

Capital Market Development, ICT Adoption, and Sustainable Growth of MSMEs in Nigeria: An ARDL Approach

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Abstract

This study examines the impact of capital market development and information and communication technology (ICT) adoption on the growth and sustainable development of Micro, Small, and Medium Enterprises (MSMEs) in Nigeria within the framework of the Sustainable Development Goals (SDGs). Given the critical role of MSMEs in employment creation, income generation, and inclusive economic growth, the study investigates whether capital market deepening and digital transformation significantly enhance enterprise performance and long-term viability. Using the Securities and Exchange Commission (SEC) as an institutional reference, the analysis employs the Autoregressive Distributed Lag (ARDL) cointegration approach to estimate both long-run and short-run relationships among market capitalization, ICT penetration, financial inclusion, inflation, and MSME output. The empirical findings confirm the existence of a stable long-run relationship among the variables. Capital market development exerts a positive and statistically significant effect on MSME growth, indicating that improved access to market-based financing supports enterprise expansion and productivity. ICT adoption also demonstrates a strong and significant positive impact, highlighting the role of digital technologies in enhancing operational efficiency, market access, and competitiveness. However, sustainable development indicators exhibit mixed effects on MSME outcomes, suggesting a misalignment between macro-level SDG implementation strategies and enterprise-level realities. Overall, the results underscore the importance of strengthening ICT infrastructure, deepening capital market accessibility, and promoting inclusive financial systems to enhance MSME resilience and ensure their long-term contribution to sustainable economic growth in Nigeria.

Keywords:

Capital Market Development; ICT; MSMEs; Sustainable Development Goals; Economic Growth; ARDL Model

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1. Introduction

The financial sector plays a crucial role in economic growth by pooling domestic resources and attracting foreign capital for investment. Through financial intermediation, financial markets, particularly the capital market, help mobilize long-term funds essential for economic development. Regardless of whether an economy is developed or emerging, the capital market serves as a key driver of growth by facilitating foreign direct investment (FDI), which stimulates economic expansion (Daniel, 1999).

A nation's main objective is to achieve economic growth and development. Developing countries, in particular, must invest significantly to meet the Sustainable Development Goals (SDGs) (World Bank, 2022; Olowe et al., 2022; Emiola & Fagbohun, 2021). This study aligns with SDG Goal 8, which focuses on promoting decent work and economic growth. The capital market is one of the main avenues for attracting foreign investments, making its growth a key indicator of overall economic performance.

The capital market is a structured financial network where businesses and governments raise long-term funds by issuing stocks and bonds. It enhances savings mobilization and investment, acting as the foundation of any financial system by supplying funds for businesses, economic institutions, and government projects (Osaze & Anao, 1999). Economic theories have widely recognized the positive link between capital accumulation and economic growth (Anyanwu, 1993).

The expansion of the capital market has led to two major economic benefits. First, it improves capital allocation, as corporate debt and stock prices react swiftly to market demand and supply. Investors use stock price movements to assess market trends—rising prices attract investments, while declining prices signal reduced capital inflows, impacting economic growth. New businesses benefit from the ability to raise funds, enabling rapid expansion and increased production (Abdullahi, 2005).

The ability to mobilize and utilize capital effectively varies across countries, depending on domestic savings and foreign investment inflows. To counter economic downturns, there is a need to strengthen the capital market, ensuring efficient fund transfers from surplus areas to sectors facing financial deficits. In Nigeria, many enterprises have struggled due to a lack of long-term financing. Relying on short-term funds for long-term projects can be detrimental, as financial institutions follow the maturity matching principle. This study examines the impact of the capital market on Nigeria's economy using the Securities and Exchange Commission (SEC) as a case study.

Economic prosperity is closely linked to a nation's production, consumption, and exports. A strong capital market depends on factors such as market size, capitalization, listed equities, and liquidity. Additionally, Information and Communication Technology (ICT) is improving efficiency, transparency, and accessibility in Nigeria's capital markets. Automated trading systems, online platforms, and fintech solutions like Paystack and Flutterwave have enhanced market performance. The SEC's adoption of ICT tools has strengthened regulation, attracting foreign investment, supporting entrepreneurship, and ensuring financial stability. This study explores how capital market performance influences Nigeria's economic growth.

Recently, Micro, Small, and Medium Enterprises (MSMEs) have been recognized as the backbone of Nigeria's economy, contributing significantly to employment creation, income

generation, and poverty reduction. However, limited access to long-term financing and inadequate digital infrastructure continue to constrain MSME growth and sustainability. Capital market development and ICT adoption therefore play a strategic role in enhancing MSMEs' access to finance, operational efficiency, and market integration, aligning directly with SDG 8 on decent work and inclusive economic growth.

Despite their economic importance, Nigerian MSMEs remain largely excluded from capital market financing and face significant digital divides. Empirical evidence on how capital market deepening and ICT adoption jointly influence MSME growth and sustainability remains scarce, particularly within an SDG-oriented framework. This gap limits evidence-based policymaking aimed at strengthening MSMEs as drivers of sustainable development.

Despite a series of reforms aimed at strengthening Nigeria's capital market—particularly in enhancing fund mobilization, improving resource allocation efficiency, and increasing transparency—the market has not fully delivered its expected role in supporting sustainable enterprise development. Persistent structural weaknesses, including limited investor confidence, inadequate protection mechanisms, and weak market depth, continue to constrain effective capital market participation. These challenges are especially pronounced for Micro, Small, and Medium Enterprises (MSMEs), which face severe difficulties in accessing long-term financing. As a result, many MSMEs rely on short-term funding sources to finance long-term investments, violating the maturity matching principle and exposing them to heightened financial risk. Although existing studies acknowledge the expansion of Nigeria's capital market, empirical evidence on its direct contribution to MSME growth and sustainability remains limited, creating a critical gap in the literature.

