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AN EMPIRICAL ANALYSIS OF THE IMPACT OF MACROECONOMICS VARIABLES ON EXCHANGE RATE FLUCTUATION IN NIGERIA

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ABSTRACT

The study empirically X-rays the influence of macroeconomic variables on exchange rate volatility in Nigeria between 1990 and 2023. Exchange rate serves as the dependent variable with inflation rate, lending interest rate, crude oil price, money supply and level of import serving as macroeconomic variables/regressors. Ex post facto research design was adopted by the study due to its ability to explore the cause –and- effect relationship between dependent variables and explanatory variables. The study carried out its empirically data analysis using the fully modified ordinary least square (FM-OLS). The result revealed, while money supply and lending interest rate have positive significant effect on exchange rate volatility, the level of import have negative significant impact on exchange rate. The result also affirmed inflation rate and crude oil price to be positive and insignificant to exchange rate fluctuation. The study concludes that macroeconomic fundamental or variables have significant influence on exchange rate volatility in Nigerian within the sampled period. Based on the findings, the study recommends that monetary authority should implement policy that will enhance effective management of money supply and interest rate in order to stabilize the exchange rate and promote economic growth.

Keywords: Exchange Rate Fluctuation, Macroeconomic Variables, Empirical Analysis, Foreign Exchange Market, Economic Stability.

1.0 INTRODUCTION

Exchange rate fluctuation has been a persistent feature of the Nigerian economy, with significant implications for the country's balance of trade, inflation rate, and economic growth. The exchange rate, which is the price of one currency in terms of another, plays a vital role in determining the competitiveness of a country's exports and imports. In Nigeria, the exchange rate has fluctuated over the years, driven by a combination of domestic and external factors. Takaendesa, et al (2005) asserted that exchange rate plays a vital role in an extensive allocation of production resources and spending in the domestic economy between foreign and home goods and as well as influences export growth, consumption, resource allocation, employment and private investments. Exchange rate fluctuations have been a persistent feature of the Nigerian economy since the 1990s. The country’s exchange rate regime has undergone significant changes, from a fixed exchange rate to a managed float. Despite these changes, the Nigerian economy has continued to experience significant exchange rate fluctuations, which have had far-reaching implications for economic growth. Dornbsch R. (1980) opined that exchange rate is the relative price of two currencies, or price of one currency in terms of another. It determines the relative prices of domestic and foreign goods and services, as well as the strength of external sector participation in the global trade. Exchange rate fluctuation is

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the rate of change in price over a given period. It is expressed as a proportion and computed as the yearly standard deviation of the proportion change in the daily price. These fluctuations have had far-reaching consequences for the Nigerian economy, including higher import prices, reduced purchasing power, and decreased economic growth.

In Nigeria, the exchange rate has been a subject of interest for policy makers and researchers due to its impact on the nation's economy. Exchange rate regime remain a vital issues of discourse in the global finance as well as in less developed countries, with more economies embracing trade liberalization as essential factor for economic growth (Obansa, Okoroafor,et al,2013). Nigeria has adopted various forms of exchange rate ranging from regulated to deregulated regimes. Ewa, W. & Przystupa, J. (2011) asserted that the Nation's currency (naira) was more stable during the oil boom period from 1970 to 1979, when Agricultural products made up over 70% of the country's Gross domestic product (GDP). When the Nigerian government implemented the Structural Adjustment Policy (SAP) in 1986, the nation moved from a peg or controlled exchange rate system to a flexible exchange rate system, in which market forces fully determine the exchange rate. This was followed by a managed float system in which monetary authorities intervene periodically in the foreign exchange market in order to stabilize the local currency (naira) so as to attain some strategic objectives, (Mordi, 2006). The managed float system, also allows the central bank to intervene in the foreign exchange market to stabilize the exchange rate, prevent excessive volatility and address economic imbalance. Nigeria government has adopted different forms of exchange rate management linking to different macroeconomic policies in order to achieve a stable and sustainable exchange rate.

