationalise the concept through digital payment adoption, mobile money transactions, electronic tax payment systems, or electronic transaction

intensity. The studies are arranged into positive and significant, negative and significant, and not significant findings.

Apeti (2023) examined the effect of mobile money adoption on tax revenue performance in 104 developing countries over 1990–2019 using entropy balancing estimators. The study found that mobile money adoption significantly increased tax revenue performance, with stronger effects observed through improved tax base expansion, institutional quality, and easier tax payments. The implication of the study is that greater digital payment usage can enhance tax base effectiveness by making transactions more visible and easier to capture within the formal tax system (Apeti, 2023).

Omodero and Ekundayo (2025) assessed the effectiveness of digital payment systems in Nigeria's tax collection process using time-series evidence and macroeconomic controls. Their findings showed that digital payment platforms improved tax revenue collection effectiveness by facilitating traceable transactions and reducing frictions in tax remittance. The study concluded that digital payment expansion contributes positively and significantly to tax mobilisation outcomes in Nigeria (Omodero & Ekundayo, 2025). Nwankwere (2024) investigated tax digitalisation and revenue tax compliance at the Federal Inland Revenue Service in Abuja, Nigeria, using multiple regression analysis. The study found that online payment systems, alongside electronic filing, electronic reporting, and electronic audit, had a positive and significant effect on revenue tax compliance. The author concluded that expanding digital payment channels can strengthen tax administration outcomes and improve the conversion of taxable activity into revenue (Nwankwere, 2024).

Pobee and Opoku-Mensah (2023) investigated whether the taxation of digital financial services adversely affects mobile money adoption in Ghana. Using a behavioural model, the study found that taxation had a negative and significant effect on the actual use of mobile money. Although the dependent variable was payment usage rather than tax revenue directly, the implication is important for tax base effectiveness: policies that suppress digital payment use may reduce transaction formalisation and weaken the observable base from which taxes can be collected (Pobee & Opoku-Mensah, 2023). Barczay, Grossman, and Witte (2025) analysed mobile money taxation and found that such taxes were inefficient and regressive, raising relatively little revenue while discouraging digital payment use. Their estimates suggested a meaningful welfare cost and indicated that taxing mobile money directly can undermine financial inclusion and shrink digital transaction activity, thereby weakening the broader base for future tax collection (Barczay et al., 2025).

Falana (2024) examined digital tax administration and tax compliance in the Nigerian informal sector. While the study supported incentives for the adoption of digital payment systems and digital tax tools, its broader conclusion was that digitalisation measures do not uniformly translate into strong tax outcomes unless supported by enforcement, awareness, and institutional readiness. This suggests that the effect of digital payment usage on tax base effectiveness may be weak or statistically limited in environments dominated by informality (Falana, 2024).

Santoro and Rossel's work on digital payments and African tax administrations emphasised that digital payments create opportunities for stronger tax systems, but the realised effect depends heavily on administrative capacity, inter-agency data use, and enforcement quality. In practical terms, this body of evidence supports the position that the relationship between digital payment expansion and tax performance can be insignificant where institutions are not able to convert transaction data into effective compliance and revenue outcomes (Santoro & Rossel, 2025/2026).

Ogbonna and related Nigerian studies on electronic tax systems and digital payment adoption indicate that digital platforms may improve convenience and administrative processes without necessarily generating a statistically significant rise in tax yield on their own. The common finding across such studies is that digital payment mechanisms require complementary reforms—such as taxpayer identification systems, audit integration, and formalisation of informal businesses—before their contribution to tax base effectiveness becomes materially significant (Ogbonna et al., 2022; Falana, 2024).

The reviewed studies show that the relationship between online payment volume and tax base effectiveness is mixed. A first group of studies found a positive and significant relationship, arguing that higher digital payment usage improves transaction traceability, compliance, and tax collection efficiency. A second group reported a negative and significant relationship, particularly where governments tax digital financial services in ways that discourage digital payment usage and reduce the size of the formal observable transaction base. A third group suggests that the relationship may be statistically weak or insignificant when digital payment growth occurs in an environment characterised by informality, weak enforcement, and poor integration of payment data into tax administration systems. Overall, the evidence indicates that online payment volume can strengthen tax base effectiveness, but the outcome depends critically on policy design, institutional capacity, and the broader tax administration framework. Therefore, we hypothesized as follows: H_{02}: Online payment volume has no significant effect on tax base effectiveness in Nigeria.

