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An Analytical Analysis Of Exchange Rate And Monetary Policy On Inflation In Nigeria

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ABSTRACT
This study examined the relationships monetary policy, exchange rate and inflation in Nigeria using monthly data from June 1999 to March 2025. Methodological approaches were employed: the Non-Linear Autoregressive Lag (NARDL) estimation techniques address potential asymmetric relationship and Diks–Panchenko nonlinear causality test was also conducted to investigate the direction of causality among the variables. The findings revealed that monetary policy variables, particularly the monetary policy rate and broad money supply, were also found to exert significant positive effects on inflation, underscoring the role of monetary policy in price stabilization. Moreover, the interaction between exchange rate and monetary policy was significant, showing that policy responses can either amplify or dampen inflationary pressures. Causality results indicated bidirectional causality between monetary policy variables and inflation, highlighting their joint influence in Nigeria's inflationary process. Based on these findings, the study recommends a coordinated monetary policy framework to enhance credibility and reduce policy conflicts. Monetary policy should strike a balance between controlling inflation and supporting growth. Additionally, structural reforms that reduce import dependence and strengthen domestic production capacity are essential to mitigate external shocks and achieve sustainable price stability.
Keywords: monetary policy, exchange rate, inflation, price stability

1.0 INTRODUCTION

Price stability one of the objectives of economic growth and development, unstable price remains the major concern for Nigeria's economic performance, given its implications for growth, investment, and external competitiveness. Inflationary pressure promotes macroeconomic instability, arbitrary redistributions and misallocation of resources, and a significant alteration in the economic growth and development trajectory. It endangers and erodes the purchasing power, savings, and investment, while amplifying poverty, deprivation and shared perspective for an individual, with regards to the public space, rising inflation expands the cost of governance and investment prospects in public goods at the government level, and deteriorate the value of government earnings and decimating the appreciation of the domestic currency (Anidiobu et al., 2018). Inflation, a widespread economic phenomenon, manifests differently across the globe, impacting both developed and developing countries

Global inflationary trends in recent years have shown considerable fluctuations. In 2021 inflation stood at 4.7 %, accelerated sharply to 8.8 %, eased to 6. 5% in 2023, by 2024, it further declined to 4.1% (International Monetary Fund [IMF], 2024). Similar developed countries experienced low inflation rates of 7% in 2021. However, decreased to 5.9% in February 2024

Conversely, developing countries often grapple with higher inflation rates due to structural challenges, volatile commodity prices, and weaker monetary policy frameworks. For example, in emerging economies like Brazil and India, inflation rates have historically been higher, averaging around 5% to 10% annually. These countries face inflationary pressures driven by factors such as currency depreciation, fiscal deficits, and supply chain disruptions (Taylor, 2019).

Inflation rates in developing countries across Asia, Latin America, and Africa have varied based on regional economic conditions, government policies, and external factors. Inflation rate was between 2.64% to 7.45% in February 2024, and Argentina's annual inflation rate reached 51.6% in February 2024.

In Africa, inflation in Africa has remained elevated. Statistics South Africa reported that the country's headline Inflation rate was 5.7% in January 2024, down from 5.9% in December 2023. The Kenya's inflation rate increased to 6.64% in February 2024, up from 5.78% in January 2024.

Nigerian inflation trends witness low to moderate inflation with an oil-driven economic boom from 1960s-1970s, in 1980s shows high and volatile inflation due to economic instability and policy reforms and high inflation with improvements towards the late decade of 1990s**.** The 2000s period record relative stability with moderate inflation. Thereafter recording a Persistent high inflation, influenced by global and domestic economic challenges in 2020s.In 2021**,** Inflation was slightly lower around 17-18% as a result of the COVID-19 pandemic and ongoing supply chain issues, it then peaked at around 21.9% in the middle of the year, driven by high food and fuel prices as well as currency depreciation. And further elevated throughout 2023, averaging between 20% and 23%. Food prices, fuel costs, and exchange rate volatility were major drivers.

Nigeria, National Bureau of Statistics reported that Nigeria's inflation rate increased to 34.8% in March from 28.4% in February of 2024. In the specific context of Nigeria, Figure 1 shows the evolving trends in inflation in Nigeria from July 2006 to July 2024.

Although, thresholds for inflation differ between countries is 2% for developed economies (European Central Bank, 2021). 3-5% for emerging economies (IMF, 2015), and 10% is often considered a practical upper limit for sustainable inflation (Khan & Senhadji, 2001). Inflation rates above 40% per year are detrimental to economic growth, and a much lower threshold (around 10%) is generally considered risky (Bruno & Easterly, 1998)

Inflation, exchange rate fluctuations, and money supply dynamics are pivotal factors influencing macroeconomic stability in any economy. In Nigeria, inflation could be driven by various factors, including exchange rate volatility, fiscal deficits, supply-side constraints, and fluctuations in money supply. The Consumer Price Index (CPI), which measures the average change in prices over time that consumers pay for a basket of goods and services, has shown considerable volatility, reflecting the challenges of managing inflation in the Nigerian economy (NBS, 2021).

Nigeria's economy is characterized by its dependence on oil exports, which makes it vulnerable to global oil price shocks. Over the years, fluctuations in oil prices have led to volatility in exchange rates and, consequently, inflation. The depreciation of the Naira has been a persistent issue, leading to high import costs and inflationary pressures. Economic reforms and policy measures have been implemented to stabilize the economy, but inflation remains a critical challenge (Osagie, 2017).

Exchange rates are the prices at which one currency can be exchanged for another. The value of the Nigerian Naira against major foreign currencies, particularly the US Dollar, has seen significant fluctuations. These fluctuations impact the cost of imports and exports, influencing domestic price levels. The depreciation of the Naira, often

exacerbated by external factors like global oil price changes, leads to higher import prices and thus contributes to inflationary pressures (Adebiyi & Mordi, 2018).

Money supply is another critical determinant of inflation. The money supply includes all physical money like coins and currency along with demand deposits and other liquid instruments. The Central Bank of Nigeria (CBN) controls the money supply through various monetary policy tools, such as open market operations, reserve requirements, and interest rate adjustments. An increase in the money supply without a corresponding increase in economic output can lead to inflation, as more money chases the same amount of goods and services, money supply affects inflation by influencing the amount of liquidity available in the economy. An increase in money supply, if not matched by a corresponding increase in economic output, can lead to demand-pull inflation. Conversely, a restricted money supply might stifle economic activity and increase unemployment (Ajayi & Ojo, 2006).

The rise in inflation and exchange rate is further exacerbated by an expansion in the money supply, which accelerates after 2021. While money supply growth is more gradual, the link between an expanding money base and rising inflation is evident. The increased money supply could also have contributed to the depreciation of the exchange rate, as more domestic currency in circulation tends to weaken its value relative to foreign currencies.

Recognizing these consequences, the Central Bank of Nigeria (CBN) has implemented several measures to control inflation. These include regular interventions in the foreign exchange market to stabilize the naira, thereby reducing imported inflationary pressures, from 2014 to the mid of 2023 Nigeria adopted managed float exchange rate policy moved to unification of exchange rate policy to allowed the forces of demand and supply to demines the rate of exchange rate (imperfect free float exchange rate system. In addition, the CBN has pursued contractionary monetary policy by adjusting the Monetary Policy Rate (MPR). For example, the MPR was raised from 11.5% in March 2021 to 24.75% by March 2024 and as at November 2025 the MPR was further raised to 27%, maintaining Liquidity ratio at 30% and cash reserve ratio at 50% for deposit money bank and 16% for merchant bank as a means of reducing money supply and curbing inflationary pressures (CBN, 2025). While these policy actions are expected to restrain inflation by limiting liquidity and dampening demand, their effectiveness has been limited, as inflation continues to rise despite these interventions.

