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Evaluating the Effectiveness of Monetary Policy in Controlling Inflation in Nigeria: A Deep Dive into the Impact of Fuel Price Fluctuations

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Abstract

This study assesses the effectiveness of monetary policy in managing inflation in Nigeria, with a particular focus on the impact of fuel price instability. Utilising monthly data from January 2016 to October 2024 and applying the Autoregressive Distributed Lag (ARDL) model with an Error Correction Mechanism (ECM), the research investigates both the long-run and short-run impact of predictors such as money supply, fuel prices, exchange rates, and private sector credit, on inflation. The findings reveal that money supply has a significant impact on inflation in the long run. Fuel prices emerge as a critical driver, significantly influencing inflation both in the long run and short run. Exchange rate depreciation demonstrates a notable long-run impact, underscoring the inflationary consequences of an unstable Naira. Though modest in its long-run influence, private-sector credit contributes to inflationary pressures by stimulating demand. The Error Correction Mechanism indicates a rapid speed of adjustment, signifying that deviations from the long-run equilibrium are quickly corrected. The study concludes that inflation in Nigeria is driven by both monetary and structural factors, necessitating a comprehensive approach that includes stringent monetary policy, stabilisation of fuel prices, exchange rate management, and targeted credit allocation. Structural reforms in energy and infrastructure, coupled with data-driven policymaking, are essential to mitigate inflationary pressures and ensure sustainable economic stability, highlighting the need for coordinated efforts to balance growth and price stability in the Nigerian economy.

Keywords: Fuel price, Inflation, Monetary policy, Money supply, Nigeria.

1. Introduction

Inflation, often described as the sustained increase in the general price level of goods and services within an economy, plays a crucial role in shaping a nation's economic stability and growth prospects. It erodes the purchasing power of money, posing challenges to both households and businesses in maintaining their financial stability. For consumers, inflation has a notable impact, as escalating prices reduce the quantity

of goods and services they can afford with the same income. This decline in purchasing power disproportionately burdens low-income households, deepening economic disparities and increasing financial struggles for vulnerable populations (Obiora et al., 2023). Meanwhile, businesses face higher operational expenses and uncertainty about future price movements, which may hinder investment, innovation, and economic growth. Additionally, inflation complicates long-term financial planning, making it harder for companies to predict costs, revenue, and profitability (Bada et al., 2016).

Globally, inflation varies significantly across different economies, with developed countries typically experiencing moderate inflation due to balanced supply-demand dynamics. In contrast, developing nations often grapple with much higher inflation rates, driven by structural deficiencies, external economic shocks, and weak monetary frameworks (Taylor, 2019). For instance, the United States has historically experienced moderate inflation, typically ranging between 1% and 3% annually, reflecting steady economic growth and the Federal Reserve's effective monetary policy interventions. However, in recent years, particularly in the wake of the COVID-19 pandemic, the U.S. has seen a sharp rise in inflation, reaching 7.9% in February 2024, the highest since 1982 (USA Bureau for Economic Research, 2024). Similarly, the United Kingdom saw a spike in inflation, which hit a 30-year high of 6.2% in February 2024, while inflation in the Eurozone also surged to 5.9% in the same month, the highest since the introduction of the Euro (Eurostat, 2024).

In developing economies, inflation rates are often much higher due to factors such as unstable currencies, fiscal deficits, and rising costs of essential commodities. Countries in Latin America, such as Argentina, Brazil, and Mexico, have historically experienced double-digit inflation, often fueled by external factors like fluctuating oil prices, geopolitical events, and structural imbalances in their economies (INEGI, 2024). In South Africa and Kenya, inflation remains persistent, further complicating the economic environment (World Bank, 2024).

For Nigeria, inflation has become a major economic challenge, with rates fluctuating significantly over the years. Between June 2015 and June 2024, the inflation rate in Nigeria rose dramatically, with figures oscillating between 9% and 33%. This sustained inflationary pressure is largely attributed to factors such as fluctuations in global oil prices, exchange rate volatility, and the impact of domestic policy decisions (Central Bank of Nigeria [CBN], 2024). In June 2024, Nigeria's inflation rate peaked at 34.19%, marking the highest level in nearly three decades (NBS, 2024). This inflationary pressure was compounded by the removal of fuel subsidies in May 2023, which has led to further increases in fuel prices, pushing inflation even higher. The removal of fuel subsidies has had a cascading effect on prices across the economy, leading to higher transportation and production costs which, in turn, have contributed to the continued rise in inflation (Enejo & Ojabo, 2024).

Persistent inflationary pressures in Nigeria have had significant adverse effects on the population. The continuous rise in the cost of living has made it increasingly difficult

for households to meet their basic needs, leading to a decline in overall living standards (Obiora et al., 2023). Additionally, high inflation discourages savings and investments, as the real value of money erodes over time. This compels individuals and businesses to seek alternative stores of value or adopt more cautious financial strategies (Musa, 2021). Consequently, reduced investment in productive assets hampers economic growth and expansion.

In response to persistent inflation, the Central Bank of Nigeria (CBN) has implemented various measures to curb inflationary pressures, primarily through adjustments to the Monetary Policy Rate (MPR). Changes in the MPR influences interest rates and the money supply, directly impacting inflation. For instance, the CBN increased the MPR from 13% in 2015 to 14% in 2016, then to 18.75% by 2023, and further to 26.75% in June 2024, aiming to mitigate inflation by restricting consumer spending and investment (CBN, 2024). However, despite these policy adjustments, inflation has remained persistent, raising concerns about the adequacy of monetary policy tools-particularly in the face of rising fuel prices and external shocks.

This study is driven by the need to evaluate the effectiveness of Nigeria's monetary policy in controlling inflation, especially given the complex interplay between fuel prices, exchange rates, and the broader economy. The removal of fuel subsidies has contributed to sustained increases in fuel prices, complicating the efficacy of monetary policy in achieving price stability. This underscores the necessity of refining monetary policy tools to enhance their effectiveness in an economy vulnerable to external shocks (Enejo & Ojabo, 2024). By analysing the impact of money supply, fuel price volatility, and exchange rate fluctuations on inflation, this study aims to provide critical insights into how Nigeria's monetary authorities can better manage inflation and foster a more stable economic environment for both consumers and businesses.

2. Literature Review

2.1 *Conceptual Review*

This section discusses the key concepts underpinning the study, beginning with inflation, followed by money supply, fuel subsidy, fuel price volatility, and monetary policy.

2.1.1 Inflation

Inflation is commonly defined as a persistent rise in the general price level, eroding the purchasing power of money. Akerlof et al. (2023) describe it as a sustained increase in prices, while Friedman (2020) links it to an oversupply of money relative to goods and services. Dornbusch and Fischer (2021) emphasise the imbalance between aggregate demand and supply, while Mishkin (2019) underscores its economy-wide implications, such as reduced purchasing power. Additionally, Parkin (2016) and McConnell et al. (2015) note its measurement through indices like the Consumer Price Index (CPI) and its impact on living and business costs. Baumol and

Blinder (2015) frame inflation as a macroeconomic phenomenon, often driven by demand-pull or cost-push factors, further reducing the real value of money.

2.1.2 Money Supply

Money supply is the total amount of monetary assets circulating within an economy at a specific time. Mankiw (2018) identifies it as encompassing currency, coins, and bank deposits, while Mishkin (2019) adds other liquid assets like savings and checking accounts. Blanchard and Johnson (2013) emphasise its role in influencing inflation and interest rates, and Friedman (2020) highlights its importance for economic stability. The money supply is categorised into measures like M1 (high liquidity), M2 (adding near-money assets), and M3 (larger, less liquid assets), with central banks closely monitoring these categories for policy implementation (Alsmadi et al., 2020).

2.1.3 Fuel Subsidy

Fuel subsidy involves government financial assistance to reduce fuel prices, aiming to alleviate economic hardship and stimulate growth. Subsidies are often employed to lower transportation and production costs, thereby reducing the overall cost of living (Gharehgozli & Lee, 2022). However, they place a heavy burden on government budgets, diverting resources from critical sectors like healthcare and education (Lim & Sek, 2015). Fuel subsidies also distort markets by encouraging overconsumption and smuggling to regions with higher prices. While subsidies help mitigate price volatility, their removal can lead to higher fuel costs, escalating transportation and production expenses, and triggering inflationary pressures (OECD, 2019).

2.1.4 Fuel Price Volatility

Fuel price volatility refers to fluctuations in fuel prices driven by factors like global oil prices, exchange rates, and government policies. Subsidies often insulate domestic markets from international volatility but create fiscal challenges and inefficiencies. In Nigeria, subsidies historically kept fuel prices low but strained government budgets, leading to their removal as part of economic reforms. This removal has resulted in higher transportation and production costs, contributing to inflationary pressures (Hussain & Zafar, 2018). However, maintaining subsidies risks fiscal deficits and inefficiency, highlighting the trade-offs policymakers face in addressing fuel price dynamics.

2.1.5 Monetary Policy

Monetary policy refers to measures implemented by central banks to manage money supply, interest rates, and credit accessibility to achieve goals such as price stability and economic growth. In Nigeria, the CBN employs instruments like the Monetary Policy Rate (MPR) to control inflation. Recent developments indicate a preference for contractionary policies aimed at addressing ongoing inflationary pressures (Emefiele, 2023; IMF, 2023). However, structural inefficiencies like a narrow industrial base and high reliance on imports weaken the effectiveness of monetary policy (Obadan, 2020).

Scholars advocate combining monetary tools with structural reforms, such as economic diversification and infrastructure development, to enhance policy impact (Olokoyo et al., 2020).

2.2 *Theoretical Review*

2.2.1 Quantity Theory of Money (QTM)

The Quantity Theory of Money (QTM) links inflation directly to the money supply, positing that an increase in money supply leads to higher price levels if velocity (V) and transactions (T) remain constant. Represented by the equation MV = PT, it assumes a stable velocity and constant transactions. The theory is useful for understanding the money-inflation relationship but is criticized for oversimplifying economic complexities like variable velocity, supply shocks, and policy effects.

2.2.2 Monetarist Theory

Developed by Milton Friedman, Monetarist Theory builds on QTM, emphasizing that inflation is a monetary phenomenon caused by excessive money supply growth. Represented by MV = PY, it assumes a stable velocity (V) and real output (Y) in the long run. Monetarists advocate controlled, steady money supply growth to manage inflation and economic stability. However, critics highlight its simplistic assumptions and neglect of non-monetary factors like supply shocks and demand changes.

2.2.3 Keynesian Theory

This theory focuses on aggregate demand and employment levels rather than the money supply as primary drivers of inflation. It posits that inflation occurs when demand outpaces supply, especially when an economy operates near full employment. Interest rates play a significant role, as lower rates boost spending, potentially leading to demand-pull inflation. The theory is critiqued for challenges in identifying full employment levels and its limitations in unique scenarios like liquidity traps.

2.2.4 Post-Keynesian Theory

This theory emphasizes the role of credit and financial instability in inflation. Unlike Monetarist or Keynesian views, it argues that inflation results from credit expansion and rising debt costs, which increases aggregate demand and price levels. Financial instability, such as asset bubbles and crises, also contributes to inflation. The theory shifts focus to credit demand rather than central bank control but is criticized for limited empirical evidence and overlooking supply-side factors.

From the foregoing, this study adopts the Quantity Theory of Money (QTM) because it directly links money supply to inflation, aligning with Nigeria's monetary-driven inflation dynamics. The QTM's core equation (MV = PT) provides a foundational framework, while the ARDL-ECM model extends it to incorporate structural factors (such as fuel prices, exchange rates), ensuring relevance to Nigeria's unique shocks like subsidy removal.

2.3 *Empirical Review*

This section synthesizes key empirical studies on the determinants of inflation, focusing on money supply, exchange rates, fuel prices, and other macroeconomic factors across different regions and countries. The findings from these studies provide insights into the underlying drivers of inflation and their implications for policy formulation.

Salim et al. (2021) examined the factors influencing inflation in 10 Asian countries, including India, Korea, and Malaysia, from 2006 to 2015. Employing a panel fixed effects model, their findings revealed that both interest rates and money supply have a negative impact on inflation. Money supply was found to be the key inflation driver, with a 1% increase reducing inflation by 2.40%, compared to a 0.46% drop from a 1% interest rate hike suggesting that money supply plays the most crucial role in inflation control within these Asian economies. In a study of 30 European countries, Binici et al. (2022) analyzed the factors driving inflation from 2002 to 2022. The study revealed that domestic monetary and fiscal policies, as well as exchange rate fluctuations were significant contributors to inflation, particularly during crises like the COVID-19 pandemic. For 37 European countries from 2010 to 2022, Wu (2023) identified GDP per capita as the most significant factor negatively influencing inflation, while oil prices and unemployment rates also played roles. The results highlighted the complex interplay between economic growth and inflation in Europe.

Analyzing inflation determinants across 40 countries from 2012 to 2023, Ujkani and Gara (2023) found that an increase in money supply leads to higher inflation. This underscored the centrality of monetary policy in controlling inflation across diverse regions. In a sample of 83 countries, Araujo et al. (2023) assessed the influence of global shocks on inflation from 2000 to 2021. Their findings revealed that commodity prices, exchange rate variations, and global conflicts significantly impacted inflation, emphasizing the importance of external factors in shaping inflation dynamics globally.

Batarseh (2021) investigated the relationship between money supply (M1) and inflation in Jordan over the period 1980–2019, applying econometric methods such as the Granger Causality Test. The study revealed a one-way causal relationship from money supply to inflation in the short run, indicating that changes in money supply play a crucial role in driving inflation in Jordan. Likewise, Silaban et al. (2021) analysed how interest rates and money supply influenced inflation in Indonesia between 2017 and 2019. Their research demonstrated that both factors contributed positively to inflation, underscoring the significance of monetary variables in shaping inflationary trends in Indonesia. Furthermore, Amhimmid et al. (2021) carried out a comparative analysis of Indonesia and Libya from 2005 to 2019, employing the Error Correction Model (ECM) to examine the effects of money supply, interest rates, and exchange rates on inflation. Their findings indicated that while money supply had a strong impact on inflation in both countries, interest rates and exchange rates did not exert notable effects.

Gharehgozli and Lee (2022) examined the effects of real GDP per capita, unemployment, money supply (M2), and the velocity of money on core inflation in the United States from 1960 Q1 to 2021 Q4. Using a multivariate VAR model, they found that core inflation could reach 8.57% unless corrective monetary policies are applied. The study highlighted that inflation post-COVID-19 was persistent rather than transitory, underscoring the need for restrictive monetary policies to control inflation in the U.S. In Vietnam, Nguyen et al. (2022) studied the relationship between money supply and inflation from 2005 to 2021. Utilizing a linear regression model, the study found that money supply growth and past inflation significantly contribute to inflation. The findings emphasized the importance of regulating money supply growth to manage inflationary pressures in Vietnam.

In Sweden, Skeppas and Sundén (2022) applied a Structural Vector Autoregression model to analyse the factors driving inflation between 2020 and 2021. Their findings highlighted energy prices and supply chain disruptions as the primary contributors, with foreign monetary policy shocks expected to become increasingly influential in the future. Meanwhile, Tirtana (2024) investigated the impact of money supply and interest rates on inflation in Northern Sumatra, Indonesia, from 2016 to 2022 using the Ordinary Least Squares (OLS) method. The study found that while money supply had a positive but insignificant effect on inflation, interest rates exhibited a positive and significant influence. This suggests that, in this region, interest rates play a more decisive role in shaping inflation compared to money supply. Similarly, Wulandari and Fuddin (2024) examined the validity of the Phillips curve in Asia from 2013 to 2022, Wulandari and Fuddin analyzed the impact of monetary variables on inflation. Their findings, based on OLS estimations, showed that the money supply positively affects inflation, while GDP and loan interest rates also substantially influence inflation. The results also demonstrated that unemployment has no notable impact, undermining the applicability of the Phillips curve in Asia. Using threshold regression, Sadeghi et al. (2024) explored the effects of oil price fluctuations on inflation in Iran between 1991 and 2021. Their findings indicated that oil prices significantly affect inflation, with a stronger impact when economic growth is below a 4.303% threshold. Additionally, unemployment and technological advancements were found to reduce inflation, while population size increased it.

Focusing on Nigeria, Musa (2021) analysed the impact of exchange rate volatility on inflation from 1986 to 2019 using GARCH and VECM models. The study found that both money supply and the nominal exchange rate positively and significantly influence inflation in Nigeria. Similarly, Okolo et al. (2022) applied a Non-linear ARDL estimation technique to examine the asymmetric effects of exchange rate fluctuations on inflation between 1981 and 2020. Their results showed that exchange rate changes, domestic interest rates, and foreign direct investment significantly influence inflation in both the short and long run.

Akpan and Udo (2023) utilised data from 1981 to 2021 and employed the Autoregressive Distributed Lag (ARDL) model to assess the impact of exchange rates

on inflation. Their findings indicated that exchange rate fluctuations and real GDP significantly drive inflation. However, the Granger causality test suggested that exchange rates do not directly predict inflation. Likewise, Chinekwu (2023) examined inflation in Nigeria from 1981 to 2017 and identified money supply, purchasing power parity, and exchange rates as key determinants. The study emphasised that increases in these factors contribute to rising inflationary pressures.

Gwani et al. (2024) explored the relationship between inflation, Premium Motor Spirit (PMS) prices, and exchange rates in Nigeria from 1985 to 2020. The OLS results revealed that PMS prices and exchange rates are significant drivers of inflation, underscoring their crucial role in Nigeria's inflation dynamics. Additionally, Mohammed (2024) investigated the effects of money supply, interest rates, and inflation on economic growth in Morocco from 1990 to 2020 using a Vector Autoregression (VAR) model. The study found that money supply significantly enhances economic growth while interest rates have a negative impact. Inflation, however, positively affects short-term growth, highlighting the complex influence of monetary variables on economic performance.

2.4 *Gaps Identified in the Literature*

A review of the existing literature reveals three critical gaps in the study of inflation dynamics in Nigeria. First, many studies use annual data, which overlooks short-term fluctuations essential for understanding inflation. But, this study addresses this by employing monthly time-series data from January 2016 to October 2024. Inflation (INFL) is measured by the Consumer Price Index (CPI), sourced from the National Bureau of Statistics (NBS). Money supply (M2) and private sector credit (CREDIT) data are obtained from the Central Bank of Nigeria (CBN) statistical bulletins. Fuel prices (Premium Motor Spirit, PMS) are collected from the Petroleum Products Pricing Regulatory Agency (PPPRA) and the Nigerian National Petroleum Corporation (NNPC). Exchange rate (EXR) data (official ₦/$ rate) are sourced from the CBN. Second, the impact of fuel price changes due to the removal of fuel subsidies is often neglected. While traditional factors like money supply and exchange rates receive focus, this study specifically examines how subsidy removal influences production and transportation costs, enhancing our understanding of its effects on inflation. This study isolates fuel price volatility as an independent driver to quantify its marginal inflationary impact beyond the aggregate CPI. This is because fuel prices indirectly affect inflation via transportation costs (such as food distribution) and production inputs (such as electricity, manufacturing).

Finally, many studies fail to consider the endogeneity of key variables, treating them as exogenous, which can lead to biased estimates. This study uses the Autoregressive Distributed Lag (ARDL) model to account for endogeneity, ensuring more accurate results. By addressing these gaps, the study offers valuable insights for policymakers regarding inflation in Nigeria.

3. Methodology

This section presents the methodological approaches employed for data analysis to achieve the study's objective.

3.1 *Theoretical Framework*

This research is anchored on the Quantity Theory of Money, which serves as a theoretical lens for examining the relationship between money supply and inflation in Nigeria. The theory posits that the general price level is directly proportional to the money supply, as proposed by Friedman (1956). It suggests that an increase in the money supply stimulates aggregate demand, leading to inflationary pressures. The theory operates under the assumption that both the velocity of money and the level of output remain unchanged. The fundamental equation expressing this concept is:

$$MV = PT \tag{1}$$

In this equation, M represents the money supply, referring to the total currency in circulation; V denotes the velocity of money, measuring how frequently money circulates within the economy; P signifies the price level, indicating the average cost of goods and services; and T stands for transactions, representing the total volume of goods and services exchanged.

3.2 *Model Specification*

The baseline inflation model is presented in equation 2:

$$INFL_t = f(M2_t) \tag{2}$$

Where: *INFL* represents inflation rate and *M2* is broad money supply.

The use of QTM justifies the focus on money supply as a key determinant of inflation, thereby highlighting the potential inflationary pressures that could arise from excessive monetary expansion or mismanagement of monetary policy. Following the approach of Gwani et al. (2024), the QTM is expanded to incorporate additional variables relevant to the context of this study. This modification allows for a more comprehensive analysis of the factors affecting inflation in Nigeria. The augmented QTM model is re-specified in a functional equation (3) as follows:

$$INFL_t = f(M2_{t,} FUEL_{t,}, EXR_{t,} CREDIT_{t,}) \tag{3}$$

In equation (3), INFL represents inflation, M2 denotes the money supply, FUEL refers to fuel price, and EXR is the exchange rate. Equation (4) is expressed in econometrics model as

$$INFL_t = \alpha_0 + \beta_1 M2_t + \beta_2 FUEL_t + \beta_3 EXR_t + \beta_4 CREDIT_t + \varepsilon_t \tag{4}$$

Where α_0 is the intercept, β_1, β_2, β_3 and β_4 are the coefficients that measure the impact of each independent variable on the dependent variable (inflation rate), and ϵ is the

error term. The parameters β_1, β_2, and β_3 represent the direction and magnitude of the effects of money supply, fuel prices, and exchange rates on the inflation rate.

3.3 *Estimation Technique*

In this study, the model's coefficients were estimated using both the Autoregressive Distributed Lag (ARDL) and Error Correction Model (ECM) methods. The ARDL approach is preferred due to its specific advantages over traditional cointegration techniques. A major advantage of ARDL is that it can be applied regardless of the integration order of the variables, whether they are I(0), I(1), or a combination of both (Pesaran et al., 2001). Additionally, ARDL yields unbiased long-term estimates and dependable t-statistics, even in cases where some of the explanatory variables are endogenous (Harris & Sollis, 2003). Consequently, the ARDL version of the model (4) is represented as follows:

$$\begin{aligned} INFL &= \alpha_0 + \sum_{i=1}^{p} \alpha_1 \Delta INFL_{t-1} + \sum_{i=0}^{q1} \alpha_2 \Delta M2_{t-1} + \sum_{i=0}^{q2} \alpha_3 \Delta FUEL_{t-1} \\ &+ \sum_{i=0}^{q3} \alpha_4 \Delta EXR_{t-1} + \sum_{i=0}^{q4} \alpha_5 \Delta lnCREDIT_{t-1} + \beta_1 INFL_{t-1} + \beta_2 M2_{t-1} + \beta_3 FUEL_{t-1} \\ &+ \beta_4 EXR_{t-1} + \beta_5 lnCREDIT_{t-1} \\ &+ \mu_t \end{aligned} \quad (4)$$

The long-run relationship between the inflation rate (INFL) and the independent variables in the model is assessed using the ARDL bounds test. A long-run relationship is confirmed if the computed Wald or F-statistic exceeds the upper bound of the I(1) critical values (Pesaran et al., 2001).

Furthermore, the study realised the presence of long run relationship in the model and thus, used the error correction model (ECM) which was specified as cointegration is confirmed. In this case, the ECM general form to be estimated is specified as:

$$\begin{aligned} INFL &= \alpha_0 + \sum_{i=1}^{p} \alpha_1 \Delta INFL_{t-1} + \sum_{i=0}^{q1} \alpha_2 \Delta M2_{t-1} + \sum_{i=0}^{q2} \alpha_3 \Delta FUEL_{t-1} + \sum_{i=0}^{q3} \alpha_4 \Delta EXR_{t-1} \\ &+ \sum_{i=0}^{q4} \alpha_5 \Delta lnCREDIT_{t-1} + \theta_t ECT_{t-1} \\ &+ \mu_t \end{aligned} \quad (5)$$

The model includes several components: α_0 is the constant term, μ_t is the stochastic error term, and α_1 to α_4 represent the short-run elasticities (coefficients of the first-differenced explanatory variables). β_1 to β_4 are the long-run elasticities (coefficients of the explanatory variables), while ECM_{t-1} is the lagged error correction term, with θ indicating the speed of adjustment. The Δ operator represents the first difference, and

p, q_1, q_2, q_3 refer to the lag lengths. Collectively, these elements capture the dynamic relationships and adjustments in the model.

4. Presentation and Discussion of Results

4.1 *Results of Unit Root Tests*

This study employed Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) unit root tests to test for stationarity of data series in levels and at first difference and the results are presented in Table 4.1.

Table 4.1 Unit Root Test Results

Variables	ADF		Order of integration	PP		Order of integration
	Level	First diff		Level	First diff	
INFL	-0.321	-5.282***	I(1)	-0.606	-4.455***	I(1)
lnNM2	-0.579	-10.683***	I(1)	-0.523	-10.684***	I(1)
lnPMSP	0.079	-9.680***	I(1)	0.402	-9.671***	I(1)
LnEXR	-2.376**	-10.220***	I(0)	-2.366**	-10.232***	I(0)
lnCREDIT	-1.047	-5.447***	I(1)	-0.976	-9.077***	I(1)

Notes: Both ADF and PP tests are conducted with intercept and trend. Asterisks (***) and (**) indicate significance at 1%, and 5% level, respectively.

