# Macroeconomic Indicators and Exchange Rate in Nigeria

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## Abstract

The effect of macroeconomic indicators on exchange rate has attracted considerable research interests in recent times. This is because interplay of macroeconomic indicators serves as barometer for measuring exchange rate. This study empirically examines the effect of selected macroeconomic indicators on exchange rate in Nigeria between 1985 and 2022 using Autoregressive Distributed Lag (ARDL) technique. The study proxy exchange rate by real exchange rate while the selected macroeconomic indicators used are real gross domestic product, money supply, degree of openness and gross fixed capital formation. The study made use of time series data which were sourced from Central Bank of Nigeria (CBN) statistical bulletin. The study tested for stationarity of the time series data with Augmented Dickey Fuller statistic and the result suggested a mixed order of integration. The result of the ARDL showed that real gross domestic product, money supply and gross fixed capital formation have positive and significant effect on real exchange rate in Nigeria while degree of openness has a negative and non-significant effect on real exchange rate in Nigeria. Based on these findings, the study therefore, concluded that macroeconomic indicators play a significant role in exchange rate in Nigeria. The study recommended among others that Central Bank of Nigeria should formulate effective monetary and fiscal policies that will stabilize the Naira against other currencies especially Dollars and Pounds Sterling as well as allow such policies to complete their gestation period before subjecting them to change; government should put in place monetary and fiscal policies that would bring about stability in exchange rate; and that government should formulate policy that is aimed at raising broad money supply; which will in turn encourage and increase investment activities in the country and bring about appreciation in exchange rate.

**Key words:** Real Exchange Rate, Real Gross Domestic Product, Money Supply, Degree of Openness, Gross Fixed Capital Formation

## Introduction

The concept of exchange rates is fundamentally linked to the uneven distribution of resources across the globe, necessitating a system of economic interdependence among nations. In the arena of international trade, where countries exchange goods and services essential for development, there arises a need for a universally accepted payment method. This necessity gave birth to the foreign exchange system, wherein exchange rates serve as a crucial metric, quantifying the value of one currency relative to another.

Exchange rates are pivotal in shaping economic policies and reform programs, particularly in nations like Nigeria, where they directly influence macroeconomic goals such as price stability, balance of payment equilibrium, full employment, equitable income distribution, and overall economic growth and development (Obansa, Okoroafor, Aluko & Millicent, 2013). The significance of exchange rates extends beyond domestic borders, impacting international trade, economic stability, external balance, and competitiveness through the pricing mechanisms of both foreign and domestic commodities, services, and assets (Asinya & Takon, 2014).

Since its independence in 1960, Nigeria has experimented with various exchange rate policies aimed at achieving a realistic rate that promotes efficient foreign exchange allocation and sustainable economic growth. The Nigerian naira enjoyed relative stability from 1973 to 1979, during the oil boom and when agriculture dominated the nation's GDP (Ewa, 2011). However, significant changes occurred in 1986 with the adoption of the Structural Adjustment Policy (SAP), transitioning from a pegged to a flexible exchange rate regime, though it currently operates under a managed float system. This system allows for periodic interventions by monetary authorities to meet strategic economic objectives, yet it has also contributed to the naira's instability and frequent fluctuations, affecting economic growth (Adeniran, Yusuf, & Adeyemin, 2014).

Furthermore, macroeconomic indicators have been identified as key determinants of exchange rate fluctuations. These indicators, which include GDP, inflation rate, unemployment rate, balance of payments, and government budget deficits, provide insights into the economic conditions that influence currency valuation (Etale & Eze, 2019). Factors such as real GDP, money supply, economic openness, and gross fixed capital formation are particularly influential in stabilizing exchange rates, underscoring their importance in strategic economic planning and policy formulation.

The Nigerian economy has faced numerous challenges over the years, failing to harness its economic potential for rapid growth and development despite numerous and frequently changing exchange rate and other macroeconomic policies. Additionally, a realistic exchange rate for the naira has not been established despite various methods adopted to determine it in Nigeria. This is because the existing exchange rate systems have continued to widen the gap between the official and parallel markets and have also failed to stabilize the exchange rate or maintain favorable

external reserve positions that would ensure external balances. Moreover, macroeconomic indicators such as the balance of payments, import obligations, inflation rate, and national savings indicate that Nigeria has not performed well in recent years.

