



Does Exchange Rate Fluctuation Cause Inflation in An Open Economy? Insight From Nigeria

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Date of Submission: 08-08-2025

Date of Acceptance: 21-08-2025

Abstract

This research delved into the critical analysis of whether exchange rate causes inflation in an open economy like Nigeria. The period of observation was from 1986:Q1 to 2024:Q4. The specific objectives analyzed the fluctuation in exchange rate and how it has affected inflation in Nigeria, investigated the effect of interest rate on inflation and analyzed the extent to which balance of trade affected inflation in Nigeria. The study was anchored on the monetary model of exchange rates. Data on exchange rate, interest rate and balance of trade were obtained from the central bank of Nigeria statistical bulletin and subjected to econometric analysis of Auto Regressive Distributed Lag (ARDL) model. The results revealed that exchange rate significantly increased inflation both in the short and long run periods, interest rate had positive effect on inflation in the short but negative effect in the long run while balance of trade decreased inflation in both short and long run periods though not significantly. The study concluded that exchange rate does actually cause inflation in an open economy like Nigeria. This is hinged on the evidence that exchange rate fluctuations exerted positive and significant effect on inflation both in the short and long run periods. The study recommended that the central bank of Nigeria should ensure that they actively manage exchange rate policies by providing foreign exchange timely for exports in addition to pursuing contractionary monetary policy through interest rate ceiling so as to decrease inflationary trends in Nigeria.

Key words: Balance of trade, exchange rate fluctuation, inflation, interest rate, open economy

I. INTRODUCTION

The impact of exchange rate fluctuations on inflation rate in Nigeria has been a subject of significant interest among researchers, academicians, investors, and policymakers. Exchange rate fluctuations can affect the price of imported goods, which is vital for a developing country like Nigeria which heavily relies on imports for essential items such as food, clothing, and

electronics (Nasiru et al., 2024). When the value of the naira depreciates against foreign currencies, the cost of importing these goods rises. Consequently, local market prices increase, compelling households to allocate more part of their incomes to the same quantity of goods, thereby reducing household purchasing power (Amanda, Akhyar, and Ilham, 2023). From another angle, when the naira depreciates, it leads to higher inflation rates i.e. the increased cost of producing goods and services in Nigeria exacerbate this effect. As a result, household incomes lose real value as Nigerian currencies tend to depreciate, making it more challenging for households to maintain their purchasing capabilities and living standards (Ozata, 2020).

The historical antecedent of exchange rate in Nigeria proves that exchange rate has grown within the time frame from regulated to deregulated regimes. Ewubare and Merenini (2019) observes that the exchange rate of the naira was relatively stable between 1973 and 1979 during the oil boom era and when agricultural products accounted for more than 70 percent of the nation's gross domestic products (GDP). During this period, the Nigerian economy was under a fixed exchange rate system. This meant that Nigeria pegged her currency to a basket of 12 currencies of her major trading partners (Ighoroje and Orife, 2024). Under this phase, Naira exchange rate to dollar was pegged at ₦0.658 from September 1971 to April 1974. In that same year, Naira was pegged at ₦0.616 from April to December of 1974. By end of 1977, the Naira was already pegged at ₦0.651 to a dollar. In 1979, the Naira value appreciated to a dollar at an average yearly value of ₦0.596 (CBN, 2022).

In 1985, the naira had depreciated against the dollar to ₦0.894 (CBN, 2021). Perhaps, Aliyu et al. (2018) attributed the naira depreciation as among the reasons for expediting the Structural Adjustment Programme (SAP) in year 1986. The Federal Government adopted Structural Adjustment Policy (SAP) in 1986 and this led Nigeria to move from a pegged exchange rate regime to a flexible exchange rate regime where exchange rate was left completely to be determined by market forces of demand and



supply (Mordi, 2006). However, this quickly changed to the managed-float system whereby monetary authorities intervened periodically in the foreign exchange market in order to attain some strategic objectives (Mordi, 2006). By the end of the year 1986, the Naira exchanged at ₦2.02 to a dollar. The depreciation is quickly noticed at this point as exchange rate went from less than ₦1 to ₦2.02 after the SAP occasioned by the managed-float exchange rate system.

The period after 1986 sparked a serious wave of exchange rate policies by the Central Bank of Nigeria. Bureau De Change was introduced in 1989 to take care of privately sourced foreign exchange in the country. The managed-float system encouraged volatility in exchange rate and this led to further reforms in 1994. Furthermore, the market was fully liberalised in 1996 with the introduction of an autonomous Foreign Exchange Market (AFEM) for the sale of foreign exchange to end-users by the CBN through selected authorised dealers at market determined bidding rate (CBN, 2019; Nasiru et al., 2024). Finally, The Autonomous Foreign Exchange Market metamorphosed into a daily Inter-Bank Foreign Exchange Market (IFEM). This trend continued till 1993 when Naira exchanged at ₦22.0511. Between 1994 and 1998, the managed-float system led the CBN to peg the naira at ₦21.8861 (CBN, 2022). In 1999, the federal government vigorously embarked on privatisation programme which aimed at advancing the free market economy and liberalising foreign exchange regime. Ayobami (2019) observes that this must have resulted in the rapid changes in exchange rate and its associated variables.

