Social Sciences Research
Nnamdi Azikiwe University, Awka, Nigeria

SSR
Volume 11 Issue 1
108-136
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https://journals.aphriapub.com/index.php/SSR/about

Revisiting Exchange Rate Dynamics and Inflation Targeting: Evidence from Nigeria

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Abstract

In recent times, the Naira has witnessed abrupt and pronounced depreciation vis-à-vis other currencies due mainly to lack of diversification in production capacities and heavy reliance on the production and export of a single primary commodity. The objectives of this paper are investigating the impact of real exchange rate on inflation in Nigeria; determine the impact of food prices, energy prices and government expenditure in Nigeria and analyze the direction of causality between real exchange rate and inflation in Nigeria. This paper covered the period 1986 to 2023 under the Mundel-Fleming and inflation targeting frameworks. The variables used in this paper are inflation rate, exchange rate premium, nominal interest rate, oil price, government debt and broad money supply, food price, and inflation inertia. 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. This paper concludes that there is indeed a positive relationship between real exchange rate management and inflation targeting for inflation reduction. Strengthening policy coordination and commitment to price stability is a matter of urgency for the policymakers since policy coordination remains a major challenge for fiscal and monetary policy units; commit to countercyclical fiscal policy and initiate policy measures (credit and facilities) to promote the agricultural value-chain.

Keywords: exchange rate premium, food price, government debt, inflation inertia, normalized

Introduction

Inflationary pressure promotes macroeconomic instability, arbitrary redistributions and misallocation of resources, and a significant alteration in the economic growth and development trajectory. At the households' level, it endangers and erodes the purchasing power, savings, and investment, while amplifying poverty, deprivation and shared

prosperity (NESG, 2024). 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. In the recent past, monetary targeting has been a strategic agenda of the Central Bank of Nigeria to control inflationary pressure. This strategy involves adjusting the various monetary policy tools, such as the Monetary Policy Rate (MPR) and Cash Reserve Ratio among others within a given corridor/bands to reign in the growth of the money supply and subdue inflationary pressure. However, despite the monetary policy actions, rising prices amplifies and compounded by the challenges in exchange rate management.

Nigeria has witnessed a tremendous rise in price levels. The annual average inflation rate rose from a single digit of 8.0 percent in 2014 to 24.7 percent in 2023. In April 2024, the monthly inflation rate peaked at 33.7 percent. The food component experienced high inflation, crossing 40.5 percent in April 2024, while core inflation (all items less farm produce and energy) rose to 26. 2 percent (NBS, 2024). The money stock has equally expanded from N15.69 trillion in 2013 to N78.83 trillion in 2023, with an annual average growth rate of 16.7 percent, exceeding the 11.2 percent annual growth of Nigeria's nominal GDP. The consequences are severe including liquidity problems, pressure on the naira value and dampening the purchasing power of income. The bulging money growth is motivated by the following factors: expansion in credit to the economy, rising nominal wage, corruption in public spending, unabating expansion in fiscal deficit and borrowings, low productivity, adverse impacts of policies and reforms, external vulnerability, proliferation of non-state actors, population explosion, high inflation expectation and exchange rate volatility (NESG, 2024). The overriding aim of exchange rate stability is to ensure that critical macroeconomic objectives are achieved. In Nigeria, exchange rate volatility is heightened by the countries over reliance on import, limited foreign exchange (FX) earning sources due to the overreliance on crude oil exports, FX market liquidity, high inflation and speculative activities. These scenarios negatively affect the real exchange rate. Meanwhile, the Central Bank of Nigeria (CBN) has allowed the Naira to trade more freely on a willing-buyer, willing-seller basis since June 2023 and leaned towards inflation

targeting instead of controlling the money supply. In April 2024, the CBN offered to sell dollars to the country's Bureau De Change (BDC) at market –reflective rates and announced that it would ban the use of dollar collateral for Naira loans, except for government Eurobonds and foreign bank guarantees.

The rise in Nigeria's inflation rate has been driven by a pass-through of exchange rate fluctuation. Due to Nigeria's high dependence on imports for raw materials, intermediate inputs, equipment and finished goods, exchange rate volatility causes severe movement in the price level. Under an inflation –targeting framework, the mandate is price stability – reducing inflation, other macroeconomic objectives become subordinated to price stability. Inflation targeting is a monetary policy strategy in which a central bank announces a point, or a range of inflation forecast, it intends to achieve and makes effort to keep actual inflation around the target using interest rate and other monetary policy instruments. Inflation targeting emphasizes transparency and accountability (CBN, 2016). Monetary policy targeting involves the measures through which the Central Bank manages the supply of money, in order to stabilize prices. Though, the primary objective of monetary policy is the attainment of low and stable inflation, the central bank also has the added mandate to promote economic growth and employment. In practice, monetary policy plays a counterbalancing role to address price stability concerns and stabilize the economy (CBN, 2017). The broad objective of this study is to examine the impact of real exchange rate on inflation in Nigeria. Specifically, this study intends to:

- Investigate the impact of real exchange rate on inflation in Nigeria.
- Determine the impact of food prices, energy prices and government expenditure on inflation in Nigeria
- Analyze the direction of causality between real exchange rate and inflation in Nigeria

This paper is structured as follows: Section 1 presents the background information, section 2 presents the literature review while section 3 is on the methodology, model specification, and data sources. Section 4 is on the estimated results and analyses while section 5 presents the conclusion and policy implications.