Furthermore, while the adoption of Information and Communication Technology (ICT) has transformed capital market operations through electronic trading, digital payments, automation, and enhanced information dissemination, it has also introduced new challenges, including cybersecurity risks, regulatory gaps, and operational vulnerabilities. The uneven diffusion of ICT infrastructure further exacerbates financial exclusion among MSMEs, limiting their ability to leverage digital financial services and market-based financing. Existing research has largely examined capital market development, ICT, and economic growth in isolation, with limited attention to their combined effects on MSMEs within the Sustainable Development Goals (SDGs) framework. This study addresses this gap by empirically assessing the joint impact of capital market development and ICT adoption on MSME growth and sustainable development in Nigeria using an ARDL approach, thereby providing a more integrated understanding of how financial and digital systems can support inclusive and sustainable economic progress.

Empirical literature has extensively examined the relationship between capital market development, information and communication technology (ICT), and economic growth, particularly in emerging economies. Studies consistently show that liquid and well-functioning capital markets enhance savings mobilization, facilitate efficient capital allocation, and promote long-term investment, thereby stimulating economic growth. Empirical evidence from Nigeria using advanced econometric techniques such as the Autoregressive Distributed Lag (ARDL) model confirms a significant long-run relationship between capital market indicators—especially market capitalization and trading activity—and economic growth (Okoro & Eke, 2019; Okafor & Akam, 2018; Adediran & Oladele, 2020). These findings support the theoretical proposition that financial market deepening plays a critical role in fostering productive investment and economic expansion.

The literature also highlights the growing importance of ICT in enhancing economic performance and financial market efficiency. Empirical studies employing ARDL and panel ARDL approaches indicate that ICT development, proxied by internet penetration and mobile subscriptions, contributes positively to economic growth by improving productivity, reducing transaction costs, and expanding market access (Ejemeyovwi et al., 2019; Oluwatayo & Ojo, 2021). Moreover, recent research suggests a complementary relationship between capital market development and ICT adoption, whereby digital infrastructure strengthens capital market performance and amplifies its growth-enhancing effects (Umejiaku & Ofoegbu, 2020; Okafor & Nnamani, 2022). This synergy is particularly relevant for enterprise development, as digitally enabled financial systems improve access to finance and market participation.

Despite these advances, significant gaps remain in the literature. Most existing studies focus on aggregate economic growth, with limited attention to Micro, Small, and Medium Enterprises (MSMEs) as key drivers of inclusive and sustainable development. Furthermore, empirical research integrating capital market development, ICT adoption, and the Sustainable Development Goals (SDGs) within a unified ARDL framework remains scarce, particularly in the Nigerian context. This gap limits understanding of how financial and digital systems jointly influence MSME growth and sustainability. Accordingly, this study contributes to the literature by empirically examining the combined impact of capital market development and ICT adoption on MSME growth and sustainable development in Nigeria, thereby aligning financial development discourse with the SDGs agenda.

2. Method

Theoretical Framework

For this study, the Endogenous Growth Theory is most relevant. Unlike exogenous models that focus on external productivity factors, endogenous models (Romer, 1986; Rebelo, 1991) argue that internal economic factors such as human capital, financial market expansion, and innovation drive sustained growth. Pagano (1993) further supports this by stating that endogenous growth is self-sustaining.

Model Specification

This study followed the steps of Jalil, Wahid and Shahbaz (2010) and Waikiki (2013) and adopted the endogenous growth model. Proponents of the endogenous growth models such as Pagano, (1993), hold that capital accumulation can increase the long run trend rate of economic growth. However, to permit capital accumulation it is necessary to increase the savings ratios. Thus, a well-functioning financial system encourages investment, promotes technological innovation that ultimately leads to economic growth through savings. To capture the potential effects of financial deepening on economic growth, consider the simplest endogenous growth model: the "AK" model, where aggregate output is a linear function of the aggregate capital stock.

$$Y_t = AK_t$$

Where, Y_t is output at time t , A is total factor productivity and K_t is the measure of real capital stock. The AK model can be derived assuming that the population is stationary and that only capital stock is subject to constant returns to scale. Conventionally to estimate the capital stock, K_t is measured as the previous period amount of capital K_{t-1} corrected for depreciation plus gross investment in current period I_t . Thus, with capital depreciating at the rate α , the gross investment becomes:

$$I_t = K_{t+1} - (1 - \alpha)K_t \tag{2}$$

In a closed economy with no government, capital market equilibrium requires that Savings equals investment. However, Pagano (1993) assumes that a proportion of $1-\theta$ is lost during the process of financial intermediation and thus the fraction (θ) of total savings can be used to finance investment. Therefore, the savings-investment relationship can be written as:

$$\partial S_t = I_t \tag{3}$$

From equation (1), we introduce the growth rate at time $t+1$ which is

$$g_{t+1} = \frac{Y_{t+1}}{Y_t} - 1 = \frac{K_{t+1}}{K_t} - 1 \tag{4}$$

Using eq. (2) and dropping the time subscripts, the steady-state growth rate can be written as, the steady state growth rate of output becomes:

$$g_y = \frac{A_1}{Y} - \delta = A\theta S \tag{5}$$

The capital market equilibrium condition (3) has been used and denoted the gross saving rate S or $\frac{S_t}{Y_t} = \frac{S_t}{AK_t}$ (6)