Furthermore, the consistent depreciation of the exchange rate since the introduction of foreign exchange auction sessions in 1986 suggests fundamental issues in Nigeria's exchange rate management system. As a result, fluctuations in the naira's exchange rate have been a source of various problems for the Nigerian economy. These fluctuations create significant uncertainty about the future direction of the economy, leading to market failures. Additionally, the changes in the exchange rate have posed numerous challenges to the Nigerian manufacturing sector, weakening and narrowing its productive base due to rising import bills. In response to these issues, this study asked the following questions; How does real gross domestic product affect exchange rate in Nigeria? to what extent does money supply affect exchange rate in Nigeria? what is the effect of degree of openness on exchange rate in Nigeria? and how does gross fixed capital formation affect exchange rate in Nigeria? Against this background, the study empirically determines the effect of selected macroeconomic indicators on exchange rate in Nigeria. Specifically, the study examines the effect of real gross domestic product, money supply, degree of openness and gross fixed capital formation on exchange rate in Nigeria.

## Literature Review

### Purchasing Power Parity (PPP) Theory

The Purchasing Power Parity (PPP) theory was propounded by Professor Gustav Cassel of Sweden in 1918. The PPP theory has a long history in economics, dating back several centuries, but the specific terminology of "purchasing power parity" was introduced in the years following World War I during the international policy debate concerning the appropriate level for nominal exchange rates among the major industrialized countries after the large-scale inflations during and after the war (Cassel, 1918).

Purchasing Power Parity (PPP) is an economic theory that states that the nominal exchange rate between two currencies should be equal to the ratio of aggregate price levels between the two countries, ensuring that a unit of currency from one country will have the same purchasing power in a foreign country. The exchange rate between two currencies is thus equal to the ratio of the currencies' respective purchasing power. The theory assumes that under certain circumstances (for example, as a long-run tendency), it would

cost exactly the same amount in, for example, US dollars to buy Euros and then use the proceeds to buy a market basket of goods as it would to use those dollars directly in purchasing the market basket of goods. A decline in either currency's purchasing power would lead to a proportional decrease in that currency's valuation on the foreign exchange market (Ohiria, Saliu & Schuller, 2008). The concept of purchasing power parity allows one to estimate what the exchange rate between two currencies would need to be for the exchange to be at par with the purchasing power of the two countries' currencies. Using that PPP rate for hypothetical currency conversions, a given amount of one currency thus has the same purchasing power whether used directly to purchase a market basket of goods or used to convert at the PPP rate to the other currency and then purchase the market basket using that currency. PPP exchange rates aid in costing but exclude profits. Thus, it is considered a more efficient methodology than the use of market exchange rates, assuming that two countries produce the same physical amounts of goods as each other in each of two different years. Since market exchange rates fluctuate substantially, when the Gross Domestic Product (GDP) of one country measured in its own currency is converted to the other country's currency using market exchange rates, one country might be inferred to have higher real GDP than the other country in one year but lower in the other; both of these inferences would fail to reflect the reality of their relative levels of production.

**The Two-Gap Model**

The two-gap model was postulated by two theorists, Harrod (1939) and Domar (1946) and their theory is regarded as a post Keynesian growth model for closed economies. The major component of the model states that most countries are underdeveloped either because they are faced with a shortage of domestic savings to augment for investment opportunity or they are faced with foreign exchange constraints to finance the needed capital and international goods. The model therefore, introduces the assumption that an imported commodity not produced domestically is essential for the production of investment goods. The model is represented thus:

$$Y = C + I + (X-M) \quad (2.1)$$

where: (X-M) equals to net export.

Equation (2.1) can be rearranged as:

$$Y + M = C + I + X \quad (2.2)$$

Thus, sources of income in the economy = uses of resources in the economy.

Equation (2.2) can be broken down further to:

$$S + C + M = C + I + X \quad (2.3)$$

Subtracting C from both sides and defining savings (S= Y-C),

$$S + M = I + X \quad (2.4)$$

The two-gap model is then represented by:

$$M-X = I-S \quad (2.5)$$

(Foreign exchange gap) = (Savings gap).

