

Real Exchange Rate Dynamic and Inflation Targeting Monetary Policy in Nigeria

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Article DOI: 10.48028/iiprds/ijsrssms.v7.i1.23

Abstract

The depreciation or devaluation of the Naira affects the price level and output directly through the importation of goods in which Nigeria is a price taker. The indirect effect of depreciation or devaluation is transmitted through the price of capital goods imported by the manufacturers as inputs in the production process. Thus, this study examined real exchange rate and inflation in Nigeria from the periods of 1986 to 2022 under the Mundel-Fleming and inflation targeting frameworks. The variables utilized in this study are inflation rate, the dependent variables and the covariates of exchange rate premium, nominal interest rate, oil price, government debt and broad money supply, food price, and inflation inertia. The Normalized Co integration and Granger causality approaches were used. The key findings from the normalized co-integration test interpreted under the basis of the ordinary least square showed a positive relationship between real exchange rate and inflation in the long run while the Granger causality result showed no feedback effect between real exchange rate and inflation. Stringent fiscal measures should be initiated by the Government. Hence, there is policy need to continue growing the domestic revenue base and increasing revenue mobilization efforts and efficiency. This will help to reduce macroeconomic imbalances that lead to public debt and inflationary pressure of fiscal origin. Moreover, 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 its agricultural intervention programmes (anchor borrower) to further minimize the impact of oil price shocks on food inflation.

Keywords: *Broad money supply, Food prices, Government debt, Inflation targeting, Nominal interest rate, Real exchange rate, Nigeria*

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Background to the Study

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).

Inflation rate which measures the rate of inflation monthly or annually is computed as a percentage change in consumer price index. In Nigeria, inflation rate is computed from the consumer price index on year-on-year, month-on-month and 12 moving average basis. The Central Bank of Nigeria (CBN, 2016) measures inflation on three categorized basis of headline inflation (all-items inflation), food inflation (farm produced and processed food) and core inflation (All-items less farm produce and energy).

The annual inflation rate in Nigeria eased to 21.34% in December, 2022, decline slightly from a 17.5% year peak of 21.47% in the previous month. It follows consecutive months of monthly increases amid a slight deceleration in prices of food (23.75% against 24.13% in November, 2022), which is the most relevant in the consumer price index (CPI). Prices also rose less for alcoholic, beverages, tobacco and kola (18.10% and 18.4%); clothing and footwear (17.55%); recreation and culture (15.74% and 16.61%) and communication (11.2% vs. 11.54%) (Trading economics, 2023). On a comparative basis, South Africa, the most second largest economy in Africa had an inflation rate of 7.2% in December, 2022 down from 7.4% in the previous month, as expected, but still above the upper limit of the South African Reserve Bank's target range of 3%-5% (Trading Economics, 2023).

Nigeria's annual inflation rate has been on the increase in Nigeria from 16.82% in April 2022, up from 15.92% the previous month driven by food and non-food prices. The annual core inflation, which excludes farm produce, accelerated for the seventh straight month to 17.8% in October, 2022, the highest since January, 2017, from 17.6% in the prior month (NBS, 2022). The National Bureau of Statistics reported further that on-a-month-on-month basis; the headline inflation rate for October 2022 was 1.24% implying a 0.11% lower rate than that recorded in September, 2022 and the percentage change in the average consumer price index (CPI) for the twelve month ending October, 2022 and the average of the CPI for the previous twelve months period was 17.86%, showing a 0.91% increase compared to the 16.96% recorded in October, 2021 (NBS, 2021). On the trend also and on year-on-year basis, in October 2022, the urban inflation rate was 21.63%, 5.11% higher when compared to the 16.52% recorded in October, 2021. Meanwhile, on month—on-month basis, the urban inflation rate was 1.33% in October 2022, this was a 0.12% decline compared to September 2022. According to the NBS report, the rising inflation rate was caused by importation costs, high energy costs and surging food prices among others (NBS, 2022).