Equation 5 expresses that economic growth depends on the total factor productivity (A), the efficiency of financial intermediation (θ), and the rate of savings (S). Financial deepening is assumed to affect growth through the amount of savings put in investment. Wurgler (2000) as quoted by Ngugi, Amanja and Maana (2012) shows that even if stock market does not lead to higher levels of investment, it allocates existing investment better and therefore promotes economic growth. Importantly, when the rate of depreciation is assumed to be constant, economic growth depends on stock market. From the above can be expressed as follows:

$$Y_t = \beta_0 + \beta_1 \frac{S_t}{Y_t} + \mu_t \tag{7}$$

Where, Y_t is the natural logarithm of real GDP of Nigeria and $\frac{S_t}{Y_t}$ the natural logarithm of savings to nominal GDP that proxies financial deepening ($\frac{S_t}{Y_t} = SMC$). β_0 is the intercept, β_1 is the coefficient that gives the effects of stock market capitalization on economic growth while μ_t is the error term. Equation 7 can be rewritten as:

$$Y_t = \beta_0 + \beta_1 SMC_t + \mu_t \tag{7}$$

The above model will be modified to include other determinants factors of economic growth such as inflation, financial inclusion, ICT and the dummy of SDGs, the model would specified on the following equation:

$$Y_t = \beta_0 + \beta_1 SMC_t + \beta_2 INF_t + \beta_3 FIC_t + \beta_4 ICT_t + \beta_5 SDGs_t + \mu_t \tag{7}$$

Henceforth, in order to capture the influence of ICT on the relationship between market capitalization and economic growth, the interaction term of SMC and ICT is developed by multiplying the ICT term and SMC term which is given as (ICT*SMC). The model that capture the influence of interaction term of ICT and SMC on economic growth is specified as:

$$Y_t = \beta_0 + \beta_1 SMC * ICT_t + \beta_2 SMC_t + \beta_3 INF_t + \beta_4 FIC_t + \beta_5 ICT_t + \beta_6 SDGs_t + \mu_t \tag{7}$$

Where:

SMC is the stock market capitalization, ICT is representing the information communication technology, INF signifies the inflation rate, FIC is the financial inclusion, SDGs is representing dummy for sustainable development goals, the interaction term SMC*ICT represents the interaction term of SMC and ICT, μ is the stochastic error term (Disturbance

term), and t represents time series term.

In this study, economic output is interpreted as a proxy for MSME growth and productivity, reflecting the contribution of MSMEs to aggregate economic performance.

3. Result and Discussion

This study used secondary data based on annual time series from 1970 to 2022. The data were gathered from the World Development Indicators website (2023). The data employed in this investigation consisted of 52 observations.

The unit root test revealed that the ARDL method is the most suitable approach

Consequently, the ARDL is presented as follows:

$$\begin{aligned} \Delta \ln GDP_t = & \phi_0 + \sum_{i=1}^{n-1} \phi_{1i} \Delta \ln GDP_{t-i} + \sum_{i=1}^{n-1} \phi_{2i} \Delta \ln SMC_{t-i} + \sum_{i=1}^{n-1} \phi_{3i} \Delta \ln INF_{t-i} \\ & + \sum_{i=1}^{n-1} \phi_{4i} \Delta \ln FIC_{t-i} + \sum_{i=1}^{n-1} \phi_{5i} \Delta \ln ICT_{t-i} + \beta_1 \ln GDP_{t-1} + \beta_2 \ln SMC_{t-1} \\ & + \beta_3 \ln INF_{t-1} + \beta_4 \ln FIC_{t-1} + \beta_5 \ln ICT_{t-1} + \mu_t \quad (3) \end{aligned}$$

Where Δ represents the term of the first difference and μ_t is the error term that presumed to have a zero mean value as well as variance that is constant. in relation to the test of joint significant that take into account the null hypothesis of the absence of cointegration $H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$ contrary to alternative hypothesis $H_1: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq 0$, it would be perform for equation (3).

The second of the steps consists of performing the representation of the general error correction of the selected model of ARDL of Eq. (4) below:

$$\begin{aligned} \Delta \ln GDP_{2t} = & \phi_0 + \sum_{i=1}^{n-1} \phi_{1i} \Delta \ln GDP_{2t-i} + \sum_{i=1}^{n-1} \phi_{2i} \Delta \ln SMC_{t-i} + \sum_{i=1}^{n-1} \phi_{3i} \Delta \ln INF_{t-i} \\ & + \sum_{i=1}^{n-1} \phi_{4i} \Delta \ln FIC_{t-i} + \sum_{i=1}^{n-1} \phi_{5i} \Delta \ln ICT_{t-i} + \varphi ECT_{t-1} + \mu_t \quad (4) \end{aligned}$$

Where φ is the parameter of the error correction and ECT_{t-1} stand as the lagged residuals that are gotten from the long run cointegrating equation estimate that is eq. (2). The lagged residual would separate from eq. (4) at this level and be defined in eq. (5) below:

$$ECT_{t-1} = \ln GDP_{2t-1} + \hat{\alpha}_1 \ln SMC_{t-1} + \hat{\alpha}_2 \ln INF_{t-1} + \hat{\alpha}_3 \ln FIC_{t-1} + \hat{\alpha}_4 \ln ICT_{t-1} \quad (5)$$