Source: *Researchers' computation (2024)*Both the ADF and PP unit root tests results in Table 4.1 revealed that all the variables, except exchange rate (lnEXR) exhibit non-stationarity in their levels, possibly due to trends or seasonality. However, differencing them once makes them stationary, which is crucial for further statistical analyses.

4.2 *Results of Co-Integration Test*

After determining the order of integration and confirming that the variables are stationary, with some integrated of order zero I(0) and others of order one I(1), the next step is to conduct a cointegration test to assess whether a long-run or equilibrium relationship exists between inflation and its explanatory variables in Nigeria. The study employed the ARDL bounds test because it is suitable for small sample sizes and allows for different lag lengths for the variables. The ARDL approach utilises a single reduced-form equation to estimate both the short-run and long-run parameters of the model simultaneously.

Tables 4.2: Result of ARDL Bounds Test

Test Statistic	Value	k
F-statistic	10.731***	4
	Critical Value Bounds	
Significance	I(0) Bound	I(1) Bound
10%	3.03	4.06
5%	3.47	5.57
1%	4.00	5.72

*Note. *** denotes a rejection of the null hypothesis of no co-integration at 1% level*

Source: *Researchers' computation (2024)*

The results from the ARDL bounds test, presented in Table 4.2, show that the F-statistic value of 10.731 exceeds the upper bound critical value at the 1% level of significance. As a result, the null hypothesis is rejected in favour of the alternative hypothesis, indicating the presence of a long-run relationship among the variables in Nigeria. This suggests that there is cointegration between the dependent variable (inflation rate) and the independent variables (money supply, price of premium motor spirit, exchange rate, and credit to the private sector). Given the confirmed long-run cointegration, it is essential to estimate both the long-run and short-run coefficients of the model using the ARDL and error correction modelling (ECM) approach. However, the model's flexibility accommodates both regulated and liberalized price regimes while isolating fuel-specific inflationary effects.

4.3 Results of the Estimated Long-run and Short-run Coefficients

This study estimated the results of both long and short-run coefficients and the outcomes are presented in Table 4.3 and Table 4.4, respectively, with the optimal lag-length (1, 1, 3, 1, 1) as suggested by Akaike Information Criterion (AIC). From Table 4.3 below, the coefficient of money supply (M2) is positive (0.868) and statistically significant at a 1% level of significance. This implies that a 1% increase in the money supply (M2) leads to approximately a 0.87% increase in inflation in the long run, holding other factors constant. The very high t-statistic and the statistically significant p-value ($p < 0.01$) indicate a strong and positive relationship between money supply and inflation in Nigeria. This finding aligns with the classical quantity theory of money, which suggests that excess money supply drives up prices if not matched by equivalent output growth.

Table 4.3 Results of Long-run Estimated Coefficients (Dependent variable: Inflation (INFL)

Variables	Coefficient	Std. Error	t-Statistic	Prob.
lnM2	0.868	0.025	34.063	0.000
lnPMSP	1.120	0.498	2.250	0.027
lnEXR	1.906	1.001	1.904	0.060
lnCREDIT	0.067	0.011	5.806	0.000

Note: Automatic-lag linear regressors (3 max. lags), Selected model: ARDL (1,1,3,1,1)
Source: *Researchers' computation (2024)*

The results of the long-run estimates in Table 4.3 also show that the coefficient of the price of Premium Motor Spirit (PMS) is positive (1.120) and statistically significant at a 5% level of significance. Suggesting that a 1% increase in the price of Premium Motor Spirit (PMS) raises inflation by approximately 1.12%. The statistically significant p-value ($p < 0.05$) confirms this effect. This finding reflects the direct and indirect inflationary pressures from fuel price hikes, as PMS prices influence transportation costs, production expenses, and overall price levels in the economy. Such effects are particularly pronounced in energy-dependent economies like Nigeria.

Similarly, the exchange rate coefficient of 1.906 indicates that a 1% increase

(depreciation) in the exchange rate results in approximately a 1.91% increase in inflation in Nigeria. Although the p-value (0.06) suggests the result is marginally significant at the 10% level, it underscores the sensitivity of inflation to exchange rate fluctuations. This is consistent with the pass-through effect, where exchange rate depreciation increases the cost of imported goods and services, fueling inflation.

Furthermore, the coefficient of 0.067 shows that a 1% increase in credit to the private sector leads to a modest 0.067% rise in inflation. This relationship is statistically significant ($p < 0.01$), indicating that increased credit availability may stimulate demand, which could lead to higher prices if not matched by adequate supply. In the short run, Table 4.4 presents the results of the error correction model (ECM) for inflation. The coefficient of the error correction term (ECM) is negative (-0.868) and statistically significant ($p < 0.01$), indicating a rapid adjustment to the long-run equilibrium. Specifically, about 86.8% of any deviation from the equilibrium level of inflation is corrected in the following period, reflecting a quick return to equilibrium. In the short-run analysis, the effect of money supply (M2) is found to be insignificant ($p = 0.947$), suggesting that changes in money supply have a minimal immediate impact on inflation. However, the lagged effects of the price of PMS are significant, with the coefficients of D(LNPMSP(-1)) and D(LNPMSP(-2)) being 1.077 and 1.120, respectively, and statistically significant ($p = 0.021$ and $p = 0.011$). This implies that past increases in PMS prices have a delayed yet strong influences on inflation. The exchange rate coefficient (-0.607) is insignificant ($p = 0.534$), indicating that exchange rate fluctuations do not affect inflation in the short run. Similarly, private sector credit (D(LNCREDIT)) does not significantly impact inflation in the short run ($p = 0.384$), suggesting that its inflationary effects are more prominent in the long run.

Table 4.4 Results of Short-run Estimated Coefficients (Dependent var: Inflation (INFL)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ECM*	-0.868	0.025	-34.063	0.000
D(LNM2)	0.121	1.806	0.067	0.947
D(LNPMSP)	0.276	0.530	0.521	0.604
D(LNPMSP(-1))	1.077	0.458	2.353	0.021
D(LNPMSP(-2))	1.120	0.433	2.586	0.011
D(LNEXR)	-0.607	0.973	-0.624	0.534
D(LNCREDIT)	1.702	1.948	0.874	0.384
C	-142.156	18.975	-7.492	0.000

Note: Automatic-lag linear regressors (3 max. lags), Selected model: ARDL (1,1,3,1,1)
Source: *Researcher's computation (2024)*

Table 4.5 shows the absence of serial correlation using the Lagrange Multiplier (LM) test. This is a good sign as it means the model does not suffer from serial dependence, where past errors influence future errors. Also, the Heteroscedasticity F-statistics of the test has a value of 54.335 with a p-value of 0.304.

Table 4.5: Summary of diagnostic tests

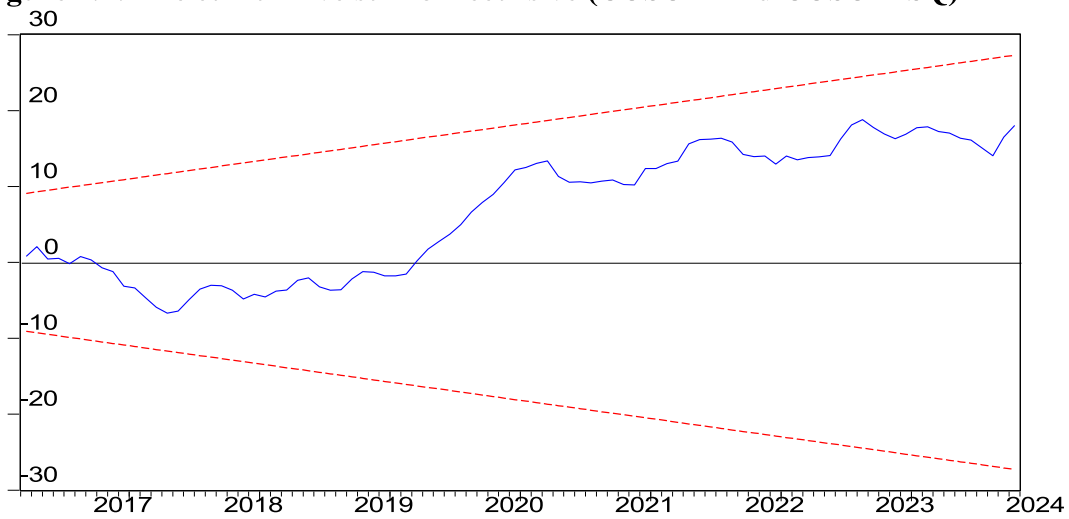
Breusch-Godfrey Serial Correlation LM Test:			**Prob.**
F-statistic	54.335	Prob. F(1,89)	0.304
Breusch-Godfrey Heteroscedasticity Test			
F-statistic	2.437	Prob. F(12,90)	0.121
Functional Form Test			
F-statistic	0.070286	Prob. (1, 29)	0.793
Normality Test			
Jaque-Bera	9.200	Prob. Chi-Square (2)	0.010

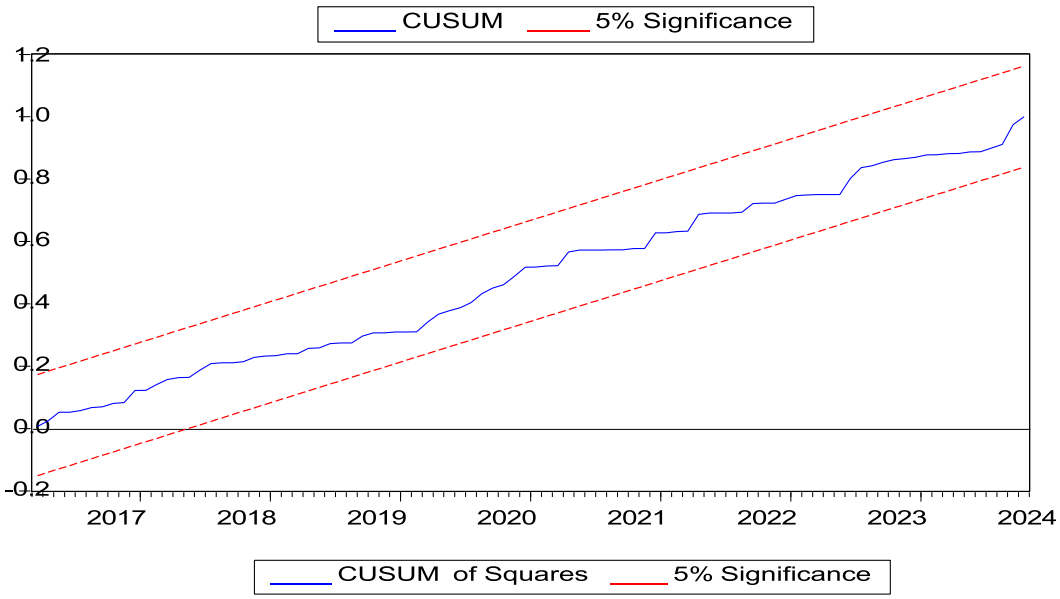
Source: *Researchers' computation (2024)*

This implies that the Breusch-Godfrey LM test result suggests no unequal variance in the model. The normality test shows that the residuals are not normally distributed. Additionally, the Functional Form test reveals no misspecification in the model, as the F-statistic of 0.0703 with a p-value of 0.793 confirms that the chosen functional form appropriately captures the relationships between the variables.

Figure 4.1 shows that the model is stable because the CUSUM (blue) lines are with the 5% boundary (red lines). This connotes that the CUSUMSQ showed that the structural break was not significant to show a significant instability in the variables, thus the blue line is within the two red stripes. However, the robust diagnostic tests provide strong evidence for the model's reliability and suitability for concluding the effect of independent variables on dependent variable in Nigeria. This strengthens the confidence in the findings and their implications for policymaking and further research.

Figure 4.1: The cumulative sum of recursive (CUSUM and CUSUM SQ)





Source: Author's Computation, 2024

4.4 Discussion of Results

The study researched the effectiveness of monetary policy to control inflation in Nigeria: Exploring the influence of fuel price volatility for the period between 2016M6 and 2024M10. This section explains the findings of the study with support/arguments of empirical studies regarding the topic. The study used broad money supply (M2) and official exchange rate (EXR) to represent the monetary policy instruments as they were often used during the period under study. It also considered the influence of fuel price volatility (FUEL) and added credit to private sector (CREDIT) as control variable. Both the monetary policy instruments and the macroeconomic variables were used as regressors and inflation rate as regressed.

The first null hypothesis of the study was that money supply (M2) does not have significant effect on inflation rate in Nigeria. Results from the ARDL estimation technique suggested that money supply (M2) has a positive and statistically significant effect on inflation in Nigeria both in the long-run and short-run. This result is supported by the findings of Hussain and Zafar (2018) and Alsmadi et al. (2020) in Nigeria and validated the quantity theory of money postulated that an increase in the money supply leads to higher prices when economic output does not grow proportionally. The ARDL estimates of this study showed that we reject the null hypothesis since the t-statistics of the instruments are above 2, and hence significant even at 1% level of significance.

On the second null hypothesis of the study that fuel price does not have a significant impact on inflation rate in Nigeria., it is evident from the result of the ARDL estimates that the price of Premium Motor Spirit (PMS) has a significant positive impact on inflation both in the short and long run in Nigeria. This aligns with studies by Iwayemi

and Fowowe (2011) and Adebayo and Nwankwo (2022), which highlighted the ripple effects of energy costs on production and consumer prices in Nigeria. However, this finding is in contrast to the work of Olowolaju (2019), who found that the inflationary effects of energy prices was more pronounced in the short run but dissipated over time due to market adjustments and substitution effects. Hence, we reject the null hypothesis and accept the alternative hypothesis that fuel price has both short-run and long-run significant impacts on the inflation rate in Nigeria.

More so, the third hypothesis read that the exchange rate has no significant effect on the inflation rate in Nigeria. Results from the ARDL estimate indicated that there was a long-run significant impact of the exchange rate on the inflation rate in Nigeria. This finding is in agreement with studies by Akpan (2008) and Ogundipe and Ojeaga (2014), who documented the sensitivity of Nigeria's inflation to exchange rate movements. In contrast, Egwaikhide and Olaniyan (2020) argue that exchange rate's depreciation had a muted effect on inflation during certain periods due to government interventions and subsidies that shielded consumers from the full impact of currency fluctuations. Hence, we reject the null hypothesis that the exchange rate does not have long run significant impact on inflation rate in Nigeria.

Lastly, the study finds private sector credit (CREDIT) has a small but significant long-run inflationary impact (0.067% per 1% increase, $p<0.01$), supporting Keynesian views that credit boosts demand. This aligns with Silaban et al. (2021) but is in contrast to Tirtana (2024), who found insignificant effects. Short-run impacts were negligible ($p=0.384$), likely due to Nigeria's financial system inefficiencies. While less critical than money supply or fuel prices, the findings suggest credit policies should prioritise productive sectors to avoid fuelling long-term inflation.

5. Conclusion and Recommendations

The study concludes that inflation in Nigeria is driven by both monetary and structural factors, with money supply exerting a significant long-term impact, consistent with the Quantity Theory of Money. Fuel prices emerge as a critical driver, influencing inflation in both the short and long run due to their cascading effects on production and transportation costs. Exchange rate depreciation also contributes substantially to long-term inflationary pressures, highlighting the vulnerability of the economy to currency instability. While private sector credit has a modest long-run effect, its role in stimulating demand underscores the need for cautious credit allocation. The rapid adjustment speed of the Error Correction Mechanism (ECM) suggests that deviations from equilibrium are quickly corrected, indicating dynamic responsiveness in the inflation model.

To address inflation effectively, the study recommends the following:

i. **Monetary Policy and Money Supply Management:** The Central Bank of Nigeria (CBN) should adopt proactive policies to ensure money supply growth aligns with the economy's productive capacity. Tools like interest rate adjustments and open market operations should be utilized to curb excess liquidity.

ii. **Fuel Price Stabilization and Energy Reforms:** Stabilizing fuel prices through targeted subsidies, investments in renewable energy, and reducing reliance on imported fuels will mitigate inflationary pressures from global oil price shocks.

iii. **Exchange Rate Policy and Economic Diversification:** Stabilizing the naira, enhancing export performance, attracting foreign direct investment (FDI), and promoting domestic production can reduce exchange rate volatility and its inflationary effects.

iv. **Promoting Structural Reforms:** Long-term investments in infrastructure, supply chain efficiency, and a conducive business environment will strengthen the economy's resilience against inflationary shocks. By integrating these strategies, Nigeria can achieve more sustainable price stability and foster economic growth.

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Regional Integration and Sustainable Development in West Africa: The Role of Governance Quality

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Abstract

Regional integration offers substantial potential for advancement but West Africa's economic growth and development through cross-border trade remains below optimal levels, impeding progress toward Sustainable Development Goals 17 (SDGs). This study examines the role of governance quality on the effectiveness of regional integration and sustainable development in West Africa from 1996 to 2022. A modified Cobb-Douglas production function, augmented with trade integration and governance quality, was estimated using the Dynamic Panel Model with Interacting Effects (DPMEs) method, specifically the system GMM. Variables such as the adjusted net savings which served as proxy for sustainable development, capital stock, and index of the six governance quality indicators, were employed and sourced from the World Bank's Development Indicators (WDI) and Governance Indicators (WGI), respectively. The findings revealed that governance quality has positive and long run significant impact on sustainable development in West Africa. But the relationship was found to be weak due to the regional characteristics. The lag in the number of people employed showed a negative and insignificant impact on sustainable development, suggesting that an increased level of unemployment could deter sustainable development. However, trade integration and the interaction of governance quality with trade integration showed positive and significant impacts, reflecting efficiencies in regional trade practices due to moderate governance quality in the region. The study therefore, recommends that strategic economic policy measures like free trade and governance policies like employment opportunities, and regional cooperation be adopted to accelerate sustainable development in West Africa.

Keywords: Regional Integration, Sustainable Development, Governance Quality, West Africa.

1. Introduction

Regional integration is increasingly seen as a key strategy for fostering economic and social progress by organizations like the Economic Community of West African States (ECOWAS) in West Africa (Bassey, Etefia, & Ebong, 2024). Integration offers

opportunities for trade diversification, economic resilience and shared infrastructure projects aimed at addressing poverty, unemployment, and food security (Muhammad & Babatunde, 2024). In the West African region, the success of regional integration in promoting sustainable development has been influenced by the uneven quality of governance across member states. While nations like Ghana and Cape Verde exhibit more substantial democratic structures and institutional stability, others face challenges such as corruption, insecurity, and institutional weakness (Economic Commission for Africa, 2021; Adeniran & Sidi, 2021; Gammadigbe, 2021). These governance disparities among member nations also create challenges in policy implementation, impacting sustainable development indicators such as healthcare, education and infrastructure.

While regional integration holds promising potential, weak institutional structures often limit the benefits, as poor policy enforcement, corruption and inefficiencies undermine cross-national collaboration (Asongu & Nwachukwu, 2021). For example, despite ECOWAS' trade policy harmonization and cross-border infrastructure efforts, inconsistencies in governance create barriers that disrupt regional projects and investment flows (Ogbonnaya & Olayode, 2021). Consequently, nations with lower governance quality face more significant obstacles to achieving sustainable development than those with stronger institutional frameworks. This study addresses the need for more empirical evidence linking governance quality to the outcomes of regional integration in West Africa, particularly regarding sustainable development. While previous research had examined economic integration as a singular aspect, few studies have considered how institutional governance differences impact broader integration goals like sustainable, equitable development across West African nations. This gap underscores the importance of exploring governance quality as a moderating factor in regional integration efforts for sustainable development.

The significance of this study lies in its potential to provide insights into how governance quality could strengthen regional integration outcomes for sustainable development. By examining the role of governance quality, this study contributes to the literature by elucidating how governance policy improvements can reduce governance disparities within ECOWAS, thereby enhancing the benefits of regional integration (Moghalu, 2018, Hope, 2019). Insights from this study can guide policies aimed at elevating governance standards, aligning with the United Nations' Sustainable Development Goals (SDGs) to foster economic stability and social progress. The primary objective of this study is to analyze the influence of governance quality on the relationship between regional integration and sustainable development in West Africa.

The study focuses on ECOWAS member countries from 1996 to 2022 because all the governance indicators for West African countries were available between the study periods and to allow a comprehensive and unbiased examination of the role of governance quality on regional integration and sustainable development outcomes.

This period enabled the analysis of both short and long-term impacts of governance quality on regional integration initiatives and sustainable development indicators, including economic growth, infrastructure, and social equity within the region. Governance quality is considered through indicators such as voice and accountability, government effectiveness, regulatory quality, rule of law, control of corruption, and political stability (Asongu & Odhiambo, 2021), which may influence the success or failure of regional integration efforts to achieving sustainable development. This study therefore, focuses on governance quality as the moderating variable to assess the impact of regional integration on sustainable development in the West African context.

The rationale for this objective is also based on the premise that improving governance quality in West Africa could significantly enhance the success of regional integration in promoting sustainable development. Researchers consistently identify weak governance manifested in corruption, policy inconsistency, and institutional inefficiencies, as critical barriers to optimizing regional integration benefits in West Africa (Adeleke, 2022; Hope, 2019). Thus, the scarcity of empirical studies connecting governance quality to regional integration and sustainable development outcomes in West Africa has been identified as a gap that this study fills. The study is organized as follows: a literature review on governance, regional integration, and sustainable development; methodology explains the approach for analyzing governance quality's impact on integration and development; the findings; and the conclusion as well as recommendations for future research.

2. Literature Review

The relationship between regional integration and sustainable development is increasingly being studied, especially in governance quality frameworks. Research in this area often follows two main theoretical perspectives. First, strong institutions facilitate trade through lower transaction costs and risk mitigation, as demonstrated by North (1990) and Acemoglu & Robinson (2012) particularly in cross-border contexts. Studies by Koirala & Pradhan (2023); Asongu, & Nwachukwu (2022); Rodriguez-Pose & Ganau (2022); Dixit (2021); and Gammadigbe (2021) indicate that strong and robust institutions promote trust, enable effective contract enforcement, and decrease uncertainties in regional trade, leading to a more conducive environment for economic cooperation. Conversely, poor institutional quality hinders trade by increasing costs and reducing import volumes, undermining economic partnerships (Rodriguez-Pose & Ganau, 2022; Dixit, 2021).

The second approach suggests that institutional or governance quality indirectly impacts trade by influencing infrastructure investment and domestic investment levels, both crucial to trade. Countries with lower institutional quality often underinvest in infrastructure, resulting in increased logistical costs and reduced trade efficiency (Zhang & Sun, 2021; Cust & Andres, 2019). Poor governance also deters

local and foreign investments needed to facilitate regional trade (Krishnan et al., 2020; Hanousek et al., 2019).

Empirically, studies on the role of institutional quality in regional integration and sustainable development yield mixed results, particularly in West Africa. For instance, Adopting the Dynamic Common Correlation Effects (DCCEs) method as the estimation technique, Jimoh et al (2023) examined how regional integration affected sustainable development in West Africa from 1980-2019 using a production function approach. Their results show that labour and capital stock have a significant positive impact on sustainable development and trade integration was reported to have an unexpected negative impact on sustainable development, suggesting that regional trade conditions may not yet support sustainable growth in the region. However, the study did not consider governance quality. Similarly, Gammadigbe (2021) investigated the contribution of institutional variables to explain the trade flows in West Africa for the period 1996-2018. Using a gravity model, the study showed that bilateral trade is influenced by political stability in the ECOWAS zone and that regional trade integration contributes to economic growth in Africa. However, the study did not consider the dynamics of cross-sectional dependence.

Some recent and related studies by Oshota & Wahab (2022) empirically analyzed the extent to which national institutional quality affects bilateral trade flows in ECOWAS based on a gravity model from 2000-2018. Specifically, the study employed the Negative Binomial Pseudo-Maximum Likelihood estimator (NBPML) and variables such as GDP, GDP per capita, common language, and landlockedness were used to measure regional integration. The results revealed that institutional variables with both aggregated and disaggregated measures of the quality of institutions have a significant and positive impact on trade flows in ECOWAS and on its sub-samples, WAEMU and WAMZ. This suggested that importing and exporting countries, reduced corruption, effective rule of law, and effective government coincide with more trade among member countries.

A number of scholars have examined regional integration's moderating role in sustainable development. For example, Jimoh & Chua (2023) and Zazerskaya & Bunko (2022) analyzed the interaction between institutional quality and trade within currency unions in West Africa and found that currency union membership and institutional quality positively influence regional trade flows. Disaggregated indicators showed that the rule of law boosts trade flows, while political stability affects them negatively. In a related manner, Ullah et al. (2021) studied regional integration's effect on sustainable development in Belt and Road Initiative countries. Ullah et al. (2021) examined the relationship between regional integration, socioeconomic determinants, and sustainable development in Belt and Road countries from 2003–2018. The study adopted the two-step system Generalized Method of Moments (GMM) to estimate the model and found that human development, health expenditure, and age structure have a positive impact on sustainable development. The moderating effect of regional integration is found to be positive. However, these

studies used either dummy variables or aggregated indexes to measure regional integration and did not consider the direct effect of governance quality on regional integration and sustainable development particularly in West Africa.