Exchange rate is the price of the unit of currency expressed in terms of other currencies. An exchange rate according to CBN (2016) is made up of two components, a domestic currency and a foreign currency. It can be quoted either directly or indirectly. This is the nominal exchange rate. Real exchange rate is the product of the nominal exchange rate (the dollar cost a naira) and the ratio of prices between the two countries. It could also be seen as the current prices businesses and customers will pay to buy a foreign product using their home currencies. It seeks to measure the value of a country's goods against those of another country, a group of countries, or the rest of the world, at the prevailing nominal exchange rate. Direct quotation states the quantity of a domestic currency that is required to purchase a unit of foreign currency. In a quotation, the price of a unit of domestic currency is expressed in terms of the foreign currency (one naira exchanged for US\$650, expressed as N/US\$650). An exchange rate which does not involve the domestic currency as one of the two currency components is referred to as a cross rate.

More dollars translate to more spending, which equates to more aggregated demand. More demand, in turn, triggers more production to meet that demand. Inflation also makes it easier on debtors, who repay their loans with money that is less valuable than the money borrowed. Inflation is good when it is mild at a single digit inflation rate. However, inflation rate is not at a single digit. Over the years in Nigeria, the rate has remained above single digit, despite monetary and exchange rate policy measures. For example, inflationary pressure remained elevated in the first half of 2020. Unlike the first half of 2019 when consumer price index trended downwards, in the first half of 2020, headline inflation, year-on-year(y-o-y) trended upwards from 12.13 percent in January to 12.26 in March, 2019, before peaking at 12.56 percent in June. The headline inflationary outcome was driven by the persistent food inflation shocks, increase in value-added tax (VAT) from 5.0 percent to 7.5 percent and disruptions to global and domestic supply chain (CBN, 2020). For the food inflation(y-o-y), it rose from 15.18 percent during the period, compared with 13.56 percent in the first half of 2019. The increase was persistent during the period, from 14.85 percent in January to 14.98 percent in March and 15.18 percent in 2020. The development was attributed to disruptions in agricultural supply chain; owing to continued conflicts and instability in most food producing regions of the country, the continued implementation of the land border protection policy, as well as COVID-19 pandemic lockdown measures. The situation has remained the same from 2020 to date as inflation is peaking against all measures to check the soaring trend.

Several empirical studies have been carried out on real exchange rate and inflation (Bada, Olufemi & Onyowo, 2016; Bello & Aliyu, 2019; Okoli, Mbah & Agu, 2016; Nwosa & Oseni, 2012; Klau, 1998; Falana, 2019; Ogbonna, 2018; Rutasitara, 2004; Uramah & Illoh, 2018). As good as these previous studies contributes to empirical knowledge, they are flawed. Nonlinearities of inflation dynamics were ignored. A possible effect of these nonlinearities is that policy decisions on inflation would be biased (Bellow & Aliyu, 2019). Majority of these studies never considered major inflation drivers like food prices, energy prices and government debt. These variables were factor in the empirical estimation of the current study. Theoretically, the inflation targeting approach to inflation dynamics was considered a major theoretical departure of this study from previous studies. There are various regimes of

exchange rate management in Nigeria. These were not captured by previous studies. References were made to these policy shifts without empirical validations. This paper included regime dummy to capture the impact of these exchange rate policy shifts from fixed to float-manager and others. The role of exchange rate policy in macroeconomic adjustment has been the subject of renewed controversy over the decades. The sources and the inconsistencies that may arise between the exchange rate dynamics and inflation targeting have also been the subject of considerable attention. Some of the empirical literature reviewed includes Klau (1998) for Nigeria; Longinus (2004) for Tanzania; Ogbonna (2010) for Nigeria; Nwosa and Ogeni (2012) for Nigeria; Okoli *et al* (2016) for Nigeria; Utazi (2017) for Nigeria; Bello and Aliyu (2019); for Nigeria (2019); Falana (2019) for Nigeria and Eneh and Amakor (2021) for Nigeria and Ighoroje and Orife (2022) for Nigeria. These studies and some other cross-country studies have conflicting results. Some recorded positive relationship, others negative and others inconclusive. Most strikingly, the studies in Nigeria ignored the exchange rate regimes. This approach failed in measuring the impact of these policy changes. Therefore, deriving policy implication from these studies may be generally erroneous. Similarly reviewed, some studies focused on volatility or fluctuation and not regime (Ighoroje & Orife, 2022; Okoli *et al* (2016). Theoretically, majority of the reviewed studies focused on the Keynesian or monetarist theories of inflation, but this study was focused on the inflation targeting framework thus bridging the theoretical knowledge gap.