In the early 2000s, the CBN attempted to devalue the naira, thereby stabilizing exchange rates movement. Both the nominal and real exchange rates increased tremendously between 2000, 2006 and 2016. It was in the year 2016 that the Federal Government announced the departure from the prevailing fixed exchange rate regime which the apex bank had adopted mid-1990s to a floating exchange rate (CBN, 2023). This was in a bid to remedy the dwindling economic growth rate and rescue the country from the recession which was ravaging the economy. The bank rather resorted to the managed-float which was previously adopted leading to the monetary authority's periodic intervention in the foreign exchange market. The Nigerian Autonomous Foreign Exchange Rate (NAFEX) was introduced in 2017 which gave impetus to the unification of the multiple exchange rates and quoting of the NAFEX rates alongside main inter-bank exchange rate (CBN, 2022).

At the end of the year 2017, while the CBN announced the gradual recovery of the economy from recession, Nigeria's exchange rate was already experiencing serious fluctuations. The inter-bank rate jumped from N360 in 2017 to N415 in 2020 while the parallel market reached N600 to one dollar in the aftermath of the global pandemic (CBN, 2024). Other macroeconomic variables like inflation rate were experiencing downturns thus plunging the Nigerian economy into further economic crisis. In the last one year i.e. from 2020 till the present time in 2021, exchange rate has risen tremendously to the extent that other macro-economic aggregates have been affected (Nwobia et al, 2020). The high fluctuation in exchange rate is projected to have dire consequences on the economic health of Nigeria if urgent measures are not taken to stabilize the rising trend. It becomes imperative on this study to critically ascertain whether exchange rate fluctuation has any significant effect on inflation in Nigeria.

Statement of the Problem

Virtually every sector of the Nigerian economy is affected by sudden changes and fluctuations in the country's exchange rate. The rapid increase in exchange rate of recent may have direct effect on the macro-economy as it makes imports more expensive for individuals and increases inflation (Hill, 2022). Theoretically, exchange rate fluctuation has been identified as one of the obstacles to sustained economic growth (Ghura and Grennes, 2019). On the one hand, a persistent exchange rate fluctuation by way of undervaluation could lead to economic overheating, which puts pressure on domestic prices and misallocates resources between tradable and non-tradable sectors. On the other hand, continuous real exchange rate overvaluation reflects unsustainable macroeconomic conditions within an economy, which could make such an economy vulnerable to speculative attack and currency crisis.

Statistics obtained from the Central Bank of Nigeria (CBN, 2022) showed that exchange rate of the naira to the US dollar increased by more than 100% from N150 in 2010, N365 in 2020 and then the year 2021 ended with official exchange rate at N402. Nigeria's exchange rate at end of 2024 was N1,550 while inflation rate reached 34.8% in the same period (CBN, 2024). Nigeria's macro-economic growth indicator (inflation rate) has been on a positive trend ever since the country emerged from negative economic growth rate with spiraling exchange rate. However, there is still uncertainty surrounding the extent to which the fluctuation



witnessed in the value of the naira has affected the rate of inflation. The problem now lies in ascertaining whether Nigeria's rising exchange rate is responsible for the steady rise in inflation with a view to making useful recommendations for policy.

Mixed reactions have continued to trail the tripartite relationship between fluctuations in exchange rate, inflation and other macro-economic variables. Several studies have analyzed the nexus between exchange rate fluctuations and inflation rate in Nigeria. While some have argued that exchange rate fluctuation has a strong long relationship with inflation in Nigeria (Okhira and Saliu, 2018; Kazeroon and Feshari, 2019; Njoku and Nwaimo, 2020), others have argued that exchange rate has adverse effect on inflation in Nigeria (Ozor, 2019; Nwobia, Ogbonnaya and Okoye, 2020; Danladi, Akomolafe, Bablola and Akpan, 2021). Proponents of the negative effect of exchange rate fluctuations hold that a more volatile exchange rate enables countries to react to asymmetric shocks, thereby stimulating output growth through decreased inflation. The positive effect of exchange rate fluctuation on inflation also have proponents who assert that price level increase when cost of production increases thus putting more pressure on disposable income. Given such contradictions, the impact of exchange rate fluctuations on inflation continues to be discussed. Possible reason for the differences in the findings of researchers may have emanated from data usage, time span of the data, methodology, the period of study and country-specific features. It is on the bases of these problems identified that this study takes asks the critical question does exchange rate fluctuation cause inflation in an open economy?

Objectives of the Study

The main objective of this study is to investigate the effect of exchange rate fluctuation on inflation in Nigeria. The specific objectives are to:

1. analyze the fluctuation in exchange rate and how it has affected inflation in Nigeria;
2. investigate the intervening effect of interest rate in the exchange rate fluctuation – inflation model;
3. analyze the extent to which balance of trade affect inflation in Nigeria.

Research Hypotheses

The hypotheses are stated in their null forms as follows:

H01: There is no significant effect of exchange rate fluctuation on inflation in Nigeria.

H02: Interest rate has no significant effect in the exchange rate fluctuation – inflation model.

H03: There is no significant effect of balance of trade on inflation in Nigeria.

Scope of the Study

The main focus of this study is on exchange rate fluctuation and how it has affected inflation in Nigeria. The study employs data from 1986 to 2024. In a bid to effectively measure fluctuation in real exchange rate and fit a time series analysis to the data, we further break the data into quarterly time series. The study is specifically centred on the following variables – real exchange rate, consumer price index (as a proxy for inflation) and balance of trade. The study is delimited to the Nigerian economy.

II. LITERATURE REVIEW

Conceptual Review

Exchange rate is the value of a country's money in international trade in goods, services and finance and usually denominated in US dollar. Therefore, exchange rate is very important in determining the financial competitiveness of a country among the major currencies of the world (Nsofor *et al*, 2018). Fluctuation in exchange rates has far reaching implications for macro and financial stability. It can affect trade negatively, through its tendency to engender exchange rate misalignment. Relentless gyrations deter foreign direct investment, due to the high risk associated with exchange losses, since operating profit of multinational companies that face competition in the domestic environment of operations could be affected (Odozi, 2013).