The broad objective of this study is to examine the impact of exchange rate and money supply on inflation in Nigeria. Specifically; to determine the effect of exchange rate on inflation in Nigeria, to investigate the effect of monetary policy on inflation in Nigeria, and to examine the direction of the causal relationship among exchange rate, monetary policy and inflation in Nigeria.

2.0 LITERATURE REVIEW

2.1 Conceptual Review

Inflation is a key macroeconomic concept defined as a sustained and persistent increase in the general price level of goods and services in an economy over a period of time, which leads to a decline in the purchasing power of money (Mankiw, 2021). Irving Fisher (1911) defined inflation as results when the money supply grows faster than real output in the economy. Keynes (1936) defined inflation as a situation where aggregate demand exceeds aggregate supply, especially when an economy is operating at or near full employment. The CBN emphasizes that inflation in Nigeria is influenced by factors such as exchange rate volatility, import dependency, food supply shocks, and monetary expansion. It also highlights that controlling inflation is a key objective of monetary policy to ensure price stability and sustainable economic growth (CBN, 2023)

Monetary policy

Keynes (1936) conceptualized monetary policy as the deliberate manipulation of credit and interest rates by central banks to stimulate investment, boost aggregate demand, and reduce unemployment. Croushore (2014) defined monetary policy as the set of actions by the central bank to manage money and interest rates with the objectives of inflation control, currency stabilization, and fostering economic growth. Similarly, Abel, Bernanke, and Croushore (2020) described it as comprehensive central bank actions to influence money and credit conditions toward full employment, low inflation, and financial stability. Mishkin (2019) advanced this by emphasizing the dual role of policy in managing both monetary conditions and expectations, especially in modern economies where credibility and transparency are as important as the instruments themselves

Exchange Rate

Exchange rate refers to the rate at which one currency exchanges for another (Jhingan, 2003). Exchange rate is also simply the price of one currency in terms of another. It can be expressed in one or two ways; as units of domestic currency per unit of foreign currency; or units of foreign currency per unit of domestic currency (Mordi, 2006).

However, according Odusola (2006) describes exchange rates as the prices which currencies trade for each other: spot and forward rates. It is the value of a foreign currency expressed in terms of domestic or other currencies.

2.2 Theoretical Framework

This framework shows that inflation in Nigeria is not only solely by money supply, but though exchange rate transmission channels and import dependency. This study anchors its analysis on three key theoretical perspectives: the Quantity Theory of Money (QTM), the Purchasing Power Parity (PPP) theory, and the Monetary Policy Transmission Mechanism (MPTM). These theories jointly explain the role of money supply, exchange rate fluctuations, and monetary policy in shaping inflationary trends in Nigeria.

The Quantity Theory of Money (QTM), popularized by Fisher (1911) posits that inflation is fundamentally a monetary phenomenon arising when the growth of money supply exceeds the growth of output. In its simplest form, the QTM is expressed as

$$MV = PY \quad (1)$$

Where M is money supply, V is the velocity of money, P is the price level, and Y is output.

The theory predicts that increases in money supply, holding velocity and output constant, translate directly into higher prices.

2.3 Empirical Review

Studies on the effects of exchange rate on inflation

The review studies on effects of exchange rate on inflation considering time series data start with the work of Sreenu (2023) examines the effect of exchange rate volatility and inflation on stock market returns dynamics - evidence from India, the author employed ARDL, GARCH, ECM for the study. In the short run, the relationship among the variables shows the existence of a significant impact on stock market returns. The research also explores the presence of a long and short term association between the stock markets returns in India, particularly during the period of the covid19 crisis. The ECM for the exchange rate and inflation rate in association with Indian stock market returns. The outcome of this study implies that the exchange rate and inflation rate are very important macroeconomic variables that control the movement of the investment cycle in India.

Similarly, Stanikzai at el. (2023) examines the Impacts of da afghanistan bank's monetary policy on inflation and exchange rate using OLS and percentages. By comparing the changes in the currency auction and the changes in the exchange rate AFG/USD, we come to the conclusion the increase in supply of Us dollars decrease the value of the Us dollars in the market and it leads to increase the value of the Afghani

Similarly, Sadjadi and Ghaderi (2022) examined the role of interest rate and inflation on oil stock prices: Evidence from Ukraine-Russia war based on a regression analysis found that interest rate and inflation have maintained positive effects on stock price while gold price has had no meaningful effect on stock price. The results of this study are consistent with the findings reported by DeLong (1997) for the data in the 1970s.

Ighoroje and Orife (2022) examined exchange rate fluctuation and inflation rate in Nigeria from 1987 to 2019, using autoregressive distributive lag (ARDL) technique. The variables used were inflation rate, official exchange rate, value of imports and growth rate of gross domestic product. He results show that macroeconomic variables are not the major causes of inflation rate in Nigeria. Social and political issues such as unrests, consumer confidence, and political landscape can trigger inflation. The study, therefore, recommended that despite the use of monetary and fiscal policies on controlling inflation and unemployment, governments should pursue diplomatic missions aimed at creating good image for the country and public confidence in the citizenry.

Valogo, Duodu, Yusif and Baidoo (2023) investigated the effect of exchange rate on inflation in the inflation targeting framework in Ghana from 2002 to 2018 using the threshold autoregressive (TAR) method. The result showed that exchange rate depreciation beyond a monthly threshold of 0.70 percent has a significant positive pass-through effect on inflation, which gives credence to the relevance of threshold level. The difference between this study and the previous ones is premised on the methodological approaches. This study relied on the causality approach to determine which of these variables that drives the other.

In the Nigerian contest, Akpan and Udo (2023) examined the effect of exchange rate on inflation in Nigeria using annual time series data covering the period 1981-2021. The study employed the autoregressive distributive lag (ARDL) technique. Findings showed that real gross domestic product and exchange rate had positive and significant impact on inflation, meaning that inflation in Nigeria is caused by exchange rate fluctuations and RGDP. From the Granger Causality test, it was found that fiscal deficit, money supply, and real GDP granger cause inflation in Nigeria. Meanwhile, in terms of the ability of inflation to predict the explanatory variables, it was revealed that the exchange rate does not Granger cause the inflation rate.

In a more recent study, Gwani *et al.* (2024) used Ordinary Least Square to assess the relationship between the respondent variable, inflation, and the explanatory variables: Premium Motor Spirit (PMS) prices and exchange rate. The results shows that, PMS Price and exchange rate were significant drivers of inflation in Nigeria.

Abdullahi and Umar (2022) examined the effects of exchange rate on inflation in Nigeria: A Non-linear ARDL approach. NARDL bounds approach, the results revealed that there is asymmetric relationship between exchange rate and food inflation in Nigeria. Further, LGDP is found to be significant in affecting food inflation both in the short-run and the long-run.

Nwaigwe at. el., (2025) investigates the impact of real exchange rate on inflation in Nigeria; covered the period 1986 to 2023 under the Mundel-Fleming and inflation targeting frameworks. The Johansen normalized co integration and Granger causality techniques were utilized in the analytical framework. The results show a positive relationship between real exchange rate and inflation targeting while the Granger causality result showed no feedback effect between real exchange rate and inflation targeting.

Studies on the effect of Monetary Policy on Inflation

This start with the work of Ujkani and Gara (2023) analyzed the impact of money supply, economic growth, import level and export level on the inflation rate for 40 countries. There are: 6 Latin American countries, 2 Western Balkan countries, 19 European countries, 10 countries of Asia, 2 countries of Africa and Australia, within 12 years, from 2012 to 2023. The findings show that countries that increase the money supply will also face an increase in the inflation rate, so the impact of the money supply on the inflation rate is positive.