The broad objective of this paper is to examine the impact of real exchange rate on inflation in Nigeria. Specifically, this study intends to:

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

This paper examined the impact of real exchange rate on inflation in Nigeria from 1986-2020. This period is chosen to enhance robustness of discussion in line with the objectives of the study. This study was anchored on the Mundell-Fleming and inflation targeting theoretical approaches. The variables of this study are real exchange rate, nominal interest rate, broad money supply, oil price proxy for energy, food price and government debt. The preliminary test are the descriptive statistics which identifies the statistical features of the included variables, the unit root test which examined the level of integration of these variables and the co integration test which examined the long-run relationship of the variables. The normalized coefficients of these variables interpreted in line with the Ordinary least square approach was used for the analysis as well as the Granger causality, which determined the causality/linkage between exchange rate dynamics and inflation targeting.

Empirical Literature Review

Longinus (2004) examined exchange rate regimes and inflation in Tanzania between the periods 1967-1995. The various variables used were inflation rate, real GDP, broad money supply (M_2) and real minimum wage and exchange rate. The autoregressive distributed lag approach (ARDL) was utilized for this study. The estimation shows that the parallel rate had a

stronger influence on inflation up until the early 1990s compared with the official rate. The study is quite related to the present. However, it was conducted in Tanzania while the current study is on Nigeria. While both studies used both the official and parallel exchange rates, the present study used the exchange rate premium. Again, the former never captured these regimes whereas the present study incorporated these policy shifts over the periods.

Aizenman, Hutchinson and Noy (2008), explored the relationship between inflation targeting and real exchange rates in emerging markets. Some of the variables used are nominal interest rate, international reserve accumulation, the output gap and inflation rate. The fixed-effects least square (LSDV) were used as the analytical technique. The implication of the result is that both inflation and real exchange rates are important determinants of policy interest rates. The results further showed that the response to real exchange rates is strongest in those countries following inflation targeting policies that are relatively intensive in exporting basic commodities. This past study focused on 16 emerging countries, while the current study focused on Nigeria, a sub-Saharan African country.

Ogbonna (2010), analyzed inflation dynamic, exchange rate and efficacy of monetary policy in Nigeria from 1960-2008. The variables of the study were exchange rate, money supply and trade balance. The vector autoregressive model (VAR) was utilized. The result showed that the deregulation of the domestic economy as occasioned by Structural Adjustment Programme (SAP) has significantly diluted the efficacy of exchange rate as a monetary policy instrument for the management of Nigeria's aggregate money stock and trade balance developments. The study recommended that the Central Bank of Nigeria (CBN) can continue to play a stabilizing role in the economy through the continuation of prudent monetary policies and frequent interventions in exchange rate management to smoothen out shocks. This study is merely on the promotion of monetary policy and the Nigerian economy. It may not be directly connected with exchange rate regime and inflation dynamic evaluation.

Tahir (2011) investigated the relationship between inflation targeting, exchange rate and financial globalization in emerging countries. The variables used are inflation, output gap, interest rate and exchange rates. The Generalized Method of Moment was used in the analysis. The study showed that the response of Central Bank to the exchange rate in case of Brazil, Chile, Mexico and Thailand is statistically significant while insignificant for Korea and Czech Republic. The previous study deviated by extending the attention to financial globalization which may be outside the scope of inflation targeting. This is the major difference between this study and the previous studies.

Nwosa and Oseni (2012), examined the nexus among monetary policy, exchange rate and inflation rate in Nigeria spanning 1986 to 2010. The study employed the co-integration and multivariate vector error correction model approach to examine both the long-run and the short-run linkages among the variables. The variables used were interest rate, exchange and inflation rates. The VECM estimates show that a uni-directional causality exists from exchange rate and inflation rate to short-term interest rate, while a bi-directional causality exists from inflation rate to exchange rate. The study recommended appropriate control and

management of both the exchange rate and inflation rate. Meanwhile, the study ignored the role of government and institutional framework in exchange rate management. Moreover, the deduction of the study on exchange rate and inflation rate granger causing a change in monetary policy could be misleading since the VECM exposes only the impulse response function and variance decomposition of the shock of one variable on another and own shocks.