Exchange rates are never static, according to Kanu and Nwadiubu (2020), Ejedegba (2015). Thus, the supply and demand of major currencies of international trade experiences fluctuations over time. The fluctuations may occur weekly, monthly, bimonthly, annually or biennially. It follows that exchange rate fluctuations means all possible changes in the value of the naira in relation to the dollar, arising as a result of market forces, formal devaluation or revaluation of the naira or from any cause howsoever arising. Changes in inflation and interest rates cause changes in currency exchange rate fluctuation.

According to Mordi (2006), fluctuation is distortionary to market mechanism; hence, it distorts merchandise trade as well as capital flows. The distortionary effects of prolonged fluctuation also have implication on determining whether the currency is overvalued or undervalued. Pronounced



volatility by itself can further fuel expectations of future realized volatility—that is, volatility clustering. Such behavior tends to intensify the speculative component that can create exchange rate bubbles. By the same token, however, it could bring about higher foreign portfolio investment as investors seek “hot money” arbitrage, with the attendant effect of capital flight when developments are not favorable. This calls for hedging, which by implication represents additional cost to the investors.

The fluctuations in exchange rate poses a threat to importers and exporters engaging in international business as they are naturally exposed to currency risks (Allayannis, Ihuig & Weston, 2016; Egbulonu, Dim & Duru, 2018). Manufacturing companies are vulnerable to potential gains and losses due to changes in the values of their raw materials and purchase prices that are denominated in foreign currencies (Ejedegba, 2015). Thus, exportation and importation activities expose these firms to foreign exchange risks. Exchange rate volatility refers to the unpredictable movement of exchange rates in the global foreign exchange market. Exchange rate fluctuation does not only affect economic growth but also the performance of firms (Ayobami, 2019; Ejedegba, 2015). For instance, exchange rate depreciation increases the cost of imported capital goods for manufacturing firms, and this result in a fall in domestic investment.

At a basic level, Oswoth (2021) and Ime (2021) noted that higher interest rates tend to lead to an appreciation in the value of a currency. In turn, the exchange rate is affected as the value of a currency increases in relation to others. In Nigeria, the Central Bank of Nigeria (CBN) has significant influence on interest rates and setting up of monetary policies (Ejedegba, 2022). Todaro and Smith (2006) asserted that monetary policies play a major direct and indirect role in governmental efforts designed to expand economic activity in times of unemployment and surplus capacity and to contract that activity in times of excess demand and inflation. There are various schools of thought on inflation, but there is a consensus among economists that inflation is a continuous rise in prices, inflation depicts an economic situation where there is a general rise in the prices of goods and services continuously, where “too much money is chasing too few goods” (Solow, 1994).

Jhingan, (2005) defined inflation as a persistent and appreciable rise in the general level of prices. When there is inflation, the currency losses purchasing power. The purchasing power of a given

amount of naira in the economy will be smaller over time. In the definition of inflation, two things must be borne in mind as noted by Egbulonu, Dim and Agba (2018). First, is aggregate, which implies that the rise that constitutes inflation must cover the entire basket of goods in the economy as distinct from an isolated rise in the prices of a single commodity or group of commodities. Secondly, the rise in the aggregate level of prices must be continuous for inflation to be said to have occurred. The aggregate price level must show a tendency of a sustained and continuous rise over different time periods (Egbulonu, Dim and Agba, 2018).

Importantly, increases in interest rates are associated with higher levels of inflation which can cause the value of a currency to fall. In order for a currency to rise in value from an increase in interest rates, Idaka et al. (2021) observed that it is necessary for a country to strike a balance between interest rates and levels of inflation. The central problem is that while higher interest rates will cause in an increase in value for an investor in a currency over time if there is an accompanying increase in inflation this will also cause a decrease in value. Where inflation occurs in a country, the value of the goods it produces increases. This in turn will cause a decrease in foreign demand for those goods (Ewubare and Merenini, 2019). Overseas buyers will then buy less of those goods, causing a decrease in demand for the currency and a fall in its value. Whether or not a currency is a good investment over time actually depends on both interest rate and the rate of inflation. It is usually necessary to look at both before determining whether an investment will grow over time.

Theoretical Framework

This study is anchored on the monetary model of exchange rates. Nzotta (1999) posits that it assumes that changes in the supply of money affect the exchange rate either directly or indirectly. The model tries to explain the changes in exchange rates in terms of changes in the demand for and supply of money between two currencies (Cushman, 2016). Conceptually, an increase in real income given a fixed nominal money supply, leads to a fall in prices, thus making exchange rates to appreciate. Conversely, an increase in money demand, leads to increase in prices, which eventually leads to exchange rates depreciation.

Flexible exchange rates have been regarded as an important tool to cope with asymmetric (real) shocks (Meade 1951, Friedman 1953). The reason is that under fixed exchange rate regimes, real exchange rate adjustments must be carried out



through relative price and productivity changes which in a world of price and wage rigidities are slow and costly. The outcome is a lower growth performance. Mundell's (1961) seminal paper on optimum currency areas extended the argument to a monetary union. Interpreting monetary and exchange rate policies as Keynesian instruments of adjustment, Mundell (1961) argued that shock absorption within a heterogeneous group of countries is easier if monetary and exchange rate policies remain independent. In particular for countries with rigid labour markets and low international labour mobility, monetary autonomy was regarded as important. Today, Mundell's (1961) framework remains the most important theoretical tool to analyze the pro-and-cons of currency volatility (Firdmuc and Korhonen, 2016).