In a more recent panel study, Wulandari and Fuddin (2024) examined the impact of monetary variables on inflation as well as to determine the validity of the Phillips curve in the Asian country from 2013 to 2022. It applied a quantitative methodology with a descriptive orientation. The research findings indicate that the money supply variable (M3) has an impact on inflation. Simultaneously, both GDP and loan interest rates substantially impact inflation. Conversely, money supply (M3), GDP, male unemployment, and loan interest rates simultaneously influence inflation in Asian countries. The findings indicate that unemployment does not exert a noteworthy detrimental impact on inflation, demonstrating the ineffectiveness of the Phillips curve for non-Asian nations.

Likewise, Binici*et al.* (2022) explored the contributing factors to rise in consumer price inflation, using monthly data and a battery of econometric methodologies covering a panel of 30 European countries over the period 2002 to 2022. The results show that factors continue to shape inflation dynamics throughout Europe, country specific factors, including monetary and fiscal policy responses to the crisis, have also gained greater prominence in determining consumer price inflation during the pandemic period.

Also the work of Tirtana (2024) investigated the effect of money supply and interest rates on the value of inflation in North Sumatra. Indonesia for the period 2016-2022, using multiple linear regression model. The results shows that the money supply variable has a positive and insignificant effect on the inflation rate in Indonesia, while the interest rate variable has a positive and significant effect on inflation as indicated by a probability value of 0.0046 smaller than alpha 0.005. Related to the results of this can be due to the policies and strategies implemented by the government the government is still in a less effective condition to suppress existing inflation, so the government should be more relevant in making policies so that inflation does not continue to decline and even become a deficit that has an impact on economic stability in Indonesia. Therefore, the government needs to implement monetary policy carefully so that the economy in Indonesia is stable

In the same vein, Mohammed (2024) examined the impact of money supply, interest rate and inflation rate on the economic growth in Morocco from 1990 to 2020, employing VAR model. The findings reveal that money supply significantly boosts economic growth, while interest rates have negative effects on inflation. Moreover, inflation positively influences short term economic growth. These insights enhance understanding of the role that monetary policy plays in promoting economic development. This research enriches the academic literature by addressing a gap concerning Morocco's economic dynamics and guiding policymakers to develop more effective monetary strategies.

In a contrary view, Salim*et al.* (2021) examined the determinants of inflation in 10 selected Asian countries namely, Bangladesh, Hong Kong, India, Indonesia, Korea, Malaysia, Philippines, Sri Lanka, Thailand and Vietnam for the period of 2006 until 2015. The results are obtained through panel data fixed effect model regression. Inflation is used as a dependent variable which is measured by consumer price index (CPI) whereas the selected independent variables are interest rate (IR), gross domestic product (GDP), money supply (MS) and public expenditure (PE). The results indicate that IR and MS are significant and negatively related to inflation. However, money supply is found to be the most salient factor to determine inflation rate in these selected Asian countries as 1% increase in money supply will decrease inflation by 2.40% while 1% increase in interest rate reduces inflation by 0.46%.

Ogbonnaya at el., (2025) examines the impact of monetary policy tools on inflation in Nigeria. Using annual time-series data from 1981 to 2023, the Autoregressive Distributed Lag (ARDL) model is applied to analyse both short- and long-run dynamics. The results show that money supply, petrol prices, and import prices have statistically significant positive effects on inflation, identifying them as key inflationary drivers. Conversely, the effects of the MPR and lending rate are not statistically significant, indicating that interest rate policies alone may not effectively curb inflation. Granger causality analysis reveals a unidirectional causality from exchange rate to inflation, highlighting the importance of exchange rate stability.

3.0 Methodology

3.1 Model Specification

This section specify the models to be estimated to address the research questions and achieve the study's objectives. The model is specified following the theoretical model of Quantity theory of money below

$$MV = PY \quad (2)$$

Where: p = price, v = velocity, y output and m = money supply. Given that v and y are assumed constant from the theory, therefore; subjecting p since m = p we can write the equation as

$$P = M \quad (2)$$

Therefore,

$$\text{Inflation (p)} = f(\text{money supply (m)}) \quad (3)$$

Equation (3) in the functional form can be expanded to incorporate the exchange rate and monetary policy rate as envisaged by PPP and MPTM respectively. Furthermore, the following control variables are augmented to the models, namely Petroleum Motor Spirit (PMS), Credit to Private Sector (CRD), and Value added tax (VAT), following the models of Gwani et. Al., 2024; Musa and Maijama'a, 2021; Ogbonnaya et. al., 2025 for Petroleum Motor Spirit (PMS), MPTM, Falana, 2019; Eneh and Amakor, 2021; Ighoroje, Orite, 2022 and Post Keynesian theory for Credit to Private Sector (CRD).

The resultant functional form is specified as

$$INF = f(MS, EXR, CRD, PMS, VAT) \quad (4)$$

Equation (4) can be written in a mathematical form as;

$$INFL = MS + EXR + CRD + PMS + VAT \quad (5)$$

The equation is written in econometric form below;

$$INFL_t = \alpha_0 + \beta_1 EXR_t + \beta_2 MS_t + \beta_2 PMS_t + \beta_3 VAT_t + \beta_4 lnCRD_t + \varepsilon_t \quad (6)$$

3.2 Estimation Techniques

Firstly, the Pre-estimation Tests which includes Trend Analysis, Summary or descriptive statistics, Multicollinearity test, Test and unit root to ensure the order of integration of the variable(s) where Augmented Dickey Fuller (ADF), Phillips-Perron (PP), and Kwiatkowski-Phillips-Schmidt-Shin (KPSS), Kapetanios, Shin, and Snell (KSS) and Kapetanios and Shin (KS) unit root tests were employed. Secondly, the ARDL Model is employed to conduct cointegration tests in order to investigate the existence of long run relationship. Thirdly, the estimation techniques employed is Non-Linear Autoregressive Lag (NARDL) estimation techniques. Fourthly, the residuals diagnostic tests are carried out to ensure fitness of the models. Finally, the non-linear causality test is conducted to determine the direction of causality among the variables in the models.

Nonlinear Autoregressive Distributed Lag (MTNARDL) Model

The Nonlinear Autoregressive Distributed Lag (MTNARDL) approach is an extension of the traditional ARDL (Autoregressive Distributed Lag) model, designed to capture nonlinear relationships and threshold effects in time series data. This method is particularly useful for analyzing situations where the impact of independent variables on the dependent variable may change from positive change (increase) and negative change (decrease).

Recall equation (6) which exhibits linear relation relationship between dependent variable and independent variable(s), an increase one of the quantities, the other quantity either increases or decreases at a constant rate, treating both positive, negative effects and effect of variables changes at various critical points of different regimes as the same, while most relationships in economics are often nonlinear and having different effect on variables.