Ebeke and Azangue (2015), examined inflation targeting and exchange rate regimes in emerging markets from the period 1978 to 2014 using a large sample of emerging markets and after controlling for the selection bias associated with the adoption of inflation targeting. The variables used are financial instability, external debt, and financial development, inflation and exchange rate pass-through and economic openness. The technique employed was that of the ordered probit/ tobit binary approach. The result showed that inflation targeting countries on average have a relatively more flexible exchange rate regime than other emerging markets. The result further showed that the marginal effect of inflation targeting adoption on the exchange rate flexibility increases with the duration of the inflation targeting regime in place, and with the propensity scores to adopt it. While the study focused on emerging market, the current study went ahead to examine the impact of broad money supply, food price, nominal interest rate and government debt on exchange rate premium, which is an addition to empirical variables used by previous authors.

Okoli, Mbah and Agu (2016), investigated the impact of exchange rate volatility and inflation in Nigeria from 1970Q₁ to 2014Q₄ 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 current 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. While the reviewed study focused on exchange rate volatility, the current study focused on exchange rate regimes.

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. While the study focused on money supply which is not inflation, the present study focused on inflation. Again, the use of Ordinary Least Square (OLS) technique is a study of exchange rate regime without considering the time series properties is prone to spurious regression.

Bello and Aliyu (2019), examined inflation dynamic and exchange rate-pass through in Nigeria for the period 1995Q₁ to 2018Q₂ 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. While the study employed the new Keynesian Philips curve approach (NKPC), the current study utilized the inflation targeting (IT) approach in the estimation exercise, thereby bridging the knowledge gap. The previous study used the STR while the current study used the Granger causality test.

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. The study lacked information on exchange rate regime, the focus of the study as the regimes were in no way reflected in the empirical validation, a major flaw of the study. Again, the use of credit to the private sector as proxy for real sector performance is questionable. The real sector performance could have been proxy by total factor productivity (TFP) or manufacturing output or agricultural output.

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. The use of OLS by the study without preliminary test of unit root tests has rendered the study spurious and therefore, economic policy prescriptions may be misleading.

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. While the study is on exchange rate fluctuation, the current study is on exchange rate regimes. The use of OLS by the study is a poor estimation of exchange rate fluctuation and therefore the shocks of exchange rate on inflation rate were poorly determined by the study.

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. Again, unlike previous studies that examined the threshold effect of inflation targeting of real exchange rate, this current study examined the relationship between inflation and real exchange rate in Nigeria.

Methodology

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:

$$Y = C(Y - T) + I(r^*) + G + NX(e) \quad (1)$$

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 Okoliet *al* (2016); Nwosa and Oseni (2012) and Klau (1998). The model of this study in its functional form is thus specified: $MPR = F(RER, NOR, OILP, M_2/GDP, GOVDBT, FOODP, INFL_1)$ (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, M_2/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:

$$MPR_t = INFR_{t-1} + \beta_1(RER) + \beta_1(NOR) + \beta_2L_n(OILP) + \beta_3(M_2/GDP) + \beta_4L_n(GOVDBT) + \beta_5L_n(FOODP) + \quad (3)$$

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

$$MPR_t = INFR_{t-1} + \beta_1(RER) + \beta_2(NOR) + \beta_3L_n(OILP) + \beta_4L_n(M_2/GDP) + \beta_5L_n(GOVDBT) + \beta_6L_n(FOODP) + U_i \quad (4)$$

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 in order to keep inflation at a desirable rate.

Inflation Intertia (INFR)

Inflation is inertia 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 2017 M_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 particular 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 pre and post estimation examinations were tested. The data set is presented in Table 1.

Table 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 + (* -), domestic inflation and , 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 (2023)

Result Presentation, Analyses and Discussion of Findings

This session presents the estimated results as shown in Table 1

Table 1a: 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 10.