In essence therefore, the model states that if the available domestic savings fall short of the level necessary to achieve the target rate of growth, a savings-investment gap is said to exist. And to close this gap requires Foreign Direct Investment (FDI); so also, if the maximum import requirement needed to achieve the growth target are greater than the maximum possible level of export, this is a situation of high importation which will lead to a shortfall in the foreign exchange. This creates the trade gap which can be corrected by foreign aid. Despite the plausible contribution of this model, however, as observed by Abdullahi, Aliero and Addullahi (2013) the model is not immune to some weaknesses, as it focuses exclusively on the savings-investment gap to achieve growth. By not considering the performance of the external sector of the borrower's economy, the model is silent on this transformation problem being a close economy growth model.

**Empirical Literature**

Kenny (2019) employed an econometric approach to assess the relationship between effective real exchange rate and selected macroeconomic variables in Nigeria from 1981to 2014. This study investigated the relationship between real exchange rate misalignment and economic growth as well as examine the short run and long run relationship between real effective exchange rates misalignment and macroeconomic performance. The study found evidence of a long run relationship between real effective exchange rate and macroeconomic variables with 46 percent speed of adjustment. Also, the positive relationship exists between effective exchange rate, openness and terms of trade indicated that the Nigerian economy is highly opened and this openness has made it highly vulnerable to external shocks and exchange rate policy changes. Likewise, the real gross domestic leads to the appreciation of naira. Hence, the government should stimulate the productive sector of the domestic economy.

Ibi, Eja and Ojong (2019) ascertained how changes in selected macroeconomic variables affect money supply growth as well as testing the money supply endogeneity hypothesis in Nigeria. To achieve the above objectives, the study employs the Augmented Dickey Fuller (ADF) and Philip-perron (PP) unit root test, cointegration test, Granger causality test and Error correction mechanism (ECM) in testing and in the estimation of the relevant equations. The results of the cointegration tests showed that there is a long-run relationship among the macroeconomic variables in the model. The results of the short-run and the long-run estimates revealed that income (GDP), credit to the private sector (CPS), net foreign asset (NFA), government expenditure (GEXP), consumer price index (CPI), interest rate (IR) and exchange rate (EXCH), all have both short-run and long-run significant effect on money supply. Furthermore, the results of the granger causality test showed that money supply is endogenously determined in Nigeria; thereby supporting the postKeynesian postulation that money supply is endogenous. This indicates that macroeconomic variables had greater influence in determining the rate of money growth in Nigeria. From the findings, it was recommended that in order to achieve a sustainable level of money supply growth that will be consistent with the projected growth rate of the economy, more credit should be allocated to the core private sector of the economy.

Ngerebo-a and Ibe (2013) investigated the causal relationship between exchange rate, balance of payment, external debt, external reserves, gross domestic product growth rate and inflation rate in Nigeria post Structural Adjustment Programme (SAP). Annual time series data 1987-2011 were used as the research sample period. The data were sourced from CBN Statistical Bulletin and Annual Reports of various years. The Johansen cointegration test, equation estimation and Granger causality tests were applied. Johansen cointegration result shows that there exists a long-run equilibrium relationship among the indicators. The Granger causality test between the dependent and independent variables shows a unidirectional causality from exchange rate to BOP, external reserves and gross domestic product growth rate. The independent variables indicate a unidirectional causality from gross domestic product growth rate to external reserve.

## Methodology

The ex-post facto research design was used in the study. Annual time series data were sourced from Central Bank of Nigeria (CBN) and World Development Indicators (WDI) of World Bank. The study adopted the multiple regression model.

The functional form of the model is:

$$REF = F(RGDP, MS, DOP, GFCF) \quad (3.1)$$

The econometric specification of the model is:

$$RER_t = \beta_0 + \beta_1 RGDP_t + \beta_2 MS_t + \beta_3 DOP_t + \beta_4 GFCF_t + \mu_t \quad (3.2)$$

Based on economic theory (a priori) $\beta_1 - \beta_4 < 0$

The autoregressive distributed lag (ARDL) model for market capitalization is provided as follows:

$$RER_t = \alpha_0 + \sum_{i=1}^{K} \alpha_{1i} \Delta RGDP_{t-1} + \sum_{i=1}^{K} \alpha_{2i} \Delta MS_{t-1} + \sum_{i=1}^{K} \alpha_{3i} \Delta POP_{t-1} + \sum_{i=1}^{K} \alpha_{4i} \Delta GFCF + ß_1 iRGDP_{t-1} + ß_2 MS_{t-1} + ß_{3i} DOP_{t-1} + ß_{4i} GFCF_{t-1} + U_t \quad (3.3)$$

Where:

RER = Real Exchange Rate

RGDP = Real Gross Domestic Product

MS = Money Supply

DOP = Degree of Openness

GFCF = gross fixed capital formation

$f$ = Function of

$\beta_0$ = the intercept/constant variable

$\beta_1 - \beta_4$ = parameters of RGDP, MS, DOP and GFCF respectively. In addition, $\beta_1$, $\beta_2$, $\beta_3$, $\beta_4$ represent the rate of change in RER for each unit change in RGDP, MS, DOP and GFCF respectively; $t$ = time; $\mu_t$ = disturbance term which is a random (stochastic) variable that has well defined probabilistic properties.