Notably, regional integration was found to positively moderate sustainable development outcomes by the empirical study of Zaman et al., (2021), who estimated the impact of IT exports, gross capital formation, FDI, and trade openness on sustainable economic growth with regional integration of Belt and Road Initiative (BRI) countries using the annual panel data from 2013 to 2018. They used regional integration as a moderating variable, while the trade freedom index, investment freedom index, real interest rate, and inflation are control variables, and applied the two-step system GMM technique. The results suggested that FDI and gross capital formation have a substantial positive impact on economic growth, whereas IT exports and trade openness have a negative, insignificant impact. However, the focus of the study was on 64 BRI countries. Adeleke (2022) on the other hand, examined ECOWAS integration and found that poor governance (corruption, weak institutions, and political instability) limited the gains from free trade and mobility.

This study therefore, highlights the ongoing challenges of theoretical frameworks, limitations of scope and inconsistent variable measurement, particularly regarding governance quality, regional integration, and sustainable development variables by using up-to-date data, adopting trade flow statistics as a comprehensive measure of regional integration, and applying a dynamic panel model with interacting effects (DPME) to better capture the role of governance quality on regional trade and sustainable development with a focus on West African countries. To address these gaps, this study uses this above method because the existing literature failed to account for the role of cross-sectional dependence in non-stationarity panels and this omission may lead to misleading results.

Literature review showed deficiency in scope and measurement of regional integration and sustainable development. Many of these studies have not specifically focused on the sustainable development effect of regional integration in West Africa rather some dealt on a limited measure of sustainable development and regional integration while others studied policy integration. To fill these gaps, this study examines the effects of regional integration on sustainable development in West Africa by using the direction of trade flows as a better and more comprehensive measure of regional integration. Finally, this study fills a methodological gap in the literature by adopting the Dynamic Common Correlation Effects (DCCEs) method of Chudik & Pesaran (2015) to estimate the model of the effects of regional integration and sustainable development.

3. Methodology

Flowing from the institutional theoretical statements and past literature discussed in section 2, this study adapted the works of Ullah et al. (2021) and Jimoh et al. (2023) which utilize a Cobb-Douglas production function to depict the relationship between output, capital, and labour with the inclusion of additional augmented determinants of

output (that is, trade integration and governance quality variables) as a modification to the previous studies. The original model is specified below:

$$Y_{it} = f(K_{it}, L_{it},) = K_{it}^{\beta 1}, L_{it}^{\beta 2} \quad (3.1)$$

Including the augmented determinants of output into equation (3.1) gives equation (3.2) as:

$$Y_{it} = f(K_{it} L_{it} TIF_{it} GQ_{it}) = K_{it}^{\beta 1}, L_{it}^{\beta 2}, TIF_{it}^{\beta 3}, GQ_{it}^{\beta 4} \quad (3.2)$$

Where *Y*, *K*, *L TIF, and GQ* denote output, capital, labour, trade integration, and governance quality index, respectively. The shares of the output with respect to each of the explanatory variables are denoted by $\beta_1 - \beta_4$.

For a robust impact, equation 3.2 can be log-linearized to form equation (3.3) thus:

$$lnY_{it} = \beta_0 + \beta_1 lnK_{it} + \beta_2 lnL_{it} + \beta_3 lnTIF_{it} + \beta_4 lnGQ_{it} + \varepsilon_{it} \quad (3.3)$$

In order to achieve the objective of this study, equation 3.3 is modified by replacing the output with Adjusted Net Savings (ANS), measured as a composite index that includes the sum of Net National Savings (NNS), Education Expenditure (EE), Carbon Dioxide (Co_2) damage, consumption of Fixed Capital (FC), energy resources depletion, mineral resources depletion and forest depletion (Solarin and Bello, 2019) and stands as a proxy for Sustainable Development (SD) as well as the dependent variable (Ullah *et al*. 2021 and Jimoh *et al*. 2023). Capital and labour are proxies by the stock of capital (Cns) and the number of employed labour (Empl), respectively. The Governance Quality index (GQ) comprises the composite of political stability, government effectiveness, and rule of law, regulatory quality, and control of corruption and voice and accountability variables, reflecting institutional robustness. The equation is specified as:

$$lnANS_{it} = \beta_0 + \beta_1 lnCns_{it} + \beta_2 lnEmpL_{it} + \beta_3 lnTIF_{it} + \beta_4 lnGQ_{it} + \varepsilon_{it} \quad (3.4)$$

Trade integration is specified below as:

$$TIF_{It} = \frac{T_{ij}}{T_i} \quad (3.5)$$

Where TIF_{It} is the intra-regional trade share of an individual country and is measured as the sum of exports and imports of countries *i* and *j* within West Africa (T_{ij}); and the trade volume of West Africa to the rest of the world (T_j) (He *et al*., 2021; Ejones *et al*., 2021; Jimoh & Chua, 2021). Therefore, interacting the trade integration variable with the governance quality index to assess the level of sustainable development will transform equation (3.4 into equation (3.6), as specified below:

$$lnANS_{it} = \beta_0 + \beta_1 lnANS_{it-1} + \beta_1 lnCns_{it} + \beta_2 lnEmpl_{it} + \beta_3 lnTIF_{it} + \beta_4 lnGQ_{it} + \beta_5 (lnTIF_{it} * lnGQ_{it}) + \varepsilon_{it} \quad (3.6)$$

Where $lnANS_{it-1}$ = lag of adjusted net savings, introduced to capture the persistence and endogeneity characteristics of the study area, and $lnTIF_{it} * lnGQ_{it}$ = GQ_TIF (that is, the interaction between trade integration and governance quality). Equation (3.6) becomes the model estimate employed to achieve the objective of this study.

3.1 Data and Sources

The study employed secondary data that covers 16 West African countries: Benin, Burkina Faso, Cape Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, and Togo. The data spans 1996–2022 and the choice of 1996 as the starting date was because data on Governance quality indicators are available from that period and to ensure unbiased analysis. Variables such as adjusted net savings and governance quality variables were sourced from the World Bank's World Development Index (WDI) and World Governance Index (WGI), trade integration was sourced from IMF Direction of Trade Statistics (DOTs) while the stock of capital and the number of labour employed were from the Penn-World Table 10.0, respectively.

3.2 Estimation Method

In addressing the role of governance quality in the relationship between regional integration and sustainable development in West Africa, this study estimated the descriptive statistics, pairwise correlation analysis, and the unit roots test as well as adopted the Dynamic Panel Method with Interacting Effects (DPME). DPME is a relatively advanced panel data model estimation technique in econometrics. This method was employed because the existing literature failed to account for the role of cross-sectional dependence in non-stationarity panels, which may lead to misleading results. Thus, Cross-sectional dependence often arises when units in a panel (e.g., countries, firms, or regions) are influenced by common shocks or factors, leading to correlations across units. Incorporating interaction effects in a dynamic panel framework, the DPME captures both time-series dynamics and the interdependence among units in the panel (Liu, 2022; Chudik & Pesaran, 2015). DPME especially when used with GMM [such as the System (GMM), Two-Staged Least Squares (2SLS), and Three-Staged Least Squares (3SLS)] also offers a robust framework for studying interdependencies in panel data, especially in contexts where units are interconnected or influenced by shared external factors. The DPME model is specified in equation 3.7 below:

$$ANS_{it} = \alpha ANS_{it-1} + \beta X_{it} + \gamma X_{it} + F_i + \delta_i + \varphi_i + \epsilon_i \quad (3.7)$$

Where ANS_{it} is the dependent variable, ANS_{it-1} is the lag of the dependent variable, X_{it} is the independent variable, $F_i, \delta_i, \varphi_i, \epsilon_i$ imply the common factors, a unit of fixed effects, time fixed effect and error term respectively.

4. Result

This section presents and interprets the results of various estimation outputs. It employs descriptive statistics, pairwise correlation, unit root tests, among others.

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
ANS	432	1.131	12.657	-37.767	31.658
lncnS	432	11.046	1.583	8.627	15.261
lnempL	432	1.099	1.298	-2.048	4.291
lnTIF	432	5.122	1.57	1.019	9.749
GQ	432	.05	1.185	-3.255	5.089

Source: Authors' Computation 2025

Table 1 above represents the summary statistics of the variables employed in this study. The result shows that the Adjusted Net Savings (ANS), which is a key indicator of sustainability in West Africa has an average mean value of 1.131 in West Africa. This suggests a modest upward trend in sustainability efforts, though the relatively low mean value implies that assessing long-term sustainable development through savings remains a challenge on the region's collectively targeting the Sustainable Development Goals (SDGs). The standard deviation value of 12.657 shows the existence of a strong variation in the countries under study. The wide range shows a minimum of -37.767 and a maximum of 31.658, reflecting significant disparities in sustainability performance within the region.

The cnS which implies the average stock of capital has an average mean of 11.046, which points to relatively strengthened opportunities for regional integration and sustainable development through effective investment of capital in intra-trade relationships. The employment level of labour (empl) recorded a lower mean average of 1.099 suggesting that there is persistent unemployment in West Africa. On the other hand, the average mean value of LnTIF was reported as 5.1, indicating that the region engages more in the importation of goods and services than exportation, which implies the existence of regional trade among the countries in the West African region.

Governance quality (GQ) formulated using an index of the six governance indicators and measured with values of -2.5 and +2.5, shows a mean value of .05, suggesting governance quality is slightly positive but weak in fostering sustainable development and deeper regional trade in West Africa.

Table 2: Pairwise correlations

Variables	ANS	lnempL	lncnS	lnTIF	pca_instq
ANS	1.000				
lnempL	0.2211***	1.0000			
lncnS	0.3919***	0.8684***	1.0000		
lnTIF	0.1464***	0.7528***	0.6815***	1.0000	
pca_instq	0.3273***	-0.0193	0.2512***	0.0425	1.0000

Source: Authors' computation (2025)

Table 2 shows the relationship between the different variables employed. The result indicates a positive and significant relationship among the variables in this study area at 5% significance level. The relationship between the Adjusted Net Savings (ANS) and log of the number of labour employed (lnempl) indicates a positive and significant relationship at a 5 per cent significance level, which suggests that countries with more employment are associated with higher sustainable development but the relationship is moderate The relationship between the Adjusted Net Savings (ANS) and capital stock (Cns) also shows a positive and moderately significant coefficient of correlation (0.3919) at the stated significance level, indicating that sustainable development in West Africa can be achieved through more capital inflows and outflows. The relationship between ANS and the log of trade integration was 0.1464. This implies that trade between the countries remains weak possibly due to cross-border hindrances. The correlation coefficients also suggest that there is no likelihood of multi-collinearity among variables because of their low values in terms of the coefficient and significance levels. However, the relationship between the number of labour employed and the capital stock indicates the existence of a very strong positive relationship suggesting that higher employment correlates closely with higher capital stock, which possibly leads to labour transfer or mobility in West Africa.

Table 3: Result of the Panel Unit Roots Test

Variable	LLC	IPS	Breitung	HT
Level				
ANS	-7.4899	-4.3913***	-2.7766**	0.6378***
lnempL	-4.4174	-	3.7085	0.8226
lncnS	-5.7217	-	3.7317	0.8413
lnTIF	-9.9452***	-5.8777***	-3.6105***	0.5654***
Pca instq	-12.8518***	-4.5336***	-0.4452**	0.5656***
First Difference				
ANS	-16.9172***	-12.6741***	-10.6195***	-23.1236***
lnempL	-15.3274***	-	-7.3916***	-17.5208***
lncnS	-12.2477***	-	-6.7879***	-17.1947***
lnTIF	-18.0228***	-12.3466***	-10.7678***	-22.7071***
GQ	-17.5817***	-13.9433***	-10.8765***	-26.5573***

Source: Authors' Computation 2025

Table 3 result represents the panel unit root test that verifies the stationarity of each of the variables considered in this study. It was conducted using the LLC, IPS, Breitung, and Hadri test (HT) propounded by Im et al. (2003), Levin et al. (2002) and Breitung (2000). The result showed that some variables are stationary both at level and at first difference known as I(0) and I(1) series. However, the Hadri test (HT) indicated that all the variables are stationary at both the level and the first difference, which differs from others that show stationarity with some at I(0) and some at I(1). Therefore, the combination of the stationarity (that is I(0) and I(1) implies that further tests such as cointegration, and cross-sectional dependence tests become necessary. To solve this problem, a dynamic panel model with an interacting effect using the system GMM was conducted and the result is presented in Table 4 below.

Table 4: Cointegration Test Result

Kao test for cointegration			
		Number of panels	= 16
H0: No cointegration Ha: All panels are cointegrated		Number of periods	= 24
Cointegrating vector: Sam			
Panel means:	Included	Kernel:	Bartlett
Time trend:	Not included	Lags:	1.50 (Newey–West)
AR parameter:	Same	Augmented lags:	1
		Statistic	p-value
Modified Dickey–Fuller t		-1.8913	0.0293
Dickey–Fuller t		-1.3049	0.0960
Augmented Dickey–Fuller t		-3.2188	0.0006
Unadjusted modified Dickey–Fuller t		-1.5973	0.0551
Unadjusted Dickey–Fuller t		-1.1549	0.1241

Source: Authors' Computation 2025

Table 4 above shows the result of the cointegration test of the variables to test the dynamics of the variables. The rule of thumb is that if the p-value is less than the significance level, we reject the null hypothesis that there is no cointegration. From the above, the Augmented Dickey-fuller test shows the presence of cointegration; thus, the need for further investigation. On the other hand, further tests conducted to test the cross-sectional dependence using the Persaran and Friedman tests, indicated a P-value of 0.0000 and 0.0001, respectively, which suggests the presence of cross-sectional dependence in achieving sustainable development. This could be because of the common characteristics among the countries of the region.

Table 5: Regression Results of Fixed Effect, Random Effect, Driscoll-Kray, and System GMM

VARIABLES	(2) Fixed Effect	(3) Random Effect	(4) DKFE	(5) DKRE	(6) SysGMM
l1_ANS	0.519***	0.515***	0.519***	0.515***	1.000***
	(0.0601)	(0.0603)	(0.0485)	(0.0510)	(0.00131)
lnempL	-0.0515	-0.939	-0.0515	-0.939	1.471*
	(1.466)	(1.366)	(2.257)	(2.802)	(1.181)
lncnS	3.098***	3.570***	3.098*	3.570*	2.066**
	(1.006)	(0.953)	(1.709)	(1.965)	(0.839)
lnTIF	1.669***	1.466***	1.669**	1.466*	-1.354**
	(0.516)	(0.507)	(0.616)	(0.782)	(0.543)
GQ	0.300	0.449	0.300	0.449	3.394***
	(0.411)	(0.392)	(0.422)	(0.588)	(0.543)
GQ_TIF	0.00191***	0.00188***	0.00191**	0.00188**	0
	(0.000332)	(0.000332)	(0.000768)	(0.000768)	(0)
Hausman Test	7.53**				
Constant	-41.80***	-44.98***	-41.80**	-44.98**	-16.24*
	(9.737)	(9.559)	(16.16)	(17.65)	(9.602)
Observations	416	416	416	416	405
R-squared	0.344				
Number of Countryid	16	16	16	16	16

Source: Authors' Computation, 2025

Standard errors in parentheses - *** p<0.01, ** p<0.05, * p<0.1; *FE= Fixed Effect, *RE= Random Effect, *DKFE= Driscoll-Kraay Fixed Effect, *DKRE= Driscoll- Kraay Random Effect, and *SysGMM= System GMM

Table 5 shows the regression results that explore the impact of regional integration on sustainable development in West Africa, with emphasis on governance quality. The result shows that the lag of the dependent variable (l1ANS) has a strong positive and statistically significant effect on sustainable development in all the models. This implies that sustainable development in the current period is persistently influenced by its previous outcomes over time. Similarly, the strong significance of the variable implies that sustainable development has a long-lasting effect on the current level and as such, past achievements or setbacks can influence future outcomes of sustainable development in West Africa. The number of labour employed exhibits a negative and insignificant relationship in achieving sustainable development in West Africa in all the models except in SysGMM, meaning that sustainable development is not significantly driven by the level of labour employed, possibly as a result of inefficiency in governance quality and lack of competency skills adopted in the policy in the study area. This outcome implies that in the long run, there may be a high level of unemployment leading to labour mobility, and skills transfer in West Africa.

Similarly, the log of capital stock (lncnS) and Trade Integration Factor (lnTIF) were all found to have a positive and significant impact on the sustainable development of West Africa but weaker in the long run, suggesting that capital stock and trade integration

may not be the only variable that can determine sustainable development except with the influence of other variables like governance quality index. Governance Quality Index (GQ) on the other hand, exhibits a positive and insignificant impact on sustainable development in FE, RE, DKFE, and DKRE models but is highly significant and positive in SysGMM (3.394). This indicates that governance quality in these countries could drive sustainable development through regional integration in the short run; it is however still faced with weak institutional structure, inconsistencies in regional policies and corruption, which could deter the region from achieving its sustainable development goals.

The interaction of the governance quality index and trade integration factor (GQ_TIF) reveals that governance quality amplifies trade integration's positive effects in enhancing sustainable development, a finding absent in earlier studies on West African (Jimoh et al., 2023). This means that a well-established institution with low corruption influences trade integration on sustainable development in West Africa. However, the SysGMM's result (0) implies insignificant interaction between governance quality and trade integration in the long run, suggesting that the dynamics in the West African region, may lead to setting trade barriers possibly due to disagreement among the member nations on border trade (as experienced recently in the case of Niger, Burkina Faso pulling out of ECOWAS. The Hausman test (7.53; $p< 0.05$) shows that the fixed effects (FE) model is most preferred over the Random Effects (RE) model, suggesting that individual West African country-specific effects could significantly impact their respective sustainable development. The R^2 (0.344), indicates that 34.4% of the variation in sustainable development in West Africa is explained by the model.

5. Conclusions and Recommendations

This study investigated the prominent role of governance quality on the relationship between regional integration and sustainable development in West Africa using an augmented Cobb-Douglas production function over the period 1996-2022. Employing a dynamic system GMM and different techniques, the result shows that governance quality has a positive and significant role in achieving sustainable development in West Africa, when interacting with other variables. On the other hand, the number of labour employed has an insignificant impact. However, the trade integration factor exhibits a significant impact but with weak influence, reflecting inefficiencies in the regional trade practices of West Africa. The study therefore recommends a strategic policy measure such as strengthening of governance quality to ensure that trade integration contributes positively to sustainable development in West Africa. To accelerate sustainable development in the region, it also advocates the adoption of better employment policy needs (such as job creation and open trade) whose impact appears inconsistent across West Africa.

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Options for Sustainable Funding of State Police in Nigeria: A Cross-Country Review

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Abstract

Amid Nigeria's worsening insecurity and growing dissatisfaction with its centralized policing structure, the debate over establishing state police has gained renewed momentum. While legal and constitutional concerns have dominated public discourse, the critical issue of sustainable funding remains insufficiently addressed. This study sought to fill this gap by undertaking cross-country comparative analyses of subnational police funding models across ten jurisdictions: South Africa, Kenya, India, Germany, the United Kingdom, Canada, Brazil, Argentina, Mexico, and Indonesia. Findings reveal a dominant pattern of multi-tiered financing systems, combining federal grants with state and local government contributions. Successful models such as those in the United Kingdom and Canada are built on equitable federal support, transparent legal frameworks, local revenue innovation, and institutional oversight. However, cases from India and Brazil show that financial investment alone does not improve policing outcomes in the absence of governance reforms and fiscal accountability. Drawing from these insights, the paper recommends a hybrid funding model for Nigeria, combining federal equity grants with state-level funding innovations.

Keywords: *Policing Reform, State Police, Police Funding, Fiscal Federalism, Funding Frameworks, Comparative Governance Sustainability*

1. Introduction

Security is universally recognized as a public good, and as such, requires deliberate, consistent, and sufficient investment (Kaul, Grunberg, & Stern, 1999). Evidently, the necessity of a secure environment for economic growth, social stability, and democratic governance cannot be overemphasized (Ahmed & Ikeme, 2024). In many countries, including Nigeria, the increasing complexity of internal security threats (ranging from terrorism and banditry to cybercrime and communal conflict) has reignited discussions on the need to decentralize policing functions as a means to enhancing effectiveness and local responsiveness (Jah, Bodi, & Nanlung, 2023).

In Nigeria, the clamor for the establishment of state police has gained traction, driven by widespread concerns over the limitations of the current centralized policing model. These concerns range from delayed response times and lack of local intelligence to jurisdictional rigidities and under-resourcing of police commands at the subnational level (Ejalonibu, Ezechi, Osolafia, Nandi, & Tongsi, 2021). In particular, the persistence of security gaps at the community and state levels has elevated the state police proposition as a structural necessity rather than a political preference.

However, beneath the legal and constitutional debates lies an even more fundamental issue: how will state police be sustainably funded? In a fiscal environment marked by declining federal revenues, high debt servicing obligations, and increasing subnational fiscal distress where states owe salaries, the prospect of assigning additional responsibilities (such as policing) to states raises serious concerns about affordability and sustainability. The Nigeria n experience is replete with examples of abandoned or underfunded projects and services at the state level, largely due to constrained revenue bases, poor budget prioritization, and systemic governance weaknesses. These fiscal realities have undermined the effective delivery of essential public services, including health, education, infrastructure, and security.

Given the strategic and continuous nature of policing, ad hoc or discretionary funding models are ill-suited to meet its demands. A functional policing system requires predictable, adequate, and transparent financing. The imperative, therefore, is not just to devolve police powers but to ensure that such devolution is backed by clear, sustainable, and equitable funding mechanisms. Without this, the creation of state police could result in uneven security provision, deepen regional inequalities, and potentially politicize security delivery at the local level.

This article seeks to address a critical gap in literature and policy discourse by examining how state-level police forces are financed in other jurisdictions to draw comparative lessons for Nigeria. The objective is not to evaluate the desirability of state police, which has already garnered broad support in some quarters, but to explore the financial viability and institutional design of funding frameworks that can support the long-term success of state policing in Nigeria. Ultimately, the study contributes to ongoing discourse on national security by foregrounding the need for fiscal realism and policy foresight in the debate over policing reform.

2. Police Structure and Funding in Nigeria

Nigeria's policing system remains primarily centralized, despite its federal constitutional structure. The Nigeria Police Force (NPF) is a single, national entity established under Section 214 of the 1999 Constitution, with command authority vested in the Inspector-General of Police (IGP), who reports directly to the

President. State police commissioners, although stationed in the states, are appointed and controlled by federal authorities.

Section 214 (1) of the Constitution of the Federal Republic of Nigeria, 1999 (as altered) established the Nigeria Police Force (NPF) while section 5 of the Police Act, 2020 mandates the police to enforce the constitutional provisions relating to the protection of human rights and crime prevention. Sections 214 (2)(a) and 215(2) of the Constitution provide for the structure of the NPF with Section 215 (2) providing that: the Nigeria Police Force shall be under the Command of the Inspector-General of Police and any contingents of the Nigeria Police Force stationed in a state shall; subject to the authority of the Inspector-General of Police, be under the command of Commissioner of Police of that state". Also, the Third Schedule of the Constitution established the National Police Council (NPC) and Police Service Commission (NPC) to provide supervision, organization and administration of the police.

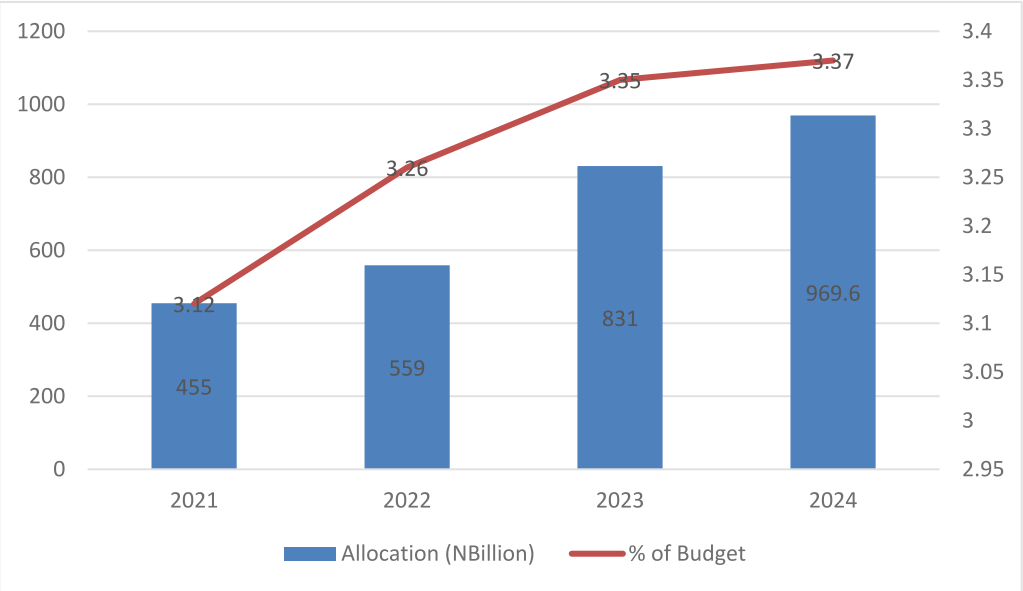
The federal government primarily funds the Nigeria Police Force through annual budgetary allocations. State governments also contribute to funding the police within their jurisdictions. Additionally, international donations and grants support various police initiatives. Section 4 of the Nigeria Police Trust Fund Act, 2019, mandates a 0.5% levy on the net profit of companies operating in Nigeria and a 0.005% allocation from the total revenue accruing to the Federation Account. Specifically, Section 4(1)(a) details the 0.5% levy on companies' net profit, and Section 4(1)(b) outlines the 0.005% from the Federation Account. These provisions aim to guarantee a consistent and dependable flow of funding for the NPF. State governments also make discretionary financial contributions, particularly in logistics and infrastructure support for police operations within their jurisdictions.