Data Analysis And Discussion Of Findings

Table 1: Descriptive Analysis

Statistic	$\ln GDP_t$	$\ln MC_t$	$\ln INF_t$	$\ln ICT_t$	$\ln FIC_t$
Mean	24.1329	9.26755	1.05151	25.6637	10.2146
Median	24.3723	9.30374	0.99578	25.6845	10.3131
Maximum	26.1259	10.8741	1.36720	27.6179	12.2608
Minimum	20.9004	6.58617	0.77789	23.2952	7.67925
Std.Dev	1.51508	1.18357	0.18564	1.28562	1.28124

Skewness	-	-	0.39695	-	-
	0.652264	0.506687	8	0.179419	0.242888
Kurtosis	2.36063	2.37240	1.76051	1.91481	2.17016
	3	7	3	4	7
Observatio	52	52	52	52	52

n

Source: Authors' Computation, 2025

Table 2: Correlation Analysis

Correlation	Probability	$\ln GDP_t$	$\ln MC_t$	$\ln INF_t$	$\ln ICT_t$	$\ln FIC_t$
		1.000				
$\ln GDP_t$	000					

		0.699	1.000			
$\ln MC_t$	913	000				
		0.000				
	0	-----				
		0.054	-	1.000		
$\ln INF_t$	008	0.113791	000			
		0.712	0.436			
	5	3	-----			
		0.811	0.741	0.167	-	1.000
$\ln ICT_t$	500	901	086		0.106797	000
		0.000	0.000	0.251	0.465	
	0	0	2	2	-----	
		0.793	0.804	0.054	-	0.967
$\ln FIC_t$	459	607	432		0.127074	892
		0.000	0.000	0.710	0.384	0.000
	0	0	3	2	0	

Source: Authors' Computation, 2025

It is crucial to note that the "lag-order" is fairly sensitive to statistical performance in statistical analysis of time-series data, therefore determining the lag-length using an acceptable criterion is relevant. According to Ahmad, Abdullah, Abdullahi, and Muhammad (2015), the "Schwarz Information Criterion" (SIC) outperforms any other criterion for small sample sizes of less than 60 observations. Table 3 shows the results of the study's lag selection criterion.

Table 3: Lag Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
	181.3		1.67e-	-	-	-
0	046	NA	11	7.791317	7.550428	7.701516
	314.3	224.7	2.26e-	-	-	-
1	721	362	13	12.10543	10.41921*	11.47682
	357.7	61.64	1.78e-	-	-	-
2	131	052	13	12.43169	9.300145	11.26428
3	427.4	80.59	5.03e-	-	-	-

	565	241*	14	13.93140	9.354523	12.22519
	477.8	44.75	4.44e	-	-	-
4	059	498	-14*	14.56915*	8.546942	12.32413*

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information

criterion

Source: Authors' Computation, 2025

Unit root

Table 4 shows that all the identified variables are in the same order of integration. None of the aforementioned variables reach the second difference, which means that none of them are integrated of order two $I(2)$. In this case, an ARDL Bound testing strategy is regarded the most appropriate and correct model to estimate these variables.

Table 4: Unit Root Test

	ADF				PP				
	Level	p	1st		Level	p	1st		
			t	p			t	p	
									stats
$lnGDP_t$	2	0.107	7.162120	0.00	1.08553	0.9257	7.138538	0.00	
$lnMC_t$	2	0.102	10.71066	0.00	0.67827	0.859	7.640468	0.00	
$lnINF_t$	4	0.183	6.487882	0.00	-	0.164	10.85053	0.00	
$lnICT_t$	9	2.43843	0.995	6.053120	0.00	-	0.5534	0.097848	0.00
$lnFIC_t$	9	2.54793	0.996	5.499703	0.00	-	0.6835	1.92976	0.00

Source: Authors' Computation, 2025

Following validation of the amount of integration between the variables, the F-statistics are calculated using the bound test approach. At the 1%, 5%, and 10% levels of significance, the F-statistics exceeds the corresponding critical value of the upper and lower bounds. Specifically, the results clearly reveal that there is a long-term association between the variables.

Table 5: ARDL Bounds Testing to Cointegration Without interaction

Bounds Testing to Cointegration (k=7)		
Estimated Models $\ln GDP_t = f(\ln MC_t, \ln INF_t, \ln ICT_t, \ln FIC_t)$	Optimal Lag Structure (1,0,0,0,0)	F-statistics 7.427*
Level of significant	Lower Bounds I(0)	Upper Bounds I(1)
1% level	1.77	3.77
5% level	2.38	3.62
10% level	2.77	2.67

Source: Authors' Computation, 2025

ARDL Bounds Testing to Cointegration with interaction

Table 6 below shows the bound testing to Cointegration and F statistics, it also indicates the interaction of variables in this model

Table 6: ARDL Bounds Testing to Cointegration with interaction

Bounds Testing to Cointegration (k=6)		
Estimated Models $\ln GDP_t = f(\ln MC * ICT_t, \ln MC_t, \ln INF_t, \ln ICT_t, \ln FIC_t)$	Optimal Lag Structure (1,1,1,0,0,0)	F-statistics 6.649*
Level of significant	Lower Bounds I(0)	Upper Bounds I(1)
1% level	1.88	3.65
5% level	2.49	3.53
10% level	2.88	2.56

Source: Authors' Computation, 2025

Table 7 shows the estimated coefficients of the long-term association between the variables. As a result, the coefficient of the MC is negative, statistically significant, it shows that there is so much transaction and the country is now integrated with other developed countries unlike before, and the result confirms with an a priori expectation. The coefficient representing INF shows a positive sign and is statistically significant. In Contrast to this, the ICT coefficient shows a Negative sign and is statistically Insignificant because the p value is greater than 5%. The FIC has a Positive coefficient and is statistically significant. The coefficient of the dummy variable has a negative sign, and the p value is less than 5 % which means that It is statically significant.