In contrast, McKinnon (1963) emphasized the benefits of fixed exchange rate regimes for small open economies in the face of nominal shocks.

Assuming that for small open economies the international price level is given and traded goods make up a high share of the domestically consumed goods, exchange rate stability ensures domestic price stability. The welfare effect of stable exchange rates originates in macroeconomic stability which provides a favourable environment for investment and consumption. From this perspective, as acknowledged by Mundell (1973) in later works, monetary and exchange rate policies are regarded as a source of uncertainty and volatility in small open economies. Growth is enhanced when the risks associated with changes in exchange rate of the naira to the US dollar i.e. volatility is smoothed.

Empirical Review

The review of empirical studies is focused mainly on related studies that were carried out from 2020 through 2024. These studies are tabulated for ease of identification and they are shown in Table 1 below

Table 1: Summary of Empirical Review

Author and Date	Study	Outcome/Finding	Method	Gap
Chhibber and Shafik (2020)	Money supply and inflation nexus in Ghana	A significant positive relationship was found between the parallel exchange rate and the general price level	ARDL	Money supply instead of exchange rate was the explanatory variable.
Njoku and Nwaimo (2020)	Impact of exchange rate on inflation in Nigeria	Fluctuating exchange rate has significantly impacted on the persistence inflation High exchange rate has led to imported inflation	Vector Error Correction Mechanism (VECM)	The study did not test for exchange rate volatility effect on inflation.
Nwobia, Ogbonnaya and Okoye (2020)	Effect of exchange rate fluctuation on Nigeria external trade	Exchange rate has a negative effect on GDP	Ordinary Least Square (OLS) and Correlation analysis	The study did not test for exchange rate volatility effect on inflation.
Babatunde, Abuh, Ekpenyong and Ehinomen (2021)	Nexus between exchange rates and economic growth in Nigeria	Exchange rates positively and significantly influences economic growth	Ordinary Least Square (OLS) and Error Correction Model	The study did not test for exchange rate volatility effect on inflation.
Ettah (2021)	Effects of price and exchange rate fluctuations on Agricultural exports (cocoa) in Nigeria	Positive significant effect of exchange rate volatility on cocoa export prices in Nigeria.	Ordinary Least Squares Regression	The study did not test for exchange rate volatility effect on inflation.
Danladi, Akomolafe, Bablola and Akpan (2021)	Impact of exchange rate volatility on international trade	Exchange rate volatility negatively affects international trade prices.	Error Correction Model (ECM)	Exchange rate on trade was the focus and not on inflation rate.



Imimole, & A Enoma, (2021)	in Nigeria Impact of exchange rate depreciation on inflation in Nigeria	Exchange rate depreciation, money supply and real gross domestic product are the main determinants of inflation in Nigeria.	Auto Regressive Distributed Lag (ARDL),	The research did not test for volatility effect.
Nuhu (2021)	Effect of exchange rate volatility on inflation in Nigeria	Money supply and nominal exchange rate had positive and significant effect on consumer price index,	GARCH and Vector Error Correction Model (VECM)	The data need to be updated to 2023
Phillip & Isiaq (2021)	Monetary policy, exchange rate, inflation rate in Nigeria	Uni-directional causation exist from exchange rate and inflation rate to short term interest rate (measure of monetary policy)	Co-integration and Multi-Variate Vector Error Correction Model	Direct effect of exchange rate on inflation was not determined.
Imimole and Enoma, (2021)	Exchange rate depreciation on inflation in Nigeria	Exchange rate depreciation, money supply and real GDP are the main determinants of inflation.	Using Auto Regressive Distributed Lag (ARDL),	Data scope was limited to 2019.
Mumtaz, and Ali (2022)	Impact of the exchange rate and its volatility on domestic consumption in India and Pakistan	The volatility of the real exchange rate in Pakistan has a positive relationship with consumption. Whereas, in India, exchange rate has a negative relationship with consumption	Auto Regressive Distributed Lag (ARDL),	The study findings may not be applicable to the Nigerian economy as it is foreign study.
Umaimah and Aliyu (2022)	Asymmetric effects of exchange rate on food inflation in Nigeria	There was a long-run significant relationship between exchange rate and food inflation	Non-Linear ARDL model	Focus was on food inflation and not on headline inflation.
Yusuf, Salaudeen and Ogbuji (2022)	Exchange rate fluctuation and inflation nexus in Nigeria	Interaction of inflation and exchange rate has a negative short run impact on the economy but positive long run.	Auto Regressive Distributed Lag (ARDL),	The study did not directly address exchange rate and inflation nexus.
Audu and Amaegberi (2023)	Impact of exchange rate fluctuation on inflation targeting on the Nigerian economy	Interest rate positively influences the growth of inflation in the Nigerian economy while exchange rate negatively impact on the economy.	Parsimonious Error Correction Model	The study did not directly address exchange rate and inflation nexus.
Ehigiator, Murtadho and Bhaumik (2024)	Relationship between the exchange rate fluctuations and economic growth in Nigeria	There was a significant relationship between exchange rate fluctuation and economic growth.	Ordinary least square method and Pearson's product moment correlation	The study did not directly address exchange rate and inflation nexus.