The federal government's unitary control over command and funding of policing has drawn increasing criticism for being unresponsive to local security challenges, unaccountable to state governments, and structurally ill-equipped to manage Nigeria's diverse and complex security landscape (Salihu & Agu, 2024). The manifest disconnect between Nigeria's federal police command and local security realities has led to mounting calls for the creation of state police services, which would operate under the jurisdiction of state governments, with powers to recruit, train, fund, and deploy officers within their territories. Advocates argue that such a reform would enhance operational effectiveness, accountability, and community trust, while critics raise concerns about potential abuse of police powers by state actors and the risk of fragmented national security coordination (Hills, 2008; Oyemwinmina & Aibieyi, 2016).

Understanding the concept of policing within a federating state is essential to evaluating Nigeria's current security architecture and its potential evolution

(Asiwaju & Marenin, 2008; Deribe, 2023; Moliki, Nkwede, & Dauda, 2020). Drawing on global models, this study provides a framework for examining how subnational policing functions are conceptualized, structured, and financed, insights that are critical to informing Nigeria's ongoing debates on police reform and fiscal federalism.

Figure 1: Budgetary allocation to the Nigeria Police (2021-2024)



***Source**: Budget Office of the Federation*

As shown in Figure 1, the annual budgetary allocation to the NPF has remained around 3% of total budget expenditure; it is clearly not enough to cater to the policing of the Nigerian population of 218.54 million people. Though the United Nations recommends police personnel-citizen ratio of 1:460, Nigeria has a police-citizen ratio of 1:650. The NPF requires an additional 190,000 personnel to be at par with the United Nations recommended ratio. This necessitates additional funding for the NPF to effectively police the Nigerian state.

3. Comparative Overview of Subnational Policing and Funding Models

Subnational policing, in this context, refers to the establishment and operationalization of police services that are created, funded, and governed at the state or local government level, with defined jurisdictions and accountability systems separate from, or complementary to, national police forces (Deribe, 2023). These subnational police units typically handle internal security functions such as community policing, traffic enforcement, by-law compliance, and local crime prevention, while federal police often retain responsibility for cross-border crime, terrorism, and national security.

A comparative review of various countries' policing and funding models highlights a broad array of fiscal arrangements, governance mechanisms, and institutional dynamics that offer critical lessons for Nigeria as it debates the decentralization of its police system. Drawing from experiences across federal and quasi-federal states such as India, Germany, the United Kingdom, Canada, Brazil, Argentina, Mexico, the United States and select African and Asian countries, this section presents key insights relevant for informing Nigeria's subnational policing reform and its fiscal sustainability.

First, the dominant trend across the countries studied is the use of multi-tiered funding arrangements, where policing is financed through a combination of federal grants, state or provincial allocations, and municipal revenue streams. This triadic funding model ensures that while the responsibility for routine policing rests with the subnational entities, the federal government retains a strategic role in guaranteeing baseline operational standards and enabling equalization across regions. For instance, in Germany, while the federal government funds the Federal Police, state and local governments assume full responsibility for day-to-day policing costs, leveraging their strong fiscal capacity (De Maillard et al., 2021). Similarly, the United Kingdom balances central government grants with the "Police Precept" from local taxation, offering communities both financial autonomy and a minimum funding floor through centrally administered support (Facchetti, 2024; Martin, 2022; Nepomuceno, Daraio, & Costa, 2021). This mixed approach is particularly suited to Nigeria's context, where regional disparities in revenue generation would necessitate federal transfers to less endowed states to avoid reinforcing structural inequalities.

Fiscal autonomy without accountability mechanisms is insufficient, as illustrated in India and parts of Brazil (Nepomuceno et al., 2021). Despite robust state-level contributions and federal modernization grants under India's MPF scheme, outcomes have been stymied by corruption, leadership deficits, and poor institutional governance. India's experience warns against assuming that increased fiscal flows automatically translate into improved policing.

Similarly, in Brazil, the absence of a clear demarcation of responsibilities between federal, state, and municipal authorities has led to overlapping functions and inefficiencies in budget implementation. These examples stress that any movement toward decentralizing police funding in Nigeria must be accompanied by strong oversight structures, performance tracking, and citizen-engaged audits to guard against misuse of funds and institutional decay.

The models in Canada and Mexico showcase the value of population-based and performance-sensitive grant systems (Sabet, 2023; Seabrook et al., 2023). Canada's MPAG and Police Officers Grant exemplify targeted financial assistance aimed at relieving municipalities of disproportionate policing costs. Mexico, though facing implementation challenges, demonstrates how federal subsidies to state and local

governments can support decentralized policing reforms (Sabet, 2023). Nigeria can adapt these mechanisms by designing an equalization formula that considers population size, crime prevalence, and states' revenue generation capacity in allocating federal grants for subnational police forces. This ensures that poorer or high-crime states are not disadvantaged in service delivery.

Countries like South Africa and Kenya provide models more regionally aligned with Nigeria's socio-political dynamics. In South Africa, municipalities such as Cape Town have successfully institutionalized municipal police funded entirely through city budgets (Govender & Pillay, 2022). Kenya's County Policing Authorities (CPAs), though lacking direct control over police forces, represent a decentralized oversight and resource-support model (Diphoorn & van Stapele, 2021). In both cases, fiscal participation by subnational entities has enhanced community engagement, localized accountability, and context-specific policing solutions. Nigeria can adapt these models by introducing State Policing Commissions and State Security Trust Funds, which could coordinate planning, budgeting, and civil oversight over police operations at the subnational level.

Indonesia and the United States offer cautionary lessons. In Indonesia, strict centralization of police funding has prevented local adaptation to security challenges and weakened police–community relations (Muradi, 2008; Sufriadi, 2024). Conversely, the U.S., while highly decentralized, has faced severe criticisms over disparities in funding between wealthy and poor states, overreliance on controversial sources such as civil asset forfeiture and traffic fines, and the absence of adequate oversight (Gaines, Kappeler, & Powell, 2021). Nigeria must, therefore, avoid extreme models by building a balanced framework that combines local flexibility with centralized safeguards, clear funding boundaries, and legal controls to prevent financial abuse or security inequities.

The importance of transparency and reporting in police funding cannot be overstated. One of the dominant criticisms of the American policing system is its opaque use of revenues from asset seizures, which sometimes distort policing priorities (Cobbina- Dungy & Jones-Brown, 2023). Nigeria should legislate and institutionalize annual budget disclosure mechanisms, internal and external audits of police expenditure, and independent review panels to promote accountability. This would enhance public trust and align policing with democratic norms.

Finally, a core insight from nearly all case studies is that funding models alone do not guarantee police effectiveness. Factors such as institutional culture, quality of leadership, intergovernmental coordination, and the rule of law are decisive. In India, Brazil, and parts of Canada, generous police funding has not always correlated with better outcomes, partly due to poor internal governance, politicization, or fragmented oversight. Nigeria's challenge, therefore, is not only

to finance state policing adequately but to embed systemic reforms, including merit-based recruitment, training, performance monitoring, and human rights compliance within the structure of subnational police institutions.

The comparative experiences surveyed underscore that for Nigeria to implement a viable state policing model, it must adopt a hybrid funding framework combining federal equity guarantees and state-level autonomy, backed by robust governance safeguards and capacity development programmes. A phased implementation strategy, starting with legal reform, pilot programmes in fiscally prepared states, and gradual rollout of federal matching grants, would allow for adjustment and learning. This approach not only aligns with global best practices but addresses Nigeria's unique political, fiscal, and security complexities, ensuring that decentralized policing enhances both local security responsiveness and national cohesion.

3.1 Lessons from Cross-country Experiences

Based on the experiences of the countries analyzed above, state police in different countries are funded mainly through a combination of federal, state, and local authorities. The state government bears the main responsibility to fund the police through its budgets while the federal government also provides financial support. In some countries, specific tax revenue is channeled to the police budget.

There is a need for a balance between state funding and federal support to ensure accountability of state police resources while also achieving nation-wide strategies and coordination. For example, in the case of Brazil, the state budget generally funds police operations, but federal support can come in the form of equipment purchase, training programmes, counter terrorism efforts, among others.

The manner of federal support to state police also varies from country to country. In some cases, the distribution of federal support is based on the population of the state. In other cases, it depends on the capacity of the state to mobilise resources for its police budget and the level of crime.

The decentralization of the police and the funding structure has little or no impact on the efficiency and effectiveness of the police system, as corruption and mismanagement of funds at the state or local level can undermine the policing standards.

4. Conclusion and Recommendations

Adopt a Mixed (Tiered) Funding Model with Central Equity Support: Nigeria should adopt a hybrid funding structure, combining federal grants and state-generated revenue to finance state police operations. Federal contributions should ensure a minimum standard of operational capacity nationwide, irrespective of state-level fiscal disparities. This model reflects UK's dual-funding approach and Canada's MPAG framework, where central support ensures national policing standards, while

local resources support context-specific services. Such an arrangement is particularly critical in Nigeria because state capacities vary widely.

Develop a Federal-State Equalization Grant Formula: A formula-driven Police Funding Equalization Grant should be developed to allocate federal resources to states based on objective indicators such as population size and density; crime rates and security vulnerabilities; internally generated revenue (IGR) performance; rural-urban policing costs. This model draws from Canada and Mexico's population-sensitive allocations and supports fiscal fairness in line with constitutional equity principles.

Institutionalize State Security Trust Funds with Legal Backing: States should be required, by law, to establish State Security Trust Funds (SSTFs) to serve as a dedicated, ring-fenced funding mechanism for their police forces. These funds should pool revenue from from the following: state budgetary allocations; private sector security levies; voluntary community contributions; and judicially awarded fines. This reflects practices in Lagos and other jurisdictions and should be subject to annual independent audits and legislative scrutiny to prevent abuse and ensure fiscal discipline.

Legislate a National Framework for Subnational Policing Finance: The National Assembly should consider enacting a State Police Fiscal Framework Act, clearly defining the following: roles and responsibilities for federal and state governments in funding; funding eligibility criteria and disbursement protocols; reporting and oversight standards; sanctions for misappropriation. Such a law would mirror Germany's clarity on fiscal roles and eliminate ambiguity around police funding in Nigeria's federal arrangement.

Establish a National Policing Accountability and Audit Commission (NPAAC): This will be a central, autonomous National Policing Accountability and Audit Commission and should be created to: vet and approve state police budgets funded through federal allocations; monitor use of grants and special funds; audit state policing expenditure and performance; ensure citizens' grievance redress. This mirrors oversight mechanisms in the United States and United Kingdom and is essential for transparency and credibility.

Incentivize States to Innovate Revenue Mobilization for Policing: The federal government, via the Revenue Mobilization Allocation and Fiscal Commission (RMAFC), should create incentives for states that commit a fixed percentage of IGR to state police funding; demonstrate improved policing outcomes; partner with local councils and private actors in safety initiatives. This could take the form of matching grants or federal performance-based top-ups, drawing lessons from U.S. and Brazilian models of incentivized local investment.

Safeguard Against Politicization and Human Rights Violations: To ensure that funding does not empower state governments to weaponize police forces against political opponents, there must be: National standards for recruitment, training, and operational codes; a centrallymonitored complaint system for rights violations; shared oversight boards comprising civil society, judiciary, and security experts. This mitigates the risks observed in India and Mexico where subnational police have been used for partisan ends.

*Integrate Community-Based Policing into State Police Budgets***:** Each state police structure should dedicate at least 10–15% of its annual budget to community policing and public engagement, including: grassroots policing forums; local security infrastructure (CCTV, lighting, emergency hotlines); training in mediation and restorative justice. This reflects Kenya's CPA model and South Africa's LEAP strategy, emphasizing responsiveness and public trust.

Build State-Level Fiscal Capacity for Sustainable Security Investment: In the long term, state governments must be supported to grow their Internally Generated Revenue base, enabling sustainable financing for security. Strategies include: expanding the formal tax net; introducing public safety levies tied to property and business licenses; monetizing security-linked economic services. This is fundamental if Nigeria is to avoid replicating the structural weaknesses observed in fiscally dependent states.

The viability of state police in Nigeria hinges not only on political will and legal reform but on the establishment of a sustainable, equitable, and accountable funding model. International experiences suggest that while decentralization offers the potential for responsive policing, it must be underpinned by multi-tiered financing, capacity-building, and governance safeguards. The recommendations of this paper, grounded in empirical insights from global models, emphasize that sustainable funding for state police in Nigeria requires more than just money; it requires institutional architecture, fiscal discipline, legal precision, and public accountability. A balanced approach that fuses equity with flexibility, and central oversight with local responsiveness, offers Nigeria an optimal pathway toward a modern, decentralized, and democratically governed policing system.

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Monetary Policy and Aggregate Investment in Nigeria

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Abstract

Amid persistent investment challenges in developing economies, understanding the robustness of monetary policy in promoting capital formation remains crucial to sustainable growth. This study empirically examines the relationship between monetary policy and aggregate investment in Nigeria, utilising year-on-year time series data within an ARDL framework. The analysis focuses on key monetary variables to assess their long-run and short-run effects on aggregate investment. The results reveal that M2 exercises a consistently positive and statistically significant control on investment, highlighting the importance of liquidity towards supporting capital formation. Conversely, the CRR exerts a contractionary influence in the short-run yet shows a non-negative long-run impact, indicating a stabilising role in the financial system over time. The MPR was found to be insignificant in both periods, suggesting a limited effectiveness of interest rate adjustments in stimulating investment. Credit ratio to the private sector exhibits a positive but weak long-run influence, while the exchange rate has a considerable and adverse impact in the short-run, reflecting the sensitivity of investment to exchange rate volatility. However, both regulatory quality and political stability are statistically insignificant, suggesting that institutional factors do not have a strong direct effect on investment. The evidence from this research leads to the conclusion that effective monetary policy for investment evolution in Nigeria must prioritise liquidity enhancement, stable credit flows, and exchange rate management, complemented by policy reforms aimed at improving financial intermediation and investor confidence. The findings contribute to policy debates on optimising monetary tools to foster sustainable investment-led growth in developing economies.

Keywords: Monetary policy, Gross fixed capital formation, Aggregate Investment, Broad money supply, Cash reserve ratio, Monetary policy rate.

1 Introduction

Investment remains a critical pathway to bridging the infrastructure gap and enhancing economic resilience in economically developing nations. However, challenges such as limited access to credit, political instability, and inconsistent policy implementation often undermine the effectiveness of investments in fixed assets (International Monetary Fund [IMF], 2022). This situation underscores the importance of sound macroeconomic policies, including monetary policy, in creating a conducive environment for capital formation. Nigeria, as the largest economy in West Africa, mirrors global and regional investment trends but also contends with distinctive

macroeconomic challenges. Despite its vast natural resources and considerable market potential, Nigeria's aggregate investment performance has remained volatile over the past four decades. In line with yearly data from the Central Bank of Nigeria (CBN, 2023), the share of Gross Fixed Capital Formation (GFCF) to GDP has fluctuated between 13.1% and 18.9% from 1981 to 2022, falling short of the 25%–30% benchmark widely recommended by the World Bank and UNCTAD for sustaining robust economic growth in developing countries. This persistent underperformance underscores structural and policy-related constraints that inhibit long-term capital accumulation.

Investment instability in Nigeria has been linked to inflationary pressures, high interest rates, exchange rate misalignments, and constrained credit access factors largely shaped by monetary policy dynamics. For instance, episodes of tight monetary policy intended to control inflation often result in reduced liquidity and elevated cost of borrowing, which stifles private sector investment. Similarly, frequent exchange rate adjustments and currency depreciation have heightened uncertainty, deterring both domestic and foreign capital formation. These recurring patterns suggest a complex interplay involving monetary policy instruments plus investment behaviour in the country, thus motivating this present research to empirically investigate how monetary policy variables like money supply, interest rates, credit ratio to the private sector, and exchange rate influence aggregate investment outcomes. By identifying the channels through which monetary policy affects investment, this study seeks to provide evidence-based insights for more effective macroeconomic policy formulation in Nigeria.

GFCF plays a pivotal role in global economic development as it reflects the investment in fixed assets such as infrastructure, machinery, and buildings, which are essential for enhancing productivity and fostering long-term growth. Globally, the correlation involving investment in capital assets and economic expansion was well established. Studies by Saada (2025), Haraguchi, Martorano and Sanfilippo (2019), and Barro (1991), demonstrated that sustained investment in fixed capital is a key driver of industrialisation, technological advancement, and employment creation in both developed and developing economies. Nations with robust Aggregate Investment levels often experience accelerated growth, as infrastructure investments lower production costs and attract private-sector participation (World Bank, 2020).

In Nigeria, the monetary policy, managed by the CBN, serves as a critical tool for stabilising the economy and fostering investment. Policy tools such as interest rates, money supply, and credit allocation are deployed to achieve macroeconomic stability. However, the effectiveness of these policies in driving GFCF has been mixed. While some interventions have successfully curbed inflation and stabilised the Naira, others

have inadvertently discouraged borrowing for long-term investments due to high financing costs (Obadan, 2018; Akinwale & Adeniyi, 2020).

Investment in fixed assets is crucial for driving economic growth and development, yet Nigeria continues to face challenges in achieving consistent growth in GFCF. Ideally, a stable monetary policy environment should stimulate such investments, facilitating infrastructure development and industrialisation. However, the Nigerian economy has been characterised by macroeconomic instability, including high inflation rates, volatile exchange rates, and varying interest rates, all of which significantly influence GFCF.

Despite successive monetary policies aimed at stabilising the economy and promoting investment, the outcomes have been inconsistent. For example, while some policies have succeeded in stabilising inflation and exchange rates, they have often led to higher borrowing costs, discouraging private-sector investments in fixed assets (CBN, 2021). Furthermore, the persistent infrastructure deficit suggests that monetary policy has not fully addressed the structural issues hindering GFCF.

Beyond macroeconomic factors, institutional quality plays a crucial role in shaping the investment climate. This study incorporates Political Stability and Absence of Violence (PSA) and Regulatory Quality (RQ) as control variables to better understand the broader environment influencing GFCF. High levels of political instability and weak regulatory frameworks often exacerbate uncertainty, deter private investment, and reduce the effectiveness of monetary policy interventions. In contexts where violence, policy inconsistency, or weak rule of law prevail, even well-designed monetary policies may fail to generate the intended economic outcomes.

This inconsistency raises critical questions concerning the suitability of monetary policy in promoting aggregate investment (INV) in Nigeria. Why have monetary policies not yielded sustainable improvements in GFCF? What are the key monetary factors influencing GFCF in Nigeria? Addressing these questions is crucial, as inadequate investment in fixed capital continues to limit the country's economic potential. This work seeks to analyze the influence of monetary policies on GFCF, identifying the factors that enhance or hinder capital formation and offering evidence-based recommendations for more effective policy implementation.

2. Literature Review

2.1 Conceptual Framework

The conceptual basis of the study highlights the interaction between monetary policy instruments and aggregate investment (INV) in Nigeria. Monetary policy variables, including M2, CRR, CRPS EXR and MPR, serve as the independent variables, while GFCF, which measures investment in fixed assets, is the dependent variable. The framework posits that effective monetary policies, particularly those promoting liquidity (e.g., M2), are crucial for facilitating investments in capital goods and

infrastructure. Conversely, restrictive policies such as high CRR or high MPR may impede capital formation by reducing credit accessibility.

Institutional variables such as Political Stability and Absence of Violence/Terrorism (PSA) and Regulatory Quality (RQ) also influence this relationship, serving as moderating variables. These dynamics are illustrated as follows:

Monetary Policy Rate **Credit to the Private Sector** **Broad Money Supply**	**→ Liquidity and Credit Availability**	**→ GFCF (Aggregate Investment [INV])**

(Moderated by PSA and RQ)

This framework highlights the need for policy balance, which aims to enhance investment while mitigating adverse effects on liquidity and credit.

2.2 Theoretical Framework

The study operates within the framework of Monetary Policy Transmission Mechanism. It explains transitions in monetary policy instruments on the broader economy, including investment levels. It further suggests that monetary policy impacts the economy through various channels, such as interest rates, credit availability, and inflation expectations. For instance, an expansion in M2 increases money supply, boosting credit availability and stimulating investment. Conversely, restrictive policies like higher CRR can tighten liquidity, reducing investments. This provides a robust foundation for analysing how monetary policy variables influence aggregate investment, offering insights into the mechanisms through which policy adjustments can promote or hinder capital formation in Nigeria.

2.3 Empirical Review

Monetary policy significantly shapes investment financing and capital formation in an economy. To this end, several studies by Cloyne et al. (2023) and Adenuga (2020) have examined the correlation among monetary policy instruments and investment development, utilising various econometric techniques and country-specific data studies relating to monetary policy and investment, highlighting methodological discrepancies, findings, limitations, and contributions have well been documented in literature. For example, Okezie (2015) analysed the connection between Nigeria's reflationary monetary policy and investment (measured GFCF) employing time series data from 1970 and 2012. The study employed Engle-Granger two-step co-integration method and the Granger causality test to assess the long-run equilibrium relationship between monetary policy and investment. The outcomes revealed a co-integration between money supply and GFCF, with a significant error correction term of -0.76, showing that 76% of disequilibrium is corrected annually. The study concluded that a contraction in money supply negatively impacts investment growth. However, the study focused solely on money supply as a proxy for monetary policy, neglecting other

important instruments such as MPR and CRR. This work addresses this limitation by incorporating a broader set of monetary policy tools to comprehensively examine their impact on investment financing in Nigeria up to 2023.

Thuy, et al. (2020) investigated the impact of monetary policy on corporate investment in Vietnam using provincial data from 63 provinces between 2009 to 2017. The study utilised Generalized Method of Moments (GMM) to analyse role of monetary policy instruments, including M2, CRPS, MPR, and EXR. Findings showed that monetary policy significantly influences private investment via M2, domestic credit, and MPR channels, while EXR effects were statistically insignificant. However, the study did not explore immediate and long-term monetary policy's effect on investment. To fill this gap, the current study employs ECM within an ARDL framework, which enables a more robust examination of both short-run and long-run effects of monetary policy and investment in Nigeria.

Agwu (2015) investigated the components of investment in Nigeria between 1981 and 2013, employing the ARDL model to analyse both long-run and short-run coefficients. Results indicated that previous income levels, fixed capital, government scale, and MPR were key determinants of domestic investment in Nigeria, with positive effects. However, EXR and inflation rate had no influence on private investment. The aforementioned study incorporated monetary policy rate but excluded other important policy instruments such as M2 and CRR. In contrast, this study adopts a more comprehensive approach by considering different monetary policy tools, including MPR, M2, and CRR, to analyse their effects on investment (proxied by gross fixed capital formation).

Cloyne et al. (2023) investigated how monetary policy affects firms' investment and borrowing behaviour, using firm age and dividend status as proxies for financial constraints. Employing a Vector Autoregression (VAR) model (1986–2016), the study showed that younger, non-dividend-paying firms exhibit greater sensitivity to monetary policy shocks compared to older firms, as their investment and borrowing are highly dependent on collateral values. This study provides valuable insights into firm-level responses to monetary policy but does not explicitly address how monetary policy influences aggregate investment financing. To bridge this gap, the current study prioritises macroeconomic influence of monetary policy on investment, using broader monetary policy tools and a longer timeframe (1986–2023).

Adenuga (2020) analysed the effects of MPR and investment in Nigeria between 1986 to 2018, utilising unit root tests, co-integration estimation analysis, and ECM. The study examined the relationships between GFCF, MPR, INFR, EXR, and real GDP. The Johansen co-integration test revealed a long-run relationship between GFCF and monetary policy variables, while the ECM showed a positive error correction term of -0.02, indicating slow adjustment to equilibrium. While Adenuga's study is closely related to this research, it lacks additional monetary policy tools like M2 and CRR, which are crucial to understanding the full effects of monetary policy and investment.

Furthermore, the study period is limited to 1986–2018, whereas this research extends the analysis up to 2023, incorporating broader monetary policy variables and employing ECM-ARDL techniques.

Wan & Lee (2023) examined the inefficiencies of monetary policy transmission in China's corporate investment sector (2001–2017). Panel data model was used to analyse the overinvestment tendencies and abnormal reactions of firms to monetary policy rate changes. Findings suggest that monetary policy in China is insignificant as a result of structural inefficiencies in the financial system, necessitating broader financial reforms. While this study provides important insights into monetary policy inefficiencies in a transitional economy, it does not specifically explore the influence of monetary policy and investment. This research builds upon these insights by focusing on Nigeria's monetary policy transmission mechanisms and evaluating their impact on investment, using the ECM and ARDL techniques.

Musthafa et al. (2024) explored monetary policy shocks in Sri Lanka between 2003–2019, distinguishing pre and post-conflict periods using a VAR model. They found that monetary policy had a stronger and longer-lasting effect on key economic variables in the post-conflict period, with the monetary policy rate and exchange rate playing dominant roles in the transmission mechanism. The study highlighted how monetary policy effectiveness evolves over time, especially in economies undergoing structural changes. However, the study is limited to Sri Lanka's economic context and focuses on general macroeconomic variables rather than investment financing specifically. This research extends the analysis to Nigeria, emphasising the role of monetary policy tools in influencing investment, incorporating M2, CRR, and MPR as key determinants.