Where: $\alpha_0$ = intercept; $\alpha_1 - \alpha_4$ = short run dynamic coefficients of the explanatory variables;

$ß_1 – ß_4$ = long run multipliers;

$\Delta$ = first difference operator;

K = maximum lag order automatically selected based on AIC; and i and t denote country of study and timeframe respectively.

**Data Analysis and results**

**The ADF Unit Root Test**

| | At Levels | | At First Difference | | | |
|---|---|---|---|---|---|---|
| **Variables** | **ADF** | **Mackinnon Critical Value at 5%** | **ADF** | **Mackinnon Critical Value at 5%** | **Remark** | **Order of Integration** |
| $InRER_t$ | -3.356154 | -2.943427 | - | - | Stationary at Level | I(0) |
| $InRGDP_t$ | -0.740884 | -2.945842 | -3.980581 | -2.945842 | Stationary at 1st Difference | I(1) |
| $InMS_t$ | -2.184773 | -2.943427 | -4.206221 | -2.945842 | Stationary at 1st Difference | I(1) |
| $InDOP_t$ | -3.484656 | -2.943427 | - | - | Stationary at Level | I(0) |
| $InGFCF_t$ | -1.441958 | -2.943427 | -4.702414 | -2.945842 | Stationary at 1st Difference | I(1) |

Source: *Author's Computation, 2023.*

The results of the Augmented Dickey Fuller (ADF) unit root test, as shown in the table, indicate that at a 5% level of significance, the ADF test statistics for the real exchange rate (RER) and degree of openness (DOP) are greater in absolute value than their respective critical values. This indicates that the real exchange rate (RER) and degree of openness (DOP) were stationary at levels and were therefore integrated of order zero [i.e., I(0)]. On the other hand, the ADF test statistics for real gross domestic product (RGDP), money supply (MS), and gross fixed capital formation (GFCF) are greater in absolute value than the critical value. This indicates that real gross domestic product (RGDP), money supply (MS), and gross fixed capital formation (GFCF) were stationary at the first difference and were therefore integrated at order one [i.e., I(1)].

**Bounds Cointegration Test**

| Null Hypothesis: No Long-Run Relationships Exist | | | | |
|---|---|---|---|---|
| Critical Value Bounds | | | | |
| T-statistic | Value | Significance | I(0) | I(1) |
| F-statistic | 5.448434 | 10% | 2.2 | 3.09 |
| K | 4 | 5% | 2.56 | 3.49 |
| | | 1% | 3.29 | 4.37 |

**Source:** *Author's Computation, 2023.*

Since the computed F-statistic (5.448434) is greater than upper bound critical value (3.49) at 5% significant level, there is sufficient statistical evidence to conclude that there exists a long run relationship or

cointegration among real exchange rate (RER), real gross domestic product (RGDP), money supply (MS), degree of openness (DOP) and gross fixed capital formation (GFCF).

**Result of Short-Run ARDL Coefficients**

| **Dependent Variable = $RER_t$** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.*** |
| $DIn(RGDP_t)$ | 2.862941 | 0.836009 | 3.424533 | 0.0021 |
| $DIn(MS_t)$ | -0.52900 | 0.274709 | -1.925679 | 0.0696 |
| $DIn(DOP_t)$ | -0.41869 | 0.164056 | -0.255214 | 0.8006 |
| $DIn(GFCF_t)$ | 1.017987 | 0.305914 | 3.327719 | 0.0027 |
| $DIn(GFCF_{t-1})$ | 0.003292 | 0.238550 | 0.013798 | 0.9891 |
| $DIn(GFCF_{t-2})$ | -1.288318 | 0.321434 | -4.008032 | 0.0005 |
| CointEqM(-1)* | -0.205433 | 0.032799 | -6.263284 | 0.0000 |
| Adjusted R-squared = 0.528698; Durbin-Watson stat = 2.652575 | | | | |

Source: *Author's Computation, 2023.*

The results of the short-run ARDL model reveal that RGDP has a positive and significant relationship with the real exchange rate in Nigeria. This is evidenced by the positive coefficient value (2.8629) of real gross domestic product and its p-value (0.0021), which is less than 0.05. This implies that an increase in the real gross domestic product by one percent will lead to a 286.3% increase in the real exchange rate in the short run.