Sanusi J.O (2004) opined that exchange rate regime was shifted from fixed exchange rate in the mid-1980s to various forms of floating system since 1986 following the adoption of the SAP. The reforms under the Structural Adjustment Programme (SAP) in 1986 brought about free market determination of the exchange rate. Ndubuisi P. ((2009) opined that among the various regimes of exchange rate management practiced by the Nigerian government include the Dutch Auction System (DAS) in April 1987, the Autonomous Foreign Exchange Market (AFEM) in 1988, the Inter-Bank Foreign Exchange Market (IFEM) in 1989, and again DAS was reintroduced in July 2002. The CBN introduced the Wholesale Dutch Auction System (WDAS) on February 20, 2006, with the goal of further liberalizing the market, reducing the arbitrage premium between the official interbank and bureau de change segments of the markets, and achieving stability. The WDAS was designed to deepen the foreign exchange market and consolidate the gains of the retail Dutch Auction System in order to gradually evolve a realistic exchange rate of the naira. Under this approach authorized dealers were allowed to deal in foreign exchange on their own accounts for subsequent sale to their clients. The country's exchange rate policy has been characterized by frequent changes, including the introduction of multiple exchange rates, the imposition of capital controls, and the use of monetary policy instruments to influence the exchange rate.

The monetary authorities through the CBN recently introduced the electronic foreign exchange market (eFEM) in order to bring transparency, flexibility and efficiency into the FEM. (CBN bulletined, 2024). The volatile nature of the naira was worsened by policy inconsistency and a lack of continuity in exchange rate regulations and management by the monetary authorities. (Gbosi A.N, 2005). In Nigeria today, exchange rates fluctuation is of great significance to the

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citizenry, this is because its fluctuation has a great effect on the performance of the economy and its ability to attain optimal productive capacity. This is serious given its macroeconomic importance particularly in a high import dependent country like Nigeria (Umoru, D, & Odjegba, O.2013). While frequent fluctuations or an inappropriate exchange rate have been a major barrier to the economic growth of many African countries, including Nigeria, a stable or appropriate exchange rate has been one of the most important factors for growth of the economies of most of the developed countries. The major macroeconomics variables that have been adjudged to have great influence in the nation's foreign exchange rate include: Gross Domestic Product (GDP), inflation, interest rate, external reserve, import and export. (Patel et al.2014) .However the influence of exchange rate on inflation is a function of the exchange rate regime as practiced in Nigeria. Changes in the real exchange rate have a significant effect on prices and output through the channels of supply and demand.

Exchange rate stability is of great importance to any nation because global trade depends heavily on foreign exchange rates. For instance, deposit money banks and businesses require a stable foreign exchange rate to assess the profitability of their investments, as well as to finance and hedge their operations in order to lower operational risk. Additionally, businesses that engage in both import and export will be significantly impacted by high costs of importation of raw materials they may incur when the exchange rate depreciates, which could raise the price of domestic goods and increase the unemployment rate (Abbasi and Safdar, 2014). Nigeria is currently a hot topic in foreign exchange because of the rapid devaluation and depreciation of the local currency which has had negative impact on the daily spending of the average citizen and the economy at large. The value of the naira began to decline in mid 2015 and hit a value low of ₦ 1600/US Dollar in 2024. In addition, Nigeria is a less developed nation; hence, foreign exchange rate is important to both the importers, multinational companies, investors and exporter. In order to help maintain stability of the Naira, it is necessarily to understand its determinants. Thus, this study seeks to examine the dynamic influence of macroeconomics variables of inflation, money supply, crude oil price, lending interest rate and level of import on exchange rate fluctuation in Nigeria over a period of 1990 - 2023.