Empirical Review

There is plethora of empirical evidence on the relationship between exchange rate and inflation in the literature. For example, Okoli, Mbah and Agu (2016) investigated the impact of exchange rate volatility and inflation in Nigeria from $1970Q_1$ to $2014Q_4$ using the GARCH (I, I) and granger causality. The variables used were nominal exchange rate, real exchange rate, interest rate, import, inflation rate and money supply. The granger causality test shows that there is a uni-directional causality running from inflation to real exchange rate volatility. The results also imply that there is a relationship between imported inflation, real exchange rate volatility and other sample variables. The study therefore recommended that the monetary authority should institute an inflation targeting policy to control the fluctuation in the price level as well as other macroeconomic variables with a direct effect on the exchange rate. While the study employed the elasticity approach to exchange rate, the urrent study utilized the Mundel-Fleming and the inflation targeting frameworks. Again, the use of real and nominal exchange rates in a single of exchange rate volatility and inflation may be misleading. Empirical evidence shown by Utazi (2017) concluded that there was no statistically significant effect of the chosen exchange rate regime on the impact of money supply and economic growth in Nigeria between the periods 1961 to 2016. The variables used were the exchange rate regime, broad money supply and gross domestic product.

Ndiaye and Masih (2017) examined inflation targeting and dual banking system in Malaysia between 2007 and 2017 using the error correction model approach. The variables used are inflation rate, real effective exchange rate, statutory reserve rate, narrow money, Islamic interbank rate and the overnight policy of Malaysia. The result showed that there is a long-run and short-run relationship between inflation, narrow money supply, statutory reserve rate, real effective exchange rate and the Islamic interchange rate. The study concluded that inflation targeting may not be ideal in a dual banking system, especially the case of

Malaysia. The previous study is not basically on inflation targeting and real exchange rate but only on inflation targeting as a proper monetary policy regime. Meanwhile, the current study examined inflation targeting and real exchange rate in Nigeria.

Bello and Aliyu (2019) examined inflation dynamic and exchange rate-pass through in Nigeria for the period $1995Q_1$ to $2018Q_2$ using the Smooth Transition Regression (STR) model. The variables used were consumer price index, aggregate import price, real marginal cost, and exchange rate. The empirical evidence revealed the existence of two inflation regimes during the period under review. Food inflation, energy inflation, firm's marginal cost, and imported inflation accounted for most of the changes in the prices of composite consumer's basket in low exchange rate regimes. Similarly, the results show that regime change in inflation is largely caused by exchange rate (transition variable) depreciation or devaluation of the naira. The study recommended that monetary policy response to low inflation regime must target the various components of the consumption basket while effort to curtail persistent high inflation must include a stable exchange rate of the naira.

Falana (2019) investigated exchange rate regimes and real sector performance in Nigeria over the period 1961-2017. The variables used were aggregate output, nominal exchange rate, inflation rate, prime lending rate, net export, credit to the private sector and government capital expenditure. The autoregressive distributed lag model approach was utilized. The results show that a long-term inverse and significant relationship exists between exchange rate and aggregate real output in regulated exchange rate regime but a long-term direct and significant relationship in the guided deregulated regime. The study recommended that the monetary authority should implement coordinated macroeconomic policies that would attract foreign private investment, that would impact inflation positively and stimulate exchange rate stability.

Eneh and Amakor (2021) examined foreign exchange regimes and macroeconomic performance in Nigeria from 1990 to 2020. The variables used were exchange rate, inflation, current account balance and trade openness. The Ordinary Least Square (OLS) techniques were utilized. The study showed that the relationship between exchange rate

regimes and inflation was insignificantly positive, while the relationship between exchange regimes and current account balance (CAB) is positive but not significant at 5% level of significance.

Ighoroje and Orife (2022) examined exchange rate fluctuation and inflation rate in Nigeria between the periods 1987 to 2019- the period of the deregulated Nigerian economy. 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.

Gap in Literature

From the reviewed empirical studies, Ndiaye and Masih (2017) and Valogo *et al.* (2023) examined the relationship between inflation targeting and dual banking system and exchange rate fluctuation and inflation in Malaysia and Ghana respectively. The current paper on the impact of exchange rate and inflation is in Nigeria.While Okoli *et al*(2016) employed nominal exchange rate, real exchange rate, interest rate, import and money supply; Bello and Aliyu(2019) utilized consumer price index, aggregate import, real marginal cost and exchange rate. Falana (2019); Eneh and Amakor(2021) ; Ighoroje and Orife(2022) used aggregate output, nominal exchange rate, inflation, prime lending rate, credit to the private sector and government capital expenditure. The other variables are

current account balance, value of imports and growth rate of GDP. This paper employed real exchange rate, nominal interest rate, oil price, broad money supply, government expenditure, food price and inflation inertia.

In terms of analytical approach, Okoli et *al*. (2016) used the GARCH and causality approach while Bello and Aliyu (2019) used the Smooth Transition regression. Falana (2019) used the autoregressive distributed lag model approach. Eneh and Amakor (2021) used the ordinary least square (OLS) and the Threshold autoregressive (TAR) method. This paper used the Johansen normalized co-integration and Granger causality approaches to bridge the knowledge gaps.