Ayodeji & Oluwole (2018) explored the impact of monetary policy on economic growth in Nigeria between employing multi variable regression technique. They found that M2 and EXR had a positive but fairly insignificant influence on economic advancement in Nigeria. MPR and liquidity ratio exert a negative but highly significant impact on economic expansion. Findings align with the broader consensus that monetary policy influences private capital formation. However, their study primarily focused on the growth effects of economy rather than the determinants of investment. This research builds on their findings by explicitly analysing how monetary policy tools drive investment in Nigeria, incorporating a wider range of monetary policy variables and institutional variables such as PSA and QR using ARDL framework to ensure robust empirical findings.

3. Methodology

This study scrutinises the influence of monetary policy and aggregate investment (INV), proxied by GFCF, in Nigeria from 1986 to 2023. The analysis is anchored on the **Monetary Transmission Mechanism framework**, which posits that monetary policy influences macroeconomic variables, including investment, through interest rates, credit channels, exchange rates, and liquidity conditions.

This study adopts an empirical adaptation of this framework, incorporating monetary and institutional variables relevant to the Nigerian context.

Table 1: Data Description

Variable	Description/Measurement	Source
GFCF	It is essentially a gauge of a nation's investment in its output-oriented capacity. It represents total value of new assets acquired by businesses, governments, and households (excluding unincorporated enterprises) minus the value of assets disposed of during a specific period.	(CBN) (2023)
MPR	This is the model interest rate set by CBN. It is a monetary policy instrument and is measured in percentage.	(CBN, 2023)
M2	This refers to aggregate amount of money flowing in the economy (cash, checking, savings). It is a monetary policy instrument and is measured in billions of naira.	(CBN, 2023)
CRR	It is the percentage of lodgments commercial banks must keep as reserves with the CBN. It is a monetary policy instrument and is measured in percentage.	(CBN, 2023)
PSA	This refers to peaceful and secure environment where governments are stable, and there is no threat of political upheaval, terrorism, or violent conflict.	World Development Indicators (WDI) (2023)
RQ	It entails formulation and implementation of viable policies and controls by regulatory authorities that stimulate private sector enhancement.	(WDI, 2023)
EXR	This is the rate of a country's currency exchanged for another country's currency. It is measured in USD.	(CBN, 2023)
CRPS	It measures the amount of credit offered to the private sector by financial institutions relative to the size of the economy. It is expressed as a percentage of the country's GDP.	(WDI, 2023)

Source: Author's Computations 2025

In line with this framework, the model specifies Investment (GFCF) as a function of selected monetary policy variables: MPR, M2, CRPS, EXR, and CRR. To account for non-monetary institutional influences, the model also includes PSA and RQ as control variables. Furthermore, the basis for selective logging of some variables is based on the need to minimise their initial quantum to lesser scale of the unlogged ones.

Thus, the linear form of the model is specified below:

GFCF = f(MPR, M2, CRR, CRPS, EXR, PSA, RQ……(1)

Transforming the equation into a log-linear form for estimation and addressing potential scale effects, the econometric model is expressed as:

$$\log GFCF_t = \beta_0 + \beta_1 MPR_t + \beta_2 \log M2_t + \beta_3 CRR_t + \beta_4 CRPS_t + \beta_5 EXR_t + \beta_6 PSA_t + \beta_7 RQ_t + \mu_t \ldots\ldots(2)$$

The ARDL model specification of equation (2) is specified thus:

$$\begin{aligned}\Delta \log GFCF_t = {} & \alpha + \sum_{i=1}^{x} \beta_i \, \Delta \log GFCF_{t-i} + \sum_{i=1}^{x} \delta_i \, \Delta MPR_{t-i} + \sum_{i=1}^{x} \tau_i \, \Delta M2_{t-i} \\ & + \sum_{i=1}^{x} \rho_i \, \Delta CRR_{t-i} + \sum_{i=1}^{x} \gamma_i \, \Delta PSA_{t-i} + \sum_{i=1}^{x} \sigma_i \, \Delta RQ_{t-i} \\ & + \sum_{i=1}^{x} \psi_i \, \Delta PCRPS_{t-i} + \sum_{i=1}^{x} \text{Ь} \, \Delta RQ_{t-i} + \varphi_1 MPR_t + \varphi_2 M2_t + \varphi_3 CRR_t \\ & + \varphi_4 CRPS_t + \varphi_5 RQ_t + \varphi_6 PSA_t + \varphi_7 RQ_t + ECT \\ & + \varepsilon_t \ldots\ldots \ldots\ldots \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)\end{aligned}$$

Where:
LnGFCF= log of Investment proxy by GFCF
MPR = Monetary Policy Rate
lnM2 = log value of Broad Money Supply
CRR = Cash Reserve Ratio
CRPS = Credit Ratio to Private Sector
EXR = Exchange Rate
PSA = Political Stability and Absence of Terrorism/Violence
RQ = Regulatory Quality
ECT = Error Correction Term
ε_t= Error term (or stochastic term)
$\alpha, \varphi_1 \ldots \varphi_5$ = Estimated parameters

ARDL-Bounds testing technique is used to assess presence of a long-run correlation, while the ECM analyses short-run dynamics and the speed of adjustment to equilibrium. Apriori expectations suggest that MPR, EXR and CRR will negatively influence GFCF, while CRPS, M2, PSA, and RQ are expected to have positive effects.

The study adopts the Monetarist framework, which emphasises the critical role of monetary policy in shaping investment outcomes. This approach provides a robust foundation for understanding the interaction between monetary policy tools and Investment in Nigeria, contributing to evidence-based policy recommendations

4.0 Result Presentation and Discussion

4.1 Descriptive Statistics

Table 2: Result of Descriptive Statistics

Statistics	GFCF	CRR	EXR	CRPS	M2	MPR	PSA	RQ
Mean	10290.02	11.01	144.54	27.61	11987.97	13.85	-1.565	-0.94
Median	4284.98	8.45	127.23	13.3	2539.22	13.50	-1.71	-0.95
Maximum	65227.13	32.50	638.7	135	78831.12	26.00	-0.59	-0.68
Minimum	87.14	1.00	1.75	1.08	27.39	6.00	-2.21	-1.29
Std. Dev.	15508.09	9.00	143.15	34.53	17510.58	3.78	0.46	0.13
Skewness	2.28	0.84	1.44	2.159	2.02	0.67	0.39	-0.50
Kurtosis	7.66	2.50	5.18	6.543	7.24	4.67	1.77	3.87
Jarque-Bera	67.36	4.92	20.70	49.40	54.26	7.22	3.36	2.75
Probability	0.00	0.09	0.00	0.00	0.00	0.03	0.18	0.25
Observations	38	38	38	38	38	38	38	38

Source: Author's Computation Using, 2023.

The descriptive statistics of the study variables reveal significant insights into Nigeria's economic environment. Among all the variables, M2 and INV (GFCF) recorded the highest mean values (11,987.97 and 10,290.02, respectively), suggesting that, on average, these economic indicators were the most substantial over the study period. In contrast, governance indicators such as PSA and RQ had the lowest mean values (-1.565 and -0.94), indicating their relative decline or underperformance in Nigeria during the observed years. A notable gap between the mean and median is observed in GFCF (mean = 10,290.02, median = 4,284.98) and M2 (mean = 11,987.97, median = 2,539.22), suggesting a skewed distribution with the presence of extremely high values (outliers). On the other hand, variables like MPR (mean = 13.85, median = 13.50) and RQ (mean = -0.94, median = -0.95) show minimal differences between mean and median, implying relatively symmetric distributions.

In terms of variability, M2 (SD = 17,510.58) and GFCF (SD = 15,508.09) exhibited the highest standard deviations, indicating significant fluctuations and volatility in investment and money supply across the years. EXR and CRPS also displayed high dispersion, reflecting considerable changes in EXR and credit allocations over time. Conversely, RQ (SD = 0.13) and PSA (SD = 0.455) showed the lowest variability, suggesting that governance indicators have been fairly stable, albeit at low levels. MPR (SD = 3.78) and CRR (SD = 9.00) recorded moderate standard deviations, implying less volatility in monetary policy indicators.

Regarding skewness, LnGFCF (2.28), LnM2 (2.02), CRPS (2.16), and EXR (1.44) were all highly positively skewed, indicating a long right tail with occasional high-value outliers. These distributions suggest that although most values were concentrated on the lower end, there were years of exceptionally high investment, credit, or EXR values. Whereas, only RQ (-0.50) variable showed a slight negative skew, suggesting a distribution concentrated toward the higher end with a few low outliers. PSA (0.394) and MPR (0.67) had near-symmetric or mildly skewed distributions.

In terms of kurtosis, LnGFCF (7.66), LnM2 (7.24), CRPS (6.54), and EXR (5.18) were all leptokurtic, implying distributions with heavy tails and peaked centers which is typical of datasets with extreme observations. MPR (4.67) and RQ (3.87) also showed moderate kurtosis. In contrast, PSA (1.77) was platykurtic, suggesting a flatter distribution with fewer extreme deviations from the mean. The Jarque-Bera (JB) test confirms that most economic variables GFCF, M2, EXR, CRPS, and MPR reject the null hypothesis of normality at the 5% significance level, indicating non-normal distributions. Only RQ (p = 0.25) and PSA (p = 0.186) had p-values above 0.05, suggesting that governance indicators are approximately normally distributed. CRR is borderline (p = 0.09), indicating marginal deviation from normality.

4.2 Test of Stationarity

To validate the stationarity of the variables, this study used two-unit root tests, Augmented Dickey Fuller (ADF) and Phillip-Perron Unit root tests. The unit root tests are vital in determining the order of integration of the variables and ensuring that appropriate estimation techniques are employed. The ADF and PP tests for both levels and the first difference are presented in the Table below.

Table 3: Result of Unit Root Tests

	ADF				PP				
Variable	**Level**		**1st Diff**		**Level**		**1st Diff**		**Remarks**
	Stat.	P-Value	Stat.	P-Value	Stat.	P-Value	Stat.	P-Value	
CRR	0.544	0.986	-5.871[a]	0.000	0.280	0.974	-6.027[a]	0.000	I(1)
GFCF	2.261	1.000	-12.90[a]	0.000	4.890	1.000	-3.914[b]	0.022	I(1)
CRPS	-2.546	0.113	-14.31[a]	0.000	-6.048[a]	0.000	-	-	I(0)
EXR	-1.512	0.516	-5.098[a]	0.000	-1.178	0.673	-5.098[a]	0.000	I(1)
M2	1.785	1.000	-4.474[a]	0.001	0.070	0.996	-6.417[a]	0.000	I(1)
MPR	-3.251[b]	0.025	-	-	-3.305[b]	0.022	-	-	I(0)
PSA	-1.480	0.533	-5.253[a]	0.000	-1.431	0.557	-5.264[a]	0.000	I(1)
RQ	-2.696[c]	0.084	-	-	-2.636[c]	0.095	-	-	I(0)

Source: Author's Computation

Note: the ADF and PP critical values at 1%, 5% and 10% are -3.621, -2.943 and -2.610 respectively. a, b and c imply that the statistics are significant at 1%, 5% and 10% level of significance respectively.

Unit root test results presented in Table 3 indicate that MPR and RQ are stationary at level I(0), while the others CRR, CRR, GFCF, M2 and PSA become stationary after first differencing, meaning they are integrated of order one I(1). The mixed order of integration among the variables (I(0) and I(1)) justifies the use of ARDL bounds test for cointegration and the use of ARDL estimation techniques. This is because the ARDL estimation technique is suitable when variables have different orders of integration. This approach is more flexible than the traditional estimation techniques like the OLS method that necessitates all variables to be integrated of the same order.

4.3 Cointegration Test

The cointegration test enables us to determine the existence of long-run equilibrium relationship among two or more non-stationary time series variables. It examines if a linear sum of these variables is stationary, showing that the variables move together over time despite short-term fluctuations. This concept is essential in econometrics, especially when analysing economic and financial variables that are integrated of the alike order, as this helps in identifying meaningful long-term relationships for model estimation and policy analysis.

Table 4: Result of ARDL Bounds Cointegration Test

F-Bounds Test		**Null Hypothesis: No levels relationship**		
Test Statistic	Value	Significance	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	11.508	10%	2.08	3
K	5	5%	2.39	3.38
		2.50%	2.7	3.73
		1%	3.06	4.15

Source: Author's Computation

Note: The cointegration result is tested at 5% level of significance.

Table 4 result reveals that ARDL bounds computed F-statistic value is 11.508. The computed F-statistics is more than the critical upper bounds value even at 1% significant level. This indicates that the null hypothesis of no long run cointegrating correlation is rejected. This cointegration suggests that both the long-run and short-run coefficients in the ARDL model can be estimated. Since the ARDL Bound test results indicate the existence of cointegration, the long-run and short-run effect of monetary policy on GFCF is presented in Table 5.

4.4 ARDL Estimates

The Autoregressive Distributed Lag (ARDL) model is an econometric approach that analyses dynamic relationship between a dependent variable and one or more independent variables in the presence of both short-run and long-run effects. The ARDL appro ach is particularly useful in dealing with variables that are integrated of

different orders, specifically I(0) and I(1). Unlike traditional cointegration techniques, ARDL model can be applied regardless of whether the underlying variables are stationary at level or first difference, making it a flexible tool for time series analysis. It permits simultaneous estimation of short-run dynamics and long-run relationships through error correction mechanism, providing a comprehensive framework for policy analysis and forecasting.

Table 5: Result of Long and Short Run Effect of Monetary policy on Investment

Dependent Variable: Log of Investment (LGFCF)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**P-Value**
Long-Run				
MPR	-0.074	0.059	-1.243	0.226
LM2	0.570**	0.266	2.145	0.042
CRR	0.095**	0.047	2.026	0.054
CRPS	0.942	0.533	1.769	0.0938
EXR	0.017	0.428	0.040	0.9682
RQ	-0.872	1.592	-0.548	0.589
PSA	1.060	0.850	1.248	0.224
C	-9.182	6.981	-1.315	0.200
Short-Run				
ΔMPR	-0.094	0.079	-1.189	0.246
ΔLM2	0.729*	0.370	1.968	0.060
ΔCRR	-0.137**	0.062	-2.209	0.037
ΔCRR(-1)	-0.201**	0.079	-2.565	0.017
ΔCRPS	-0.071***	0.081	-0.875	0.3933
ΔEXR	-0.545***	0.108	-5.039	0.0001
ΔEXR(-1)	-0.519***	0.138	-3.751	0.0015
ΔRQ	-1.115	2.024	-0.551	0.587
ΔPSA	1.356	1.152	1.177	0.250
ECM(-1)	-0.278***	0.186	-6.874	0.000

Source: Author's Computation

*Note: ***, ** and * indicate that the coefficients are significant at 1%, 5% and 10% levels of significance respectively. (.) indicates P-value*

This table presents ARDL model estimation results on the effect of monetary policy and aggregate investment (INV), proxied by GFCF, in Nigeria. In the long run, the coefficient of MPR is negative (–0.074) but statistically insignificant (p = 0.226). This reveals that variations in MPR do not significantly influence investment in Nigeria, indicating that the transmission channel of monetary policy through interest rates is weak in the context of the Nigerian economy. The weak effect of MPR is consistent with studies such as Sarin and Singh (2023), who argue that in economies facing structural challenges such as inadequate infrastructure and regulatory inefficiencies, interest rates alone cannot effectively stimulate physical investments. Similarly, in the short run, MPR remains negative (–0.094) and statistically insignificant, reinforcing the notion that monetary policy adjustments are not promptly reflected in investment decisions.

Broad Money Supply (M2) exhibits a positive and statistically significant relationship with investment in the long run and short run. In the long run, a 1% increase in M2 leads to a 0.57% increase in GFCF. The short-run effect is even more pronounced, with a 1% increase in M2 resulting in a 0.729% increase in GFCF. This result highlights the critical role of liquidity in fostering investment, as more money in circulation enhances access to financing for investments. These findings align with Okezie (2015) and Adenuga (2020), who emphasised the importance of money supply in supporting investment in capital goods and infrastructure. Thuy et al. (2020) also noted that an increase in M2 boosts investments in credit-constrained economies. The significance of the short- and long-run effects underscores importance of monetary expansion in supporting investment, particularly in an environment where liquidity constraints are common.

The long-run coefficient of CRR is positive and statistically significant at the 10% level, which contradicts conventional view that a higher CRR reduces the available funds for lending. This suggests that, in Nigeria, a higher CRR may encourage banks to seek alternative investment outlets, some of which could be in the form of fixed capital formation. Additionally, CRR could enhance financial stability, which may improve investor confidence and, in turn, promote long-term investments. However, in the short run, both the current and lagged values of CRR have negative and statistically significant effects on investment, indicating that an increase in CRR contracts loanable funds, thereby hindering investment. These findings are consistent with Agwu (2015) and Musthafa et al. (2024), who noted that restrictive CRR policies tend to suppress private sector growth and short-term investments by limiting the credit available for productive use.

In the long run, CRPS has a positive coefficient (0.942), though it is statistically significant only at the 10% level (p = 0.0938). This suggests that enhanced access to credit promotes long-term investment in Nigeria, as businesses and households can better finance their capital projects. This finding aligns with the theoretical literature on financial development, which posits that credit availability is crucial for supporting capital accumulation and economic development (Fischer, 2002; Beck et al., 2000).

Conversely, the relatively weak significance level suggests that other constraints-such as high borrowing costs, limited credit accessibility, and inefficiencies in financial intermediation—may dampen the strength of this relationship. In the short run, CRPS has a negative coefficient (–0.071) but is statistically insignificant (p = 0.3933). This may reflect the slow response of investment decisions to immediate changes in credit availability or inefficiencies in the banking sector, which could limit the effectiveness of credit in stimulating investment in the short term.

The long-run effect of EXR is positive (0.017) but statistically insignificant (p = 0.9682). This implies that in the long run, changes in the EXR do not significantly affect investment in Nigeria. This may be due to structural weaknesses such as import dependency and limited investor responsiveness to currency fluctuations in the Nigerian economy. Investors may also adapt to long-term exchange rate volatility, making it a less influential factor in long-term investment decisions. In contrast, in the short run, both the current and lagged values of EXR have negative and statistically significant coefficients (–0.545 and –0.519, p = 0.0001 and 0.0015, respectively). These results highlight that short-term EXR volatility discourages investment, likely as a result of the increased cost of imported investable goods plus uncertainty in investment planning. The negative impact persists beyond the immediate period, possibly due to the delayed effects of currency adjustments on financing and investment decisions, as noted by Ismail (2017).

Both Regulatory Quality (RQ) and Political Stability (PSA) are statistically insignificant in the long run, suggesting that institutional variables do not have a strong direct influence on investment. The outcomes align with the findings of Arezki et al. (2016), who noted that while institutional quality and political stability are generally important for investment, their impact can be overshadowed by macroeconomic and financial variables. Lack of significance for RQ may reflect inefficiencies in regulatory enforcement and implementation, which hinder the positive effects of regulation on investment. Similarly, while political stability is generally considered a key determinant for attracting investment, the insignificance of PSA in this study suggests that economic variables such as liquidity, credit, and EXR volatility may play a key role in shaping investment decisions in Nigeria.

Error Correction Term (ECT) is negative and significant at the 1% level, with a value of –0.278, implying that deviations from the long-run equilibrium are corrected at a rate of 27.8% per period. This suggests that while the economy adjusts to shocks over time, the speed of adjustment is relatively slow, reflecting rigidities in the financial and monetary systems. These rigidities may include structural frictions such as inefficiencies in financial intermediation, which hinder the smooth and timely adjustment of investment to long-run equilibrium.

Overall, the findings emphasise the pivotal role of liquidity proxied by M2 in promoting productive investments in Nigeria, as both short-run and long-run effects were significantly positive. In contrast, restrictive CRR were found to hinder capital formation in the short term, underscoring the contractionary nature of tight reserve policies. Notably, CRPS exhibited a positive and moderately significant long-run

influence on investment, suggesting that deepening credit access can foster sustainable capital formation over time. However, its short-run influence was weak, indicating potential frictions in credit transmission or delays in investment response. Meanwhile, EXR movements showed significantly negative effect on investment in the short run, reflecting destabilising effect of EXR volatility on investor confidence and cost of imported capital goods, although no long-run relationship was observed. The muted effect of the MPR further highlights limited effectiveness of interest rate adjustments alone in stimulating investment. These results collectively underscore the need for comprehensive financial sector reforms that improve credit intermediation, enhance EXR stability, and address institutional bottlenecks. Strengthening these areas is crucial for enhancing the responsiveness of investments to monetary policy tools in Nigeria.

4.5 Post-Estimation Diagnostics Test

Table 6: Diagnostic Test results

Test	Results (Prob)
R-squared	0.758
Adjusted R-squared	0.681
Durbin-Watson stat	1.984
F-statistic Prob(F-stat)	9.795 (0.000)
Jarque-bera	4.231 (0.121)
Serial Correlation LM Test: F-statistic	0.048 (0.953)
Heteroskedasticity Test: F-statistic	2.143 (0.069)

Source: Author's Computation
Tests are evaluated at a 5% level of significance

The test statistics for the overall model indicate that the model is significant as suggested by the F-Statistics. The value of the R-squared is 0.758, indicating that 75.8% of variation in GFCF is explained by the model. The Jarque-Bera Test indicates normally distributed residuals. The Durbin-Watson Statistic of 1.984 indicates no serious autocorrelation issues. The Durbin-Watson statistic of 1.984 indicates the absence of serious autocorrelation issues in the residuals of the model, suggesting that the error terms are independent and do not exhibit systematic patterns over time. This finding is further reinforced by the Breusch-Godfrey Serial Correlation LM Test results, which confirm that the model does not suffer from serial correlation. The absence of autocorrelation enhances the reliability of the estimated parameters, as it implies that the results are not biased by omitted variable effects or model misspecification. Similarly, the results from the heteroskedasticity tests indicate no significant heteroskedasticity issues, implying that the variance of the residuals is constant across observations.

This is critical for ensuring the efficiency and consistency of the estimated coefficients, as heteroskedasticity can distort standard errors and affect hypothesis testing. The stability in variance reinforces the robustness of the model for policy analysis.

Figure 4.1 CUSUM Sum of Square

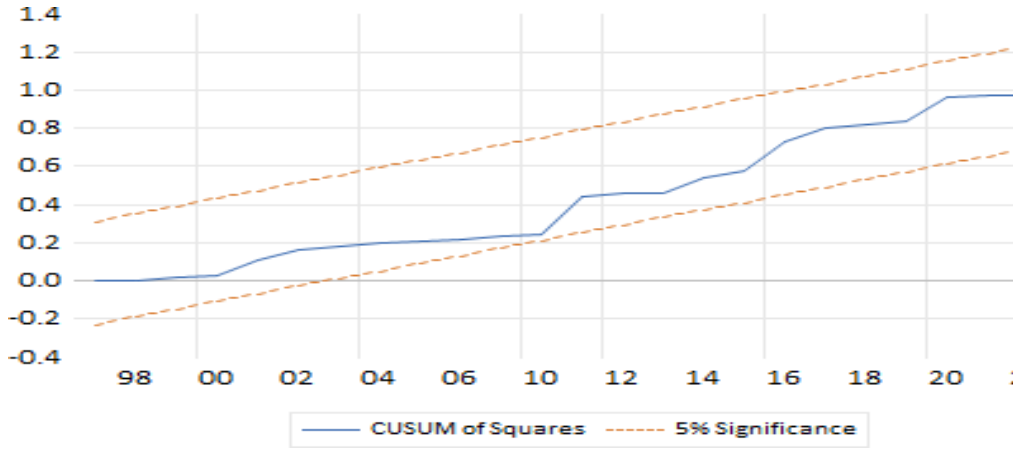
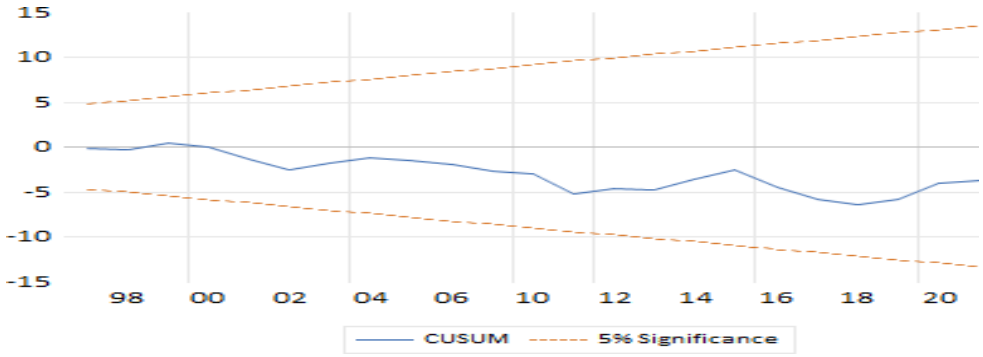


Figure 4.2 CUSUM



The results of the CUSUM and CUSUM of Squares tests, presented in Figures 1 and 2, respectively, further validate the stability of the model's parameters. The lines in both figures lie within the 5% critical boundaries, demonstrating that the parameters remain consistent over time. This stability is a key requirement for models intended for policy analysis, as it indicates that the relationship between the variables has not undergone significant structural changes during the study period. Overall, these diagnostic tests confirm that the model is well-established, free from major econometric issues, and robust enough to provide reliable insights for monetary policy analysis and decision-making. The stability and consistency of the model's parameters make it a solid foundation for drawing meaningful policy recommendations.