1.1 Statement of the Problem

Exchange rate fluctuation has been a persistent and disturbing problem in Nigeria, with severe consequences for the country's economic growth, stability and development. The Nigerian local currency (naira) has experienced frequent and volatile fluctuations against major international currencies, particularly the US dollar for a long time. The exchange rate fluctuation have been driven by a combination of domestic and external factors including dependence on oil export, fiscal policy mismanagement, inadequate foreign capital inflow, consistent fluctuations in crude oil earnings, monetary policy inconsistencies and external shocks, (Obadan, 2006). The Nigerian government has taken several steps to stabilize the naira. Recently, the Central Bank of Nigeria (CBN) issued a directive to deposit money banks (DMBs) to disclose their positions on foreign exchange holdings and reduce them to not more than twenty percent short of their shareholders' funds. This move aims to prevent further depreciation of the naira and restore confidence in the currency.(CBN bulletined 2024).

Despite the various policies and reforms implemented by the monetary authority aimed at stabilizing the local currency and bringing the Naira to its fair value, exchange rate fluctuation

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and volatility have become a recurrent issue in the Nigerian economy. Nnanna, Englama and Odoko (2004) in their study concludes that the Nigeria's economy is always experiencing deficit balance of payment (BOP) and naira depreciation because of over reliance on imported goods. The instability and volatile nature of the exchange rate has far- reaching implications for the Nigeria's economic development, and it is important to investigate the underlying causes and consequences of exchange rate fluctuations to inform effective policy strategies. Hence this study seeks to carry out an in-depth analysis of the effect of macroeconomics fundamentals on exchange rate fluctuation in Nigeria.

2.0 CONCEPTUAL FRAMEWORK

2.1 Inflation

Inflation is a sustained increase in the general price level of goods and services in an economy over a period of time, (Jhingan M.L, 2005). It is a monetary phenomenon where the value of money decreases and the purchasing power of consumers are reduced. Inflation is one of the major factors that influence the foreign exchange rate. The monetary model of exchange rate determination suggests that inflation differentials between countries can influence exchange rate. According to this model, a country with high inflation rate will experience depreciation of its currency. Inflation has been a persistent problem in the Nigerian economy and it has had a great effect on exchange rate fluctuation. For instance, in the 2010s, Nigeria's inflation rate increased significantly as a result of: monetary policy easing, fiscal policy mismanagement and depreciation of the naira. The inflation rate peaked at 18.3% in 2017, driven by a significant increase in food prices and a decline in agricultural production. In 2020, Nigeria's inflation rate increased significantly due to COVID-19 pandemic, higher food prices and depreciation of the naira .The inflation rate peaked at 18.17% in March 2021 and in 2022, the inflation rate declined slightly as a result of improved agricultural production, strengthening of the naira and monetary policy tightening(CBN ,Statistical bulletin, 2023). From 2023 till date, there has been persistent rise in the country's inflation especially food inflation attributed to removal of fuel subsidy. Studies have shown that inflation has a significant impact on exchange rate fluctuation in Nigeria. For instance, Okoli, Mbah and Agu (2016) explored the link between exchange rate volatility and inflation in Nigeria and conclude that there was a unidirectional causality running from inflation to real exchange rate volatility. Similarly, Inam, U. S. (2015), empirically investigated exchange rate volatility and inflation in Nigeria using time series data from 1970 to 2011. The study found that there was no causality between exchange rate and inflation. The relationship between exchange rate and inflation is influenced by various factors; hence exchange rate fluctuation has a significant implication for the growth of Nigerian economy.