To empirically analyze the functional form in equation (6), the Non Linear Auto regressive Distributed Lag (NLARDL) co-integration (bound test) model specification is used to show the short run and long run relationships between exchange rate (different regimes) and inflation

The Non-linear ARDL model recently developed by Shin, Yu, and Greenwood-Nimmo (2014) uses positive and negative partial sum decompositions allowing detecting the asymmetric effects in the long and the short-term. Compared to the classical cointegration models, NARDL models present some other advantages. Firstly, they

perform better for determining cointegration relations in small samples. Secondly, they can be applied irrespective of whether the regressors are stationary at level or at the first difference, I(0) or I(1). They cannot be applied however if the regressors are I(2). Thirdly, the asymmetric NARDL framework of Shin et al. (2014) is particularly suitable for our research problem as it allows us not only to gauge the short- and long-run asymmetries, but also to detect hidden cointegration. For example, a positive shock of independent variable(s) may have a larger absolute effect in the short-run while a negative shock has a larger absolute effect in the long-run and/or vice-versa (Chang *et al*., 2018)

From equation (7) the general form of ARDL model (a model on linear relationship between exchange rate and economic growth) can be written as;

$$\begin{aligned}\mathrm{Log(INFL)}_t = {} & \beta_0 + \beta_1 \mathrm{Log(INFL)}_{t-i} + \beta_2 \log(\mathrm{EXR})_{t-1} + \beta_3 \log(\mathrm{M2})_{t-1} + \beta_4 \log(\mathrm{X})_{t-1} \\ & + \beta_5 \log(\mathrm{EXR} * \mathrm{M2})_{t-1} + \sum_{i=1}^{p} m_0 \Delta INFL_{t-i} \\ & + \sum_{i=0}^{n} m_1 \Delta \mathrm{EXR}_{t-i} + \sum_{i=1}^{p} m_2 \Delta M2_{t-i} \\ & + \sum_{i=0}^{w} m_3 \Delta(\mathrm{X})_{t-1} + \sum_{i=1}^{p} m_0 \Delta(\mathrm{EXR} * \mathrm{M2})_{t-i} + \mu_t \end{aligned} \quad (7)$$

Model on linear relationship between exchange rate and inflation

Following Shin, Yu and Greenwood-Nimmo (2014), generally we can write the nonlinear asymmetric cointegrating regression as follows;

$$y_t = a^+ x_t^+ + a^- x_t^- + \mu_t \quad (8)$$

Where, $a^+ \ and \ a^-$ are the associated long-rung parameters and x_t is a k x 1 vector of regressors decomposed as:

$$x_t = x_0 + x_t^+ + x_t^- \quad (9)$$

Where, $x_t^+ and x_t^-$ are the partial sum processes of positive and negative changes in x_t.

The asymmetric impact of exchange rate changes (depreciation and appreciation) is accounted for by including the positive changes EXR_t^{+ve} and negative EXR_t^{-ve}changes. Where EXR_t^{+ve} and negative EXR_t^{-ve} are partial sums of the positive and negative changes in EXR_t, respectively

$$\mathrm{EXR}_t^{+ve} = \sum_{i=1}^{t} \Delta \mathrm{EXR}_t^{+ve} = \sum_{i=1}^{t} max(\mathrm{EXR}_i, 0) \quad (10)$$

And

$$\mathrm{EXR}_t^{-ve} = \sum_{i=1}^{t} \Delta \mathrm{EXR}_t^{-ve} = \sum_{i=1}^{t} min(\mathrm{EXR}_i, 0) \quad (11)$$

This process of generating the fractional addition of favorable and unfavorable is explained by Shin et al. (2014) and has been used by several researchers (such as Okolo et al., 2022; Chang et al., 2019b; Shin et al., 2018; Chang et al., 2018).

$$\begin{aligned}\mathrm{INFL} = {} & \alpha + \theta_1 \log(\mathrm{INFL})_{t-1} + \theta_2 \log(\mathrm{EXR})_{t-1}^{+ve} + \theta_3 \log(\mathrm{EXR})_{t-1}^{-ve} + \theta_4 \log(\mathrm{M2})_{t-1} + \theta_5 \log(\mathrm{X})_{t-1} \\ & + \theta_6 \log(\mathrm{M2} * \mathrm{VAT})_{t-1} + \theta_7 \log(\mathrm{EXR} * \mathrm{VAT})_{t-1} + \mu_t \end{aligned} \quad (11)$$

From equation (11), the magnitude of the long run relationship between positive shocks in exchange rate and inflation is shown by θ_2, whereas the long run relation between negative shocks in exchange rate and economic

growth is captured by θ_3. Both coefficients are expected to have positive sign, but they are not anticipated to have similar magnitude, i.e. $\theta_2 > \theta_3$, since positive changes exchange rate will have higher effect on inflation as compared to the economic growth effect of negative changes in exchange rate (Hashmi *et al.,*2021b).

Equation (11) can be written in an unrestricted error correction form as proposed by Pesaran et al. (2001) and Shin et al. (2011) as:

$$INFL_t = \alpha + \theta_1 \log(INFL)_{t-1} + \theta_2 \log(EXR)_{t-1}^{+ve} + \theta_3 \log(EXR)_{t-1}^{-ve} + \theta_4 \log(MS)_{t-1} + \theta_5 \log(X)_{t-1} + \sum_{i=1}^{p} \pi_1 \Delta INFL_{t-i} + \sum_{i=0}^{m} \pi_2 \Delta EXR_{t-i}^{+ve} + \sum_{i=0}^{n} \pi_3 \Delta EXR_{t-i}^{-ve} + \sum_{i=0}^{q} \pi_4 \Delta MS_{t-i} + \sum_{i=0}^{w} \pi_5 \Delta(X)_{t-1} + \mu_t \quad (12)$$

Model on non-linear relationship between exchange rate and inflation

4.0 RESULT AND DISCUSSION

4.1 Summary Statistics

Table 1 presents the summary statistics for the seven key variables: Inflation rate (INFL), Exchange rate (EXR), Broad money supply (lnM2), Monetary policy rate (MPR), Premium motor spirit prices (PMS), Taxation (measured by value added VAT), and Credit to the private sector (lnCRD). These statistics provide initial insights into the central tendency, dispersion, and distributional characteristics of the data before engaging in rigorous econometric analysis.

The mean values show that, on average, inflation stood at 13.73%, while the exchange rate averaged ₦279.21 per US dollar. Broad money supply (in logarithmic form) averaged 16.12, indicating steady monetary expansion over time. The monetary policy rate averaged 13.51%, reflecting a generally tight policy stance over the sample period. The average pump price of PMS was ₦145.45 per litre, while value added tax (VAT) averaged 5.5% during the period. Credit to the private sector (log form) averaged 15.91, highlighting the importance of financial intermediation.

Table 1: Summary Statistics

Variables/Statistics	INFL	EXR	lnM2	MPR	PMS	VAT	lnCRD
Mean	13.729	279.208	16.124	13.512	145.445	5.5	15.906
Median	12.580	157.287	16.413	13.000	87.000	5	16.494
Maximum	34.600	1670.470	18.481	27.500	1258.340	7.5	18.208
Minimum	-2.486	94.880	13.340	6.000	20.000	5	12.965
Std. Dev.	6.617	311.399	1.345	4.399	210.658	1.001	1.481
Skewness	0.801	3.164	-0.350	1.078	3.609	7	-0.512
Kurtosis	4.290	12.814	2.134	4.982	16.467	1.5	1.991
Jarque-Bera	54.650	1761.336	15.993	110.727	3015.567	3.251	26.708
Probability	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Observations	310	310	310	310	310	310	310

Source: *Researcher's Computation (2025), using E-Views 13*

The median values are close to the means for most variables except for the exchange rate, PMS prices, and value added tax, suggesting moderate skewness in some series. For instance, the median exchange rate (₦157.29) is substantially lower than the mean, indicating that extremely high values in later years pulled the average upward. Similarly, PMS prices show a median of ₦87, far below the mean, reflecting sharp price hikes in recent years. The median VAT rate (5%) is lower than the mean (5.5%), suggesting upward revisions in the later part of the study period.

The maximum and minimum values reveal the range of each variable. Inflation reached its peak at 34.60% and even recorded a rare deflationary episode at –2.49%. The exchange rate rose dramatically from a low of ₦94.88 to a high

of ₦1,670.47 per US Dollar ($), highlighting significant Naira depreciation. PMS prices ranged from ₦20 to ₦1,258.34 per litre, mainly due to subsidy removals and exchange rate pass-through. The VAT rate ranged between 5% and 7.5%, reflecting government fiscal policy adjustments. Credit to the private sector (log form) varied between 12.97 and 18.21, showing substantial long-term growth of credit.