Nwankwo (2024)	Effect of exchange rate fluctuations on the Nigerian economy	Devaluation of the domestic currency does not lead to improvement in the exchange rate stability	Error Correction Model (ECM)	The study did not directly address exchange rate and inflation nexus.
Ighoroje and Orife (2024)	Effect of exchange rate fluctuation on inflation rate in Nigeria	Exchange rate and other macroeconomic variables are not significantly impacting on inflation in Nigeria.	Ordinary Least Square (OLS) and Generalized Least Square (GLS)	There exist gaps on volatility effect of exchange rate on inflation.
Odoh, Ugwoke and Ogomgbunam (2024)	Relationship between exchange rate fluctuations and economic development in Nigeria	Exchange rate fluctuation had strong impact on the gross domestic product in Nigeria.	Ordinary Least Square (OLS)	Exchange rate and inflation was not considered
Odoh and Onyeonu (2024)	Impact of exchange rate fluctuation on Nigeria's inflation-growth nexus	Inflation and exchange rate fluctuation harm the nation's economic growth.	ARDL model	The study did not directly address exchange rate and inflation nexus.
Nasiru <i>et al</i> (2024)	Effect of exchange rate fluctuation on household's purchasing power in Nigeria	Exchange rate has a negative and statistically significant impact on GDP per capita	Vector Error Correction Model	The study did not directly address exchange rate and inflation nexus
Olamide, Kanayor and Andrew (2024)	Influence of exchange rate instability on the inflation-growth nexus of the SADC region	The higher the level of instability in exchange rate, the worse the inflationary-growth relationship of the region.	Pooled Mean Group estimator of the Panel Autoregressive Distributed Lag	The study did not show country-specific effect of exchange rate on inflation.

Source: Author's computation

Empirical evidence from table 1 above shows that many authors have examined exchange rate and inflation nexus in Nigeria. While most of the studies have their time scope limited to 2019, most of the studies need the data observation to be updated to 2023 so as to establish an updated knowledge of exchange rate and inflation nexus. This knowledge can enhance policy formulations and recommendations. Also, the direct effect of exchange rate on inflation was not determined by most of the studies as they were either on interest rate or on economic growth of Nigeria. Additionally, most of the research works reviewed did not test for volatility effect of exchange rate on inflation. This is necessary because a complete analysis of exchange rate fluctuation requires the volatility effect to be ascertained. These gaps in

literature identified and mentioned will be filled in this present study.

III. RESEARCH METHODOLOGY

Ex-post facto research design is adopted to investigate the effect of exchange rate fluctuation on inflation in Nigeria. The data are sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin quarterly edition 2024. The Autoregressive Distributed Lag (ARDL) Model was used in analyzing the data having found first and level orders of integration in the data. The data were analyzed based on three criteria: Economic, Statistical and Econometric criteria. The economic criterion created a correspondence of economic theories with obtained estimates by examining the magnitude of the signs of the parameter estimates. This is also known as the a-priori expectations. The



statistical criterion involved the use of statistical tools and E-views 10 software to obtain the parameter estimates. The estimated parameters were analyzed via the t-test, F-test, cointegration test, causality test and model stability test. The econometric criterion investigated if there were violations of classical Econometric assumptions of no autocorrelation and heteroscedasticity.

Model Specification

The model is a modification of the specification of Imimole & Enoma, (2021) where-in they used exchange rate, money supply and real GDP as the independent variables while inflation rate was the dependent variable in their model. This present study modifies the previous model of Imimole & Enoma, (2021) by introducing trade balance as an important intervening variable since it has been established in the literature to be a significant variable that determine exchange rate fluctuation in addition to interest rate. Thus, using consumer price index as a proxy for inflation rate in Nigeria, the model is stated as:

$$CPI = f(Exchange\ Rate\ Fluctuation) \quad (1)$$

$$CPI = f(EXR, INT, BTR). \quad (2)$$

Where:

CPI = Consumer price index

EXR = Exchange rate (naira to the US dollar)

INT = Interest rate

BTR = Balance of Trade (difference between import and export)

Thus, expressing this model in explicit econometric (Linear equation) form as:

$$CPI = \alpha_0 + \alpha_1 EXR + \alpha_2 INT + \alpha_3 BTR + U \quad (3)$$

Where:

α_0 = Intercept

$\alpha_1, \alpha_2,$ and α_3 = Partial slope or coefficients of the variables EXR, INT and BTR respectively

U = error term.

It is expected that depreciation in exchange rate should have increasing (positive) effect on consumer price index while exchange rate appreciation should have negative effect on price index. Thus, the expected relationship is inverse. Also, interest rate and balance of trade should both be favorable to consumer price index and exert positive effect in the model. This is represented mathematically as: $\alpha_1 < 0; \alpha_2 > 0; \alpha_3 > 0$

IV. DATA ANALYSIS AND DISCUSSION OF RESULTS

Table 2: Summary of the ADF Unit Root Test

Variables	ADF test statistics @		Decision Rule	Order of integration
	Level	1 st difference		
CPI	-3.3844*	-3.5073*	Stationary at Level	I(0)
EXR	-0.8105	-8.3184*	Stationary at 1st Difference	I(1)
INT	-1.8639	-3.5591*	Stationary at 1st Difference	I(1)
BTR	-3.8799*	-9.9649*	Stationary at Level	I(0)
Critical value at 5% level = -2.8802				
Critical value at 5% 1st difference = -2.8818				

The unit root test above shows that exchange rate (EXR) and interest rate (INT) are both stationary after first differencing and are said to be integrated of order one I(1). However, consumer price index (CPI) and balance of trade (BTR) attained stationarity at level and are said to be integrated of order zero i.e. I(0). This indicates that there is mixed order of integration and as such we adopt the ARDL approach to long run test (Bounds test) as well as the ARDL estimation (Pesaran, Shin & Smith, 2001).