2.2 Money supply

Money supply is the total amount of money circulating in an economy. Kelly R. C. (2024) defined Money supply as the total sum of currency in an economy inclusive of cash in circulation and bank deposits that can easily be converted to cash. Money supply plays a crucial role in determining exchange rate fluctuation. In Nigeria, money supply has been a significant factor contributing to exchange rate fluctuations. Monetary policy tools are designed to exercise a direct influence on the money supply and the amount of credit available in the economy and indirectly impact the foreign exchange rate. The quantity theory of money posits

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that money supply has a direct link with prevailing price level in the society. An increase in money supply leads to increase in aggregate demand, which in turn causes an appreciation of the exchange rate. Conversely, a decrease in aggregate demand causes a depreciation of the exchange rate. The link between money supply and exchange rate has been investigated by many scholars over the years. For instance, Yakubu M. S (2016) explored the impact of money supply on exchange rate in Nigeria and concludes that money supply has a positive significant effect on exchange rate volatility. Similarly, Aid, L., & Benelbar, M. (2023) investigated the link between exchange rate and money supply in Nigeria and found that money supply has direct relationship with exchange rate fluctuation in the country. Money supply has been found to plays a significant role in exchange rate determination in Nigeria. The link between money supply and exchange rate is complex and influenced by various factors including fiscal policy, inflation, monetary policy and external shocks.

2.3 Import

Imports play a vital role in Nigeria's economy as the country relies heavily on imported goods to meet its consumption and production needs. Import is the act of purchasing or acquiring goods or services from other countries. It involves the transfer of ownership of goods or services from a foreign seller to a local buyer, typically through international trade. Imports have a significant effect on the economic growth of a country and imports are derived from a nation's desire to improve its production capability and efficiency. Imports are dependent on the real exchange rate. A high exchange rate will decrease the size of imports as it makes the price of imports more expensive. Many studies have been conducted on the link between exchange rate fluctuation and level of import. Their findings are contradictory. For instance, Nucu, A. E. (2011), conducted a study on the link between exchange rate and import in Romania and found that increase in imports has negative impact on the country's current account balance thus leads to currency depreciation. Similarly, Razak and Masih (2018) investigated the relationship between exchange rate and trade balance in Malaysia and found that imports and exports were significant drivers of the country's exchange rate. On the contrary, Ijirsha, Okpe and Andohol (2022) explored the effect of the exchange rate on trade flow in Nigeria from 1986 to 2021, found the exchange rate to have a symmetric effect on imports, exports and trade balance in Nigeria. The relationship between imports and exchange rate is influenced by various factors; hence exchange rate fluctuation has a significant implication for nation's economy.

2.4 Lending Interest Rate:

The lending interest rate is a critical monetary policy tool used by central Banks to regulate economic activities. In Nigeria, for instance, the lending interest rate has a significant impact on exchange rate fluctuations. Ngumo (2012) defined lending interest rate as a price which a borrower pays in order to use resources. In other words, it is an amount charged by a lender to borrower for uses of assets. The interest rate parity theory proposed by Cassel Gustav in (1918) suggests that the difference in interest rates between two countries is equal to the difference in the expected depreciation of their currencies. This theory implies that a country with high interest rates will attract foreign investors causing its currency to appreciate. The level of interest rates and the total supply of money (M2) in circulation are the two vital instruments of monetary policies which can either be achieved by controlling the growth of the money supply

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as asserted by monetarist theorist or increasing the level of money supply in circulation which causes excess demand thus causing the interest rates to fall as argued by the Keynesian economists. The lending interest rate in Nigeria is currently at 27.5% as November, 2024.((CBN, statistical bulletin, 2024)). The central Bank has been adjusting the monetary policy rate (MPR) to tackle inflation and protect the local currency. There are various studies that have evaluated the relationship between lending interest rate and foreign exchange rate. For instance, Mirchandani A. (2013) investigated the link between exchange rate volatility and interest rate and establishes that lending interest rate and foreign exchange rate were highly correlated. Bashar and Kabir (2013) also found a positive and significant connection between lending interest rate and foreign exchange rate in the long run.