Theoretical Review

The review of theories provides the foundation for explaining how digital economy growth influences tax base effectiveness. The emergence of digital economic activities, particularly e-commerce and online payment systems, has transformed public finance by creating new opportunities and challenges for tax administration. Understanding these dynamics requires theoretical perspectives that explain the interaction between economic activity, taxation, and revenue mobilisation. Accordingly, this study draws on three complementary theories—Optimal Tax Theory, Fiscal Exchange Theory, and the Digital Economy Taxation Framework—to explain how expanding digital transactions may influence tax base effectiveness.

Optimal Tax Theory, developed by Ramsey (1927) and extended by Mirrlees (1971), posits that tax systems should maximise government revenue while minimising economic distortions and maintaining administrative feasibility. The theory argues that effective tax policies should generate adequate public revenue without discouraging production, investment, or consumption (Slemrod & Gillitzer, 2014). Within the digital economy, the theory underscores the need for tax systems to adapt to emerging digital transactions, cross-border commerce, and platform-based businesses that may otherwise escape taxation (OECD, 2022). The increasing availability of electronic transaction records through online payments and digital platforms further enhances tax transparency, compliance monitoring, and revenue mobilisation (Okunogbe & Santoro, 2023).

Fiscal Exchange Theory explains tax compliance from the perspective of reciprocity between taxpayers and government. The theory argues that taxpayers are more willing to comply with tax obligations when they perceive that governments utilise tax revenues transparently and provide quality public goods and services (Torgler, 2007; Alm & Torgler, 2011). In developing economies, weak institutional quality and poor public service delivery often weaken voluntary compliance and tax system effectiveness (Gaspar et al., 2020). However, digital payment systems, electronic tax filing, and automated tax administration can strengthen this fiscal exchange by improving

transparency, reducing compliance costs, and enhancing interactions between taxpayers and revenue authorities (Mascagni et al., 2021; Okunogbe & Santoro, 2023).

The Digital Economy Taxation Framework, developed under the OECD's Base Erosion and Profit Shifting (BEPS) initiative, recognises that conventional tax systems based on physical presence are increasingly inadequate for taxing digitally mediated economic activities (OECD, 2020; OECD, 2022). The framework highlights the challenges posed by cross-border digital services, intangible assets, and platform-based businesses while emphasising the opportunities created by digital transaction records for improving tax administration and reducing informality (UNCTAD, 2021; Okunogbe & Santoro, 2023). Collectively, these theories suggest that digital economy growth can strengthen tax base effectiveness through improved transaction traceability, compliance, and tax administration. Nevertheless, Optimal Tax Theory is adopted as the principal underpinning of this study because it most directly explains how tax systems should adapt to emerging digital economic activities to maximise sustainable revenue while minimising economic distortions, thereby providing the strongest theoretical basis for examining the effects of e-commerce growth and online payment volume on tax base effectiveness in Nigeria.

Gaps in Literature

The reviewed literature reveals several important gaps that justify further investigation into the relationship between digital economy activities and tax base effectiveness, particularly in Nigeria. First, most empirical studies focus on tax revenue generation rather than tax base effectiveness, despite the latter providing a broader measure of a tax system's ability to convert economic activities into sustainable revenue. Second, much of the existing evidence is drawn from developed economies with advanced digital infrastructure and stronger tax institutions, limiting its applicability to developing countries characterised by high informality, regulatory constraints, and weaker tax administration. Third, Nigerian studies have largely relied on survey or cross-sectional approaches, providing limited evidence on the dynamic relationship between digital economy growth and fiscal outcomes over time.

Another notable gap is that previous studies commonly employ broad proxies for digitalisation, such as internet penetration or fintech adoption, without distinguishing between specific digital economy indicators such as e-commerce growth and online payment volume, which may influence tax mobilisation through different channels. This study addresses these gaps by examining the effects of e-commerce growth and online payment volume on tax base effectiveness in Nigeria using annual time-series data. By adopting tax base effectiveness as the outcome variable and employing the Autoregressive Distributed Lag (ARDL) approach, the study provides empirical evidence that extends the literature on digital economy taxation within the context of an emerging economy.