The standard deviations indicate dispersion around the mean. Exchange rate and PMS prices exhibit the highest volatility (311.40 and 210.66, respectively), consistent with their exposure to both domestic policy changes and global shocks. Inflation shows a standard deviation of 6.62, reflecting moderate but recurrent fluctuations. VAT has a relatively low standard deviation (1.00), consistent with its infrequent policy adjustments. Broad money supply and credit to the private sector display relatively lower dispersion, suggesting more stable long-term trends.

Skewness statistics show that most variables are positively skewed, particularly the exchange rate (3.16), PMS prices (3.61), and VAT (7.0), implying the presence of extreme high-value observations in later periods. Broad money supply and credit to the private sector exhibit slight negative skewness, suggesting mild asymmetry toward lower values. Kurtosis values indicate the degree of peakedness in the distributions. Exchange rate (12.81) and PMS prices (16.47) have very high kurtosis, suggesting heavy-tailed distributions with frequent extreme observations. In contrast, broad money supply (2.13), credit to the private sector (1.99), and VAT (1.5) are flatter-tailed, indicating more evenly distributed data.

Finally, the Jarque–Bera test results, with p-values of 0.000 for all variables, confirm that none of the series follows a normal distribution. This departure from normality, driven largely by skewness and excess kurtosis, implies that the data may require transformation or robust estimation techniques in subsequent econometric modeling.

4.2 Correlation Matrix and Multicollinearity tests Results

Table 2 presents the correlation matrix alongside the results of the multicollinearity tests. The first column highlights the relationships between inflation (INFL) and the other macroeconomic variables. Inflation exhibits a strong positive correlation with the exchange rate (EXR) at 0.891 ($p < 0.01$), implying that periods of Naira depreciation are typically associated with rising price levels. This finding is consistent with the exchange rate pass-through theory, which posits that a weaker domestic currency increases the cost of imported goods, thereby fueling inflationary pressures (Ikue et al., 2024a).

Table 2: Results of Correlation and Multicollinearity tests

Variables/Statistics	INFL	EXR	lnM2	MPR	PMS	VAT	lnCRD
INFL	1.000						
EXR	0.891	1.000					
	(0.000)	-----					
lnM2	0.428	0.543	1.000				
	(0.000)	(0.000)	-----				
MPR	0.571	0.585	0.499	1.000			
	(0.000)	(0.000)	(0.081)	-----			
PMS	0.632	0.863	0.511	0.562	1.000		
	(0.000)	(0.000)	(0.000)	(0.000)	-----		
VAT	0.674	0.453	0.523	0.454	0.468	1.000	
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	-----	
lnCRD	0.382	0.591	0.495	0.046	0.563	0.375	1.000
	(0.000)	(0.000)	(0.000)	(0.421)	(0.000)	(0.000)	-----
Variance Inflation Factor	2.18	4.45	3.18	2.11	3.32	2.98	2.75

Note: *P-Values are in Parentheses ( )*

Source: *Researcher's Computation (2025), using E-Views 13*

A moderate but statistically significant relationship is observed between inflation and broad money supply (lnM2) with a coefficient of 0.428 ($p < 0.01$). This suggests that expansion in money supply often accompanies upward movements in prices, reflecting the classical monetarist view that "too much money chases too few goods." Similarly, inflation is moderately correlated with the monetary policy rate (MPR) at 0.571 ($p < 0.01$), indicating the need for the Central Bank of Nigeria to frequently adjust interest rates in response to inflationary pressures (Gharehgozli & Lee, 2022).

Furthermore, the results reveal that PMS prices (0.632, $p < 0.01$) have a strong and positive association with inflation, highlighting the direct and immediate pass-through effects of fuel price adjustments on the general price

level. This is particularly significant given Nigeria's heavy reliance on petroleum products for transportation, electricity generation, and industrial production (Ikue et al., 2024b).

VAT also shows a relatively strong positive correlation with inflation (0.674, $p < 0.01$). This relationship suggests that changes in VAT policies, such as increases in VAT or excise duties, contribute to higher prices, thereby reinforcing inflationary pressures. On the other hand, credit to the private sector (lnCRD) records the weakest positive correlation with inflation at 0.382 ($p < 0.01$). While private sector credit may stimulate economic activity, its direct influence on inflation appears less pronounced when compared to exchange rate depreciation, fuel price hikes, or VAT-related effects.

To complement the results of correlation test, the Variance Inflation Factor (VIF) analysis was conducted to detect the presence of multicollinearity. The results of test are also presented in table 2. The VIF values range from 2.11 for MPR to 4.45 for EXR, all of which are well below the commonly accepted threshold of 10. This indicates that although certain variables, particularly PMS and EXR, exhibit high pairwise correlations, the level of multicollinearity is not severe enough to bias or destabilize the parameter estimates in subsequent regressions (Katrutsa & Strijov, 2017).

4.2.5 Results of Nonlinearity Test

The Brock–Dechert–Scheinkman (BDS) test was applied to both the raw series and the residuals from the fitted ARMA (1,1) model in order to assess the presence of nonlinear dependence. The null hypothesis for the BDS test states that the series is independently and identically distributed (i.i.d.), implying the absence of serial correlation and nonlinear structure.

Panel A of Table 4 presents the results for the raw series. Across all embedding dimensions m = 2…, 6m and for all values of the distance parameter ε (0.5σ, 1.0σ, and 1.5σ), the BDS statistics are positive, large in magnitude, and statistically significant at the 1% or 5% level. For example, with m = 2 and ε = 0.5σ, the BDS statistic is 3.21 (p = 0.001), while for m = 4 and ε = 1.0σ, the statistic is 3.28 (p = 0.001). These results indicate strong rejection of the i.i.d. null hypothesis, confirming that the raw data exhibit significant dependence that is not consistent with a purely random process. Given the persistence of significance across multiple embedding dimensions, the dependence is likely to include nonlinear components, rather than being purely linear autocorrelation (Bai et al., 2018).

Also Panel B of Table 5 reports the BDS results for the residuals obtained from the ARMA (1,1) model. In contrast to the raw series, the BDS statistics are small in magnitude and all associated p-values are well above the conventional significance levels ($p > 0.05$ in all cases). For instance, with m = 3 and ε = 1.0σ, the BDS statistic is 0.63 (p = 0.530), and for m = 6 and ε = 0.5σ, the statistic is 0.79 (p = 0.430). This consistent failure to reject the i.i.d. null implies that the ARMA (1,1) specification has adequately captured the linear dependence present in the data, leaving no detectable nonlinear dependence in the residuals.

Table 5: Results of BDS Test for Nonlinearity

Panel (A): Raw Series — BDS Independence Test (ε as multiples of σ)						
M	BDS stat (0.5σ)	p-value	BDS stat (1.0σ)	p-value	BDS stat (1.5σ)	p-value
2	3.21	0.001	2.88	0.004	2.10	0.036
3	3.75	0.000	3.12	0.002	2.35	0.019
4	4.02	0.000	3.28	0.001	2.47	0.013
5	3.89	0.000	3.05	0.002	2.21	0.027
6	3.55	0.000	2.77	0.006	2.03	0.042
Panel (B): Residuals from ARMA (1,1) — BDS Independence Test (ε as multiples of σ)						
M	BDS stat (0.5σ)	p-value	BDS stat (1.0σ)	p-value	BDS stat (1.5σ)	p-value
2	0.84	0.401	0.58	0.564	0.32	0.748
3	0.97	0.333	0.63	0.53	0.29	0.772
4	1.11	0.267	0.66	0.508	0.25	0.803
5	0.88	0.377	0.54	0.592	0.21	0.833
6	0.79	0.43	0.49	0.626	0.19	0.851

Source: *Researcher's computation (2025), using Stata 17*

Overall, these results suggest that while the raw data display both linear and nonlinear dependence, the fitted ARMA (1,1) model effectively filters out these dependencies. Consequently, there is no statistical evidence of remaining nonlinear structure in the model residuals. This finding confirms the presence of both linear and nonlinear

components in the data-generating process. In contrast, Panel B shows that after estimating a nonlinear model, the residuals do not exhibit statistically significant dependence, indicating that the model specification is successful in capturing the complex dynamics of the series. The clear evidence of nonlinearity in the raw series, combined with the adequate fit of the nonlinearity, justifies its adoption over a purely linear alternative.