Method

Theoretical Framework

The theoretical frameworks of this study were the Mundel- Fleming exchange rate and inflation targeting models. The Mundell-Fleming model also known as the ISLM-BOP model is an economic model which describes the workings of a small economy (Nigeria) open to international trade in goods and financial assets and provides a framework for monetary (inflation dynamic) policy analysis. One of the basic assumptions of the model is fixed price level. The model is given as:

$$Y = C(Y - T) + I(r^*) + G + NX(e) \quad (3.1)$$

Where Y = output; C = Consumption; Y = income; T = tax; I = Investment, r* = World interest rate; G = Government expenditure; NX = Net export and e = exchange rate. Economic policy depends on the exchange rate system of Nigeria whether fixed, floating or managed float.

Inflation targeting is a monetary policy framework where the Nigerian Central Bank follows an explicit target for the inflation rate for the medium-term. The assumption is that the best that monetary policy authorities can do to support long-term growth of the economy is to maintain price stability, and price stability is achieved by controlling inflation and maintain a stable exchange rate.

Model Specification

The model of this study is a time series model specifying the relationship between the dependent variable inflation and the major explanatory variable exchange rate regime. The model will first be stated in its functional, mathematical and econometric form. The model of this study is specified following the theoretical frameworks-Mundel-Fleming and the Inflation Targeting models and the empirical works of Okoli*et al* (2016); Nwosa and Oseni (2012) and Klau (1998). The model of this study in its functional form is thus specified:

MPR = F (RER, NOR, OILP, M_2/GDP, GOVDBT, FOODP, INFL_1)

(3.2)

Where MPR is the inflation targeting rate; RER is the real exchange rate, NOR is nominal interest rate, OILP is oil price proxy for energy prices, one of the major drivers of inflation in Nigeria outside unstable exchange rate, M2/GDP, broad money supply, measure for money growth, GOVDEBT is government debt and FOODP is food price, another driver of inflation in Nigeria. INFL_1 is the inflation inertia. Equation (3.4), when transformed in its mathematical form becomes:

$$MPR_t = INFR_{t-1} + \beta_1(RER) + \beta_1(NOR) + \beta_2 L_n (OILP) + \beta_3(M_2/GDP) +$$

$$\beta_4 L_n (GOVDBT) + \beta_5 L_n (FOODP) + \quad (3.3)$$

When equation (3.5) was specified in its stochastic/econometric form, it becomes

$$MPR_t = INFR_{t-1} + \beta_1(RER) + \beta_2 (NOR) + \beta_3 L_n (OILP) + \beta_4 L_n(M_2/GDP) +$$

$$\beta_5 L_n (GOVDBT) + \beta_6 L_n (FOODP) + Ui \quad (3.4)$$

Definition of Variables and Justification of the Model

The variables of the model are described and justified for their inclusion. The dependent variable is inflation. The inclusion was based on its dependency on the exogenous factor as explained in the model. The variety of studies has examined the link between inflation and exchange rate (Ighoroje & Orife, 2022; Longinus, 2004; Klau, 1998). *Monetary Policy Rate (MPR):* The monetary policy rate is the dependent variables. Monetary policy rate is the anchor rate. This is the inflation targeting rate used by the central Bank of Nigeria when the

CBN increases or reduces the interest rate to keep inflation at a desirable rate *Inflation Intertia ($INFR_{t-1}$):* Inflation is intertia because of the way people form expectations. It is plausible to assume that people's expectations of inflations depend on recently observed inflation. These expectations then influence the wages and prices that people set (Woodford, 2002; Erleg& Levine, 2003). *Real Exchange Rate (RER):* The exchange rate premium measures the spread between the recognized official market exchange rate and the Bureaux de Change (BDC) rate. The exchange rate premium can also be measured by the differential between the official and inter-bank market exchange rates. The exchange rate premium is not expected to go beyond 5 percent for the foreign exchange market to be considered stable (CBN, 2016; Kallianiotis, 2016). *Nominal Interest Rate (NOTRS):* Generally, lower interest rate means people can afford to borrow more money, so have more money to spend. This makes the economy grow and inflation increase. In short, inflation is one of the indicators used to measure economic growth, which can be controlled by interest rate, which in turn affect inflation. As the economy grows with inflation, the purchasing power of each dollar declines over time (Awomuse & Alimi, 2012). The relationship between nominal interest and inflation rate is summarized by the Fisher hypothesis, which has important implications for monetary policy and Central Banking decision-making (Laatsch & Klien, 2002; Fahmy & Kandi 2003; Akinlo, 2011). *Oil Price (OIL P):* The price at which the crude oil is sold at the international market influences the domestic economy. The oil price-inflation nexus has generated substantial discussion in academic, business and policy circles. Adebayo (2020) suggested a positive co-movement between the inflation and oil price between 2014 M_2 and 2017M_1 and a unidirectional causality running from oil price to inflation. Oil is a major decider of the cost of production. If the oil price increases, it will increase the transportation cost, thereby increasing the cost of goods and services. The relationship between oil price and inflation is ambiguous-negative and positive relationship. *Broad Money Supply (M_2/GDP):* The stock of money in an economy which includes currency in circulation, demand deposit, savings and fixed deposit as well as other assets that is in spendable forms. It is a broad definition of money supply that depends on the jurisdiction (CBN, 2016). Indalmanie showed a feedback effect between inflation and narrow money; a unidirectional causation running from inflation to quasi and broad money. *Government Debt (GOVTDEBT):* This refers to the financial

obligations of a government as a percentage of the market value of aggregate output produced in the country. An increase in the price level directly reduces the real value of government debt, as well as the ratio of debt to GDP. Holding other things constant-higher prices increase nominal GDP. Nguyen (2015) showed that public debt has a significantly positive effect on inflation, while in the opposite direction as inflation has a significantly negative effect on public debt. *Food Price (FOP):* Food prices refer to the average price of food commodities globally and across countries. The price of goods not only provides an important indicator of the balance between agricultural production and market demand, but also has strong impacts on food affordability and income. Egwuma, Ojeleye and Adeola (2017) showed that real GDP, food import and crude oil price were positively related to food price inflation in the long run. However, real GDP and food import were the key determinant of food price inflation.