3.0 Methodology

This study adopts an ex-post facto research design to examine the relationship between digital economy indicators and tax base effectiveness in Nigeria. The design is appropriate because it relies on historical macroeconomic data that cannot be manipulated by the researcher and is widely used in economic and financial research to investigate causal relationships among variables (Gujarati & Porter, 2009). The study utilises annual time-series data covering the period 2000–2024, yielding 25 observations, which adequately capture the evolution of Nigeria's digital economy and tax mobilisation over time.

Secondary data were obtained from credible institutional sources, including the Central Bank of Nigeria (CBN) Statistical Bulletin, Federal Inland Revenue Service (FIRS) Annual Reports, National Bureau of Statistics (NBS), and the World Bank Development Indicators. These sources provide consistent information on digital payment transactions, tax revenue, and macroeconomic indicators. Tax base effectiveness (TBE), measured by the VAT-to-GDP ratio, serves as the dependent variable, while e-commerce growth (ECG) and online payment volume (OPV) are the principal indicators of digital economy growth. To account for macroeconomic conditions that may influence tax mobilisation, gross domestic product growth (GDP) and inflation rate (INF) are included as control variables (Gupta et al., 2023; Tanzi & Zee, 2021; OECD, 2021; Klapper et al., 2022; Okunogbe & Santoro, 2023; IMF, 2022; World Bank, 2024). The study adapts the modelling framework of Apeti (2023) and Okunogbe and Santoro (2023), with modifications to incorporate e-commerce growth and online payment volume as indicators of the digital economy. The functional relationship among the variables is specified as:

TBE = f (ECG, OPV, GDP, INF)

The econometric model is expressed as: $TBE_t = \beta_0 + \beta_1 ECG_t + \beta_2 OPV_t + \beta_3 GDP_t + \beta_4 INF_t + \varepsilon_t$

where TBE denotes tax base effectiveness, ECG represents e-commerce growth, OPV is online payment volume, GDP denotes gross domestic product growth, INF represents inflation rate, β_0 is the intercept, β_1–β_4 are the regression coefficients, and ε_t is the stochastic error term. The model is estimated using the Autoregressive Distributed Lag (ARDL) approach developed by Pesaran, Shin, and Smith (2001). The ARDL technique is appropriate because it accommodates variables integrated of order I(0) and I(1), performs efficiently with relatively small samples, and estimates both short-run and long-run relationships simultaneously. Prior to estimation, the stationarity properties of the variables are examined using the Augmented Dickey–Fuller (ADF) unit root test, while the ARDL Bounds Test is employed to determine the existence of a long-run equilibrium relationship among the variables. The robustness of the estimated model is further assessed through the Breusch–Godfrey serial correlation test, Breusch–Pagan heteroskedasticity test, Variance Inflation Factor (VIF) for multicollinearity, and CUSUM/CUSUMSQ stability tests. All analyses are conducted using Stata statistical software.

Table 1: Definition and Measurement of Variables

Variable	Measurement/Proxy	Expected Sign	Supporting Literature
Tax Base Effectiveness (TBE)	VAT-to-GDP Ratio	Dependent	Gupta et al. (2023); Tanzi & Zee (2021)
E-Commerce Growth (ECG)	Total value of online retail transactions	+	OECD (2019); UNCTAD (2021)
Online Payment Volume (OPV)	Total value of digital payment transactions	+	Ozili (2018); IMF (2020)
GDP Growth (GDP)	Annual percentage growth rate of GDP	+	Barro (1991); Mankiw, Romer and Weil (1992)
Inflation Rate (INF)	Annual growth rate of the Consumer Price Index (CPI)	±	Fischer (1993); Bruno and Easterly (1998)

4.0 Results and Discussions

Descriptive Statistics

Table 2: Descriptive Statistics of Study Variables (2000–2024)

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
Tax Base Effectiveness	28.00	30.00	42.00	13.00	8.30	25
E-Commerce Growth	4.70	4.10	14.00	0.00	5.00	25
Online Payment Volume	12.00	15.00	24.00	0.00	9.40	25
GDP Growth Rate	5.10	6.20	15.00	-2.80	4.00	25
Inflation Rate	13.00	12.00	29.00	5.40	5.20	25

Source: Author's computation using STATA output (2026).