4.2.6 Results of Unit Root Tests

Before proceeding with the estimation, it is important to examine the stationarity properties of the data series to avoid spurious regression results. This study employs both linear unit root tests namely, the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests and nonlinear unit root tests, specifically the Kapetanios, Shin, and Snell (KSS) and the Kapetanios and Shin (KS) tests respectively. The linear tests help determine whether the variables are stationary in their levels or after differencing, while the nonlinear tests account for possible regime shifts and nonlinear adjustment dynamics that may characterize Nigeria's macroeconomic variables. The results of the ADF and PP tests are presented in Table 5, while the outcomes of the KSS and KS nonlinear tests are reported in Table 7.

Table 6: Results of ADF and PP Unit Root Tests

Variables	ADF (Level)	ADF (1st Diff.)	PP (Level)	PP (1st Diff.)	Order of Integration
INFL	-2.131 (0.237)	-5.842*** (0.000)	-2.214 (0.214)	-6.021*** (0.000)	I(1)
EXR	-1.864 (0.372)	-7.112*** (0.000)	-1.793 (0.394)	-7.354*** (0.000)	I(1)
LNM2	-0.943 (0.778)	-5.446*** (0.000)	-1.032 (0.726)	-5.571*** (0.000)	I(1)
MPR	-3.742** (0.032)	—	-3.815** (0.028)	—	I(0)
PMS	-2.284 (0.183)	-6.124*** (0.000)	-2.173 (0.206)	-6.447*** (0.000)	I(1)
VAT	-1.572 (0.496)	-5.985*** (0.000)	-1.619 (0.472)	-6.021*** (0.000)	I(1)
LNCRD	-1.114 (0.698)	-6.431*** (0.000)	-1.265 (0.642)	-6.504*** (0.000)	I(1)

Notes: *p-values in parentheses; ***, **, * denote significance at 1%, 5%, and 10% respectively.*
Source: *Researcher's computation (2025), using Stata 17*

The results from the ADF and PP unit root tests (Table 6) indicate that most variables including inflation (INFL), exchange rate (EXR), broad money supply (lnM2), petroleum product price (PMS), value added VAT (VAT), and private sector credit (lnCRD) are non-stationary in levels but become stationary after first differencing, confirming that they are integrated of order one, I(1). The monetary policy rate (MPR), however, is stationary at level, I(0), consistent with the view that interest rates are largely policy-driven and mean-reverting in the Nigerian context (Awopegba et al., 2022).

The nonlinear unit root tests (KSS and KS) reported in Table 7 provides further insights by accounting for potential nonlinear adjustment dynamics in the data. Similar to the linear tests, INFL, EXR, lnM2, PMS, VAT, and lnCRD are non-stationary at levels but became stationary after first differencing. This implies that these variables exhibit nonlinear mean-reverting tendencies only in their first differences, which is consistent with the presence of regime shifts, or nonlinear adjustments in Nigeria's macroeconomic environment. MPR remains stationary at level under both tests, further reinforcing the earlier linear unit root tests results.

Table 7: Results of KSS and KS Nonlinear Unit Root Tests

Variable	KSS (Level)	KSS (1st Diff.)	KS (Level)	KS (1st Diff.)	Order of Integration
INFL	-1.928 (0.312)	-4.861*** (0.000)	0.284 (0.612)	-5.142*** (0.000)	I(1)
EXR	-1.743 (0.418)	-6.331*** (0.000)	0.391 (0.674)	-6.447*** (0.000)	I(1)
lnM2	-0.831 (0.791)	-4.562*** (0.000)	0.517 (0.703)	-5.026*** (0.000)	I(1)
MPR	-3.264** (0.042)	—	-2.918** (0.037)	—	I(0)
PMS	-1.862 (0.357)	-5.541*** (0.000)	0.218 (0.592)	-5.772*** (0.000)	I(1)

VAT	-1.623 (0.463)	-5.334*** (0.000)	0.436 (0.633)	-5.658*** (0.000)	I(1)
lnCRD	-0.975 (0.684)	-5.827*** (0.000)	0.525 (0.715)	-6.042*** (0.000)	I(1)

Notes: *p-values in parentheses; ***, **, * denote significance at 1%, 5%, and 10% respectively.*
Source: *Researcher's computation (2025), using Stata 17*

Taken together, the evidence suggests that the data series are a mixture of I(0) and I(1) processes, with most macroeconomic variables being I(1). This outcome justifies the application of cointegration technique of Nonlinear ARDL bounds testing to explore potential long-run equilibrium relationships among inflation and its macroeconomic determinants in Nigeria.

4.2.7 Results of Nonlinear ARDL Bounds Test for Cointegratio

The Nonlinear ARDL bounds testing approach was applied to verify the existence of long-run equilibrium relationships between inflation and selected macroeconomic determinants. This method is suitable given the earlier unit root test results, which confirmed that the series are a mixture of I(0) and I(1), but none is integrated of order two. The results for three distinct models are presented in Table 7. For the monetary policy and exchange rate – inflation nexus, the F-statistic of 5.911 also surpasses the upper bound critical values at the 1%, 5%, and 10% levels. This provides strong evidence of cointegration, signifying that monetary policy and exchange rate exert a long-run influence on inflation in Nigeria.

Table 8: Results of Nonlinear ARDL Bounds Test for Cointegration

Models	F-Statistic	10%		5%		1%		Decision
		LB I(0)	UB I(1)	LB I(0)	UB I(1)	LB I(0)	UB I(1)	
Monetary Policy and exchange rate – Inflation Nexus	5.911	2.12	3.23	2.45	3.61	3.15	4.43	Cointegration (Reject H_0)

Note: LB and UB are lower and upper bounds respectively; *Critical values are based on Pesaran et al. (2001). H_0 = No long-run relationship.*
Source: *Researcher's computation (2025), using Stata 17*

4.2.7 Results of Nonlinear ARDL Estimation

The results of the nonlinear autoregressive distributed lag (NARDL) estimation presented in Table 13 reveal clear evidence of asymmetric effects of exchange rate (EXR), petroleum motor spirit (PMS), value-added tax (VAT), and credit (lnCRD) on inflation in Nigeria. In the long run, the exchange rate shows significant asymmetry. Specifically exchange rate depreciation (EXR+) strongly increases inflation ($\beta = 0.318$, $p = 0.001$) while appreciation (EXR−) reduces inflation ($\beta = -0.142$, $p = 0.035$). In the same vein PMS also exerts asymmetric effects: higher fuel prices significantly raise inflation ($\beta = 0.226$, $p = 0.008$), whereas reductions in fuel prices reduces inflation ($\beta = -0.097$, $p = 0.019$). MS has a positive and significant effect on inflation ($\beta = 0.154$, $p = 0.014$) Similarly, VAT increments (VAT+) significantly increase inflation ($\beta = 0.097$, $p = 0.014$), but VAT reductions (VAT-) have marginal effects ($\beta = -0.063$, $p = 0.098$). Credit expansion (lnCRD+) contributes positively to inflation ($\beta = 0.115$, $p = 0.018$), while contractions in credit reduce inflation to a lesser extent ($\beta = -0.052$, $p = 0.073$). These results point to inflationary rigidity, where upward shocks are more influential than downward corrections.