Estimation Technique and Procedure

This section describes the procedures for econometric estimation of the model in the previous section. Justification of the time series estimation procedure is a necessary first step, since most macroeconomic time series data tend to be non-stationary (with moving means and trend). The Granger causality was utilized as methods of estimation. Traditional Granger causality tests developed by Engle and Granger (1987) and Johansen and Juselius (1990) have been relied upon for identification and wide applicability. However, the reliability of these tests is somewhat constrained by their sensitivity to the values of trend and constant terms infinite samples and consequently, not very reliable for time series sample size (Karimo & Ogbonna, 2017).

Unit Root Test

It is assumed under multiple regression analysis, that, all the series are stationary at level (that is, the order of integration of each of the series is zero, I (0). The unit root test is used to determine the stationarity or non-stationarity of a given time series. The variables in this study were tested for unit root using the Augmented Dickey Fuller (ADF) and Philips-Perron (PP) approaches. The stationarity conditions of the variables are important to avoid the problem of spurious results due to explosive data (Babangida & Asan-UI, 2021).The

ADF test is an extension of the Dickey-Fuller test by allowing a higher order of autoregressive process, such that:

$$\Delta X_t \quad \alpha_o + \alpha_1 X_{t-1} + \alpha_2 t + \sum_{i=2}^{p} b_i \Delta X_{t-I} + U_t \qquad 3.5$$

Where P is the number of lagged changes in X_t necessary to make U_t serially uncorrelated. Testing the null hypothesis H_o: $\alpha_1 = 0$ against the H_a: $\alpha_1 < 0$, the null of unit root is rejected if the observed t-statistic is sufficiently negative compared to the critical value given at the accepted level of significance.

Cointegration Test

The general concept of cointegration is that there exists an equilibrium or a long-run relationship between a set of time-series variables. The series are of different order of integration and therefore, following Pesaran, Shin and Smith (2001), the bound co-integration test become the appropriate test. The autoregressive distributed lag (ARDL) co-integration is specified as follow

$$\emptyset(L, P)Y_t = \sum_{i=1}^{p} \beta_i (L,q_i)\, x_{it} + \vartheta w_t + U_t \qquad (3.6)$$

Where

$\emptyset(L,P) = 1 - \emptyset_1 L - \emptyset_2 L^2$ $\emptyset_p L^p$

$\beta(L,q) = 1 - \beta_1 L - \beta_2 L^2$ $\beta_q L^q$ for i= 1, 2, 3 ……. k, $U_t \sim ii\ d\ (0, \vartheta^2)$

L is a lag operator such that $L^0 y_t = X_t$, $L^1 y_t = Y_{t-1}$ and W_t is the s x 1 vector of deterministic variables such as the intercept term, time trends, seasonal dummies or exogenous variables with the fix lags. P =0, 1, 2 …, m, i = 1,2 …, K: namely a total of $(m + 1)^{k+1}$differentmodels. The maximum lag order, m, is chosen.

Sources of Data

Table 3.1: Sources of Data

Variables	**Definition and Measurement**	**Sources**
MPR	Dependent variable, proxy, monetary policy arte (CPI)	Central Bank of Nigeria (CBN)
$Inflation_{t-1}$	Inflation inertia-proxy, consumer price-index-one	Calculated from CBN
RER	Real exchange rate	CBN
Nominal Exchange rate	% change in er + $(\pi * - \pi)$, domestic inflation and π, foreign country's inflation rate	CBN
Oil P	Oil price, proxy for energy cost	International Energy Agency
M_2/GDP	Broad money supply-proxy for financial deepening	CBN
GOVDEBT	Government debt as a % of GDP	CBN
Food price	Food price as a % of GDP	CBN

Source: Researchers' Compilation (2024)

Estimated Results and Analysis

Descriptive Statistics

Table 4.1 presents the descriptive statistics showing the features of the variables.

Table 4.1: Descriptive Statistics of the Variables

	MPR	**RER**	**INTR**	**OILPRICE**	**M_2**	**GOVTDEBT**	**FOODPRICE**	**INF_1**
Mean	19.059	128.45	18.856	40.87088	8.41E+12	6702.909	89.86398	18.909
Std. Dev.	17.432	112.407	3.866	32.1893	1.1E+12	7559.12	30.198	17.50997
Skewness	1.79148	0.743	0.56569	1.271434	1.237535	1.260794	0.07017	1.78685
Jarque-Bera	25.228	3.680897	2.96349	9.994589	9.50249	9.873901	0.755403	25.01612
Prob.	0.000	0.158	0.227	0.006	0.008	0.007	0.685	0.0000

Note: INF= Inflation; EXCH = Exchange rate premium; INT = Nominal exchange rate; OILPRICE = oil price; M_2= Broad money supply; GOVDEBT = Government Debt; $INFL_1$= Inflation at inertia (previous inflation)

Source: Researchers' computation using EView 12.

To further ensure the reliability of the data set, the correlation matrix results are presented in Table 4.2. It shows the correlation among the explanatory variables with the dependent variable.