5. Conclusion and Recommendations

This research examined the connection between monetary policy variables and aggregate investment in Nigeria, employing the ARDL approach. The findings reveal that M2 significantly and positively influences GFCF in the short and long run, highlighting the crucial role of liquidity in fostering physical investments. Similarly, CRR exerts a negative and significant effect in the short run suggesting contractionary effects on credit availability but shows a positive influence in the long run, possibly due to enhanced financial stability over time. While MPR fails to exhibit a significant impact on investment in either the short or long run, the result suggests that structural rigidities and weak monetary transmission mechanisms limit the effectiveness of interest rate adjustments in driving capital formation. Importantly, CRPS shows a positive and moderately significant effect in the long run, indicating that increased credit flow to productive sectors can enhance investment over time. However, its short-run effect is negligible, which may reflect issues related to credit access, risk pricing, or investor responsiveness. Both Regulatory Quality (RQ) and Political Stability and Absence of Violence/Terrorism (PSA) are statistically insignificant in the long run, suggesting that institutional factors do not have a strong direct effect on investment.

The EXR exhibits a significantly negative influence on investment in the short run, reflecting adverse impact of EXR volatility on investor confidence and the cost of imported investable goods. This underscores the vulnerability of investment to external shocks and macroeconomic instability. Drawing from these outcomes, the study recommends that policymakers should prioritise sustainable expansion of M2 to support liquidity and investment. CRR adjustments should be carefully calibrated to avoid excessive credit tightening, especially in the short run. Furthermore, enhancing CRPS through improved financial intermediation, reduced lending constraints, and support for productive enterprises—particularly SMEs can reinforce long-term investment growth.

Given the limited effectiveness of the MPR, alternative strategies such as targeted fiscal interventions, public-private partnerships, and investment-friendly regulatory frameworks should be pursued. Finally, stabilising EXR through sound macroeconomic management and diversification of the foreign exchange base is essential to mitigate external shocks and maintain investor confidence. Reforms aimed at reducing institutional bottlenecks, improving infrastructure, and strengthening financial inclusion remain critical for maximising the influence of monetary policy and aggregate investment in Nigeria.

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Economic, Environmental, and Political Determinants of Exchange Rate in Nigeria: An Augmented ARDL Approach

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Abstract

This study investigates the determinants of exchange rate fluctuations in Nigeria (1980-2024) using a multidisciplinary framework integrating economic, environmental, and political factors. Grounded in a synthesized Purchasing Power Parity-Monetary framework, the analysis employs the Augmented Autoregressive Distributed Lag (A-ARDL) method to accommodate a mixture of I(0) and I(1) variables. The results confirm a stable long-run relationship, with an error correction term indicating a moderate adjustment speed of 24.8 percent annually. Empirical findings validate traditional monetary fundamentals: real GDP differentials lead to currency appreciation, while inflation differentials cause depreciation. Furthermore, environmental degradation (proxied by CO2 emissions) emerges as a significant driver of depreciation, and government stability contributes to appreciation. This reveals that Nigeria's exchange rate is determined by a complex interplay of monetary, environmental, and institutional factors. Consequently, achieving lasting exchange rate stability requires a multidimensional policy approach that enables price stability, stimulates domestic output, strengthens environmental regulations, and maintains political stability.

Keywords: Exchange rate, Augmented ARDL, CO2 Emissions, Government Stability, Nigeria.

1. Introduction

The exchange rate is the price of one currency in terms of another and serves as a critical link between domestic and international markets. It affects the cost of imports and exports, foreign investment flows, inflation, interest rates, and ultimately, economic growth. As Nigeria remains highly dependent on international trade especially crude oil exports and importation of manufactured goods exchange rate movements significantly impact economic stability and policy outcomes (CBN, 2024).

The importance of exchange rate in economic management cannot be overstated. It influences the competitiveness of a country's exports, the cost of imported goods and services, and the real income of consumers and producers. A stable exchange rate environment encourages investment, both foreign and domestic, and fosters economic planning (Bello & Olayungbo, 2022). According to Bello and Olayunbo (2022), exchange rate management remains a fundamental macroeconomic tool for monetary authorities in Nigeria, especially in the context of inflation targeting and balance of payments adjustments.

According to the Central Bank of Nigeria (CBN) as of late 2024 and early 2025, Naira has significantly fluctuated, continuing a trend of depreciation following the Central Bank of Nigeria's decision to float the currency in June 2023. Driven by reasons like dollar shortages, dwindling oil revenues, and speculative pressures, the Naira depreciated by over 82% from January 2023 to about ₦1,635 per US dollar in the parallel market by mid-2024. The currency encountered fresh difficulties, falling to about ₦1,600 by July 2024, despite minor recoveries like a rise to ₦1,278 per dollar in April 2024 as a result of Central Bank actions such interest rate hikes and direct dollar sales. Inflation soared to a 28-year high, exacerbating the cost-of-living crisis, while the persistent gap between official and parallel market rates underscored ongoing foreign exchange market distortions.

Moreover, the economic instability surrounding Nigeria's exchange rate has been worsened by environmental and political factors. Environmental shocks such as oil pipeline vandalism, flooding, and the effects of climate change disrupt oil production, which remains Nigeria's main source of foreign exchange (Adebayo, 2023). These shocks reduce foreign earnings and exert downward pressure on Naira. From political angle, periods of heightened uncertainty, particularly during general elections or times of policy inconsistency, have contributed to capital flight and reduced inflow of foreign direct investment, thereby aggravating exchange rate pressures. Despite numerous empirical studies on exchange rate determinants in Nigeria, few studies like Esra and Arslan (2023), Adebayo (2023), Mosugu (2018) and Akinyede et al. (2016) integrates economic, environmental, and political variables in a unified framework. Most existing models emphasize economic fundamentals alone, neglecting the broader context in which exchange rate behavior occurs. This creates a knowledge gap in policy formulation and weakens the ability of government institutions to respond effectively to exchange rate crises.

Therefore, this study seeks to bridge that gap by analyzing the key determinants of exchange rate in Nigeria, focusing not only on traditional economic indicators such as inflation and interest rates but also on environmental disruptions and political instability. A deeper understanding of these factors is essential for designing a sustainable and responsive exchange rate policy that promotes economic stability and inclusive growth. Also, in order to fill a methodological gap in the literature, the study estimates the model using Augmented ARDL approach. The specific objectives of the study are to: 1) investigate the economic determinants of exchange rate in Nigeria; 2)

examine the environmental determinants of exchange rate in Nigeria; and 3) explore the political determinants of exchange rate in Nigeria. The corresponding research questions are as follows: 1) What are economic determinants of exchange rate in Nigeria? 2) What are environmental determinants of exchange rate in Nigeria? 3) What are political determinants of exchange rate in Nigeria.

The rest of the paper is organized as follows: Section 2 discussed the literature review. It begins with an introduction of a few fundamental concepts, then moves on to a discussion of related theories, and closes with a review of recent studies. Discussion on theoretical foundation, model formulation, and estimating methods focused on the methodology section (Section 3). The nature, coverage, measurement, and sources of the data are covered in the fourth section, along with the presentation and evaluation of the actual results. Finally, Section 5 contains the summary, conclusion, and recommendations.

2. Literature Review

2.1 Theoretical Review

Currency adjustments are recommended by Purchasing Power Parity (PPP) in order to balance the cost of goods across national borders. It is based on the Law of One Price and occurs in both absolute and relative forms. According to the theory, global prices are aligned by market factors such as arbitrage. However, price equalization is hampered by trade restrictions and transportation expenses (Krugman et al., 2017). Interest Rate Parity (IRP) links interest rates to exchange rate movements to prevent arbitrage. It exists in covered and uncovered forms. Covered Interest Rate Parity (CIRP) uses forward contracts, while Uncovered Interest Rate Parity (UIRP) relies on expectations. The theory assumes efficient markets but faces challenges from real-world frictions (Krugman et al., 2017).

The Balance of Payments (BOP) theory posits exchange rates adjust to balance international transactions. It comprises the Current Account and the Capital and Financial Account. Surpluses or deficits in these accounts drive currency appreciation or depreciation. The theory assumes flexible exchange rates and market-driven adjustments (Pilbeam, 2018). The Monetary Approach to Exchange Rate (MAR) emphasizes monetary factors like money supply. It focuses on money market equilibrium and is rooted in the Quantity Theory of Money. MAR assumes price flexibility, high capital mobility, and that PPP holds. An increase in money supply causes currency depreciation. Its reliance on long-run conditions limits short-term accuracy (Copeland, 2019).

2.2 Empirical Review

Economic determinants

Oladipo (2010) explored how exchange rates link to FDI and growth in Nigeria from 1981 to 2010. Data was sourced from CBN and World Bank, including economic variables (exchange rate, GDP, inflation), political variables (instability implicit), and environmental variables (energy consumption). Using OLS, it was found that exchange rates is unstable and negatively impact FDI. Yet, the study's pre-2010 cutoff misses' recent volatility and the study lacks explicit political and environmental shock analyses

Onyeiwu and Onyeiwu (2014) examined the effect of real Exchange Rate and Foreign Direct Investment in Sub-Saharan Africa, this study assessed the real exchange rate-FDI nexus in Sub-Saharan Africa, including Nigeria, from 1980 to 2005, extended in discourse to 2014. Data was sourced from World Bank and National Bureau of Statistics (NBS), consisting of variables like exchange rate, FDI, inflation, macro volatility and commodity price effects. Granger causality and simultaneous estimation showed lagged exchange rate effects on FDI, stronger in floating regimes. However, the study only highlights the outdated sample and limited environmental variable specificity.

Oke and Temitayo (2018) examine factors influencing Nigeria's exchange rate from 1986 to 2016. Utilizing the ARDL Bounds test approach to co-integration, the study employs variables such as gross domestic product (GDP), interest rate, inflation rate, and degree of openness. Results indicate that GDP, interest rate, and inflation rate positively affect the exchange rate, while the degree of openness has a negative effect. The study recommends policies to boost domestic production and reduce importation. However, it does not consider political or environmental factors, which could provide a more nuanced understanding of exchange rate determinants. The ARDL model may not fully capture short-term speculative movements or black-market exchange rate dynamics, necessitating further research using high-frequency data.

Adewuyi (2018) examined the factors influencing foreign exchange rate fluctuations in Nigeria between 1986 and 2016. It utilized time series data from the Central Bank of Nigeria (CBN) Statistical Bulletin. Key variables included in the study are economic factors like GDP, interest rates, inflation, and trade balance. The study employed Granger causality and vector error correction mechanism (VECM) techniques. Results showed no causality between exchange rate volatility and international reserves, suggesting monetary authorities should not rely on reserves to stabilize the Naira, with GDP and trade balance having significant impacts. However, the study excludes environmental factors like CO^2 emissions.

Satanda and Iyekoretin (2018) analyzes Naira's real effective exchange rate (REER) from 1980 to 2010, with REER as the dependent variable and real oil price, productivity differentials, money supply (M2), interest rate differentials, and foreign reserves as independent variables. Using a Vector Error Correction Model, it was found that oil prices drive REER appreciation, while productivity and money supply cause depreciation. It is noted that the 2010 data cutoff excludes recent shocks like the 2014 oil crash, and productivity differentials are hard to measure accurately.

Yusuf (2019) investigates the determinants of exchange rate in Nigeria. A comparison of the official and parallel market rates compares drivers of official and parallel Naira/USD exchange rates, with both rates as dependent variables and GDP, inflation, interest rates, oil exports, non-oil exports, and foreign reserves as independent variables. Employing the ARDL model from 1986 to 2017, it was found that GDP, inflation, and non-oil exports significantly affect parallel rates, while oil exports drive official rates. Its relevance lies in addressing Nigeria's dual exchange rate system, aiding monetary policy. Although the study ignores speculative activities in the parallel market, and the 2017 data cutoff misses recent oil price volatility. The ARDL model may also under capture short-term fluctuations.

Ogbonna and Uma (2019) examined the determinants of exchange rate in Nigeria from 1981 to 2017. Data were sourced from the CBN and World Bank, with variables including economic (GDP, interest rates, inflation, and trade openness). Using the error correction mechanism (ECM), results indicated that GDP, interest rates, and inflation positively affect exchange rates, while trade openness has a negative effect. However, they fail to consider environmental variables like CO_2 emissions and political instability metrics, which limits the explanatory power of the study in Nigeria's context.

Kayode and Awoniyi (2021) examined the foreign exchange market intervention and exchange rate stability, with Naira/USD exchange rate stability (volatility) as the dependent variable and foreign reserves, oil price, interest rate, and foreign assets as independent variables. Using ARDL 2000–2020 data, the study found that reserves significantly stabilize the Naira, relevant for forex policy in Nigeria's volatile market. But the study overemphasizes CBN interventions.

Ogboi et al. (2023) examine Naira/USD exchange rate determinants using an ECM from 1981 to 2020, with the exchange rate as the dependent variable and oil prices, money supply, interest rate differentials, and foreign reserves as the independent variables. The study found that oil prices and monetary factors significantly influence the Naira, which is relevant for Nigeria's oil-driven economy. The ECM's short- and long-term analysis aids policy design.

Goddey et al. (2025) investigate the factors affecting Nigeria's exchange rate from 1986 to 2022. Utilizing data from the Central Bank of Nigeria, it employs a Structural Vector Autoregressive (VAR) model, along with impulse response function and variance decomposition tests. Results revealed that broad money supply, government capital expenditure, oil price fluctuations, and inflation rates significantly influence the exchange rate. The study recommends monitoring money supply and increasing capital expenditure. However, it overlooks political and environmental variables, which could provide a more holistic understanding of exchange rate dynamics.

This comparative analysis reveals a clear evolution in the study of Nigeria's exchange rate. Early studies like Oladipo (2010) and Onyeiwu and Onyeiwu (2014) established the negative impact of exchange rate volatility on FDI, while subsequent research

shifted to its direct determinants. Methodologies diverged, with studies such as Oke and Temitayo (2018) using ARDL and Adewuyi (2018) employing VECM to identify key drivers like GDP, inflation, and the trade balance. A critical distinction was made by Yusuf (2019), who highlighted the dual-rate system by showing oil exports drive official rates, whereas non-oil exports and inflation affect parallel markets. Later studies, including Ogboi et al. (2023) and Goddey et al. (2025), reinforced the centrality of oil prices and monetary factors while introducing new elements like government expenditure. Despite these advancements, a universal limitation persists, as most studies exclude political and environmental variables and suffer from outdated data, limiting their analysis of recent economic shocks.

Environmental determinants

Setyorini & Ishak (2012). This study provides an examination of Indonesian corporate social and environmental disclosure in the Positive Accounting Theory (PAT) perspective. This study identified three key hypotheses, such as the management compensation hypothesis (bonus plan hypothesis), the debt hypothesis (debt/equity hypothesis), and the political cost hypothesis. The population of this study is about 1857 companies (for a five-year period), yielding a sample of 911 usable companies listed on the Indonesia Stock Exchange. The social and environmental disclosure level is measured using a combination of the Clarson Environmental Index (2007) and Sutantoputra's Social Index (2009). The regression analysis shows that corporate social and environmental responsibility in Indonesia is associated with ROA, firm size, and the firm's earnings management. Thus, the results support the bonus plan hypothesis and political cost hypothesis; conversely, the debt/equity hypothesis can not be supported. A potential criticism is that the study's data may be outdated (1980-2006), and the results may not reflect current market dynamics. Additionally, the study could benefit from exploring other macroeconomic variables or using more advanced statistical techniques like Augmented ARDL.

Akinyede et al. (2016) investigated the impact of environmental forces on Nigeria's foreign exchange market from 1973 to 2015. They used multiple regression models with variables like interest rate spread, inflation, population growth, and technology exports to evaluate their effect on official exchange rates. The study found that interest rate spread, fuel exports, and democratic rule significantly influenced exchange rates, while other variables didn't. Overall, the study revealed a significant positive relationship between environmental forces and the foreign exchange market, recommending that stakeholders pay attention to these factors. The study's findings are relevant for policymakers and stakeholders in Nigeria's foreign exchange market, but potential criticisms include the study's reliance on a single statistical method (OLS) and the broad categorization of environmental forces.

Mosugu (2018) investigates how environmental factors, including oil-related pollution, influence the Naira/USD exchange rate, using the exchange rate as the dependent variable and environmental degradation (via the PEST framework,

capturing oil spills and regulatory changes), inflation, and trade balance as independent variables. Employing a classical multiple regression model with data from 1980 to 2014, the study found that environmental factors account for 76.11% of exchange rate variations, as oil pollution undermines investor confidence and economic stability, which is highly relevant for Nigeria's oil-dependent economy. The study model lacks robustness checks for nonlinear effects or endogeneity, limiting its methodological strength.

A comparative analysis reveals distinct approaches to environmental determinants. The Nigerian studies by Akinyede et al. (2016) and Mosugu (2018) directly model macroeconomic impacts on foreign exchange, with the former finding a positive relationship and the latter quantifying that environmental factors explain 76% of exchange rate variations. In contrast, Setyorini & Ishak (2012) offer an Indonesian corporate perspective, linking environmental disclosure to firm performance. While their focus differs—macroeconomic versus corporate—all three studies converge on a significant environmental influence. However, they share a critical limitation in methodological scope, as each relies on basic statistical models like OLS or multiple regression, lacking the robustness checks or advanced techniques needed for more definitive conclusions.

Political determinants

Adamu (2022) investigates the political economy factors influencing Nigeria's decision to liberalize its foreign exchange market, focusing on the choice between a liberalized and administratively controlled exchange rate system. Covering the period from 1987 to 2019, the authors employ a Probit regression model, with the dependent variable being the decision to liberalize the foreign exchange market (a binary outcome) and independent variables including politically influential economic sectors, urban consumer influence (particularly elites benefiting from controlled rates), and Nigeria's trade deficit driven by import dependence. The findings highlight that these factors, especially elite interests and persistent trade deficits, make a fully liberalized exchange rate politically and economically challenging, while controlled systems foster rent-seeking and corruption. The study's relevance lies in its call for pragmatic exchange rate policies that account for domestic political constraints, offering insights for Nigerian policymakers and international advisors. However, it may be criticized for potentially oversimplifying complex economic distortions or for not fully addressing external global economic influences on Nigeria's exchange rate policy during the study period.

Adebayo (2023) examined the political economy of exchange rate crises in Nigeria. The estimated model of the study contains exchange rate (EXR), which is treated as the dependent variable, with trade balance, oil price, external debt, and political instability (proxied by election violence and policy uncertainty) as independent variables. Its relevance is linking political instability to exchange rate crises. These studies collectively emphasize that political instability, through disrupted governance

and investor uncertainty, significantly drives exchange rate volatility in Nigeria, though more granular political variables (such as political risk/socioeconomic condition) are needed for comprehensive analysis.

Esra and Arslan (2023) investigate the political economy of real exchange rate levels. This study explores why countries, particularly developing ones, often avoid pursuing real exchange rate (RER) undervaluation despite evidence linking it to economic growth, focusing on economic, institutional, and policy factors. Between 1989 and 2013, the authors analyze variables such as the non-tradable sector's share of output, import intensity of exports, central bank independence, democracy levels, capital account openness, foreign liabilities, and exchange rate regimes using a panel dataset with econometric methods like Generalized Method of Moments (GMM) and robustness checks with lagged variables. Their results indicate that a higher non-tradable sector share and greater central bank independence or democracy is associated with more overvalued RERs, while foreign debt burdens surprisingly correlate with undervaluation, possibly boosting competitiveness. However, the reliance on macro-level data across countries limits the depth of understanding specific sectoral dynamics, which could be better addressed through case studies or firm-level analyses. Also, environmental determinants were not considered.

Based on a comparative analysis, the political economy studies by Adamu (2022), Adebayo (2023), and Esra & Arslan (2023) collectively demonstrate that political and institutional factors are critical drivers of exchange rate policy and stability. Adamu (2022) focuses on Nigeria's policy choice, using a Probit model to reveal that elite interests and trade deficits hinder full liberalization. In contrast, Adebayo (2023) examines exchange rate crises directly, linking volatility to domestic political instability proxied by election violence. Expanding the scope, Esra & Arslan (2023) employ a cross-country GMM analysis to find that institutional factors like central bank independence and democracy can lead to overvalued real exchange rates.

Summarily, there are still gaps yet to be filled in the literature about the determinants of exchange rates in Nigeria. Most studies only look at economic determinants like GDP, inflation, interest, and reserves. They don't consider environmental issues like climate change and political factors such as political risk/socioeconomic condition.

3. Methodology

3.1 Theoretical Framework

The theoretical foundation of this study is based on purchasing power parity (PPP) and monetary approach theories of exchange rate. The core premise of combining the two theories is because no single theory can fully explain exchange rate behaviour. Therefore, a synthesized model is proposed in the study. This synthesis acknowledges that while the exchange rate may deviate from its PPP value in the short run due to

monetary factors, it is ultimately bound by the discipline of relative national price levels in the long run (Sarno & Taylor, 2002).

Relative PPP posits that the change in the exchange rate is determined by the inflation differential between two countries.

$$\%\Delta E_t \approx \pi_{d,t} - \pi_{f,t} \quad (1)$$

Where:

$\%\Delta E_t$ is the percentage change in the domestic currency price of foreign currency (a positive change denotes domestic depreciation); $\pi_{d,t}$ is the domestic inflation rate; and $\pi_{f,t}$ is the foreign inflation rate. If domestic inflation consistently exceeds foreign inflation, the domestic currency must depreciate over the long run to restore its purchasing power parity. This relationship establishes the fundamental trajectory for the exchange rate (Krugman et al., 2017).

The flexible-price monetary approach models the exchange rate as the relative price of two monies, determined by the equilibrium in the money markets of two countries. It starts with a stable money demand function for each country (Gandolfo, 2016).

$$M_d = P_d * L(Y_d, i_d) \quad (2)$$

where M_d is the money supply, P_d is the domestic price level, and $L(Y_d, i_d)$ is the demand for real money balances, which is an increasing function of real income (Y_d) and a decreasing function of the interest rate (i_d). Therefore, the foreign money market equilibrium is specified in Equation (3) below.

$$M_f = P_f * L(Y_f, i_f) \quad (3)$$

Assuming the functional form for money demand is $L(Y, i) = Y^{\lambda} * e^{-\eta i}$ and that PPP holds in the long run ($E = P_d/P_f$), we can derive the fundamental monetary model:

$$E_t = \frac{M_{d,t}/M_{F,t}}{(Y_{d,t}/Y_{F,t})^{\lambda} * e^{-\eta(i_{d,t}-i_{F,t})}} \quad (4)$$

Equation (4) is re-specified as Equation (5) below in a log-linear form:

$$e_t = (m_d - m_f) - \lambda (y_d - y_f) + \eta(i_{d,t} - i_{f,t}) \quad (5)$$

where lowercase letters denote natural logarithms (e.g., $e_t = In\ (E_t)$)

Where $(m_d - m_f)$ is the money supply differential. A relative increase in the domestic money supply leads to a proportional depreciation of the domestic currency

(Copeland, 2014); $(y_d - y_f)$ is the real income differential. A relative increase in domestic income increases the demand for domestic money, causing the currency to appreciate (Gandolfo, 2016); and $(i_{d,t} - i_{f,t})$ is the interest rate differential. A relative increase in the domestic interest rate reduces the demand for money (as it raises the opportunity cost of holding money), leading to depreciation *(Isard, 1995)*.

Integrating the PPP into the Monetary model require the three assumptions below. The contradiction in the role of interest rates is resolved by invoking uncovered interest rate parity (UIP) and inflation expectations.

i) Uncovered Interest Parity (UIP) states that the interest rate differential equals the expected rate of depreciation (i.e. $i_{d,t} - i_{f,t} = \%\Delta E^e_{t+1}$) (Sarno & Taylor, 2002). ii) In the long run, the market's expectation of depreciation ($\%\Delta E^e_{t+1}$) should be driven by the expected inflation differential, which is the core of RPPP: $\%\Delta E^e_{t+1} \approx \pi^e_d - \pi^e_f$ (Krugman et al., 2017). iii) If real interest rates are equal across countries ($r_d = r_f$), then the nominal interest rate differential reflects the expected inflation differential: $i_d = i_f \approx \pi^e_d - \pi^e_f$.

The synthesized model is specified as Equation (6):

$$e_t = (m_d - m_f) - \lambda\,(y_d - y_f) + \eta(\pi^e_d - \pi^e_f) \quad (6)$$

It is not the level of the interest rate that affects money demand, but what it signals about future inflation. A high domestic interest rate typically signals high expected domestic inflation, which leads to an expected future depreciation (via PPP). This expectation can cause an immediate depreciation in the flexible asset market.