Test for Long Run Relationship

The long run property of the data is ascertained using the ARDL Bounds test. The hypothesis of the Bounds test states that

H₀: There is no long run relationship existing amongst the variables.

H₁: There is long run relationship amongst the variables.

The test is summarized below:



Table 3: Summary of the ARDL Bounds Test

Test Statistic	Value	K
F-statistic	5.91975	3
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.72	3.77
5%	3.23	4.35
2.5%	3.69	4.89
4	3.29	5.61

Decision Rule: The F-statistic value of 5.919 is greater than the critical values at I(0) and I(1) bounds at 5% level of significance. Therefore, the null hypothesis is rejected which states that there is no long run relationship. The study therefore concludes that there is long run relationship between exchange rate and inflation in Nigeria. Since the study has confirmed the existence of long run relationship amongst the variables, the study estimates the short and long run parameters of the ARDL model below.

Summary of the Short Run Relationship between Exchange Rate and Inflation

The short run relationship between exchange rate and inflation in this study is estimated based on the appropriate lag order. The distributed lag (DL) of the AR model chose 3 lag periods for the dependent variable (consumer price index), no lags for exchange rate, 2 lag periods for interest rate and no lag for balance of trade. This is represented in the figure 4.1 below:

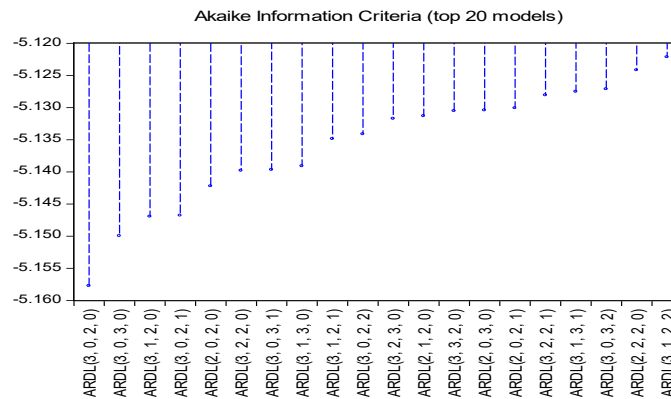


Figure 1: Lag Selection Criterion (AIC)

As seen in figure 1 above, the model selected 3 lag periods for consumer price index (CPI), no lag for exchange rate and balance of trade and 2 lags for interest rate. The lag selection was made possible using the Akaike information criteria (AIC) which selected the highest possible AIC value. The lag structure of the ARDL model is stated as ARDL(3, 0, 2, 0). Consequently, the short run estimates are summarized as follows:

Table 4: Short Run ARDL Model

Selected Model: ARDL(3, 0, 2, 0)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
CPI(-1)	1.608188	0.078747	20.42210	0.0000
CPI(-2)	-0.465031	0.145686	-3.192020	0.0017
CPI(-3)	-0.153909	0.075319	-2.043436	0.0428



EXR	0.010514	0.003982	2.640578	0.0092
INT	0.065169	0.037269	1.748618	0.0825
INT(-1)	-0.198741	0.061491	-3.232028	0.0015
INT(-2)	0.116520	0.035070	3.322455	0.0011
BTR	-0.002339	0.001612	-1.450992	0.1490
C	0.068580	0.026309	2.606723	0.0101
CoIntEq(-1)	-0.010752	0.003799	-2.830316	0.0050
<hr/>				
R-squared	0.819899	F-statistic	17.82581	
Adjusted R-squared	0.829893	Prob(F-statistic)	0.000000	
S.E. of regression	0.017840	Durbin-Watson stat	1.923313	

The short run estimates above has a speed of adjustment of 1.075% annually. This means that the distributed lag model corrects its previous period's disequilibrium at an estimated speed of 1.075% every year. Thus, holding exchange rate at a steady state of 1.075% annually, domestic price (inflation) will experience equilibrium in the long run.

The lagged coefficients of consumer price index (CPI) show that it is positive in the first lag period but negative in the second and third lag periods. This implies that in the previous year, CPI contributed 1.608 units to its own growth. The previous two years exerted -0.465 and -0.154 units decrease in CPI in the current year. Thus, the own-effect of CPI is negative for most of the lagged periods but only positive in the previous year leading up to the current year. This is an indication of positive return to equilibrium as evidenced in the error correction coefficient.

Going further, exchange rate showed no lagged effect on consumer price index. Only the current year effect is seen in the model. In the current year, exchange rate accounted for 0.0105 units increase in consumer price index. The probability value of 0.0092 showed that the positive trend in exchange rate was significant at 5% level. Thus, exchange rate significantly increased inflation in Nigeria in the short run period.

Interest rate increased consumer price index by 0.0652 units in the current year. However, the two previous years showed positive effect of interest rate in the second lagged period but negative in the previous year (first lag period). In the

previous year, interest rate decreased consumer price index by 0.1987 units but it turned to positive effect in the current increasing price index by 0.0652 units. The probability values of interest rate for the current year and first lagged periods shows that the positive short run effect in the current year is not significant while the negative short run effects of interest rate on CPI in the first lagged period is significant at 5% level.

For balance of trade, the short run coefficient shows that there is negative trend in balance of trade which exerts 0.0023 units decrease on CPI. This implies that there is decreasing effect of balance of trade on consumer price index in the short as changes in balance trade of trade led to decrease in consumer price index by 0.0023 units. The probability value (p -value = 0.1490) shows that the negative effect of balance of trade on CPI was not statistically significant at 5% level.