Table 2 presents the descriptive statistics of tax base effectiveness (TBE), e-commerce growth, online payment volume (OPV), GDP growth, and inflation over the study period. The results indicate considerable variation across the variables, reflecting the dynamic nature of Nigeria's digital economy and macroeconomic environment. While e-commerce growth and online payment volume exhibit substantial expansion and variability, tax base effectiveness displays moderate fluctuations, suggesting that the growth of digital economic activities has not consistently translated into proportional improvements in tax mobilisation. Similarly, variations in GDP growth and inflation underscore the influence of changing macroeconomic conditions on fiscal performance. Overall, the descriptive statistics provide preliminary evidence of heterogeneous movements among the variables, justifying further econometric analysis to examine their short-run and long-run relationships.

Correlation Analysis (Interpretation)

Table 3: Correlation Matrix of Study Variables (2000–2024)

Variable	TBE	OT	OP	GDPR	INFR
TBE	1.0000				
OT (E-Commerce Growth)	-0.6591	1.0000			
OP (Online Payment Volume)	-0.5214	0.9025	1.0000		
GDPR (GDP Growth Rate)	0.6578	-0.5969	-0.6830	1.0000	
INFR (Inflation Rate)	-0.4451	0.5656	0.3610	-0.1990	1.0000

Source: Author's computation using STATA output (2026)

Table 3 presents the Pearson correlation matrix, providing preliminary evidence of the relationships among the study variables. Tax base effectiveness (TBE) exhibits a strong negative correlation with e-commerce growth ($r = -0.6591$) and a moderate negative correlation with online payment volume ($r = -0.5214$), suggesting that the expansion of digital economic activities has not translated proportionately into improved tax mobilisation in Nigeria. In contrast, GDP growth shows a strong positive association with TBE ($r = 0.6578$), indicating that conventional economic growth contributes more directly to tax base expansion, while inflation is weakly and negatively correlated with TBE ($r = -0.4451$). A notably high positive correlation between e-commerce growth and online payment volume ($r = 0.9025$) reflects their close relationship as complementary indicators of

digital economic activity and suggests the possibility of multicollinearity, which is further examined in the diagnostic tests. Overall, the correlation results provide preliminary evidence that, despite their strong interrelationship, digital economy indicators are not positively associated with tax base effectiveness, thereby justifying the subsequent ARDL regression analysis.

Lag Length Selection

Table 4: Lag Length Selection Criteria

Lag	Log Likelihood	LR Statistic	p-value	FPE	AIC	HQIC	SBIC
0	-290.908	—	—	1.20e+06	28.1817	28.2357	28.4304
1	-224.109	133.60	0.000	24180.1	24.2009	24.5247	25.6931
2	-193.804	60.612	0.000	23952.9	23.6956	24.2893	26.4312
3	-84.7999	218.01	0.000	49.1165*	15.6952	16.5588	19.6744
4	2962.930	6095.50*	0.000	—	-272.184*	-271.051*	-266.961*

Source: Author's computation using STATA (2026)

Table 4 presents the lag selection criteria used to determine the appropriate lag structure for the time-series analysis. Although the Final Prediction Error (FPE) criterion selects lag 3, the Akaike Information Criterion (AIC), Hannan–Quinn Information Criterion (HQIC), Schwarz Bayesian Information Criterion (SBIC), and the Likelihood Ratio (LR) test all identify lag 4 as the optimal lag length. However, given the relatively small sample size (25 annual observations), adopting four lags would substantially reduce the degrees of freedom and may lead to over-parameterisation. Consistent with econometric best practice for small-sample time-series analysis, a maximum lag length of 2 is therefore adopted to ensure model parsimony and estimation efficiency. The selected lag structure is subsequently employed in the Augmented Dickey–Fuller (ADF) unit root test and the Autoregressive Distributed Lag (ARDL) estimation.