3.2 Model Specification

Based on this synthesized framework as stated in Equation (6), the following long-run equilibrium relationship can be specified for empirical testing by adding both environmental factor variable (proxy by CO2 emissions) and political variable (proxy by government stability and political risk/socioeconomic condition) including the constant and slope parameters and error term. It should be noted that exchange rate is quoted indirectly i.e. increase in exchange rate (e_t) denotes depreciation.

$$lne_t = B_0 + B_1 ln(m_d - m_f)_t + B_2 ln(y_d - y_f)_t + B_3(\pi^e_d - \pi^e_f)_t + B_4 lnCEM_t + B_5 GS_t + B_6 PR_t + U_t \quad (7)$$

$$B_1, B_3, B_4, B_5 \text{ and } B_6 > 0 \text{ and } B_2 < 0$$

Where:

e_t: Nominal exchange rate.

$(m_d - m_f)_t$: Difference of domestic and foreign money supply.

$(y_d - y_f)_t$: Difference of domestic and foreign real GDP.

$(\pi^e_d - \pi^e_f)_t$: Expected domestic-foreign inflation differential. (proxied by lagged inflation rates, as they embody inflation expectations).

CEM_t: CO2 emissions.

GS_t: government stability.

PR_t: political risk.

This combined PPP-Monetary framework provides a robust foundation for exchange rate modeling. It specifies that the nominal exchange rate is determined in the short run by monetary fundamentals (money supply and demand), while being constrained by the long-run anchor of relative prices (PPP). The model elegantly resolves the paradoxical role of interest rates by tying them to inflation expectations, which is the very bridge that connects the Monetary Approach back to its PPP foundation. Empirical analysis would involve testing for this long-run cointegrating relationship and then modeling the short-run dynamics through an augmented autoregressive distributive lag (A-ARDL) method (See Saffarudin et al., 2025).

Equations (7) is respecified as Equations (8) below, following A-ARDL model specification format.

$$\Delta lne_t = \theta_0 + \theta_1 lne_{t-1} + \theta_2 ln(m_d - m_f)_{t-1} + \theta_3 ln(y_d - y_f)_{t-1} + \theta_4(\pi^e_d - \pi^e_f)_{t-1} + \theta_5 lnCEM_{t-1} + \theta_6 GS_{t-1} + \theta_7 PR_{t-1} + U_t + \sum_{i=1}^{4} \emptyset_i \Delta lne_{t-i} + \sum_{j=1}^{4} \emptyset_j \Delta ln(m_d - m_f)_{t-j} + \sum_{k=1}^{4} \emptyset_k \Delta ln(y_d - y_f)_{t-k} + \sum_{l=1}^{4} \emptyset_l \Delta(\pi^e_d - \pi^e_f)_{t-l} + U_t \quad (8)$$

Where $\emptyset_i$ is the lagged differenced dependent variables whilst $\emptyset_j$, $\emptyset_k$ and $\emptyset_l$ are the lagged differenced independent variables, t represents the time dimensions $t = 1, 2, \ldots, T$; definitions of other acronyms are in line with Equation (7).

3.3 Estimation Techniques

In line with Saffarudin et al. (2025), the estimation techniques in this study follows the following steps including: i) Descriptive statistics; ii) Pre-estimation tests (unit root test); iii) Estimation of the ARDL model using Least Squares (a general-to-specific approach is adopted to remove insignificant first-differenced variables and obtain reduced form of ARDL model) iii) Conduct diagnostic tests (normality, serial correlation, heteroscedasticity and white noise residuals); iv) Conduct cointegration tests (overall F-test, T-test for lagged-level dependent variable, and F-test for the

lagged-level independent variables); and iv) Compute and interpret the long-run coefficients.

3.4 Data Nature, Coverage, Sources and Measurements

The table shows the nature coverage, measurements and sources of variables that were used for the estimation of the model in the study.

Table 1: Data Sources and Measurements

Variable	**Measurement**	**Data source**
Nominal Exchange rate (e_t)	Official exchange rate (Naira per USD)	World Development Indicator (WDI)
Foreign Money Supply proxy with United States M2 (m_f)	Current local Currency (LCU), $	WDI
Domestic Money Supply (m_d)	LCU converted to US Dollars ($) by dividing M_2 LCU by official exchange rate (N)	WDI
Foreign GDP proxy with United States GDP (y_f)	PPP (constant 2021 international $)	WDI
Domestic GDP (y_d)	PPP (constant 2021 international $)	WDI
Expected Foreign Inflation rate proxy by United States inflation rate (π^e_f)	Lagged of Annual % of Consumer Price Index (CPI)	WDI
Expected Domestic Inflation rate (π^e_d)	Lagged of Annual % of CPI	WDI
CO2 Emissions (CEM)	Metric tons	World development bank WDI
Government stability (GS)	Index	International Country Risk Guide (ICRG)
Political risk proxied by socio economic conditions (PR)	Index	International Country Risk Guide (ICRG)

4. Presentation and Discussion of Results

4.1 Pre-estimation Analyses

4.1.1 Descriptive Summary

The descriptive table reports that the average of the nominal exchange rate is 3.704, with a standard deviation of 2.166. This shows significant fluctuations in naira during the period of the study. This volatility indicates a period of domestic currency instability, which could show a response to external shocks. Its distribution is negatively skewed and approximately normal. For the domestic-foreign money supply differential, it has a mean of -5.548 with moderate variability and a near-normal distribution. The concurrent negative mean implies that, on average, the domestic money supply was lower than the foreign money supply throughout the study period. The domestic-foreign real GDP differential shows a mean of -2.573 with very low dispersion and a normal distribution, indicating a stable but persistent negative output gap relative to the foreign economy, which may point to long-term structural differences in economic capacity.

The expected domestic-foreign inflation differential has a high mean of 15.196 and a substantial standard deviation of 16.191, indicating extreme volatility and periods of very high domestic inflation expectations relative to the foreign benchmark. This suggests a history of unstable price levels and potentially weak anchoring of inflation expectations, which is a consideration for exchange rate modelling. Carbon dioxide (CO2) Emissions show a mean of 4.561 with low variability and a normal distribution, indicating a relatively stable, but persistent level of emissions over the years. Finally, the institutional variables show government stability with a mean of 6.715 and a normal distribution, suggesting a generally stable political environment. Conversely, political risk has a lower mean of 3.273 and exhibits a non-normal distribution, showing that the data are skewed towards the periods of higher risk. This implies that whilst the government was stable, and the country at the same time experiencing political uncertainty could affect investment and economic policy consistency.

Table 2: Descriptive Statistics of Variables Employed

Variable	Mean	Max.	Min.	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Prob.
lne	3.70	7.30	-0.60	2.17	-0.70	2.36	4.44	0.11
$ln(m_d - m_f)$	-5.55	-4.32	- 6.75	0.67	-0.07	1.83	2.62	0.27
$ln(y_d - y_f)$	-2.57	- 2.36	- 2.82	0.12	-0.04	2.55	0.39	0.82
$(\pi_d^e - \pi_f^e)$	15.20	70.03	- 3.58	16.19	1.89	5.75	40.84	0.00
$lnCEM$	4.56	4.88	4.22	0.20	-0.03	1.84	2.55	0.28
GS	6.72	10.5	3.75	1.54	0.16	2.96	0.18	0.91
PR	3.27	7	1.5	1.83	0.68	1.83	6.04	0.05

Source: *Authors' Computation (2025)*

Explanatory notes: Variable definitions: lne *= Nominal Exchange Rate;* $ln(m_d - m_f)$ *= Domestic-Foreign Money Supply Differential;* $ln(y_d - y_f)$*= Domestic-Foreign Real GDP Differential;* $(\pi_d^e - \pi_f^e)$ *= Expected Domestic-Foreign Inflation Differential;* $lnCEM$ *= CO2 Emissions; GS = Government Stability; PR = Political Risk.*

4.1.2 Correlation Analysis

The correlation analysis in Table 3 provides the linear associations among the variables employed in the study. In terms of strength, several variables demonstrate a statistically significant relationship with the nominal exchange rate. A very strong positive correlation is observed between CO2 emissions and the nominal exchange rate (0.856). A strong positive correlation is found between government stability and the nominal exchange rate (0.596). Political risk exhibits a very strong negative correlation with the nominal exchange rate (-0.800). The real GDP differential shows a moderate positive correlation with the nominal exchange rate (0.300). The money supply differential and the expected inflation differential show weak and statistically insignificant correlations with the nominal exchange rate. High positive correlations are observed among other variables, especially between the real GDP differential and the money supply differential (0.414). The relationship between the expected inflation differential and political risk is positive and statistically significant (0.334). A moderate positive correlation is found between government stability and CO2 emissions (0.458). A strong negative correlation is observed between government stability and political risk (-0.636).

Table 3: Correlation Matrix

Variables	1	2	3	4	5	6	7
lne	1.000						
$ln(m_d - m_f$	-0.176	1.000					
$ln(y_d - y_f)$	0.300*	0.414**	1.000				
$(\pi_d^e - \pi_f^e)$	-0.046	-0.290	-0.126	1.000			
$lnCEM$	0.856**	0.058	0.268	-0.069	1.000		
GS	0.596**	-0.310*	-0.190	-0.107	0.458**	1.000	
PR	-0.800**	-0.037	-0.106	0.334*	-0.697**	-0.636**	1.000

Source: Authors' Computation (2025)
Note: *** and ** denote 1% and 5% significance levels, respectively.

4.1.3 Stationarity Test Using the Phillips-Perron unit root test, results of the stationarity tests reveal that all variables are stationary at first difference, that is, I(1) series except expected inflation differentials ($(\pi_d^e - \pi_f^e)$) and CO2 emissions ($lnCEM$) that are stationary at level I(0). Therefore, with a mixture of I(1) and I(0) variables, the study proceeds to estimates the model using augmented-autoregressive distributive lag (A-ARDL) method (Saffarudin et al., 2025). It should be noted that series for $ln(y_d - y_f)$ is initial stationary at second difference I(2) but was *differenced* to reduce the stationarity to I(1) as it is displaced in Table 4 (Goh et al., 2023).

Table 4: Unit Root Test Results

Variables	Phillips-Perron (Level)	Phillips-Perron (First Diff.)
lne	-1.693	-4.998***
$ln(m_d - m_f)$	-2.308	-5.680***
$ln(y_d - y_f)$	-1.690	-3.015***
$(\pi_d^e - \pi_f^e)$	-3.092**	-
$lnCEM$	-4.209***	-
GS	-2.020	-5.925***
PR	-1.527	-6.594***

Note: ***, ** and * denote 1% and 5% levels of significance.
Source: Authors' Computation (2025)

4.2 *Regression Estimate*

Short run estimates

In Table 5, the results of the short-run A-ARDL exchange rate model are presented. The estimate displays the coefficients, standard errors, t-statistics, probability values and variance inflating factors (VIF).

The overall significance of the model, as indicated by the F-statistic and confirmed through comprehensive diagnostic tests, demonstrates the robustness of the specified relationship.

The absence of serial correlation, heteroscedasticity, and significant multicollinearity, coupled with normally distributed residuals, validates the statistical reliability of the estimates. The high explanatory power of the model, with approximately 72.5 percent of exchange rate variations explained by the included variables, underscores the importance of considering both economic and non-economic factors in exchange rate modeling.

The empirical results obtained from the A-ARDL analysis in Tables 5 and 6 indicate that the coefficients of the key variables are statistically significant and align with a priori expectations. The error correction term, represented by the lagged nominal exchange rate lne(−1), is negative and statistically significant at the 5 percent level, with a coefficient of -0.248. This confirms the existence of a stable long-run relationship and a satisfactory speed of adjustment back to equilibrium following a short-run shock, with approximately 24.8 percent of disequilibrium corrected within one year.

Considering the variables of interest, the coefficient associated with the real GDP differential ln(yd−yf) demonstrates a negative and statistically significant relationship in both the short-run and long-run. The long-run coefficient of -17.537, significant at the 10 percent level, suggests that an increase in domestic output relative to foreign output leads to an appreciation of the domestic currency. This finding is consistent with the monetary approach to exchange rate determination, which posits that higher domestic income increases money demand, thereby causing the currency to appreciate (Gandolfo, 2016).

The expected inflation differential (πde−πfe) also exhibits a negative and statistically significant coefficient. The long-run estimate of -0.386, significant at the 5 percent level, indicates that a higher expected domestic inflation rate relative to foreign inflation leads to currency depreciation. This result validates the core proposition of Relative Purchasing Power Parity, which states that currencies of countries with higher inflation rates will depreciate (Krugman et al., 2017).

Table 5: A-ARDL Short-run Regression Results: A-ARDL (4, 4, 4, 4, 3, 3) Model

Variables	Coefficient	Std. Error	t-Statistic	Prob.	VIF
$lne(-1)$	-0.248	0.092	-2.697	0.017	0.008
$ln(y_d - y_f)(-1)$	-4.353	0.975	-4.466	0.001	0.950
$(\pi_d^e - \pi_f^e)(-1)$	-0.096	0.019	-5.036	0.000	0.0004
$lnCEM(-1)$	1.902	0.786	2.420	0.030	0.617
$GS(-1)$	-0.433	0.096	-4.505	0.001	0.009
$d(lne(-1))$	2.812	0.528	5.328	0.000	0.279
$d(lne(-4))$	1.979	0.590	3.355	0.005	0.348
$d(ln(m_d - m_f)(-1))$	2.926	0.519	5.642	0.000	0.269
$d(ln(m_d - m_f)(-2))$	0.894	0.169	5.280	0.000	0.029
$d(ln(m_d - m_f)(-3))$	1.505	0.279	5.399	0.000	0.078
$d(ln(m_d - m_f)(-4))$	2.083	0.587	3.550	0.003	0.344
$d(ln(y_d - y_f)(-3))$	-9.565	2.482	-3.854	0.002	6.158
$d(\pi_d^e - \pi_f^e)(-1)$	0.055	0.015	3.698	0.002	0.0002
$d(\pi_d^e - \pi_f^e)(-2)$	0.034	0.011	3.191	0.007	0.0001
$d(\pi_d^e - \pi_f^e)(-3)$	0.031	0.008	3.747	0.002	6.79E-05
$d(\pi_d^e - \pi_f^e)(-4)$	-0.015	0.004	-3.933	0.002	1.41E-05
$d(lnCEM(-1))$	1.939	0.882	2.197	0.045	0.779
$d(lnCEM(-2))$	7.482	1.654	4.523	0.001	2.737
$d(lnCEM(-3))$	3.491	0.872	4.004	0.001	0.760
$d(lnCEM(-4))$	2.638	0.859	3.073	0.008	0.737
$d(GS(-1))$	0.500	0.089	5.617	0.000	0.008
$d(GS(-2))$	0.571	0.109	5.241	0.000	0.012
$d(GS(-3))$	0.489	0.111	4.409	0.001	0.012
$d(\backslash PR(-1))$	0.472	0.086	5.491	0.000	0.007
$d(PR(-3))$	-0.373	0.083	-4.523	0.001	0.007
F-Stat			5.105***	0.0013	
Adj. R^2	0.725				
$d(\backslash PR(-1))$	0.472	0.086	5.491	0.000	0.007
$d(PR(-3))$	-0.373	0.083	-4.523	0.001	0.007
Breusch-Godfrey test for Serial Correlation			1.159	0.347	
Breusch-Pagan test for Heteroscedasticity			0.498	0.937	
Jarque-Bera test for Normality			1.155	0.561	

***, ** and * denote 1%, 5% and 10% significance levels, respectively. VIF – Variance inflation factor test for multicollinearity.
Source: Authors' Computation (2025)

4.2.2 Long run estimates

Table 6, the results of the long-run A-ARDL exchange rate model are presented. The estimate displays the coefficients, t-statistics, probability values and the standard errors.

The coefficient for CO2 emissions lnCEM is positive and statistically significant at the 1 percent significance level in both the short and long run.

The long-run coefficient of 7.662 suggests that environmental degradation, proxied by carbon emissions, is associated with a depreciating domestic currency. This finding aligns with studies such as Mosugu (2018), who found that environmental pollution arising from CO_2 emission may adversely affect agricultural output (for domestic consumption and export) and then lead to reduction in foreign exchange earnings which results in Naira depreciation.

The coefficient for government stability GS is negative and statistically significant at the 10 percent significance level in the long run, with a value of -1.746. This implies that improved government stability contributes to currency appreciation. This finding supports the theoretical expectation that stable governance attracts foreign investment and fosters confidence, thereby strengthening the currency (Adebayo, 2023). The results for political risk PR in the short run show mixed effects, with the first lag being positive and the third lag negative, both significant, indicating complex short-run dynamics.

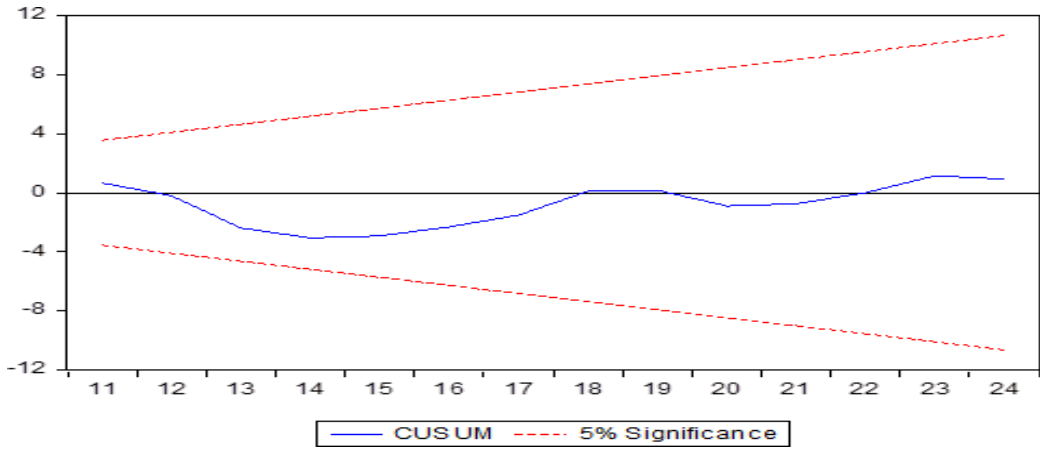
Table 6: A-ARDL Long-run Regression Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$ln(y_d - y_f)$	-17.537*	8.747	-2.005	0.065
$(\pi_d^e - \pi_f^e)$	-0.386**	0.168	-2.304	0.037
$lnCEM$	7.662***	1.420	5.396	0.000
GS	-1.746*	0.892	-1.957	0.071

***, ** and * denote 1%, 5% and 10% significance levels, respectively
Source: Authors' Computation (2025)

4.2.3 Stability Test

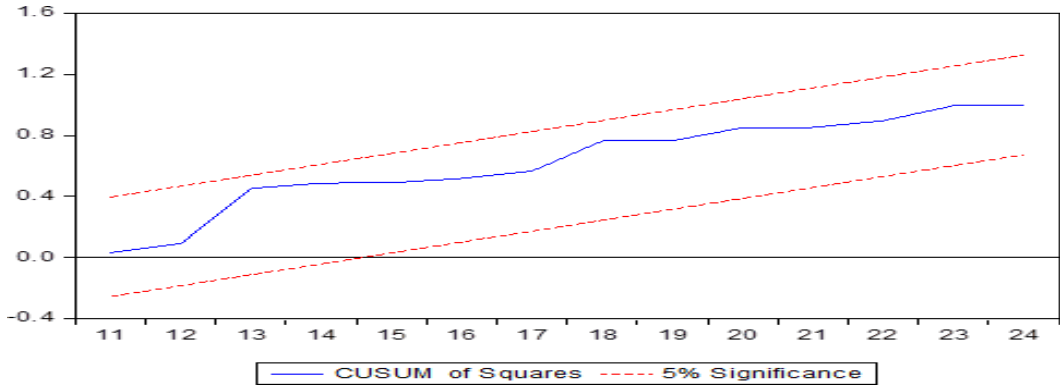
Figure 4.1: Cumulative Sum of Recursive (CUSUM)



Source: Authors' Computation (2025)

The parameter stability of the model is further ascertained through the Cumulative Sum (CUSUM) test. The graphical representation demonstrates that the CUSUM statistic, plotted against the critical bounds at the 5 percent significance level, follows a trajectory that does not diverge outside the established confidence bands. As the entire path of the CUSUM statistic remains within the 5 percent significance lines, the test fails to reject the null hypothesis of parameter stability. This result provides strong evidence that the coefficients of the estimated A-ARDL model are stable over the sample period, thereby affirming the robustness of the model for meaningful economic inference.

Figure 4.2: Cumulative Sum of Recursive (CUSUM SQ)



Source: Authors' Computation (2025)

The stability of the long-run parameters is verified using the Cumulative Sum of Squares (CUSUM of Squares) test. As illustrated in the figure, the plot of the CUSUM of Squares statistic remains entirely within the 5 percent critical bounds. This finding indicates that the null hypothesis of coefficient constancy cannot be rejected. The A-ARDL exchange rate model demonstrates structural stability over the study period, as the recursive residuals show no sign of systematic variation outside the confidence interval. Consequently, the A-ARDL exchange rate estimated model is deemed stable and reliable for policy analysis and economic inference.

4.2.3 Cointegration Tests

Table 7: A-ARDL Cointegration tests

A-ARDL test	Statistic
F_1	11.875***
t_{DV}	-2.697**
F_2	10.530***

Source: Authors' Computation (2025)

Explanatory notes: ***, ** and * denote 1%, 5% and 10% significance levels, respectively. F_1 = overall F-statistic, t_{DV} = t-statistic of the lagged-level dependent variable and F_2 = the joint significance of all the lagged-level independent variable.

The cointegration analysis conclusively establishes a robust long-run relationship

among the variables, as evidenced by the successful passage of all three Augmented ARDL tests. The significant overall F-test (F_I = 11.875) provided initial evidence against the null of no levels relationship, a finding that was substantiated by the significant t-test on the lagged dependent variable (t_{DV} = -2.697), thereby ruling out a degenerate case. Furthermore, the significant F-test on the lagged independent variables (F_2 = 10.530) confirmed that the explanatory variables collectively contribute to the cointegrating equation, thus validating the existence of a genuine long-run equilibrium and permitting the interpretation of the long-run coefficients.

4.2.4 Discussion of findings

The empirical findings from the A-ARDL estimation provide robust evidence on the determinants of Nigeria's exchange rate, confirming several theoretical postulates while offering new insights into the roles of environmental and political factors. The results align with the synthesized PPP-Monetary framework, demonstrating that both traditional fundamentals and non-traditional variables significantly influence exchange rate behavior. The negative and statistically significant coefficient of the error correction term validates the existence of a stable long-run relationship among the variables. This finding is consistent with the work of Pesaran et al. (2001) and confirms the model's capability to capture both short-run dynamics and long-run equilibrium. The speed of adjustment of approximately 24.8 percent annually indicates a moderate pace of convergence to equilibrium following external shocks, which is characteristic of developing economies with structural rigidities.

The real GDP differential demonstrates a negative and significant long-run relationship with the exchange rate. This finding supports the monetary approach to exchange rate determination, which posits that higher relative income increases money demand, leading to currency appreciation (Gandolfo, 2016). The result corroborates earlier studies by Oke and Temitayo (2018) and Ogbonna and Uma (2019), which found positive output effects on exchange rate stability in Nigeria. The expected inflation differential exhibits a negative and statistically significant coefficient, providing strong empirical validation for Relative Purchasing Power Parity theory. This finding aligns with Krugman et al. (2017) and confirms that inflation differentials serve as a fundamental anchor for long-run exchange rate movements. The result is consistent with Yusuf (2019), who identified inflation as a key driver of both official and parallel exchange rates in Nigeria.

Environmental degradation proxied by CO2 emissions shows a positive and highly significant relationship with exchange rate depreciation. This finding extends the literature by demonstrating that environmental factors constitute important determinants of currency values in resource-dependent economies. The result supports Mosugu (2018), who found that environmental factors account for significant variations in Nigeria's exchange rate, and Akinyede et al. (2016), which emphasized the role of environmental forces in foreign exchange market dynamics.

Government stability (GS*GS*) exhibits a negative and significant long-run coefficient, indicating that political institutional quality contributes to currency appreciation. This finding validates the theoretical expectations of Adebayo (2023) and Adamu (2022), who emphasized the crucial role of political economy factors in exchange rate determination. The result suggests that stable governance enhances investor confidence and reduces capital flight, thereby supporting currency stability.

The monetary differential while showing complex short-run dynamics through its differenced terms, confirms the fundamental proposition of the monetary approach that relative money supply influences exchange rate movements. This finding aligns with Goddey et al. (2025), who identified money supply as a significant determinant of Nigeria's exchange rate, and Ogboi et al. (2023), who emphasized the role of monetary factors in exchange rate fluctuations.

These findings collectively demonstrate that Nigeria's exchange rate is determined by a complex interplay of monetary fundamentals, environmental conditions, and political institutional quality. The results provide empirical support for the synthesized theoretical framework and offer valuable insights for policymakers seeking to achieve exchange rate stability through multidimensional approaches.

5 Conclusion and Recommendations

This study confirms the long-run determinants of the nominal exchange rate in Nigeria using the A-ARDL approach from 1980 to 2024. It contributes to the literature by integrating economic, environmental, and political variables into a unified analytical framework. The results of the study show that traditional monetary fundamentals—specifically the real GDP differential and the expected inflation differential—exert a significant long-run influence on the exchange rate, in line with the synthesized PPP-Monetary framework. Furthermore, environmental factors (CO2 emissions) and political factors (government stability) are also identified as robust long-run determinants.