Table 1 of the descriptive statistics of the variables showed the result in term of characteristics of the variables. From the result presented, inflation which is the dependent variable had an average value of 19.06 percent during the reviewing period. This implies that the major

explanatory variable, exchange, proxy by RER and the control variables may have had so much influence on inflation targeting. Exchange rate premium had an average of N128.45k to 1 dollar; while nominal interest rate had 18.856 percent. Mostly, inflation inertia had 18.909 percent, very close to the current rate of 19.059. This implies and supports the hypothesis that past inflation trend has a major explanation on current inflation rate. The results show that all the variables are positively skewed to the right of the normal distribution of the variables. The skewness ranges from 0.037 to 1.79. The kurtosis showed that inflation and inflation inertia are the two variable above the standard values and kurtosis value of less than or equal to 3. At kurtosis of 4, the variables are leptokurtic, which implies excess kurtosis, which is the tailedness of the distribution of inflation and inflation inertia relative to the normal distribution. The rest of the variables ranges between 1.148485 to 3.801382, which implies that they are platykurtic with low kurtosis and mesokurtic (medium tails). The Jarque-Bera statistic showed that the variables are non-negative with significant and non-significant variables in line with the 0.05 level of significance. From the Jarque-Bera results monetary policy rate, oil price, broad money supply, exchange rate, Government debt and inflation inertia are significant while exchange rate premium, nominal interest rate, and food price are insignificant.

To further ensure the reliability of the data set, the correlation matrix results are presented in Table 2. It shows the correlation among the explanatory variables with the dependent variable.

Table 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	-	1.00000					
		0.029012						
OILPRICE	-0.3367	0.15697	-0.4324	1.00000				
M₂	-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	
INF₁	0.6367	0.3995	0.3626	-0.2965	-0.29778	-0.31034	-0.381617	

Source: Researchers' Computation using EView 10

From the results presented in Table 2, inflation targeting is negatively correlated with real exchange rate, oil price, broad money supply and government debt, especially when the debt is financed by currency printing. It was also indicated that inflation was negatively correlated with food price. This supports that fact that in Nigeria, inflation is driven by nominal exchange rate, oil price, broad money supply, and government debt and food price. From the correlation matrix result, inflation is correlated at 0.64 percent to inflation. Expectations of the inflation targeting are formed on the basis of actual inflation that occurred in the recent past, the adaptive expectation. Furthermore, the exchange rate regime is correlated with inflation at 0.10 percent. This implies that the MPR changes had a minimal impact on inflation in Nigeria.

From the result presented, real exchange rate was highly correlated with government debt and food prices. A country with high debt could cause a fall in the value of the currency as in Nigeria today, especially in the case of not serviced debt. When default becomes likely, foreign investors will want to sell government bonds in that country. That can have the effect of reducing the value of the domestic currency. Exchange rate movements are thought to affect the domestic price level mainly through the prices of imports: exchange rate appreciation makes imports cheaper; this in turn retards increases in the prices of domestic goods through cheaper imported inputs and through competition from cheaper finished imported goods.

Table 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 10

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 presents the co-integration test results.

Table 4: Johansen Co-integration Tests

Trace Test				Max-Eigen Test		
H ₀	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 10.

From the results presented in Table 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.

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 5.

Table 5: Granger Causality Result

Null Hypothesis	Obs	F-Statistic	Prob.	Remark
RER Does Not Granger Cause MPR	35	2.12053	0.1376	Feedback
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	
OIL Does Not Granger Cause MPR	35	1.01168	0.3757	Feedback
MPR Does Not Granger Cause OIL	35	0.01704	0.9831	
M ₂ Does Not Granger Cause MPR	35	1.00735	0.3772	Feedback
MPR Does Not Granger Cause M ₂	35	0.20857	0.8129	
GOVDEBT Does Not Granger Cause MPR	35	0.98570	0.3849	Feedback
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 PRICE	35	0.02637	0.9740	
INFL ₋₁ Does Not Granger Cause MPR	35	NA		
MPR Does Not Granger Cause INFL ₋₁	35	NA		

Source: Authors' Computation using EView 10

Table 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. This explains the causality between inflation targeting and nominal interest rate. From the result also, food price has uni-directional relationship with inflation rate. Rapid increases in food prices have been one of the main drivers of quickening inflation in Nigeria and around the world. Global inflation was generally moderating when the pandemic began, and the downward trend continued into the early months of the crisis. But surging prices since late 2020 have pushed inflation steadily higher. The average global cost of living has risen more in the 18 months since the start of 2021 than during the preceding five years combined (Barrett, 2022).