The constant or intercept of the model is positive and is estimated at 0.0686. This is indicative of the fact that holding the exchange rate variables constant at zero, there will be positive trend in domestic prices (inflation) in the short run to the tune of 0.0686. This underlines the role played by not only exchange rate in determining domestic prices in the economy but other economic factors that are not considered in this model. These other economic factors not considered in this model are taken care of by the stochastic error term.

Long run Relationship between Exchange Rate and Inflation

The long run relationship between exchange rate and inflation in Nigeria is summarized below:

Table 5: Long Run ARDL Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXR	0.977857	0.192481	5.080277	0.0000
INT	-1.585979	0.770000	-2.059713	0.0412
BTR	-0.217542	0.191947	-1.133344	0.2590
C	-6.378532	2.884163	-2.211571	0.0286



Table 5 above shows that exchange rate (NER) increased domestic price by 0.9779 units in the long run and the p -value of 0.0000 indicates that the positive effect of exchange rate on inflation is statistically significant at 5% level.

Interest rate and balance of trade both have negative coefficients of -1.5859 and -0.2175 which shows that interest rate and balance of trade exert negative and inverse effects on inflation in the long run. Consequent upon this, we can assert that a unit change in interest rate decreases inflation by 1.5859 units. Also, a unit change in balance of trade decreases inflation by 0.2175 units. The p -values of 0.0412 and 0.2590 for interest rate and balance of trade indicates that the negative effect of interest rate on inflation in the long run is statistically significant while the negative effect of balance of trade on inflation is not statistically significant at 5% level.

The intercept in the long run estimate is negative (-6.3785). This implies that there is negative trend in inflation occasioned by static movement in exchange rate indices. Thus, the long run equilibrium of inflation is being stabilized by exchange rate and the absence of exchange rate changes in the long run means that there will be fall in inflation.

Test of Hypotheses One

H_{01} : There is no significant effect of exchange rate fluctuation on inflation in Nigeria.

t-statistic (Long run estimates) = 5.0803

Probability value (p -value = 0.0000)

Decision Rule: Since the probability value of the t-statistic 0.0000 is less than the 5% critical value, the study rejects the null hypothesis and accepts the alternate hypothesis. The study therefore concludes that there is significant effect of exchange rate fluctuation on inflation in Nigeria.

Test of Hypothesis Two

H_{02} : Interest rate has no significant effect in the exchange rate fluctuation – inflation model.

t-statistic (long run estimates) = -2.0597

Probability value (p -value = 0.0412)

Decision Rule: Since the probability value of the t-statistic 0.0412 is less than 0.05 critical value, the null hypothesis stated above is rejected. The study therefore concludes that interest rate has significant effect in the exchange rate fluctuation – inflation model.

Test of Hypothesis Three

H_{03} : There is no significant effect of balance of trade on inflation in Nigeria.

t-statistic (long run estimates) = -1.1333

Probability value (p -value = 0.2590)

Decision Rule: The probability value of the t-statistic is 0.2590 which is greater than 0.05 critical value. Since the probability value is greater than 0.05 critical value, the null hypothesis is accepted and the study concludes that there is no significant effect of balance of trade on inflation in Nigeria.

The adjusted R-squared value is 0.819: This is an indication that the exchange rate variables explains up to about 81.9% of the changes in inflation for the period under review. Thus, the estimate has a coefficient of determination of 81.9% which is a very high explanatory coefficient.

Serial Correlation Test: The Durbin Watson statistics is estimated at 1.9233. Going by the rule of thumb, there is no autocorrelation in the model since the Durbin Watson statistic tends towards 2 than 0.

Ramsey Reset Test: The F-statistic value of 0.3133 with probability value of 0.5766 implies that the null hypothesis (H_0) of correct specification is accepted, and we therefore conclude that the model is correctly specified.

Normality Test: The Jacque-Bera (JB) statistic (273.27; p -value = 0.0000) shows that the data come from a non-normally distributed data. Thus, since the residuals of the ARDL model are not normally distributed, they were converted to normal distribution by taking their natural logarithm values. This proved effective in ensuring normal distribution of the data as proven in the autocorrelation test.

Stability Test: The cumulative sum (CUSUM) recursive line is within the upper and lower 5% critical value bounds as seen below:

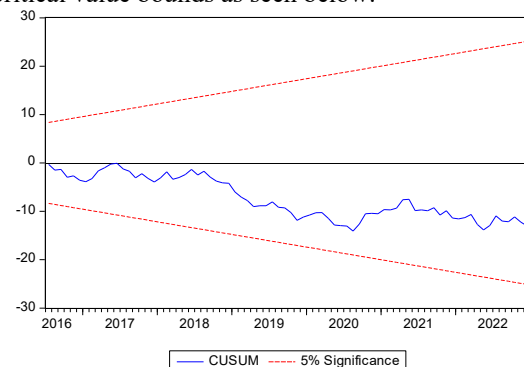


Fig. 2: Cumulative Sum test

The implication of the CUSUM line above is that since the recursive residuals lie within the two 5% critical bounds, we conclude that the model is stable for the period 1986:Q1 to 2024:Q4.

V. Discussion of Findings



This study set out to achieve the main objective of investigating the effect of exchange rate fluctuation on inflation in Nigeria. The study asked the critical question: does exchange rate cause inflation in an open economy such as Nigeria? To provide valuable insight into this critical question, the study gathered data from relevant government agency (Central Bank of Nigeria). The data gathered included exchange rate, interest rate and balance of trade. The period covered was from 1986 through 2024. However, the data were converted to quarterly series (1986:Q1 – 2024:Q4) in order to effectively capture the fluctuating effect of exchange rate on inflation in Nigeria. The analysis of data was carried out using the Autoregressive Distributed Lag (ARDL) since the variables were integrated of mixed order. The ARDL Bounds test confirmed the existence of a long run relationship between exchange rate and inflation.