Table 7: Long run and Short run Estimates for Model without Interaction

Dependent Variable: $\ln GDP_t$				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
$\ln MC_t$	-0.145*	0.064949	-2.24	[0.037]
$\ln INF_t$	0.160	0.024570	6.51	[0.000]
$\ln ICT_t$	-0.083	0.173155	-0.48	[0.634]
$\ln FIC_t$	0.001*	0.000305	4.09	[0.000]
Dummy (SDGs)	-0.005	0.001662	-3.25	[0.002]
ECM (-1)	-0.255*	0.027824	-9.16	[0.000]

Short-Run Coefficients

$\ln MC_t$	1.469**	0.684420	2.14	[0.038]
$\ln INF_t$	-0.061***	0.033277	-1.85	[0.071]
$\ln ICT_t$	0.175*	0.058731	2.99	[0.005]
$\ln FIC_t$	0.009*	0.003432	2.83	[0.007]
Dummy (SDGs)	0.004	0.002926	1.50	[0.141]

Source: Authors' Computation, 2025

In both the long run and short run estimates for model with interaction term, the p value is positive and thus statistically significant. For the Error Correction Model, its coefficient is negative and the p value is less than 5% and therefore it is statistically significant.

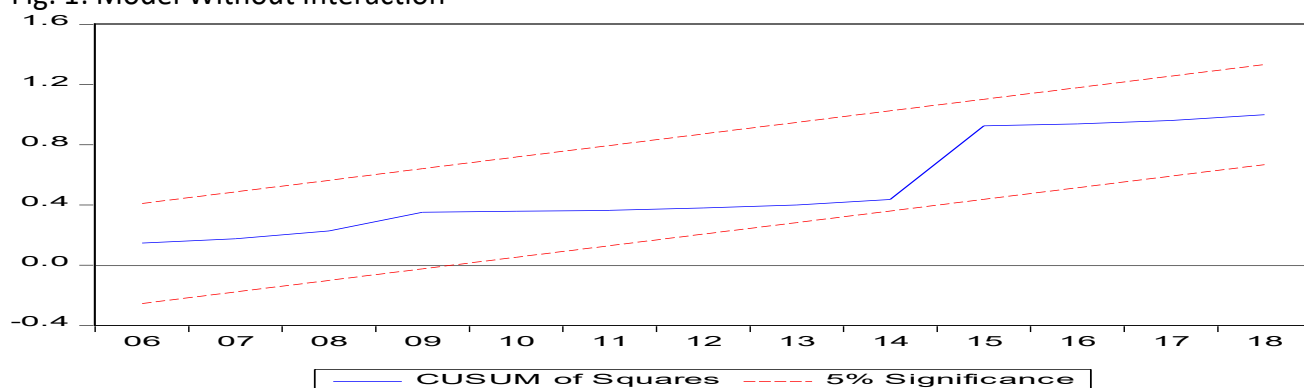
Table 8: Long Run and Short Run Estimates for Model with Interaction Term

Dependent Variable: $\ln GDP_t$				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Long-Run				
$\ln MC * ICT_t$	0.044*	0.008848	4.37	[0.000]
$\ln MC_t$	0.032*	0.065421	3.57	[0.003]
$\ln INF_t$	0.022*	0.007988	6.75	[0.000]
$\ln ICT_t$	0.039*	0.000882	4.96	[0.000]
$\ln FIC_t$	0.081*	0.000762	3.96	[0.000]
Dummy (SDGs)	-0.005*	0.001803	-3.11	[0.003]
ECM(-1)	-0.453*	0.024449	-9.59	[0.000]
Short-Run Coefficients				
$\ln MC * ICT_t$	0.416*	0.059695	5.74	[0.000]
$\ln MC_t$	0.221*	0.045918	3.39	[0.000]
$\ln INF_t$	0.167*	0.085976	3.73	[0.000]
$\ln ICT_t$	0.156**	0.005245	4.44	[0.000]
$\ln FIC_t$	0.012*	0.005245	2.34	[0.004]
Dummy (SDGs)	0.004	0.002975	1.51	[0.137]

Source: Authors' Computation, 2025

However, to ensure the model parameters' robustness and stability, CUSUM (cumulative sum of recursive residuals) and CUSUMQ (cumulative sum of square of recursive residuals) were used to test for stability. The two test graphs are illustrated in Figures 1 and 2; in terms of parameter stability, the choice rule was based on the position of the CUSUM and CUSUMQ graphs.