Similarly, the gross fixed capital formation has a positive and significant effect on the real exchange rate in Nigeria. This is evidenced by the positive coefficient value (1.0179) of gross fixed capital formation and its p-value (0.0027), which is less than 0.05. This indicates that an increase in gross fixed capital formation by one percent will lead to a 101.8% increase in the real exchange rate in the short run.

However, Money supply has a negative and insignificant effect on the real exchange rate in Nigeria. This is evidenced by the negative coefficient value (-0.5290) of money supply and its p-value (0.0696), which

is greater than 0.05. This indicates that an increase in money supply by one percent will lead to a 52.9% decrease in the real exchange rate in the short run.

Moreso, degree of openness has a negative and insignificant effect on the real exchange rate in Nigeria. This is evidenced by the negative coefficient value (-0.0418) of degree of openness and its p-value (0.8006), which is greater than 0.05. This indicates that an increase in degree of openness by one percent will lead to a 41.8% increase in the real exchange rate in the short run.

Furthermore, the coefficient of the CointEq(-1)* at -0.2054 indicates that the speed of adjustment to long-run equilibrium is 21%, meaning any past deviation will be corrected in the present period.

In addition, the Adjusted R-squared (Adj. R^2) value of 0.5286 indicates that 53 percent of the systematic variation in the real exchange rate is explained by real gross domestic product, money supply, degree of openness, and gross fixed capital formation in the short run, while the remaining 47 percent of the variation in the model is captured by the error term (unknown factors/variables outside the model).

**Result of Long-Run ARDL Coefficients**

| **Dependent Variable =** $InRER_t$ | | | | |
|---|---|---|---|---|
| Variable | Coefficient | Std. Error | t-Statistic | Prob.* |
| $InRGDP_t$ | 0.713394 | 0.218567 | 3.263957 | 0.0032 |
| $InMS_t$ | 2.862941 | 1.177631 | 2.431103 | 0.0226 |
| $InDOP_t$ | -0.003292 | 0.305793 | -0.010764 | 0.9915 |
| $InGFCF_t$ | 1.017997 | 0.398658 | 2.553556 | 0.0171 |
| C | 0.713394 | 0.218567 | 3.263957 | 0.0032 |

*Source: Author's Computation, 2023.*

The long-run ARDL results reveal that real gross domestic product has a positive and significant relationship with the real exchange rate in Nigeria. This is evidenced by the positive coefficient value (0.7133) of real gross domestic product and its p-value (0.0032), which is less than 0.05, implying that an

increase in the real gross domestic product by one percent leads to a 71.3% increase in the real exchange rate in the long run.

Furthermore, money supply has a positive and significant impact on the real exchange rate in Nigeria. This is evidenced by the positive coefficient value (2.8629) of money supply and its p-value (0.0226), which is less than 0.05, indicating that a unit increase in money supply leads to a 286.2% increase in the real exchange rate in the long run.

However, the degree of openness has a negative and insignificant effect on the real exchange rate in Nigeria. This is evidenced by the negative coefficient value (-0.0032) of degree of openness and its p-value (0.9915), which is greater than 0.05, showing that an increase in the degree of openness by one unit leads to a 3.2% decrease in the real exchange rate in the long run.

In addition, gross fixed capital formation has a positive and significant effect on the real exchange rate in Nigeria. This is evidenced by the positive coefficient value (1.0179) of gross fixed capital formation and its p-value (0.0171), which is less than 0.05. This implies that a unit increase in gross fixed capital formation increases the real exchange rate by 101.8% in the long run.