Unit Root Test

Table 5: Augmented Dickey-Fuller (ADF) Unit Root Test Results (Level Form)

Variable	ADF Test Statistic	5% Critical Value	p-value	Order of Integration
TBE	-1.802	-3.600	0.7037	Non-Stationary
OT	-1.791	-3.600	0.7091	Non-Stationary
OP	-2.402	-3.600	0.3784	Non-Stationary
GDPR	-1.767	-3.600	0.7203	Non-Stationary
INFR	-1.509	-3.600	0.8259	Non-Stationary

Source: Author's computation using STATA (2026)

Table 5 presents the results of the Augmented Dickey–Fuller (ADF) unit root test conducted to examine the stationarity properties of the variables. The findings indicate that tax base effectiveness (TBE), e-commerce growth (ECG), online payment volume (OPV), GDP growth (GDP), and inflation rate (INF) are all non-stationary at their levels, as evidenced by their insignificant ADF statistics and p-values greater than 0.05. This suggests the presence of unit roots and the possibility

of spurious regression if the variables are estimated in their level form, thereby necessitating further testing at first difference to determine their order of integration.

Table 6: Augmented Dickey-Fuller (ADF) Unit Root Test Results (First Difference)

Variable	ADF Test Statistic	5% Critical Value	p-value	Order of Integration
D(TBE)	-2.615	-3.000	0.0900	Stationary at 10%
D(OT)	-2.694	-3.000	0.0751	Stationary at 10%
D(OP)	-2.959	-3.000	0.0389	Stationary at 5%
D(GDPR)	-3.561	-3.000	0.0066	Stationary at 1%
D(INFR)	-3.794	-3.000	0.0030	Stationary at 1%

Source: Author's computation using STATA (2026)

Table 6 presents the Augmented Dickey–Fuller (ADF) unit root test results at first difference. The findings show that all variables become stationary after first differencing, with tax base effectiveness (TBE) and e-commerce growth (ECG) attaining stationarity at the 10% level, online payment volume (OPV) at the 5% level, and GDP growth (GDP) and inflation rate (INF) at the 1% level. The results confirm that all variables are integrated of order one, I(1), satisfying the underlying assumption for the application of the Autoregressive Distributed Lag (ARDL) approach, which accommodates variables integrated of order I(0) and I(1) but not I(2). Consequently, the study proceeds with the ARDL estimation and bounds test for cointegration.

ARDL Model Estimation Results

Table 7: ARDL Model Estimation Results (Dependent Variable: Tax Base Effectiveness)

Variable	Coefficient	Std. Error	t-Statistic	p-value	Decision
L.TBE	0.8049	0.1909	4.22	0.001	Significant
OT	-0.0658	0.5507	-0.12	0.906	Not Significant
OP	0.4617	0.3605	1.28	0.219	Not Significant
L.OP	-0.6330	0.2534	-2.50	0.024	Significant
GDPR	0.0923	0.3544	0.26	0.798	Not Significant
INFR	0.0211	0.2169	0.10	0.924	Not Significant
Constant	6.0038	5.7902	1.04	0.315	Not Significant

Model Summary

Statistic	Value
R-squared	0.8728
Adjusted R-squared	0.8251
F-statistic	18.30
Prob (F-statistic)	0.0000

Source: Author's computation using STATA output (2026)

Table 7 presents the ARDL estimation results examining the relationship between digital economy indicators and tax base effectiveness in Nigeria. The model demonstrates a good fit ($R^2 = 0.8728$) and is jointly significant ($F = 18.30$, $p < 0.001$), indicating that the explanatory variables account

for about 87.3% of the variation in tax base effectiveness. The lagged dependent variable is positive and highly significant ($\beta = 0.8049$, $p < 0.01$), suggesting persistence in tax performance over time. E-commerce growth (ECG) exerts a negative but insignificant effect, while the contemporaneous effect of online payment volume (OPV) is positive but insignificant. However, the lagged value of online payment volume is negative and statistically significant ($\beta = -0.6330$, $p < 0.05$), implying that past digital payment activities may not necessarily translate into improved tax mobilisation. Furthermore, GDP growth and inflation are statistically insignificant, indicating that macroeconomic conditions do not significantly influence tax base effectiveness during the study period. Overall, the findings suggest that although Nigeria's digital economy has expanded, its contribution to strengthening tax base effectiveness remains limited.