The short run and long run ARDL estimates revealed that exchange rate exerts positive and significant effect on inflation in the short and long run periods. What this implies is that given the increasing value of exchange rate in Nigeria, domestic price level continues to increase and the increase is significantly felt in the economy. Therefore, the direct effect of increase in exchange rate is a corresponding increase in domestic prices as is evident in the Nigerian economy. This corroborates previous works of Mordi (2015), Aliyu et al (2018), Imimole, & A Enoma, (2021), Nuhu (2021), Ozor (2019), Umaimah and Aliyu (2022). These studies found that there was a long-run significant relationship between exchange rate and food inflation and that exchange rate is a significant determinant of inflation in Nigeria. There were no contrary indications in previous studies which is a sign of consistency in the findings.

The effect of interest rate on inflation was positive but not significant in the short. However, in the long run, interest rate exerted a significantly negative effect on inflation in Nigeria. This means that a unit change in interest rate decreases domestic prices significantly in the long run. Thus, as interest rate changes, inflation increases immediately in the short run but prolonged increase in inflation will be affected by variations of the long term which leads to a significant fall in inflation. However, this situation is described by Phillip & Isiaq (2021) as the production effect. Phillip & Isiaq (2021) found that increased production will reduce the consequences of high interest rate on inflation thus leading to decrease in inflation in a one-way flow. The short run positive effect of interest rate supports the finding of Audu and Amaegberi (2023) and

Ighoroje and Orife (2024) while the negative trend in inflation occasioned by interest rate in the long run aligns with the finding of Njoku and Nwaimo (2020).

Further analysis of balance of trade effect on inflation showed that there was negative relationship between balance of trade and inflation in Nigeria. One interesting aspect of this finding is that the decreasing effect of balance of trade on inflation was not significant for the period reviewed. This implies that Nigeria's trade activity is comprised mostly of imports as against exports and this should ordinarily increase inflationary pressure due to the high import cost which affects the domestic currency. However, the decreasing effect balance of trade has on inflation confirms the finding from Danladi et al (2021) which stated that trade surplus resulting from oil trade has potentially offset some inflationary pressure from the Nigerian economy. However, Nwobia, Ogbonnaya and Okoye (2020) made contrary finding that exchange rate negatively affects trade balance and this leads to inflationary pressure. The studies differ in findings due to the different control variables used in specifying the different models.

Result of the ARDL estimates revealed a significant long-run relationship between exchange rate and inflation in Nigeria. The model exhibited long run stability for the period 1986:Q1 to 2024:Q4 given the cumulative sum test. Exchange rate in the model accounted for up to 81.9% of the changes in inflation.

Policy Implication of the Findings

The implications for policy are outlined below:

Change in Nigeria's Trade Policy: The negative effect of balance of trade on inflation means that there is urgent need for Nigeria to make changes to her trade policy so as to attain significant decline in inflation in the long run. This can be done by way of intensifying local production of both oil and non-oil products so as to boost domestic consumption and export surplus. This will drive down domestic prices and ensure balanced trade.

Preference for Contractionary Monetary Policy: Nigeria's interest rate policy is hinged on the central rate (monetary policy rate). Thus, the MPR should be increased so as to make borrowing more expensive and curb consumer excess business spending which is a potential cure for inflation.

Fixed or Managed Floating Exchange Rate Policy: The monetary authority in Nigeria should adopt fixed exchange rate policy which will create a constraint on the domestic money supply and reduce the risk of rapid inflation currently facing Nigeria.



In the absence of strict control over the exchange rate policy, the monetary authority can observe strict compliance with the current managed floating exchange rate policy and ensure that intervention in the foreign exchange market is wide spread and timely to maintain stability in prices and avoid excessive inflation.

VI. CONCLUSION AND RECOMMENDATIONS

The study concludes that exchange rate does actually cause inflation in an open economy such as Nigeria. This is hinged on the evidence that exchange rate fluctuations exerted positive and significant effect on inflation both in the short and long run periods. Additionally, interest rate has immediate positive effect on inflation as it increases inflation in the short run but steadily normalizes in the long run due to some policy impacts. Notwithstanding the intervening role of interest rate, Nigeria's balance of trade showed decreasing effect on price index (inflation) which augurs well for the economy. But the negative effect was not significant which is indicative of a potential increasing effect on inflation. Thus, Nigeria needs to urgently device policies that will hinge on exchange rate stabilization so as to manage increasing inflation in the economy. The recommendations emanating from the study are stated below:

1. The central bank of Nigeria should ensure that they actively manage exchange rate policies by providing foreign exchange timely for exports. This will reduce the pressure on sourcing of foreign exchange and drive down domestic prices.
2. There should be moderate increase in interest rate by commercial banks and the central bank of Nigeria should exercise caution when raising interest rate to control inflation as this will translate into reducing domestic prices. The Central Bank of Nigeria may also use alternative monetary tool such as reserve requirement or Open market operations to manage inflation.
3. Efforts should be made by the government to ensure trade surplus which is associated with lower inflation. This is done by promoting export led growth, diversify export base and improve trade facilities. Goods will become cheaper thus driving down prices and making local production to increase capacity to meet local demands.
4. Government effective overall supervision of the economy is required to ensure that exchange rate fluctuation does not cause too much harm to inflation in the economy. The monetary policy of the government should be targeted towards inflation reduction.

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