2.5 Crude Oil Price

Crude oil is Nigeria's main export commodity, accounting for a significant portion of the country's foreign exchange earnings. Hence, fluctuations in the global crude oil prices have a substantial impact on Nigeria's exchange rate. Nigeria is one of the world's oil exporters. The Nigerian economy is heavily reliant on crude oil prices. The country's crude oil price, specifically the Bonny light has fluctuated significantly over the years. During the COVID-19 pandemic of 2020, the price of Brent crude fell to $32.1 per barrel at the start of the lockdown in March and fell as low as $18.38 per barrel in April. This made the Nigeria government to devalue the exchange rate to as low as ₦381/$1 by May 2020 (Okeke, Nwoha and Duru, 2024). The fluctuation in crude oil prices has affected the Nigerian economy in various ways. For instance, when crude oil prices are high, Nigerian's economy benefits from increased revenue, which is used to fund developmental projects. However, when the crude oil prices are low, the economy suffers from reduced revenue, leading to budget deficits and economic instability. Several studies have investigated the link or causality between crude oil and exchange rate fluctuations. For instance, Nandelenga and Simpasa (2020) explored the link between crude oil prices and exchange rate of selected emerging countries found a level of bivariate dependence between exchange rates and crude oil prices in those countries. Their findings also affirm that oil prices have a positive significant effect on the exchange rate. On the same note, Suliman and Abid (2020) examined the impacts of oil price on exchange rates in Saudi Arabia and found that crude oil price has a positive link with the exchange rate in Saudi Arabia. Unlike, Hlongwane (2022) who carried out this same study in South Africa and found a negative link between crude oil prices and the exchange rate. Most of the empirical findings affirm that crude oil prices are great determinant of the exchange rate.

2.6 Exchange Rate

The exchange rate is a crucial monetary policy tool used by central Banks to achieve macroeconomic objectives, such as price stability, idea unemployment level, economic growth and balance of payment equilibrium. The exchange rate is an intermediate policy variable through which monetary policy is transmitted to the larger economy through its impact on the value of the domestic currency, domestic inflation (which is the pass-through effect), the external sector, macroeconomic credibility, capital flows, and financial stability,(CBN, annual report, 2023). Ezike, E. (2009) described foreign exchange rate as the price of the unit of one country's currency expressed in terms of another country's currency. It is the relative price that measures the worth of a domestic currency in relation to a foreign currency. Central Bank can

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adopt various exchange rate systems to achieve their monetary policy objectives. The three main types of exchange rate systems are the fixed exchange rate system, floating exchange rate system and the managed float system. The fixed exchange rate system or regime is when the exchange rate is pegged to a foreign currency or a basket of currencies, while the floating exchange rate system is when the exchange rate is determined by forces of demand and supply. In the managed float system, the exchange rate is determined by market forces, but the central Bank intervenes to smooth out fluctuations, (Unuafe 2005). Using the exchange rate as a monetary policy tool has several advantages such as flexibility, effectiveness and transparency. It also poses challenges of volatility and uncertainty. Bala & Asemota (2013) defined exchange rate volatility as a swing or fluctuation over a period of time in the exchange rate. It also entails unusual movements of the exchange rate. These fluctuations have had far-reaching impact for the Nigerian economy, including higher import prices and reduction in purchasing power. Some of the factors responsible for exchange rate fluctuation in Nigeria range from internal factors like: Inflation rate, interest rate, monetary and fiscal policies to external factors like: Changes in oil prices, global economic trend, trade balance and changes in foreign direct investment. In management of exchange rate volatility, monetary authority must pay key attention to internal and external factors responsible for its fluctuation.

3.0 THEORETICAL LITERATURE

2.1 Purchasing Power Parity Theory (PPP)

The purchasing power parity theory was developed by Cassel Gustav in 1918. The theory states that the exchange rate between two currencies is determined by the differentials in the rate of inflation in these countries. Put differently, the purchasing power parity theory states that the exchange rate between two currencies is in equilibrium when the purchasing power of these two countries is the same. Cassel Gustav (1918) argued that the exchange rate between two countries should be determined by the relative prices of goods and services in the two countries. In other words, the theory posits that exchange rate movements are driven by relative changes in price levels between countries. The Purchasing Power Parity theory is important in determining whether changes in the nation's exchange rate correspond with shifts in the rate of inflation at home in comparison to its trading partners. Following the purchasing power parity theory approach, Ukangwa J. and Ikechi, V. (2022) examined the effect of exchange rate on economic growth in Nigeria. The study concludes that relative price level has a positive significant effect on the exchange rate. Similarly, Eichengreen, B. (2004) assessed the link between exchange rate and monetary policy in Korea and found that exchange rates volatility has great impact on the economy The purchasing power parity theory can be represented mathematically as follows:

S= P-domestic / P- foreign Where: S=Exchange rate (domestic currency per unit of foreign currency) P- domestic = price level in domestic country and P- foreign = price level in foreign country. The purchasing power parity theory is based on the following assumptions:(i)Free trade (ii)No transport cost(iii) No tariffs and quotas and (iv) Homogeneous goods

The purchasing power parity theory is an important concept in global finance that describes the relationship between exchange rat and the price of goods and services between two countries.

2.2 Interest Rate Parity Theory

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The Interest Rate Parity theory was developed by Cassel Gustav in 1918. The theory posits that the difference in interest rates between two countries is equal to the difference in the expected depreciation of their currencies. This shows that the difference in interest rate is a huge determinant of the rate of exchange in the country. Based on the assumption of the interest rate parity theory, when there is a difference in interest rates between two countries, investors will tend to borrow from the country with the lower interest rate and invest the funds in a country with higher interest rate. As such, the currency of the country with the lower interest rate depreciates due to increased supply, while the currency of the country with the higher interest rate appreciates due to increased demand (Hayes, 2021). The interest rate parity theory can be represented in a mathematical form as follows :(1+r-domestic/ 1+r-foreign) = (S-spot/ F-forward). Where: r-domestic =domestic interest rate r-foreign = foreign interest rate S-spot = spot exchange rate F-forward = forward exchange rate

The interest rate parity theory is based on several assumptions including: perfect capital mobility, no transaction cost, no exchange rate risk and perfect information. On the basis of interest rate parity theory, Sinha, P. & Kohli, D. (2013) explored the dynamics between exchange rate and lending rate and concludes that exchange rate has a positive significant relationship with lending interest rate. Based on the same theoretical framework, Nwude E.C. (2012) assessed exchange rate determinant in Nigeria and concludes that lending interest rate has no statistical significant relationship with exchange rates. The interest rate parity theory is a fundamental concept in international finance that describes the connection between interest rates and exchange rates between two countries.

2.3 Empirical Review

The issue of the impact of macroeconomics variables on exchange rate fluctuation has assumed strong prominence in economic literature. For instance, Iliyasu, M. et al (2024) assessed the impact of monetary policy on exchange rate volatility in Nigeria from 1987 to 2023. The study concludes that exchange rate volatility is driven by changes in money supply and interest rate. Similarly, Chinwe G, Ebele S &Maria C (2024) investigated the impact of money supply on exchange rate volatility in Nigeria using autoregressive distributed lag model. The study found a long run relationship between money supply and exchange rate and concludes that money supply has positive significant impact on exchange rate volatility in Nigeria. Using the Vector Auto regression model, Dieu C. and Nguyen T. (2023) examined the link between foreign exchange rate and foreign direct investment in Vietnam and concludes that exchange rate is significantly impacted by foreign direct investment. In a related study, Aid and Benelbar (2023) explored the relationship between money supply and exchange rate in Algeria, using the autoregressive distributed lag model. The finding reveals that money supply has a positive significant effect on the exchange rate. The study concludes that a long run relationship exists between money supply and exchange rate in Algerian economy. Also, Aliyu, Olalekan, and Olusegun (2022) evaluated the long-term relationship between foreign direct investment (FDI) and exchange rate in Nigeria. The study adopted the Dynamic Ordinary Least Squares (DOLS) technique for its empirical analysis. The finding shows that foreign direct investment does not have significant impact on exchange rate fluctuation. On another note, Ijirsha V.U et al (2022) investigated the impact of exchange rate fluctuation on trade flow in Nigeria using time series data from 1986 to 2021. The study concludes that exchange rate has a symmetric effect on imports, exports and trade balance on the Nigerian economy. Furthermore, Okonkwo, Osakwe