**ARDL Model Diagnostic Tests**

| Test | Statistics | P-Value | Null Hypothesis | Decision |
|---|---|---|---|---|
| A. Serial Correlation | 0.938025 | 0.4206 | **$H_0$:** No serial correlation | Do not Reject $H_0$ |
| B. Functional Form | 2.879347 | 0.1155 | **$H_0$:** Correctly specified | Do not Reject $H_0$ |
| C. Normality | 1.08452 | 0.5814 | **$H_0$:** Normally Distributed | Do not Reject $H_0$ |
| D. Heteroskedasticity | 1.202566 | 0.3737 | **$H_0$:** Homoscedasticity | Do not Reject $H_0$ |

**Source:** *Author's Computation, 2023.*

***NB:***

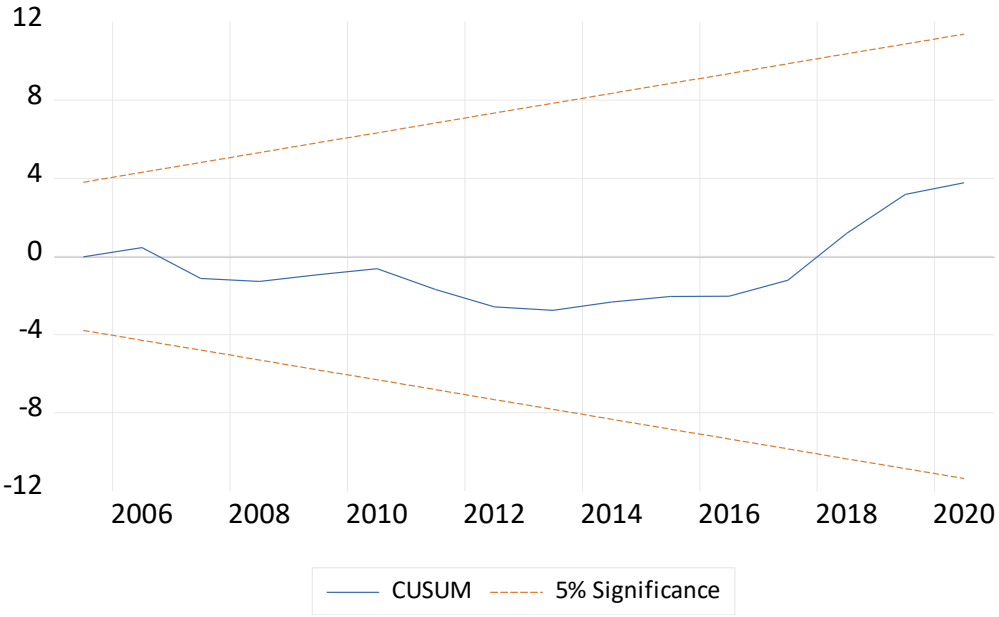
*A: Lagrange multiplier test of residual serial correlation*

*B: Ramsey's RESET test using the square of the fitted values*

*C: Based on a test of skewness and kurtosis of residuals*

*D: Based on the regression of squared residuals on squared fitted values*

However, the outcome of the Lagrange multiplier test of residual serial correlation, Ramsey's RESET test, Jarque Bera normality test and Heteroscedasticity test as presented in Table above indicates the model passed all the tests. This further implies that it has a correct functional form, its residuals are serially uncorrelated, normally distributed and homoscedastic.




**Stability Cusum Test**

The cumulative sum (CUSUM) was used to test the stability of the long-run coefficients with the short-run dynamics. The result of stability test presented in Figure above indicates that the CUSUM line stayed within the 5 percent critical bound while neither did CUSUM plot crosses the 5 percent critical lines. The implication of this is that there is stability of the long-run coefficients of the regressors that have an effect on exchange rate changes in Nigeria.

**Conclusion**

The study found that selected macroeconomic indicators such as real gross domestic product, money supply and gross fixed capital formation has a positive and significant effect on real exchange rate in Nigeria. The study therefore concluded that macroeconomic indicators play a significant role in exchange rate changes in Nigeria.

**Recommendations**

Based on the findings and conclusion drawn from the study, the following recommendations are made:

1. Government should put in place monetary and fiscal policies that would bring about stability in exchange rate.
2. Central Bank of Nigeria should formulate effective monetary and fiscal policies that will stabilize the Naira against other currencies especially dollars and pounds as well as allow such policies to complete their gestation period before subjecting them to change.
3. Government should stimulate the productive sector of the economy so that the Nigeria economic growth in terms of real gross domestic product can sufficiently stimulate the appreciation of the Naira.
4. Government should formulate policy that is aimed at raising broad money supply; which will in turn encourage and increase investment activities in the country and bring about appreciation in exchange rate.

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