ARDL Bounds Test for Cointegration

Table 8: ARDL Bounds Test Results

Test Statistic	**Value**
F-statistic	0.984
t-statistic	-1.022
Critical Values (Kripfganz and Schneider, 2020)	
Significance Level	**I(0) Lower Bound**	**I(1) Upper Bound**
10%	2.924	4.269
5%	3.664	5.249
1%	5.591	7.790

Source: Author's computation using STATA output (2026*)*

Table 8 presents the ARDL bounds test results for the existence of a long-run relationship among tax base effectiveness, e-commerce growth, online payment volume, GDP growth, and inflation. The computed F-statistic (0.984) is lower than the lower bound critical value, while the associated t-statistic (−1.022) fails to exceed the corresponding critical values. Consequently, the null hypothesis of no cointegration cannot be rejected, indicating the absence of a long-run equilibrium relationship among the variables. This suggests that the expansion of e-commerce and online payment activities has not translated into sustained improvements in tax base effectiveness in Nigeria, implying that any observed relationships are predominantly short-run rather than long-run in nature.

Short-Run Dynamics (Error Correction Representation)

Table 9: ARDL Error Correction Representation

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**p-value**	**Decision**
ECT (L.TBE)	-0.1951	0.1909	-1.02	0.322	Not Significant
Short-Run Dynamics					
ΔOP	0.6330	0.2534	2.50	0.024	Significant
Constant	6.0038	5.7902	1.04	0.315	Not Significant

ECT = Error Correction Term

Source: Author's computation using STATA (2026)

Table 9 presents the short-run ARDL error correction results following the absence of a long-run cointegrating relationship. Although the error correction term (ECT) is negative ($\beta = -0.1951$), as theoretically expected, it is statistically insignificant ($p > 0.05$), confirming the absence of a stable

long-run equilibrium among the variables. In the short run, however, changes in online payment volume (ΔOPV) exert a positive and statistically significant effect on tax base effectiveness ($\beta = 0.6330$, $p < 0.05$), indicating that increased digital payment activities enhance tax mobilisation through improved transaction traceability and monitoring. Conversely, e-commerce growth (ΔECG), GDP growth, and inflation remain statistically insignificant, suggesting that the broader digital economy has yet to be effectively integrated into Nigeria's tax system to generate sustained fiscal gains. Overall, the findings indicate that digital payment systems contribute to tax mobilisation only in the short run, while structural and institutional constraints limit their long-run impact on tax base effectiveness.

Diagnostic Tests

To assess the validity and robustness of the estimated ARDL model, post-estimation diagnostic tests for serial correlation, heteroskedasticity, multicollinearity, and parameter stability were conducted to ensure that the model satisfies the classical regression assumptions and provides reliable statistical inference.

Serial Correlation Test

Table 10: Breusch–Godfrey Serial Correlation Test

Statistic	Value
Chi-square	0.007
Prob > Chi-square	0.9323

Source: Author's computation using STATA output (2026)

The Breusch–Godfrey LM test was conducted to assess serial correlation in the residuals. As shown in Table 10, the probability value (0.9323) exceeds the 5% significance level, indicating that the null hypothesis of no serial correlation cannot be rejected. This confirms that the residuals are independently distributed and that the ARDL model is appropriately specified, producing reliable estimates for statistical inference.

Heteroskedasticity Test

Table 11: Breusch–Pagan Test

Statistic	Value
Chi-square	8.04
Prob > Chi-square	0.0046

Source: Author's computation using STATA output (2026)

The Breusch–Pagan test was conducted to examine the presence of heteroskedasticity. As reported in Table 11, the probability value (0.0046) is below the 5% significance level, indicating the presence of heteroskedasticity in the model. Although this does not bias the estimated coefficients, it may affect the efficiency of the estimates and the reliability of statistical inference. Consequently, heteroskedasticity-robust standard errors are recommended to ensure valid inference.