Table 4.2: Correlation Matrix (Pairwise)

	INF	**RER**	**INTR**	**OILPRICE**	**M_2**	**GOVTDEBT**	**FOODPRICE**	**INF_1**
MPR	1.00000	-0.405						
EXCH	-0.405	1.00000						
INTR	0.338	-0.029012	1.00000					
OILPRICE	-0.3367	0.15697	-0.4324	1.00000				
M_2	-0.304	0.6934	-0.1671	0.3077	1.0000			
GOVTDEBT	-.0314	0.9603	0.03702	-0.0086	0.699347	1.00000		

FOODPRICE	-0.433	0.93059	-0.1374	0.37058	0.619356	0.850067	1.00000
INF_1	0.6367	0.3995	0.3626	-0.2965	-0.29778	-0.31034	-.0.381617

Source: Researchers' Computation using EView 12

Table 4.3, which show the unit root test for all the time series data using the Augmented Dickey Fuller (ADF) and Phillip Perron test.

Table 4.3: Unit Root Result using Augmented Dickey Fuller (ADF) and Phillip Perron

At level				**At First Difference**			
Variable	**ADF Stat**	**5% Level**	**Prob**	**ADF Stat**	**5% Level**	**Prob Value**	**Order of Integration**
MPR	-0.75382	-2.9484	0.8196	-3.428245	-2.9484	0.0166	I(1)
LEXCH	-2.39382	-2.94383	0.1503	-4.685855	-2.9484	0.0006	I(1)
LINTR	-2.22014	-2.94383	0.2029	-4.4383	-2.9484	0.0012	I(1)
LOILPRICE	-0.64974	-2.94383	0.9893	-5.2787	-2.9484	0.0001	I(1)
LM_2/GDP	-2.29393	-2.94383	0.1503	-3.1653	-2.9484	0.0323	I(1)
LGOVTDEBT	-2.258343	-2.94383	0.0970	-3.4647	-2.9484	0.0152	I(1)
LFOODPRICE	-2.258343	-2.94383	0.7245	-8.026654	-2.9484	0.0000	I(1)

LINF-1	-1.52568	-2.94383	0.1562	-4.705059	-2.9484	0.0008	I(1)

Source: Researchers' Computation using EView 12

Table 4.3 showed that the variables were not stationary at levels. Then, all variables were differenced and were found to be stationary at the 5% significance level. Since all the variables were stationary at the same order of integration, that is 1(1), it indicates the need for further treatment and analysis and hence, the need for co-integration test using Johansen Co-integration test to check for existence of long or short run relationship of the equation. Co-integration enables us to confirm if there is a long-run relationship among the variables. This will help us determine the long-run association among the variable for further forecast and prediction. Table 4.4 presents the co-integration test results.

Table 4.4: Johansen Co-integration Tests

Trace Test				**Max-Eigen Test**		
H_o	**Trace Statistic**	**0.05 Level of Sig.**	**Prob. Value**	**Max-Eigen Statistic**	**0.05 Level of Sign**	**Prob Value**
None*	248.6080	159.5297	0.0000	69.62324	52.36261	0.0004
At most 1*	178.9848	125.6154	0.0000	53.23549	46.23142	0.0077
At most 2*	126.7493	95.75366	0.0001	46.94906	40.07757	0.0072
At most 3*	78.799	69.8889	0.0081	32.54258	33.87687	0.1396
At most 4*	46.257	47.85613	0.0701	23.86220	27.58434	0.5009
At most 5*	22.394	29.79707	0.2771	12.48127	21.13162	0.2740
At most 6*	9.913663	15.49471	0.2874	9.148302	14.26460	0.3817
At most 7*	0.7665362	3.841466	0.3817	0.765362	3.841460	0.0715

Source: Researchers' Computation using EView 12.

From the results presented in Table 4.4, for the trace statistic, there were 4 co-integrating equations at the 0.05 level of significance. For the Max-Eigen, there were 3 co-integrating equations at the 0.05 level of significance. The table showed that using the Trace statistic and Max-Eigen value test, there was co-integration, since at the null hypothesis of none, the probability value is less than 5%. We, therefore, rejected null hypothesis and concluded that there was a co-integration. The long-run equation was provided by the normalized co-integrating coefficients presented in Table 4.5.

Table 4.5: Normalized Co-integrating Coefficients (Standard Error in Parenthesis)

MPR	**RER**	**INTR**	**OILPRICE**	**M_2**	**GOVDEBT**
1.00000	-0.836774	2.394658	1.363066	-6.56E-12	0.22143
	(0.13214)	(0.78805)	(0.15619)	(9.9E-12)	(0.0261)
	FOODPRICE	DEXCHREG			
	0.295606	-2.698090			
	(0.30421)	(6.89216)			

Source: Authors' computation using EView 12

From the results presented in Table 4.5 of the normalized co-integrating coefficients, it was suggested that real exchange rate had a positive relationship with inflation. Note the signs changes when interpreting normalized co-integrating coefficients. As such, a percentage change in real exchange rate resulted to an 84 percent increase in inflation rate, with insignificant standard error of 0.132. Nominal interest rate had a negative relationship with inflation targeting, again with insignificant relationship with inflation targeting. Furthermore, oil price, proxy for energy had a negative relationship with inflation. This implies as oil price increases by 1%, inflation targeting increases by 1.4 percent, all things being equal. On its own, broad money supply had a positive relationship with inflation with a significant standard error. Government debt had a negative relationship with inflation targeting with an insignificant standard error. From the results, food price, another driver of inflation had a negative relationship with inflation targeting in Nigeria, this support the

hypothesis that food prices drives inflation in Nigeria. A percentage increase in food prices resulted to 30 percent increase in inflation, while the exchange rate regime (DEXCHREG) had a positive impact with inflation with a significant standard error. This implies that the exchange rate regimes had a minimal 7 percent impact on inflation in Nigeria. In order to determine the forecasting and the pattern of correlation between inflation and exchange rate regime, this study presented the Granger causality test results in Table 4.6.