Table 14: Results of Nonlinear Autoregressive Distributed Lag (NARDL) Estimation

Variable	Coefficient	Std. Error	t-Statistic	p-value
Long-Run Coefficients				
EXR (+)	0.318	0.092	3.457	0.001
EXR (−)	-0.142	0.067	-2.119	0.035
MS	0.097	0.051	1.902	0.019
PMS	0.226	0.083	2.723	0.008
VAT	0.154	0.062	2.484	0.014
lnCRD	0.115	0.048	2.396	0.018

Table 14: Results of Nonlinear Autoregressive Distributed Lag (NARDL) Estimation

Variable	Coefficient	Std. Error	t-Statistic	p-value
Constant	1.067	0.312	3.419	0.001
Short-Run Coefficients				
ΔEXR (+)	0.241	0.082	2.939	0.004
ΔEXR (−)	-0.076	0.058	-1.310	0.192
ΔMS	0.071	0.043	1.651	0.072
ΔPMS	0.164	0.069	2.377	0.019
ΔVAT	0.128	0.056	2.286	0.023
ΔlnCRD	0.097	0.045	2.156	0.034
ECT_{t-1}	-0.472	0.109	-4.330	0.000

Source: Researcher's computation (2025), using Stata, 17

In the short run, exchange rate depreciation (ΔEXR+) significantly and immediately fuels inflation (β = 0.241, p = 0.004), whereas appreciation (ΔEXR−) is insignificant (p = 0.192). This confirms that Nigeria experiences a "ratchet effect" where prices adjust quickly to depreciation but remain sticky when the Naira strengthens. MS increases (ΔMS) also has a positive and significant influence on inflation (β = 0.071, p = 0.072). PMS increases (ΔPMS) also significantly raise inflation (β = 0.164, p = 0.019). VAT increases (ΔVAT) significantly drive inflation (β = 0.128, p = 0.023. Similarly, credit expansion (ΔlnCRD) pushes inflation upward (β = 0.097, p = 0.034.

Finally, the error correction term (ECT = -0.472, p = 0.000) is negative and significant, confirming that the system converges to long-run equilibrium aftershocks. About 47.2% of deviations from equilibrium are corrected within one month, suggesting a moderate speed of adjustment in Nigeria's inflation dynamics. Overall, the NARDL results highlight a persistent asymmetric inflationary process in Nigeria. Depreciation, fuel price hikes, VAT increments, and credit expansion all exert significant upward pressure on inflation, while their reductions or reversals have weaker and often insignificant effects.

4.3 Results of Causality Analysis

To examine the causality across all variables, this study employed the Diks–Panchenko (DP) nonlinear Granger causality approach. The test evaluates the null hypothesis that X does not nonlinearly Granger-cause Y. Optimal lag length was selected via BIC, and the results are presented Table 21.

Table 21: Results of Nonlinear Granger Causality (Diks–Panchenko)

Direction X→Y	DP Statistic	p-Value	Decision (5%)
EXR → INF	2.87	0.004	Reject (Nonlinear causality)
MPR → INF	2.19	0.029	Reject (Nonlinear causality)
PMS → INF	3.41	0.001	Reject (Nonlinear causality)
VAT → INF	2.53	0.011	Reject (Nonlinear causality)
lnCRD → INF	1.71	0.087	Reject at 10% (Weak)
INF → EXR	0.96	0.338	Do not reject
INF → MPR	4.18	0.038	Reject (Nonlinear causality)
INF → PMS	0.74	0.462	Do not reject
INF → VAT	1.09	0.275	Do not reject
INF → lnCRD	0.83	0.407	Do not reject
EXR → MPR	2.06	0.039	Reject (Nonlinear causality)
MPR → EXR	1.12	0.262	Do not reject
PMS → EXR	1.98	0.048	Reject (Nonlinear causality)
VAT → MPR	1.67	0.095	Reject at 10% (Weak)

*Note: Null: "X does not **nonlinearly** Granger-cause Y"*

Source: Researcher's computation (2025), using Stata, 17

The nonlinear causality results in Table 18 indicate that exchange rate movements significantly cause inflation in Nigeria. Both positive and negative exchange rate shocks transmit strongly into price dynamics, confirming that exchange rate is a major driver of inflation. Similarly, the monetary policy rate (MPR) is found to nonlinearly cause inflation, though its effect operates differently across regimes. This means that changes in interest rate policies influence inflation, particularly when combined with exchange rate fluctuations.

Petroleum motor spirit (PMS) prices also significantly cause inflation, reflecting the critical role of fuel costs in Nigeria's consumption and production structure. The results further show that value-added tax (VAT) causes inflation, highlighting the pass-through effect of fiscal policy on consumer prices. Broad money supply (lnM2) is also a significant nonlinear cause of inflation, suggesting that excess liquidity directly fuels price increases under certain conditions.

On the other hand, credit to the private sector (lnCRD) does not cause inflation in the nonlinear framework, except in limited threshold regimes identified earlier in the MTR results. This implies that credit expansion does not independently drive inflation, unless it interacts with other macroeconomic pressures. Finally, the feedback direction is generally weak. Inflation does not nonlinearly cause exchange rate, MPR, PMS, VAT, lnCRD, or lnM2. In other words, inflation is more of an outcome variable in Nigeria rather than a source of shocks to other macroeconomic fundamentals

Results of Post Estimation Tests

The Jarque–Bera test for normality indicates that all three models reject the null hypothesis of normally distributed residuals at the 5% significance level ($p < 0.05$). This suggests that the residuals deviate from normality. While this may raise concerns, it is important to note that normality of residuals is less critical in large-sample time series econometrics due to the asymptotic properties of estimators. Thus, the results remain valid, though caution is warranted in small-sample interpretations. The Breusch–Godfrey LM test shows that none of the models suffer from serial correlation, as the null hypothesis cannot be rejected ($p > 0.05$). This implies that the models are dynamically stable. Similarly, the Breusch–Pagan test results confirm homoskedastic error variance across all models ($p > 0.05$), suggesting that the estimators are efficient and inference based on standard errors is reliable. Similarly, the Ramsey RESET test reveals no evidence of functional form misspecification, as all models pass the test ($p > 0.05$). This indicates that the models are well-specified, and no relevant variables have been omitted.

Table 22: Results of Post-Estimation Tests

Diagnostic Tests	**Monetary Policy and Exchange Rate–Inflation Nexus**
Jarque–Bera Test (Normality of Residuals)	JB = 9.462 (p = 0.009)
Breusch–Godfrey LM Test (Serial Correlation)	LM(2) = 1.920 (p = 0.170)
Breusch–Pagan Test (Heteroskedasticity)	χ^2 = 6.120 (p = 0.290)
Ramsey RESET Test (Functional Form)	F(3,120) = 1.340 (p = 0.260)

Source: Researcher's computation (2025), using Stata, 17

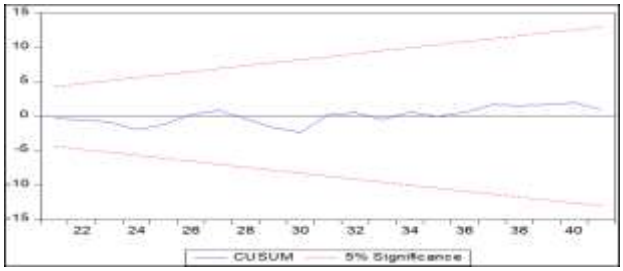
In summary, while the models suffer from residual non-normality, they pass the key diagnostic tests relating to autocorrelation, heteroskedasticity, and functional form. This ensures that the estimated models are robust, and the results can be relied upon for policy implications.

The stability of the estimated models was further assessed using the Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUMSQ) tests, which are particularly useful for detecting structural instability in recursive residuals over time.

The graphical outputs of the CUSUM plots in figures 4A, 4B, 5A, 5B, 6A and 4B display the cumulative sum of recursive residuals against time together with the 5% significance bounds, while the CUSUMSQ plots show the cumulative sum of squared recursive residuals over the same period. In both cases, the decision rule is that the estimated parameters are considered stable if the plots remain within the 5% critical bounds, whereas any crossing of the bounds would indicate the presence of structural breaks and parameter instability.