Multicollinearity Test

Table 12: Variance Inflation Factor (VIF)

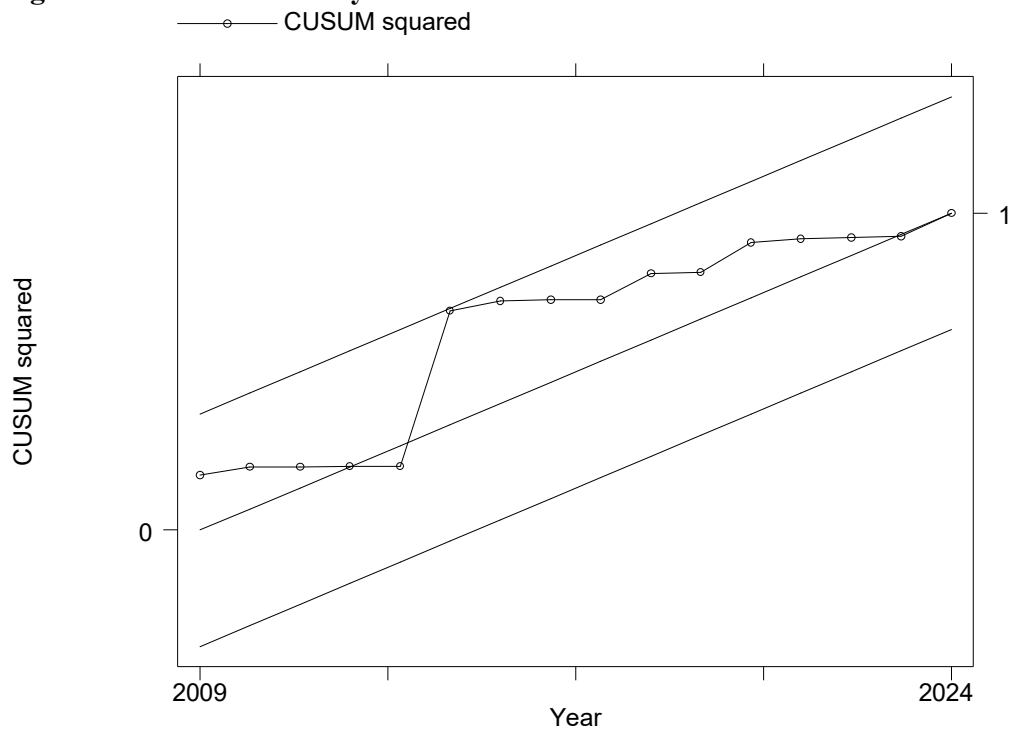
Variable	VIF	Tolerance
OT	8.39	0.119
OP	7.60	0.132
GDPR	1.88	0.531
INFR	1.79	0.559
Mean VIF	**4.92**	—

Source: Author's computation using STATA output (2026)

The Variance Inflation Factor (VIF) was used to assess multicollinearity among the explanatory variables. As shown in Table 12, all VIF values are below the conventional threshold of 10, with a mean VIF of 4.92, indicating the absence of serious multicollinearity. Although e-commerce growth (ECG) and online payment volume (OPV) exhibit relatively higher VIF values, they remain within acceptable limits, suggesting that the estimated coefficients are reliable and can be interpreted with confidence.

4.8.4 Model Stability Test

Figure 1: CUSUM Stability Test



Source: Author's computation using STATA output (2026)

The stability of the estimated ARDL model was assessed using the CUSUM test. As shown in Figure 1, the CUSUM plot remains within the 5% critical bounds throughout the study period, indicating that the model is structurally stable and the estimated parameters are consistent over time. Overall, the diagnostic tests confirm that the model is free from serial correlation and serious multicollinearity, while parameter stability is maintained. Although heteroskedasticity is present, it can be addressed using robust standard errors, indicating that the model is sufficiently reliable for estimation, interpretation, and policy analysis.

Hypothesis Testing and Discussion of Findings

Hypothesis One

H_{01}: E-commerce growth has no significant effect on tax base effectiveness in Nigeria.