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and Nwadibe (2021) conducted a study on the link between exchange rate and foreign direct investment from 1981 to 2001 using error correction model for its empirical analysis. The study concludes that foreign direct investment has a positive significant relationship with exchange rates volatility. On the same note, Nwiado, Korgbeelo and Onu (2021) studied the relationship between remittances vis-à-vis the exchange rate between the local currency (Naira) and the US dollar. The finding shows a long-run relationship between exchange rates and migrant remittances. The study concludes that Diaspora remittances have a positive significant effect on real exchange rate in Nigeria. Suliman, T. H., & Abid, M. (2020) explored the impacts of oil price on exchange rates in Saudi Arabia. Owing to the findings, the study concludes that crude oil price has a positive significant relationship with the prevailing exchange rate in the country.

3.0 RESEARCH METHODOLOGY

3.1 The Economic Model and Estimation Technique

The functional relationship between the dependent variable and the explanatory variables of this study is anchored on the purchasing power parity theory of Cassel Gustav (1918). The model is expressed in line with the analytical framework of Nwude E.C. (2012) who explored exchange rate determinants in Nigeria. In order to effectively investigate the effect of macroeconomic variables on exchange rate fluctuation in Nigeria, the study model exchange volatility as a function of five independent variables as shown below in equation one

$$EXR_t = a_0 + a_1 LIR_t + a_2 IMP_t + a_3 INF_t + a_4 COP_t + a_5 MS_t + e_t \quad (1)$$

Where: EXR is exchange rage; LIR is lending interest rate; IMP is level of import; INF is inflation; COP is crude oil price and MS is money supply (M2). α_1-α_5 are coefficients, α_0 is the intercept and e_t is the error term

3.2 Estimation Technique

The study employed fully modified least squares (FM-OLS) proposed by Phillips and Hansen (1990) to estimate the cointegrating regression model. This method is appropriate for this study since FMOLS largely helps to overcome the main weakness of the static ordinary least squares as it accounts for serial correlation effects and for the endogeneity in the regressors that results from the existence of a cointegrating relationship. Omojimite B.U (2012) asserts that the FM-OLS is a semi-parametric correction of the OLS estimator which is asymptotically equivalent to maximum likelihood and yields median-unbiased and asymptotically normal estimates, so that conventional techniques for inference are valid. More importantly, the characteristics of difference stationary depicted by economic time series makes the FM-OLS an ideal technique for estimating the long run behavior of the explanatory variables. The model is expressed as fully modified least square as follows: $\beta\hat{} i * = (X'X)^{-1} (Xi' yi * - T\delta)$

Where: $\beta\hat{} i *$ is Fmols estimator of the cointegrating vector X is matrix of regressors (including a constant term) $yi *$ is the transformed variable; T is the number of time periods; and δ is the adjustment parameter for serial correlation.

3.3 Diagnostic Tests

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3.3.1 The Unit Root Test

The study use the Augmented Dickey-Fuller unit root procedure proposed by Dickey and Fuller (1981) to determine the stationary status of the basic economic time series and to indicate their order of integration. The general representation of the unit root model with intercept and trend is provided as:

$$\Delta W_t = b_0 + b_1 \mathrm{W}_{t-1} + \sum_{i=1}^{n} c_i \Delta W_{t-i} + u_t \qquad (2)$$

Where: Wt = economic time series under investigation

b_1 and c_i= parameter estimate of the variables
n = optimal lag length
Δ= First difference operator
ut = Stochastic term

The optimal lag length for each of the variables was decided using Akaike information criterion (AIC). Evidence of a unit root implies that the economic time series concerned is not stationary at levels. This prompts the testing for difference stationarity for each of the series.