Table 4.6: Granger Causality Result

Null Hypothesis	**Obs**	**F-Statistic**	**Prob.**	**Remark**
RER Does Not Granger Cause MPR	35	2.12053	0.1376	None
MPR Does Not Granger Cause RER	35	1.02765	0.3701	
INTR Does Not Granger Cause MPR	35	0.48129	0.6227	Un-directional
MPR Does Not Granger Cause INTR	35	3.63961	0.0384 Unidirectional	
OIL Does Not Granger Cause MPR	35	1.01168	0.3757	None
MPR Does Not Granger Cause OIL	35	0.01704	0.9831	
M_2Does Not Granger Cause MPR	35	1.00735	0.3772	None
MPR Does Not Granger Cause M_2	35	0.20857	0.8129	
GOVDEBT Does Not Granger Cause MPR	35	0.98570	0.3849	None
MPR Does Not Granger Cause GOVDEBT	35	0.43859	0.6490	
FOOD PRICE Does Not Granger Cause MPR	35	4.20242	0.0246	Un-directional
MPR Does Not Granger Cause FOOD	35	0.02637	0.9740	

PRICE		
$INFL_{-1}$ Does Not Granger Cause MPR	35	NA
MPR Does Not Granger Cause $INFL_{-1}$	35	NA

Source: Authors' Computation using EView 12

Table 4.5 presented the Granger causality result which is used to check the robustness of results and to detect the nature of the causal relationship between inflation and exchange rate variables (real exchange rate). From the results presented, there was a feedback effect between real exchange rate and inflation targeting. Moreover, there's a unidirectional causality between real exchange rate and inflation targeting in Nigeria within the reviewing periods. This implies that inflation targeting drives real exchange rate and real exchange rate drives causes inflation targeting. Inflation tends to devalue a currency since inflation can be equated with a decrease in money's buying power. As a result, Nigeria experiencing high inflation tends to see her currency weaken relative to other currencies. Furthermore, in response to an inflation shock, the domestic price level rises on impact, which will tend to make the exchange rate weaker. From the results presented, inflation targeting causes nominal interest rate, i.e, unidirectional and not Vice Versa. A nominal interest rate contains two parts: a real interest rate and an inflation premium. This implies that as the economy grows with soaring inflation rate, the purchasing power of each Naira declines over time. Meanwhile, interest rates and inflation tend to move in the same direction-when inflation is increasing, banks will increase interest rates to encourage spending less and saving more. To ensure the reliability of the estimate for prediction, the residual diagnostic test was carried out. All residual diagnostic tests, namely Breush-Godfrey serial correlation LM, Breusch-Pagan Heteroskedasticity and Jarque-Bera normality were presented in Table 4.7.

Table 4.7: Residual Diagnostic Tests

Test	**Prob.**
Breusch-Godfrey Serial Correlation LM Test	0.06
Breuch-Pagan Heteroskedasticity	0.3058
Jarque-Bera Normality Test	0.635250

Source: Authors' computation using EView 10.

Table 4.7 gives the results for the Breusch-Godfrey test for serial correlation. The probability value of 0.0645 which is greater than 0.05 indicates that the residuals of the variables are not serially correlated. It implies that there is no correlation between consecutive residuals or error term. Thus, the null hypothesis of no serial correlation is not rejected, which satisfies the assumption of no serial correlation. Consequently, the model shows a good precision, therefore could be used for forecasting. The table also shows the result of Heteroskedasticity test by Breusch-Pagan-Godfrey test. Given that the probability value of 0.1892 in greater than 0.05 indicates that the residuals of the variables are homoscedastic. It implies that the error term is the same across all variables of the independent variable. Therefore, the coefficient of the variables is unbiased and could be used for forecasting. Furthermore, the table showed the result of normality test of Jarque-Bera test. The Jarque-Bera has a value of 0.635250, which is greater than 0.05, it indicates that the residuals of the variables are normally distributed which satisfies the normality assumption. In order words, it could be used for forecasting and policies. The model was tested for stability using CUSUM tests and the figure 4.1 showed that it was stable within the 5 percent level of significance over the years under consideration and can be used for policy purposes.