The ARDL results indicate that e-commerce growth exerts a negative but statistically insignificant effect on tax base effectiveness. Consequently, the null hypothesis is not rejected, implying that e-commerce growth does not significantly influence tax base effectiveness in Nigeria. This finding suggests that the rapid expansion of digital commerce has not translated into meaningful improvements in tax mobilisation. The result is consistent with studies that argue digitalisation alone does not enhance tax performance in the absence of effective regulatory and institutional frameworks. For instance, UNCTAD (2024) reported that the rapid growth of e-commerce without adequate tax frameworks can erode the domestic tax base, while Kraus (2025) found that poorly designed digital tax regimes may discourage digital participation and weaken the taxable base. Similarly, Ogbonna et al. (2022), Apalowowa et al. (2024), and Santoro et al. (2024) concluded that digital tax initiatives may improve administrative processes without producing significant gains in tax mobilisation where institutional capacity remains weak.

The insignificant effect may be attributed to the structure of Nigeria's digital economy, where a substantial proportion of online transactions occur through informal platforms, social media channels, and unregistered businesses that remain outside the formal tax system. Consequently, although e-commerce has expanded economic activity, the tax administration system appears insufficiently integrated with digital platforms to identify taxable transactions and enforce compliance effectively. The finding therefore supports the view that digital commerce alone is insufficient to strengthen tax base effectiveness without corresponding legal, institutional, and administrative reforms.

Hypothesis Two

H_{02}: Online payment volume has no significant effect on tax base effectiveness in Nigeria.

The ARDL results indicate that online payment volume has no significant long-run effect on tax base effectiveness. However, its short-run coefficient is positive and statistically significant, indicating that increased digital payment activity enhances tax mobilisation only in the short term. Accordingly, the null hypothesis is not rejected in the long run but rejected in the short run, suggesting that online payment volume exerts only a temporary positive influence on tax base effectiveness.

This finding is consistent with studies that highlight the short-term benefits of digital payment systems for tax administration. Apeti (2023) found that increased digital payment usage improves tax revenue by enhancing transaction visibility, while Omodero and Ekundayo (2025) reported that digital payment platforms strengthened tax collection efficiency in Nigeria. Similarly, Nwankwere (2024) observed that online payment systems significantly improved tax compliance through better transaction traceability and audit trails. These findings support the view that digital payment systems can facilitate tax mobilisation by improving the visibility of economic activities.

Nevertheless, the absence of a significant long-run relationship suggests that these gains are not sustained over time. This finding aligns with Falana (2024), who argued that digitalisation does not automatically improve tax outcomes without effective enforcement and taxpayer awareness. Likewise, Santoro and Rossel (2025/2026) maintained that digital payments strengthen tax systems only when supported by strong administrative capacity, inter-agency data integration, and effective enforcement, while Ogbonna et al. (2022) emphasised that digital payment mechanisms alone are

insufficient to improve tax yield without complementary reforms such as taxpayer identification, audit integration, and the formalisation of informal businesses.

The findings therefore suggest that although digital payment systems provide short-term support for tax mobilisation through improved transaction traceability, Nigeria's tax administration has not yet developed the institutional capacity required to transform these temporary gains into sustained improvements in tax base effectiveness.

5.0 Conclusion and Recommendations

This study examined the relationship between e-commerce growth, online payment volume, and tax base effectiveness in Nigeria using annual time-series data spanning 2000–2024 and the Autoregressive Distributed Lag (ARDL) approach. The findings reveal that e-commerce growth does not significantly influence tax base effectiveness, while online payment volume exerts a positive and significant effect only in the short run. Furthermore, the absence of a long-run equilibrium relationship and the insignificant error correction term indicate that the expansion of digital economic activities has not translated into sustained improvements in tax mobilisation. These findings suggest that Nigeria's digital economy is growing faster than the institutional capacity of the tax system to capture and convert digital transactions into sustainable fiscal revenue.

The study therefore concludes that digitalisation alone is insufficient to strengthen tax base effectiveness without complementary legal, institutional, and administrative reforms. Accordingly, policymakers should strengthen the digital tax framework, integrate digital payment data into tax administration systems, promote the formalisation of digital businesses, enhance collaboration between tax authorities and fintech service providers, and invest in advanced digital technologies to improve tax compliance and enforcement. Future studies should extend the analysis by incorporating additional dimensions of the digital economy, institutional and governance variables, firm-level or cross-country data, and alternative econometric techniques to provide deeper insights into digital taxation and revenue mobilisation in developing economies.

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