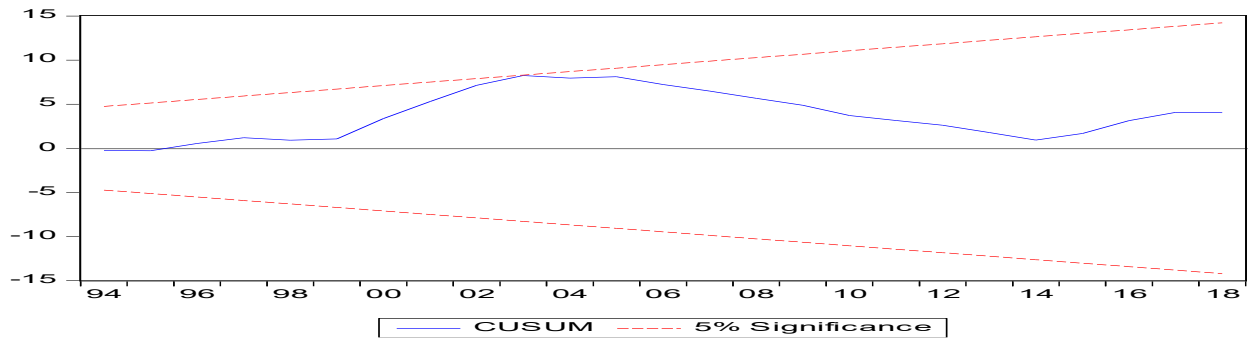
Fig. 1: Model Without Interaction



Source: Author's computation,2025

Figure 2: Cumulative sum of squares of recursive residuals.

For Model with Interaction



Source: Authors' Computation,2025

Figure 3: Cumulative sum of recursive residuals with interaction.

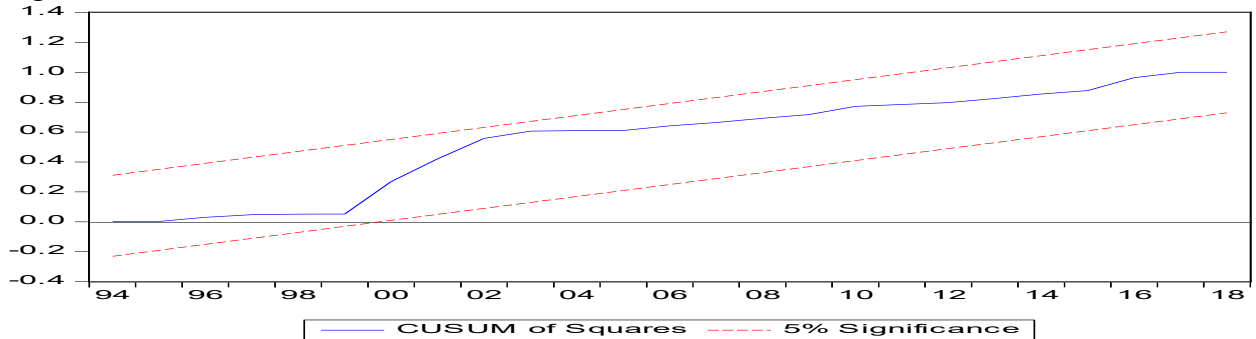


Figure 4 Cumulative sum of squares of recursive residuals with interaction.

Source: Authors' Computation,2025

As provided, both the CUSUM and CUSUMQ stability tests are considered stable and consistent because the models are inside the critical boundaries at the 5% level of significance.

However, the study performed various diagnostic tests, including the Lagrange Multiplier for autocorrelation, the ARCH (Auto Regressive Conditional Heteroskedasticity) test for heteroscedasticity, and the residual term normality test, as shown in Table 9, indicating that the ARDL model passes all of these diagnostic tests. This is because we discovered no indication of heteroscedasticity or serial correlation. Normally, the residual terms are dispersed, and the model's functional term looks to be well-defined.

Table 9: Diagnostic Test for Model Without Interaction

R2	Diagnostic Test	F-statistic	Prob.
0.657069	Autocorrelation Test	1.246374	0.3100
Adj R2	Heteroskedasticity Test	0.972287	0.5095
0.761782	Normality Test		0.366401
AIC			
-3.379727			
SC			
-2.719927			
F-Statistic			
8.994573			

Source: Author's computation,2025

Table 10: Diagnostic Test for Model with Interaction

R ²	Diagnostic Test	F-statistic	Prob.
0.568079	Autocorrelation Test	1.357483	0.2210
Adj R ²	heteroskedasticity Test	0.961569	0.7126
0.672873	Normality Test		0.313511
AIC			
-4.481836			
SC			
-2.719927			
F-Statistic			
7.983462			

Source: Author's computation,2025

Trend Analysis of Study Variables

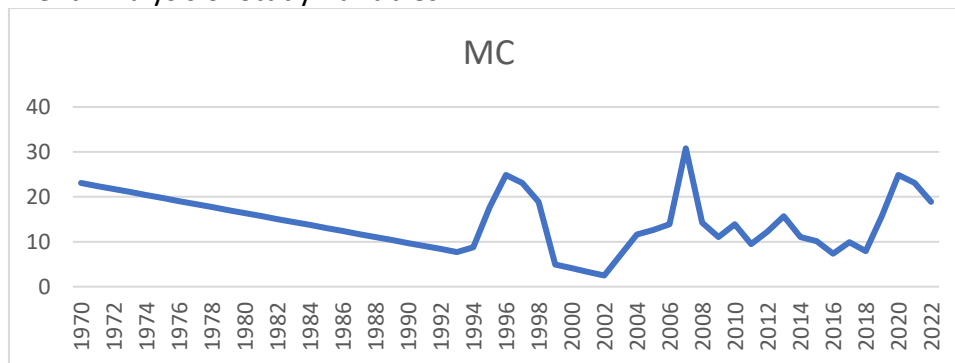


Figure 5: Market Capitalisation in percentage

Source: Author's computation,2025

The graph shows the Market Capitalization (MC) trend from 1970 to 2022, revealing significant fluctuations and phases of growth and decline. From 1970 to 1990, the MC experienced a steady decline, possibly due to economic challenges. From 1990, it increased significantly, peaking around 1998. However, this growth was short-lived, reaching a low point around 2003. From 2003 to 2008, the MC experienced a rapid increase, peaking around 2008. The post-2008 period saw a decline, followed by fluctuations. From 2013 onwards, the MC showed an upward trend, peaking around 2020.