The results from the CUSUM and CUSUMSQ plots for all three estimated models namely, the exchange rate–inflation nexus, the monetary policy–inflation nexus, and the exchange rate–monetary policy interaction show that the recursive residuals largely remained within the 5% significance bands throughout the sample period (1999M6–

2025M3). This suggests that the estimated coefficients are stable over time, and no evidence of structural instability was detected except in figure 4B where CUSUMSQ is bottom line slightly. The combined evidence from both tests therefore confirms the long-run stability of the models, lending further credibility to the reliability of the empirical findings and reinforcing their usefulness in informing monetary and exchange rate policies in Nigeria



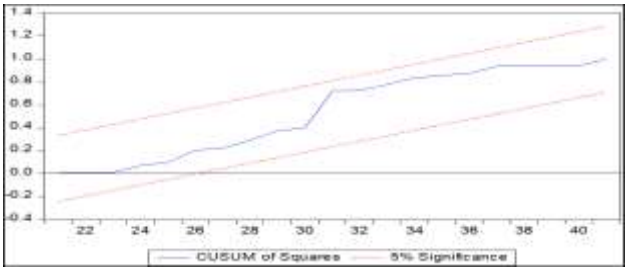
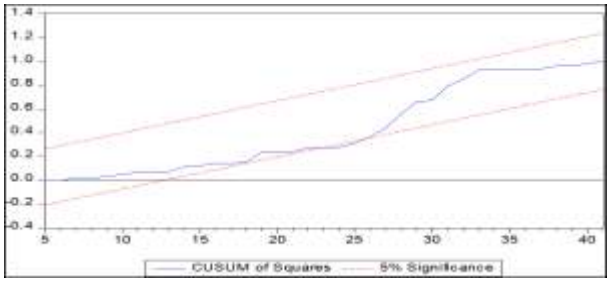


Figure 4A and 4B: CUSUM and CUSUMSQ plots of Model 1



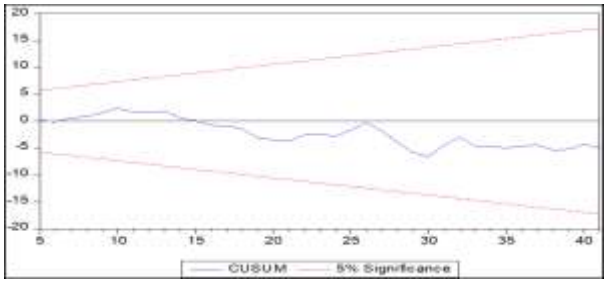
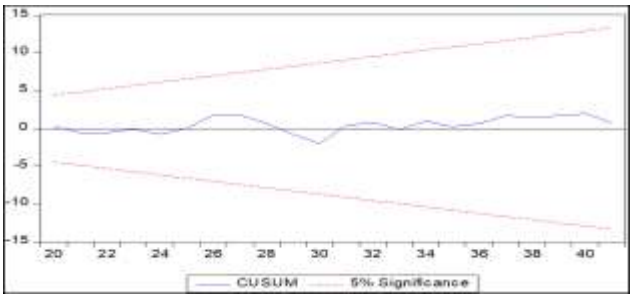


Figure 5A and 5B: CUSUM and CUSUMSQ plots of Model 2



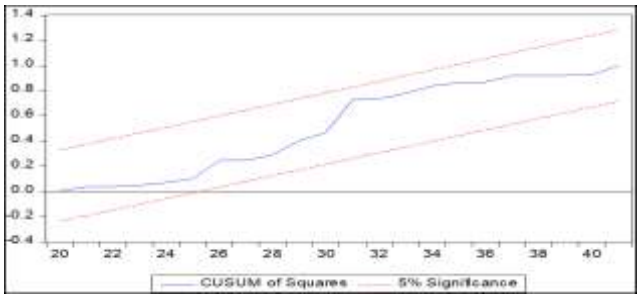


Figure 6A and 6B: CUSUM and CUSUMSQ plots of Model 3

5.0 CONCLUSION AND POLICY RECOMMENDATION

This study set out to investigate the relationships among exchange rate dynamics, monetary policy, and inflation in Nigeria. The hypotheses formulated in Chapter One were empirically tested, and the findings provide robust evidence that deepens our understanding of inflationary processes in Nigeria. Based on the tested hypotheses, this study concludes that exchange rate fluctuations play a critical role in driving inflationary pressures in Nigeria, as exchange rate depreciation significantly and persistently transmits into higher domestic prices in both the short and long run.

Furthermore, the study concludes that monetary policy variables, particularly the Monetary Policy Rate (MPR) and broad money supply (M2), exert significant effects on inflation and remain important tools in the short-run adjustment process of prices. This underscores the pivotal role of effective monetary management in controlling liquidity conditions and stabilizing inflation. In addition, the study establishes that monetary policy moderates the degree of exchange rate pass-through to inflation, thereby confirming the importance of policy coordination between exchange rate management and monetary control in mitigating inflationary shocks.

Finally, the study concludes that causality exists among the investigated variables, with evidence of unidirectional causality from exchange rate to inflation and from monetary policy variables to inflation. This outcome confirms that exchange rate dynamics and monetary policy actions are not only correlated with but also causally linked to inflationary outcomes in Nigeria.

Based on the empirical evidence obtained from the findings of this study, several policy recommendations are suggested to address the persistent inflationary challenges in Nigeria:

Given that exchange rate was found to significantly affect inflation, monetary authorities should prioritize exchange rate stability. To achieve this, Nigeria must pursue a deliberate diversification of its export base beyond crude oil. Expanding into agriculture, manufacturing, and solid minerals, particularly through the promotion of value-added exports such as agro-processing industries, would generate more sustainable foreign exchange earnings. In addition, strengthening foreign reserves is crucial, as this would provide the Central Bank of Nigeria (CBN) with the capacity to intervene during episodes of exchange rate depreciation. This can be realized through prudent management of oil revenues during boom periods, the reduction of financial leakages, and the attraction of stable foreign investment inflows. Equally important is the promotion of non-oil exports, which would reduce Nigeria's vulnerability to external shocks. This can be accomplished by implementing export financing schemes, reducing trade barriers, and improving port infrastructure to enhance the competitiveness of Nigerian firms in global markets. Furthermore, providing incentives such as tax reliefs or subsidies for small and medium enterprises engaged in non-oil exports would boost foreign exchange inflows and reduce overdependence on oil revenue.

At the same time, efforts should be made to encourage local production of consumer goods and industrial inputs. Strengthening domestic manufacturing capacity would help Nigeria reduce its dependence on imports, thereby minimizing the pass-through effect of exchange rate depreciation on domestic prices. Achieving this requires addressing critical supply-side constraints such as the high cost of doing business, limited access to affordable credit, and unreliable electricity supply. By improving the business environment, local industries will become more competitive and capable of meeting domestic demand, which will ultimately cushion the inflationary impact of exchange rate in Nigeria.

Beyond exchange rate management, the study also underscores the importance of strengthening monetary policy effectiveness. The results confirmed that both the monetary policy rate (MPR) and broad money supply significantly influence inflation in Nigeria. This implies that the Central Bank of Nigeria (CBN) should adopt a cautious but flexible approach in managing money supply growth. While tightening measures such as increasing interest rates can help control inflation, they should be balanced with growth considerations to avoid stifling investment and employment. In addition, improving the monetary transmission mechanism particularly the credit channel remains essential. Ensuring that changes in monetary policy rates are transmitted effectively to lending rates and aggregate demand will enhance the effectiveness of monetary policy in addressing inflationary pressures.

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