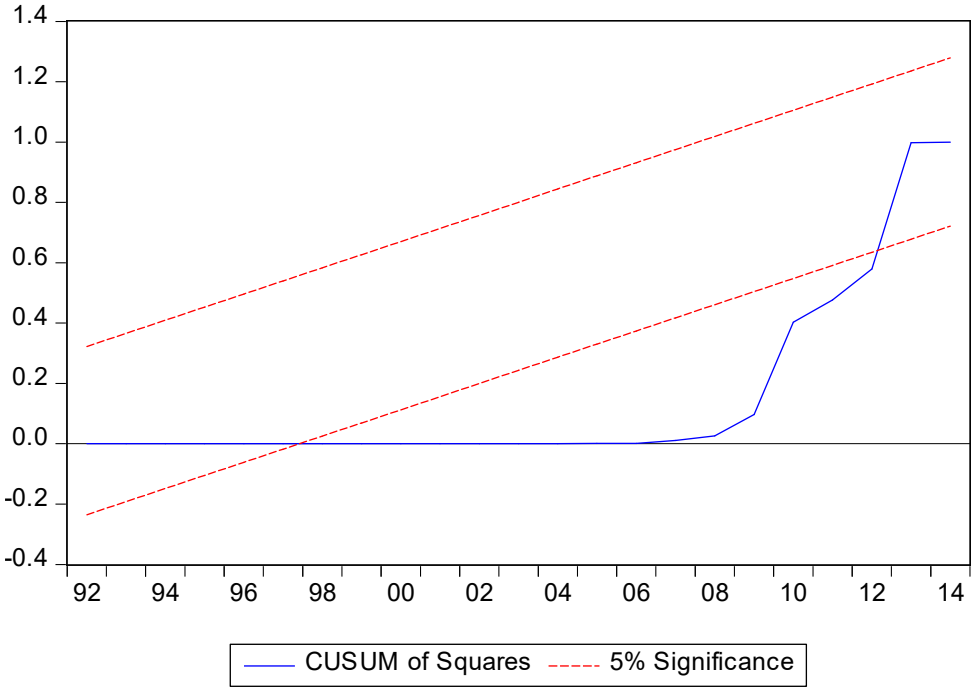

Figure 4.1: Cumulative Sum Square Stability Test

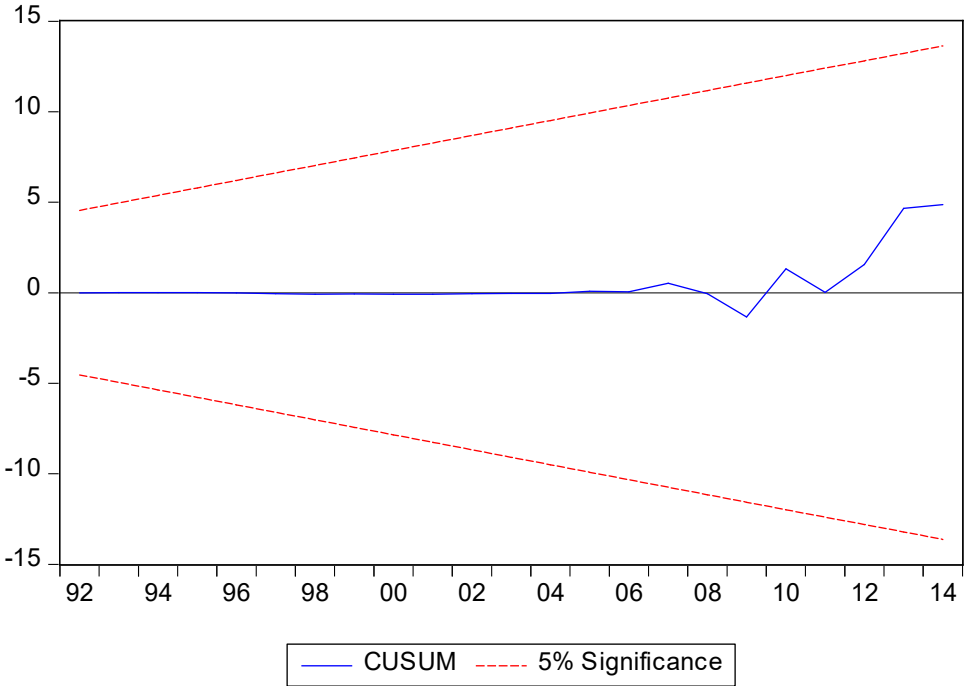

Figure 4.2: Cumulative Stability Test

Discussion

The findings of this study were discussed in line with the objectives of this study, in relation to similar findings and contemporary development in the Nigerian economy. The first objective is to examine the impact of real exchange rate on inflation rate in Nigeria. From the empirical results presented, real exchange rate had a positive relationship with inflation, such that a unit changes in real exchange rate leads to an84 percent increase in inflation rate over the period under review. The outcome is in line with the a-priori expectation. In Nigeria, the low exchange rates have pushed up the cost of imported consumables and raid materials. A major cause of high inflation rate in Nigeria because the country imports a large volume of consumables and raw materials annually at higher prices. A low exchange rate means a higher unit of local currency (NGN) is exchanged for just a unit of the other country's currency (US Dollar). A low exchange rate lowers the prices of exported goods and services but raises the prices of imported goods and services but raises the prices of imported goods and services for consumers in the low-value currency country; this is the case in Nigeria today. This submission is substantiated by the work of Ebeke and Azangue (2015) who submitted that the flexibility of the exchange rate regime shows strong heterogeneity among inflation targeting countries depending on their degree of openness and exposure to foreign exchange risk.

Furthermore, from the results presented oil price, proxy for energy price had a negative relationship with inflation. This implies that as oil price increases by 1 percent, inflation increase by 14 percent, all things being equal. The association between oil price and inflation was much elaborated by Choic, *et al* (2017) who believed a 10 per increase in global oil inflation increases, on average, domestic inflation by 0.4 percentage point on impact, with the effect vanishing after two years and being similar between advanced and developing economies.