The findings demonstrate that a relative increase in domestic economic growth leads to currency appreciation, while higher expected inflation differential and increased carbon emissions lead to currency depreciation. The study also establishes that greater government stability is associated with a stronger currency. There are recommendations for managing Nigeria's exchange rate based on these empirical findings. The significance of consolidating economic, environmental, and political governance is highlighted by their interdependent impact on the currency. Monetary authorities should prioritize price stability to anchor inflation expectations, as this directly supports the exchange rate. Fiscal and structural policies should be implemented to stimulate and diversify domestic economic output, thereby strengthening the currency through the income channel.

Environmental policies should be strengthened to reduce carbon emissions and mitigate environmental degradation. This includes enforcing stricter regulations on pollution and investing in cleaner technologies, as a deteriorating environment undermines the currency. Policymakers must also intensify efforts to ensure political and government stability, as this fosters the investor confidence necessary for a stable and strong exchange rate.

Given the substantial influence of the inflation differential, the monetary authority should implement prudent monetary policy to maintain price stability. Efforts should also be made to enhance the measurement and monitoring of expected inflation to better guide policy decisions. Lastly, the results confirm the importance of a stable political environment. Therefore, institutional reforms that promote policy consistency, reduce political risk, and strengthen governance structures are essential for achieving long-term exchange rate stability.

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ICT Adoption and Financial Performance: Implications for Cooperative Thrift and Credit Societies in Enugu Metropolis

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Abstract

The integration of information and communication technologies (ICT) into cooperative operations has become increasingly critical to enhancing efficiency, transparency, and competitiveness in emerging economies. This study examines the adoption of Information and Communication Technology (ICT) and its effects on the financial performance of Cooperative Thrift and Credit Societies (CTCS) in Enugu Metropolis. Anchored on the Technology Acceptance Model (TAM) and the Resource-Based View (RBV), the research employed a descriptive survey design with 340 respondents sampled from 215 registered cooperatives. Data was collected using structured questionnaires and interviews, and analyzed with SPSS version 28. Results showed that 77.6% of societies had adopted at least one ICT tool, with WhatsApp communication (92.7%), mobile banking (83.7%), and accounting software (74.8%) being the most common. ICT adopters significantly outperformed non-adopters across financial indicators, recording higher surplus growth (18% vs. 6%), improved loan recovery, and increased member savings. Correlation analysis confirmed a strong positive relationship between ICT adoption and financial performance ($r = 0.614$, $p < 0.01$), while regression estimates identified mobile banking ($\beta = 0.41$, $p < 0.01$) and accounting software ($\beta = 0.35$, $p < 0.05$) as key drivers. The study established that ICT adoption improves transparency, efficiency, and trust in cooperatives, thereby enhancing financial performance. However, low adoption of advanced systems suggests room for improvement. It recommends deeper ICT integration, targeted training for cooperative staff and executives by government and cooperative, as well as acquire or upgrade accounting software to improve financial record-keeping, enhance transparency, and strengthen financial management.

Keywords: ICT adoption, financial performance, cooperative societies, sustainability, Nigeria, digitalization

1. Introduction

Cooperative Thrift and Credit Societies have a long history of acting as grassroots financial institutions in Nigeria, providing low-income households with access to savings mobilization, credit, and risk-sharing services that conventional banks often overlook (Nwankwo, Ogbodo, & Ewuim, 2016). Their role in promoting financial

inclusion and community development is particularly apparent in urban centres such as Enugu Metropolis, where cooperative societies cater to diverse socioeconomic groups. The sustainability and competitiveness of cooperative treasury cash services (CTCS) in modern financial environments are increasingly reliant on their ability to implement information and communication technologies (ICT). ICT adoption is no longer a choice but a crucial factor in achieving efficiency, accountability, and long-term financial sustainability for cooperative institutions (Lila, 2012; Oladejo & Yinus, 2014).

Many Nigerian cooperatives continue to rely on manual record-keeping and traditional methods for loan management and transactions, hindering operational efficiency, transparency, and their competitiveness with microfinance banks and digital financial service providers (Okonkwo, 2017; Olise, Anigbogu, Edoko, & Okoli, 2014). Adopting ICT tools such as electronic record systems, mobile banking applications, and digital payment platforms could substantially enhance loan recovery, savings mobilization, and customer satisfaction (Keah, 2014; Wachira, Muturi, & Sirma, 2014). Researches from other areas indicate that ICT adoption can boost productivity and financial outcomes by simplifying internal procedures, decreasing transaction expenses, and improving service provision (Gargallo-Castel & Galve-Górriz, 2012; Montegut-Salla, Cristóbal-Fransi, & Gómez-Adillón, 2013). Despite challenges like infrastructural deficiencies, the cost of adopting new technology, and a lack of digital literacy, cooperatives in Nigeria continue to face persistent obstacles (Oladejo & Yinus, 2014; Okonkwo & Ugwa, 2020).

CTCS' financial performance is crucial not only for their continued existence but for their ability to provide socioeconomic benefits to their members. Their performance is typically assessed using indicators like liquidity, profitability, and loan repayment rates (Eljelly, 2004; Okonkwo, 2017). In a highly competitive and digitally driven financial environment, ICT adoption can have a substantial impact on these performance dimensions by allowing cooperatives to expand their operations, enhance member participation, and guarantee accountability (Okonkwo & Okafo, 2024; Okafor, Okonkwo, & Ngene, 2024). In addition, digitalization has been associated with increased cooperative sustainability in the post-COVID-19 period, as firms increasingly rely on ICT for resilience and adaptation (Okonkwo & Okafo, 2024).

Academic discussions highlight the fact that ICT not only enhances financial indicators but contributes to customer satisfaction, brand loyalty, and competitive standing in related sectors (Chendo, 2019a, 2019b; Anetoh, Nnabuko, Okolo, & Anetoh, 2020; Unukpo, Nwankwo, Chendo, & Okeke, 2025). The application of CTCS to this context implies that ICT integration has the potential to redefine member experiences by enhancing transparency, efficiency, and reliability in financial services. Insights from empirical research remain limited in Nigeria's cooperative context, particularly at the metropolitan level, where both the possibilities and obstacles to digitalisation are clearly evident.

Against this background, the current study examines the adoption of ICT and its effects on the financial outcomes of CTCS in Enugu Metropolis. The study specifically set out to: (i) investigate the extent of ICT adoption among community thrift and credit societies in Enugu Metropolis; (ii) evaluate the relationship between ICT adoption and financial performance metrics like profitability, savings growth, and loan repayment; and (iii) determine the primary obstacles hindering ICT adoption in these cooperatives. The study adopts profitability, savings growth, and loan repayment as important financial performance metrics for CTCS because they collectively reflect the cooperative's operational effectiveness and sustainability. Profitability indicates the cooperative's capacity to generate surplus and reward members, aligning with organizational efficiency goals (Akabogu, et al., 2024; Okafor, et al., 2023). Savings growth captures the ability to mobilize member contributions, which is the foundation for lending activities and promotes financial inclusion, particularly when enhanced by ICT tools such as mobile banking and digital payments (Ogbonna & Kaine, 2023; Agbo, 2010). Loan repayment rates measure operational efficiency and credit risk management, reflecting the effectiveness of loan monitoring and recovery processes that can be strengthened through ICT adoption (Okafor, et al., 2023). Hence, these metrics provide a comprehensive framework for assessing how ICT integration impacts CTCS performance, consistent with the Resource-Based View, which positions ICT as a strategic asset driving competitive advantage. The study is based on the Technology Acceptance Model (TAM), which describes user acceptance of technology through perceived usefulness and ease of use (Davis, 1989), and the Resource-Based View (RBV), which views ICT as a strategic resource that can foster organisational competitiveness (Barney, 1991). This study offers timely insights into how urban cooperatives in Enugu Metropolis can use ICT to drive growth and sustainability in Nigeria's rapidly evolving financial sector. The outcomes will be pertinent to cooperative leaders, policymakers, and development partners aiming to enhance the role of CTCS in financial inclusion, economic empowerment, and sustainable development.

2. Literature Review

2.1 Conceptual Review

Cooperative Concept

The International Cooperative Alliance (ICA) defines a cooperative as a group of people who unite in a common venture, adhering to six key principles that are outlined as follows:

(i) Membership is open and voluntary.
(ii) There is democratic control, usually on the basis of one man, one vote.
(iii) Interest on share capital is limited.
(iv) Distribution of surplus proportionally, according to the level of transactions
(v) Cooperatives devote some part of their surpluses to education.
(vi) Cooperatives cooperate among themselves.

The cooperative's main objective is to offer more benefits to its members, including higher individual earnings and improved living standards, through provision of essential services. Several types of cooperatives exist.

Workers Cooperative Society

Workers cooperative society is a firm owned and controlled by the individuals who work for it, as stated by Sapovadia and Patel (2013). Employees inherently possess the right of ownership due to their association with the firm. A workers' cooperative is a type of organisation for the employment of a group of workers who are associated with one another for working together and sharing a joint reward from business activities.

Cooperative Thrift and Loan Society

According to the Free Dictionary by Farlex, thrift is defined as prudent management of money and resources, encompassing frugality and organisations such as savings and loan associations, credit unions, or savings banks.

ICT Adoption in Cooperative and Financial Institutions

The integration of digital tools, including mobile banking and online transaction systems, into organizational processes is referred to as Information and Communication Technology (ICT) adoption. Adopting ICT in cooperative societies results in enhanced transparency, lowered transaction expenses, and more efficient service provision, as noted by Oladejo & Yinus (2014; Oladejo & Yinus, 2014 as cited in Oladejo & Yinus, 2014). A study conducted in Egba Division, Ogun State, Nigeria, discovered that IT adoption has a positive effect on cooperative performance, indicating that cooperative organisations investing in ICT are likely to experience higher patronage and operational efficiency.

Cooperative Financial Performance

A cooperative's sustainability hinges on key financial indicators like profitability, liquidity, and loan recovery rates (Eljelly, 2004). For CTCS, improved financial performance enables growth, higher member returns, and increased resilience. Theorists believe that ICT adoption can enhance these performance metrics by automating back-office tasks, enhancing monitoring, and decreasing default risk.

Cooperative Growth through ICT

ICT serves not only as a tool for enhancing efficiency but as a means of facilitating growth. Cooperatives utilising ICT may increase their membership base, broaden their services, and achieve a competitive edge in a digital financial context. Reviews of ICT adoption in African cooperatives stress the need for integrated and user-friendly management information systems to facilitate expansion, as stated in the Coops4Dev Report on ICT adoption in African Cooperatives.

2.2 Theoretical Frameworks

Technology Acceptance Model (TAM)

The Technology Acceptance Model suggests that the adoption of a new technology is influenced by its perceived usability and perceived usefulness to users. In a cooperative environment, managers and members are more likely to implement ICT systems if they believe these systems will enhance their operations and be user-friendly.

Resource-Based View (RBV)

The Resource-Based View theory suggests that organisational assets, such as ICT capabilities, can be strategic resources which provide a sustainable competitive edge. Companies that develop ICT competence may outperform their peers who lack such resources.

Liquidity–Profitability Tradeoff

Eljelly (2004) indicates that businesses need to weigh liquidity (possessing cash or liquid assets) against profitability. Implementing ICT technologies can help cooperatives maintain this balance by improving cash flow monitoring, managing risk, and facilitating timely decision-making.

2.3 Empirical Evidence

ICT and Institutional Performance

Akujor, et al., (2021) examined the effect of ICT on corporate performance in Zenith Bank and UBA using financial data from 2010–2016 and OLS regression. Results showed that ICT had a weak effect on return on equity, almost no effect on return on assets, but a positive effect on earnings per share. The authors recommend prioritizing ICT investments, enhancing staff training for effective ICT use, and improving the business environment through government support.

Oladejo and Yinus (2014) found that information technology usage has a positive impact on cooperative services and performance in Nigeria. Their analysis, which employed ANOVA, revealed that cooperatives investing in IT experience higher patronage and service quality (An Influential Analysis of the Impact of Information Technology on Cooperative Services in Nigeria).

Yunis, et al., (2017) analyzed the link between ICT adoption, innovation, and organizational performance in Lebanese SMEs, emphasizing the mediating role of corporate entrepreneurship. Using survey data from employees and managers, the study found that ICT and ICT-based innovations are valuable resources, but their impact on sustainable performance depends on entrepreneurial behaviors and implicit organizational capabilities. The authors highlight managerial and policy implications for enhancing ICT adoption and competitive advantage, while noting limitations such as convenience sampling and self-reported performance data.

ICT in Savings & Credit Institutions

Verma, et al., (2023) investigated the interplay between ICT diffusion, financial development, and economic growth across developing countries from 2005–2019 using PCA, co-integration techniques, and causality tests. The study found that ICT diffusion, financial development, and trade openness significantly enhance growth, while inflation reduces it. Results further showed a bidirectional causal relationship between ICT growth and financial development, and a unidirectional causality from financial development to ICT diffusion. The authors recommend coordinated public–private ICT investments, financial sector strengthening, subsidies for affordable ICT access, and digital literacy training to foster inclusive growth.

Asongu and Nwachukwu (2017) analyzed the role of ICT (internet and mobile penetration) in shaping financial access through financial sector development across 53 African countries from 2004 to 2011, applying generalized method of moments (GMM). The study found that ICT interacting with financial formalization reduced financial exclusion, whereas ICT interacting with financial informalization increased financial activity; however, the overall net effects of ICT on financial access were positive. Their findings suggest that ICT expansion enhances access when aligned with formal financial structures, while also leveraging informal systems to widen participation. Policy recommendations include strengthening mobile and internet banking, reducing information asymmetry, and tackling surplus liquidity in African financial markets.

Research conducted in Kenya discovered that mobile banking and internet banking boosted transaction volumes and reduced time spent by both clients and SACCO staff, suggesting ICT's part in achieving greater efficiency (Effects of Information Communication Technology Adoption on SACCOs).

Mutie and Kibe (2024) examined the effect of ICT adoption on the financial performance of Kitui Teachers' Sacco (KTS), Kenya. Using a mixed-method approach with questionnaires administered to board members, managers, and departmental heads, the study combined descriptive and inferential analyses, including Pearson's correlation via SPSS v24. Results showed that ICT adoption had a positive and statistically significant impact on KTS's financial performance ($\beta = 0.287$, $p < 0.05$), with descriptive statistics yielding an overall mean of 3.72 (SD = 0.495). The study concluded that ICT adoption is a vital determinant of SACCO financial performance, recommending stronger ICT integration to sustain growth and efficiency.

ICT Adoption Barriers in Southeastern Nigeria

Nwonye, Nkan, and Akpan (2025) examined the challenges of ICT usage among academic staff at the University of Uyo, Nigeria, using a mixed-methods design with data from 317 respondents. The study found that inadequate infrastructure (M = 3.85, SD = 0.42), high internet costs (M = 3.78, SD = 0.65), and limited digital literacy (M

= 3.48, SD = 0.70) were the most critical barriers to ICT adoption, alongside frequent power outages, insufficient training, and cybersecurity risks. These constraints were more pronounced in rural areas, worsening the digital divide. The study recommended improved ICT infrastructure, subsidized internet, digital literacy training, and stronger government–private sector–academic collaborations to foster inclusive ICT use in Nigerian universities.

Lenee (2020) investigated barriers to information technology adoption (ITA) in universities across the Niger Delta (BRACED states) using questionnaires and interviews with 113 respondents. The study found that key barriers included negative attitudes toward technology, cultural resistance, inadequate funding, lack of infrastructure, fear of change, and politically motivated policies. Using the Relative Importance Index, lack of electricity emerged as the most critical barrier. A Kruskal–Wallis test showed a significant variance between attitudes to ITA and infrastructure deficits. The study recommended improved government funding, enforceable ITA policies, capacity building for students and lecturers, and partnerships with international IT experts to strengthen IT adoption in the region.

Moshood et al. (2020) conducted a systematic review of 102 publications (2003–2020) to examine barriers and benefits of ICT adoption in Nigeria's construction industry. The study conceptualized ICT adoption as an interaction between technology, tasks, and individuals. While ICT offers competitive advantages, its benefits cannot be realized without effective user adoption. Findings highlight that the construction industry still struggles with implementation challenges, requiring attention to both technological readiness and human factors to achieve meaningful outcomes.

ICT Adoption in SMEs and Comparative Contexts

Çallı, et al., (2019) examines ICT adoption in SMEs by focusing on determinants, adoption levels, and effects on organizational innovativeness. They found that ICT adoption and utilization depend largely on owner/manager characteristics, ICT awareness, and firm-specific features. Using a mixed-methods design with surveys and semi-structured interviews of Turkish SMEs, the study revealed that higher ICT adoption positively influences multiple dimensions of innovativeness, underscoring ICT as a driver of sustainability and competitive advantage in SMEs.

Yuwono, Suroso, and Novandari (2024) conductes a systematic literature review of 25 highly cited publications (2014–2023) on ICT adoption in SMEs, using the PRISMA framework. The review found that while ICT adoption is growing, SMEs in developing countries face persistent barriers such as limited finance, inadequate ICT knowledge, weak infrastructure, and resistance to change. Findings show that ICT positively influences SME productivity, competitiveness, and market access, but the benefits are unevenly realized due to structural constraints. The study also highlighted publication trends, the most cited works, and fields where ICT research in SMEs is

concentrated. The authors conclude that customized strategies and context-specific policies are needed to strengthen ICT adoption and maximize its role in fostering innovation and sustainable growth among SMEs in developing nations.

Ardiansah et al. (2024) examines determinants of ICT adoption among 237 early-stage SME entrepreneurs in Indonesia using structural equation modeling (SEM). The study found that perceived benefits of ICT and integration with consumers are the strongest determinants of adoption in the post-pandemic period, as entrepreneurs seek efficiency and market capture during economic recovery. Other potential factors (e.g., cost, infrastructure, or skills) were less significant compared to usefulness and consumer connectivity. The findings highlight that ICT adoption in emerging SMEs is primarily driven by its strategic value in improving customer engagement and business process effectiveness, underscoring the role of digital transformation in accelerating SME resilience and competitiveness.

Ritchie and Brindley (2005) developes a conceptual model to examine how ICT adoption reshapes relationships and management in SMEs. Drawing on evidence from two organizations, the study found that ICT adoption alters interfaces with customers, suppliers, and employees, leading to changes in communication flows, control mechanisms, and working practices. For managers, ICT enables greater efficiency but requires new skills in relationship management and strategic integration. For employees, it introduces both opportunities (flexibility, skill development) and challenges (work intensification, role adjustments). The findings underscore that ICT adoption in SMEs is not only a technical change but also a transformational shift in organizational dynamics and stakeholder relationships.

2.4 Research Gaps and Justification

The literature indicates that ICT adoption can bolster performance in cooperatives and related institutions. Yet, notable gaps remain:

i. Most Nigerian studies (Agbo, 2010; Izekor & Alufohai 2010; Okonkwo, et al., 2022) focus on cooperative service sectors broadly or agricultural contexts; few (Okafor, et al., 2023; Ogbonna & Kaine 2023; Akabogu, et al.,2024) examine cooperative thrift and credit societies in urban/metropolitan settings but not Enugu.

Addressing these gaps, the current study focuses on CTCS in Enugu Metropolis, examining both ICT adoption levels and their relationship with concrete financial outcomes, while capturing the contextual challenges confronted by cooperative leaders.

3. Methodology

This study uses a descriptive survey design to investigate the extent of ICT adoption in Cooperative Thrift and Credit Societies (CTCS) and its impact on financial performance. The study was conducted in Enugu Metropolis, specifically in Enugu North, Enugu South, and Enugu East Local Government Areas, which were selected

due to their high concentration of cooperative thrift and credit societies. The population comprised all 215 registered CTCS with a projected membership in excess of 3,000. A total of 340 participants were selected using a proportionate stratified random sampling technique that took into account the size and location of the societies. Original data was primarily used. Data was collected from structured questionnaires and interviews with executives and members of the CTCS. The ICT-CFPQ questionnaire was validated by experts and its reliability was assessed using Cronbach's alpha, which yielded a result of 0.82, thereby confirming its internal consistency. Trained assistants distributed copies of the questionnaire directly, while interviews were conducted with the leaders who had been chosen for participation.

Data analysis utilizes SPSS software, version 28. Statistics including means, frequencies, and standard deviations were calculated. Correlation and regression analysis by Pearson were conducted to assess the relationship between ICT adoption and financial performance, and t-tests and ANOVA were used to investigate variations across different types and sizes of cooperatives. Thematic analysis was conducted on qualitative responses from interviews. Consent from participants was obtained after receiving ethical approval.

Model Specification

The study examined the effect of ICT adoption on the financial performance of Cooperative Thrift and Credit Societies (CTCS). The general linear regression model is expressed as: $FP = \beta_0 + \beta_1 MB + \beta_2 AS + \beta_3 CP + \beta_4 ERP + \varepsilon$

FP= Financial Performance

- MB= Mobile Banking Services
- AS= Accounting Software Usage
- CP= Digital Communication Platforms (e.g., WhatsApp)
- ERP= Advanced Record-Keeping / ERP Systems
- β_0= Intercept
- $\beta_1 - \beta_4$= Coefficients of predictors
- ε= Error term

4. Presentation and Discussion of Results

Out of 340 questionnaires administered, 317 were returned, giving a response rate of 93.2%, which was considered adequate for analysis.

Table 4.1: Overall ICT Adoption Status in CTCS (N = 317)

Adoption Status	Number of Societies	Percentage (%)
Adopters (at least one ICT tool)	246	77.6
Non-Adopters (no ICT tool)	71	22.4
Total	**317**	**100.0**

Source: Field Survey, 2024

Table 4.1 shows that out of 317 cooperative societies surveyed, 246 (77.6%) had adopted at least one ICT tool, while 71 (22.4%) had not adopted any. This indicates that the majority of cooperative societies in the study area are integrating ICT into their operations, though about one-fifth still rely entirely on traditional methods.

Table 4.2: Distribution of ICT Tools Among Adopters (N = 246, Multiple Responses Allowed)

ICT Tool Adopted	Number	Percentage of Adopters (%)
Mobile banking applications	206	83.7
Computerized accounting software	184	74.8
WhatsApp/digital communication	228	92.7
Advanced record-keeping/ERP	89	36.2

Source: *Field Survey (2024)*

Table 4.2 shows that, out of 317 cooperative societies, 246 (77.6%) had adopted at least one ICT tool, while 71 (22.4%) had not adopted any. Among adopters (N = 246), WhatsApp/digital communication was the most prevalent (92.7%), followed by mobile banking applications (83.7%), computerized accounting software (74.8%), and advanced record-keeping/ERP systems (36.2%).

Table 4.3 Financial Performance Indicators

Indicator	ICT-Adopters (Mean %)	Non-Adopters (Mean %)
Annual surplus growth	18.0	6.0
Loan default rate (reduction)	12.5	3.8
Member savings mobilization (increase)	21.0	7.5

Source: *Field Survey (2024)*

Table 4.3 shows that Cooperatives with higher ICT adoption recorded stronger financial outcomes, with surplus growth averaging 18% compared to 6% in non-adopters. Similarly, adopters had better loan recovery and mobilized more savings.

Table 4.4 Correlation Results

Variable	r	Sig. (2-tailed)
ICT adoption × Performance	0.614	0.000**

Source: *SPSS Output (2024)*

Table 4.4 shows that the correlation coefficient ($r = 0.614$, $p < 0.01$) shows a positive and significant relationship between ICT adoption and financial performance.

Table 4.5 Regression Estimates

Model Variable	Coefficient (β)	t-value	Sig. (p)
Constant	2.145	5.276	0.000
Mobile banking services	0.410	3.962	0.001**
Accounting software	0.350	2.514	0.013*
Communication platforms	0.188	1.763	0.079
Advanced ERP systems	0.092	0.844	0.400

Source: *SPSS Output (2024)*

Model Summary: $R^2 = 0.37$, Adj. $R^2 = 0.34$, $F = 14.62$, Sig. = 0.000 Significant at 0.01, * Significant at 0.05

Table 4.5 shows that the regression model indicates that ICT adoption explains 37% of the variation in financial performance of cooperative societies ($R^2 = 0.37$, Adj. $R^2 = 0.34$, $F = 14.62$, $p < 0.001$). Among the predictors, mobile banking services ($\beta = 0.41$, $p < 0.01$) and accounting software ($\beta = 0.35$, $p < 0.05$) were statistically significant, showing strong positive effects. By contrast, communication platforms ($\beta = 0.19$, $p = 0.079$) and advanced ERP systems ($\beta = 0.09$, $p = 0.400$) had positive but not statistically significant relationships with financial performance.

Decision

The null hypothesis of no significant effect of ICT adoption on financial performance was rejected. ICT adoption was shown to have a positive and significant impact on CTCS performance in Enugu Metropolis.

5. Conclusion

The study established that ICT adoption improves transparency, efficiency, and trust in cooperatives, thereby enhancing financial performance. However, low adoption of advanced systems suggests room for improvement.

6. Recommendations

It is therefore, recommended that CTCS should deepen ICT adoption, particularly in digital accounting and mobile banking.

Government should embark on targeted training for cooperative staff and executives as this is necessary to improve ICT competence and encourage adoption among the 22.4% of societies still not using any ICT tools.

Cooperatives societies should acquire or upgrade accounting software to improve financial record-keeping, enhance transparency, and strengthen financial management.

Although, ERP systems currently show low adoption and no significant effect, cooperative federations should support gradual uptake through subsidized access and training.

Future research should investigate other variables such as governance and external economic conditions.

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