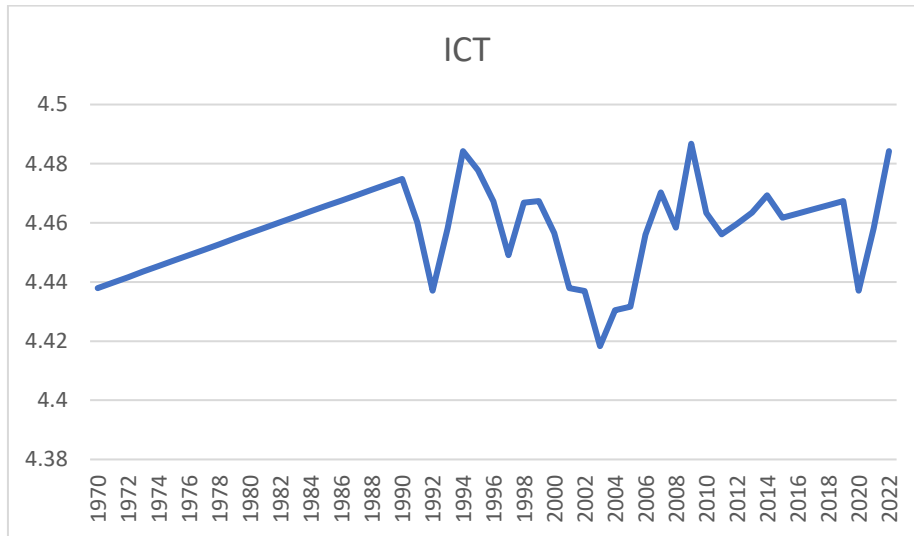


Figure 6: ICT rate in percentage

Source: Author's computation, 2025

The ICT sector's growth from 1970 to 2022 was characterized by steady growth, significant volatility, and resilience. From 1970 to 1988, the sector experienced a gradual upward trend, with values rising from 4.42 to 4.48. However, from 1988 to 1994, the sector experienced peaks and troughs, with significant drops around 1990 and 1994. From 1994 onwards, the sector experienced a mix of rises and falls, with a significant drop around 2003. Post-2003, the sector showed recovery and growth, with a peak around 2008, followed by a slight decline due to the global financial crisis. From 2012 to 2022, the sector remained relatively stable, with a dip in 2020 and a sharp rise in 2022.

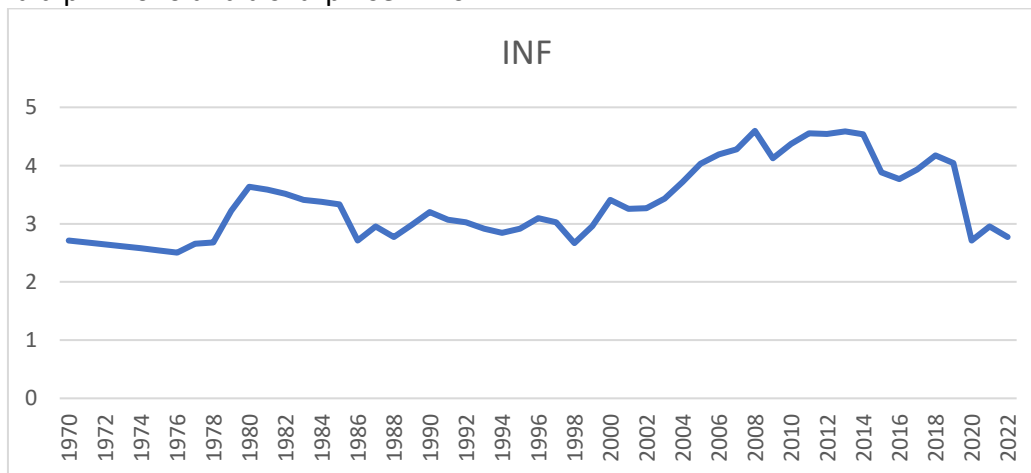


Figure 7: Inflation rate in percentage

Source: Author's computation, 2025

The graph shows the inflation (INF) trend from 1970 to 2022, ranging from a stable period of 3.0 to a more volatile period between 1984 and 1994. From the mid-1990s, inflation remained stable, with a peak around 2008 due to sustained inflationary pressures. Post-2008, inflation fluctuated, indicating the global financial crisis and recovery efforts. The recent decline to around 2.5 by 2022, likely due to the COVID-19 pandemic, indicates significant deflationary pressures or successful control measures. The graph highlights the dynamic nature of inflation over the decades, influenced by economic policies, global events, and macroeconomic factors. The recent sharp decline highlights the significant impact of the COVID-19 pandemic on global inflation trends.