Crude oil is a major economic input, so a rise in oil prices contributes to inflation, which measures the overall rate of price increases across the economy. Rising fuel prices increases the cost of transporting goods and services, and as a result worsened inflation by raising the end price that customers have to pay for all goods. 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 6.

Table 6: Residual Diagnostic Tests

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

Source: Authors' computation using EView 10.

Table 6 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 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.

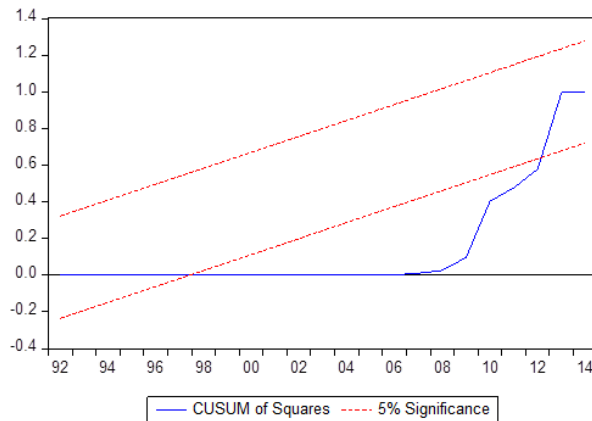


Figure 1: Cumulative Sum Square Stability Test

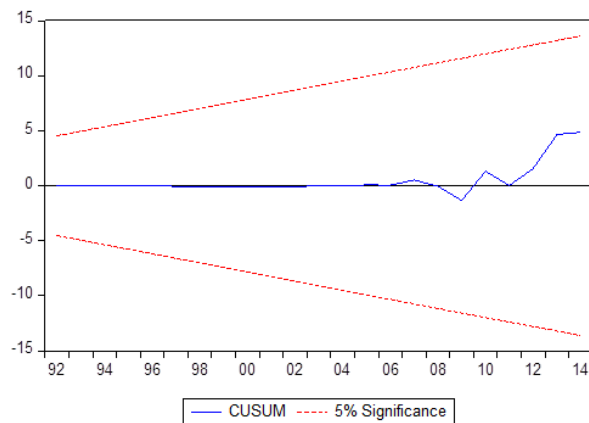


Figure 2: Cumulative Stability Test

Discussion of Findings

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 an 84 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 raw 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 was of the opinion that 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.

Policy Implication of Findings

The applications of these findings in practical terms are summarized thus:

- (i) The normalized co-integrating coefficients showed that there is a positive relationship between real exchange rate and inflation targeting. These suggest that policy makers need to initiate exchange rate and inflation targeting monetary policy measures to maintain the stability of the Naira for inflation control in Nigeria.
- (ii) The empirical result also suggested that nominal interest rate and negative relationship on inflation targeting. This suggests that the monetary authority; the CBN-needs to critically evaluate the extant monetary policy rate so as to reduce inflation rate through the adjustment of the interest rate above the current 17.5 percent band.

- (iii) It was also suggested that the government debt impacted negatively on inflation targeting during the reviewing period. This implies that the Government needs to re-evaluate the debt stock so as to cushion its impact on inflation in Nigeria.
- (iv) Oil and food prices both had negative impacts on inflation targeting in Nigeria within the reviewing periods. This implies that the government and policymakers should initiate macroeconomic policy measure to control the negative impacts of oil price shocks and food/agricultural prices on shocks and food/agricultural prices on the economy.

Conclusion and Policy Recommendation

Conclusion

The main objective of this study is to examine the impact of real exchange rate on inflation targeting in Nigeria from 1986 to 2021. 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, 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 study on the impact of real exchange rate and inflation rate 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 policy implication of findings, the following recommendations are suggested to improve the management of 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.
- ii) Again, in line with one above, the Monetary Policy Rate (MPR) will continue to be the anchor rate for short-term interest rates.
- iii) Government debt impacted negatively on inflation. Therefore, the government should be mindful of increases 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.
- iv) 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 (Anchor Borrowers) to further minimize the impact of oil price shocks on food inflation.
- v) Again, the fiscal authorities should ensure that the fiscal stance is not excessively procyclical in periods of rising oil prices.

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