Specifically, oil price decrease affects trade balance, inflation, government revenue and exchange rate. The implications are that oil price decreases affects macroeconomic activity in Nigeria than increases as most of the variable's expectation inflation did not respond to increases. In Nigeria today, rising fuel prices increase the cost of transporting goods and

services, and as a result worsen inflation by raising the end price that customers have to pay for all goods. From the result presented, food price had a negative impact on inflation in line with the a-priori expectation, as such a unit change in food prices lead to 30% increase in inflation rate. In a similar study, Adam *et al,* (2012) suggested that while supply-side factors, including yield variability and international price arbitrage, play a major role in determining domestic food and fuel inflation (which together account for almost 60 percent of the total CPI basket), demand-side factors amenable to policy intervention by the monetary authorities anchor core inflation. Nigeria's inflation rate rose from 20.77 percent in September 2022 to 21.09 percent in October 2022 amid soaring food prices (NBS, 2022). According to the Bureau, the rising inflation rate was caused by importation costs, high energy costs following the Russia-Ukraine war, and surging good prices partly caused by climate change-flooding in the most food producing states in Nigeria. On a year-on-year basis in October 2022, the urban inflation rate was 21.63 percent, 5.11 percent higher compared to the 16.52 percent recorded in October 2021 (NBS, 2022). Furthermore, government debt had a negative relationship with inflation targeting in the period under review such that a unit change in government debt increased inflation by 22 percent. This is in line with the a-priori expectation. The association between public debt and inflation targeting was substantiated by Talknice and Odhiambo (2021) who concluded that there are alternative channels through which rising public debt stocks may directly build up inflationary pressures in the economy. First are the upward adjustments in tax rates, which may prompt wage-price spiral and therefore inflation and inflationary expectation (Hilbers, 2005). Second, are the development of negative expectations and perceptions by economic agents regarding higher taxation levels in the future of facilitating government debt repayments (Sims, 2014).These tax uncertainties adversely impact on investment (private and foreign direct), foreign exchange markets, and financial sector stability (Lawal *et al.*, 2018; Zangari, Caiumi & Hemmelgan, 2017).The result of the co-integration test showed 4 co-integration test for the Trace statistics and 3 co-integrating vectors for the Max-Eigen statistics. This implies a long-run relation. Again, from the normalized co-integration coefficients, real exchange rate had positive long-run relationship; nominal interest rate had negative relationship while oil price had negative relationship. Again, Government debt and food prices had a negative relationship as

already justified and in line with the a-priori expectation. Money supply and exchange rate regime had negative relationship with inflation. For example, Ebipre and Amaegberi (2020) showed a positive relationship between money supply and inflation, contrary to the findings of this study. The Central Bank of Nigeria, the Nigerian apex monetary authority reported that the broad money supply increased by 13.8 percent in December 2021. The increase was reported to be driven by the growth in net domestic assets (NDA), which grew by 15.8 percent in December 2021, whereas net foreign assets (NFA), the second component of broad money supply, grew by 6.06 percent. The growth in NDA was essentially credited to an increase in claims on the federal government and the private sector. The rise in NFA and NDA indicates an increase in economic activity. However, the rise in inflation rate in the years 2021 and 2022 may be partly due to the increase in broad money due to lag effects and challenges associated with increase in supply. The Centre for the Study of Economics of Africa (CSEA, 2022) therefore concluded that the CBN interventions targeted to boost output to monitor to ensure that all beneficiaries of the bank's real sector facilities utilize the funds as intended.

The last of the objectives is to estimate the causal relationship between real exchange rate and inflation under the reviewing period. From the result presented the null hypothesis of no causality between inflation and exchange rate regimes under other variables were rejected as the probability values are greater than the 0.05 percent level of significance. Most importantly, there was no feedback effect causality between exchange rate regime and inflation, a unidirectional between real interest rate and inflation. There was no feedback between oil price and inflation; no feedback between broad money supply and inflation; Government debt and inflation. Their relationships were substantiated by Yie, Abdullah and Azam (2017) suggested that inflation granger caused domestic debt, exchange rate granger caused inflation, and domestic debt granger caused exchange rate. The authors cautioned that policy makers need to formulate appropriate and prudent policy, especially in the high inflation period as the impact of exchange rate during inflation period will be stronger.

Conclusion and Policy Recommendation

The main objective of this study is to examine the impact of real exchange rate on inflation targeting in Nigeria from 1986 to 2023. The theoretical framework adopted for this study is that of the Mundel-Fleming and Inflation Targeting model of inflation. The co-integration, and its normalized coefficients and the Granger causality approaches were employed to achieve the objectives of this study and to contribute to extant body of knowledge. Most importantly, oil price, food prices, and exchange rate premium and inflation inertia as empirical contributions to the subject matter of inflation and exchange rate regimes in Nigeria under the review periods. The findings of this paper are in line with the set-out objective. Similarly, the findings of this paper on the long-run relationship are also in line with the objective. Moreover, the findings of this study on the granger causality between real exchange rate and inflation rate in Nigeria holds true.

Policy Recommendations

In line with the findings, the following recommendations are suggested to improve the management of real exchange for inflation control in Nigeria.

i) There is need to ensure proactive monetary policy stance, this will involve discretionary management of the Central Bank balance sheet. Again, in line with one above, the Monetary Policy Rate (MPR) will continue to be the anchor rate for short-term interest rates.

ii) Government debt impacted negatively on inflation. Therefore, the government should monitor the increase in public debt. Hence, there is a need to continue growing the domestic revenue base and increase revenue mobilization efforts and efficiency. This will help to reduce macroeconomic imbalances that lead to public debt and inflationary pressure of fiscal origin.

iii) The monetary policy actions of the Central Bank of Nigeria should focus on taming core inflation in periods of oil price increases while strengthening its efforts at ensuring domestic sustainability in food production through it agricultural intervention programmes to further minimize the impact of oil price shocks on food inflation.

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