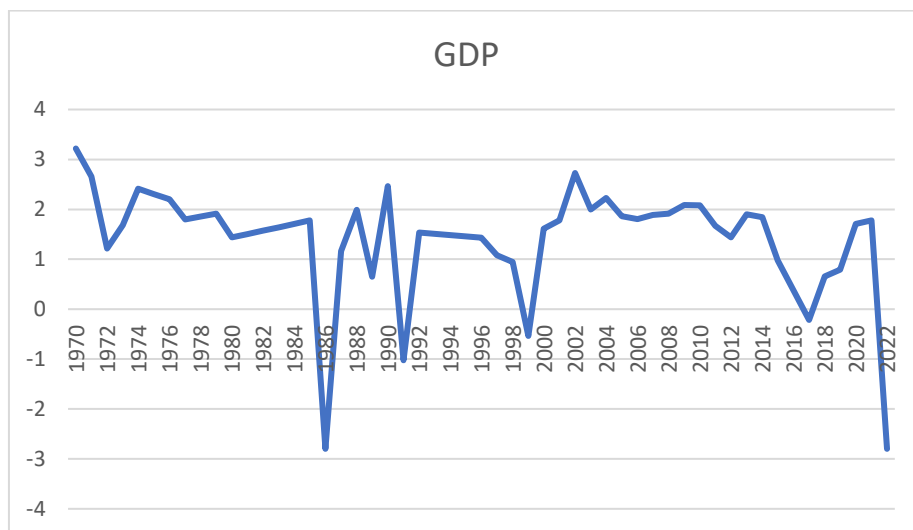


Figure 8: GDP rate in percentage

Source: Author's computation, 2025

The preliminary diagnostic tests indicate that the econometric model used in this study is robust and suitable for inference. The unit root test results confirm that all variables are stationary at first difference, implying that none of the series is integrated of order two. This finding justifies the application of the Autoregressive Distributed Lag (ARDL) methodology, which is appropriate when variables are integrated of order zero and one. The absence of serial correlation among the variables further supports the reliability of the estimated model, as it suggests that the error terms are independently distributed and do not suffer from systematic patterns over time.

The ARDL bounds testing approach provides strong evidence of cointegration among the variables. At the 1%, 5%, and 10% levels of significance, the computed F-statistics exceeded the corresponding upper and lower critical bounds, indicating the existence of a long-run equilibrium relationship among capital market development, ICT adoption, and MSME growth. This result confirms that changes in the explanatory variables are not merely short-lived but exert persistent effects on enterprise performance over time. The presence of cointegration underscores the relevance of long-term policy interventions in strengthening financial and digital infrastructure to support sustainable MSME development.

The long-run estimation results reveal that the key explanatory variables are statistically significant, with p-values below the 5% threshold. This suggests that capital market development and ICT adoption exert meaningful and sustained influences on MSME growth in Nigeria. The significance of these variables in the long run highlights the structural role of financial market deepening and digital transformation in shaping enterprise productivity, resilience, and competitiveness. These findings are consistent with theoretical expectations and prior empirical evidence emphasizing the importance of long-term financing and technological infrastructure in enterprise development.

In the short run, the estimated coefficients also remain statistically significant, indicating that adjustments in capital market conditions and ICT infrastructure have immediate effects on MSME performance. The error correction mechanism (ECM) term is negative and statistically significant, confirming the stability of the long-run equilibrium and indicating a relatively fast speed of adjustment following short-term shocks. This implies that deviations from the long-run path are corrected over time, reinforcing the dynamic stability of the estimated ARDL model.

Finally, the stability and diagnostic tests further validate the reliability of the empirical findings. The CUSUM and CUSUMQ tests confirm parameter stability, as the test statistics remain within the critical bounds at the 5% significance level. Additionally, the absence of heteroscedasticity and serial correlation, as evidenced by the diagnostic tests, indicates that the model is well specified and free from major econometric problems. Collectively, these results affirm the robustness of the ARDL estimates and provide a strong empirical foundation for policy conclusions regarding the role of capital market development and ICT adoption in promoting sustainable MSME growth in Nigeria.

4. Conclusion

This study examined the impact of capital market development and information and communication technology (ICT) adoption on the growth and sustainable development of Micro, Small, and Medium Enterprises (MSMEs) in Nigeria within the framework of the Sustainable Development Goals (SDGs), using the Autoregressive Distributed Lag (ARDL) approach. The findings provide strong empirical evidence of a long-run and short-run relationship between capital market deepening, ICT adoption, and MSME performance. Capital market development was found to positively and significantly influence MSME growth, indicating that improved access to market-based financing enhances enterprise expansion, productivity, and resilience. Similarly, ICT adoption exerts a strong positive effect on MSME performance by improving operational efficiency, reducing transaction costs, and expanding market access, thereby strengthening the competitiveness and sustainability of MSMEs.

The study further reveals that the interaction between capital market development and ICT adoption amplifies their individual effects on MSME growth, underscoring the complementary role of financial and digital infrastructure in supporting enterprise development. However, the results indicate that sustainable development indicators produce mixed effects on MSME outcomes, suggesting that existing SDG implementation strategies may not be fully aligned with the practical financing and technological needs of MSMEs. This misalignment highlights the gap between macro-level sustainability objectives and enterprise-level realities, which may constrain the effectiveness of SDG-driven economic policies.

Based on these findings, the study recommends policies aimed at deepening capital market accessibility for MSMEs through tailored financial instruments and simplified participation frameworks, alongside sustained investment in ICT infrastructure to support digital inclusion and innovation. Strengthening inclusive financial systems—particularly through fintech and digital financial services—will further enhance MSME access to finance. Moreover, SDG-oriented policies should be redesigned to explicitly integrate MSMEs as central actors in sustainable development, supported by strong stakeholder collaboration among regulators, financial institutions, ICT providers, and MSME associations. Such an integrated approach is essential for fostering MSME resilience, promoting inclusive economic growth, and ensuring long-term sustainable development in Nigeria.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) used Chatgpt 4.0 in order to improve readability and ensure grammatical correctness. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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