3.3.2 Cointegration test:

The test for cointegration focused on the approach proposed by Johansen and Juselius (1990). It is considered by earlier studies: Dieu and Nguyen (2023) and Okonkwo, Osakwe and Nwadibe (2021) as appropriate for equations of multivariate variety. The trace and Max-Eigen statistics as computed by Johansen and Juselius formed basis for testing. The log-likelihood ratio equations for the cointegration test focused on Trace and Max-Eigen statistics as expressed below:

$$J_{trace}(r) = -N \sum_{i=r+1}^{q} In\left(1-\hat{\lambda}_i\right) \qquad (3)$$

$$J_{\max}(r, r+1) = -N\, In\left(1-\hat{\lambda} r+1\right) \qquad (4)$$

Evidence of at least one cointegration equation indicates that the variables are cointegrated and as such exhibits long run relationship.

4.0 RESULTS AND DISCUSSION

4.1 Unit Root Test

As a result of the unique feature of non-stationarity of time series data, the variables under consideration were subjected to unit root tests and the outcome of the test is showed below:

Table 4.1: Summary of ADF unit root test results

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ADF Unit root test results					
Variable	Levels test results		First Difference test results		
	t-stat.	5% critical value	t-stat.	5% critical value	Order of integration
INFLATION	2.2931	3.574	8.048	3.574	I(1)
INT. RATE	3.914	3.574	3.229	3.574	I(0)
MONEY SUPPLY	3.472	3.574	4.142	3.574	I(1)
EXC. RATE	3.395	3.574	4.526	3.574	I(1)
IMPORT	3.712	3.574	2.391	3.574	I(0)
CRUDE OIL PRICE	1.867	3.574	5.062	3.574	I(1)

Source: Author's computation from E-views 12

Table 4.2 dipicts the unit test results for each of the variables. The leftmost part shows the test results at levels while the rightmost part shows the test results at first difference. Interest rate and import were found to be stationary at levels. Evidences from the unit root test results indicate that the variables are mixed integrated and thus can enter into the FM-OLS model upon confirmation of long run relationship among the variables..

4.2 Cointegration Test

The Johansen and Juselius (1990) test methodology was applied as shown in Table.4.2

Table 4.2: Cointegration test results for model

Series: EXR COP IMP INF INTR MS					
TRACE TEST RESULT			**MAX-EIGEN TEST RESULT**		
Null Hypothesis	**Trace Statistic**	**0.05 Critical Value**	**Null Hypothesis**	**Max-Eigen Statistic**	**0.05 Critical Value**
r = 0*	198.5	107.3	r = 0*	89.3	43.4
r ≤ 1*	109.2	79.3	r ≤ 1	36.3	37.2
r ≤ 2*	72.9	55.3	r ≤ 2	30.4	30.8
r ≤ 3	42.5	35	r ≤ 3	26	24.3
r ≤ 4	16.5	18.4	r ≤ 4	11.1	17.2
r ≤ 5	5.5	3.8	r ≤ 5	5.5	3.9

Source: Author's computation from E-views 12

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Both Trace and Max-Eigen statistics show evidence of atleast a cointegrating equations in table 4.2. The result shows that the variables have long run relationship.

4.4: Estimation of the Cointegration Model

The cointegration models that portray the long run behavior of the variables are estimated using fully modified ordinary least squares.

Table 4.3 Cointegrating regression results for model

Dependent Variable: EXR				
Method: Fully Modified Least Squares (FMOLS)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
CRUDE_OIL_PRICE	0.241675	0.169156	1.428712	0.165
IMPORTS	-1.40E-09	1.65E-10	-8.477883	0
INF__RATE	-0.345351	0.233623	-1.478243	0.1514
INT__RATE	3.92309	1.144898	3.426585	0.002
MS	4.19E-12	3.99E-13	10.49979	0
C	-81.02027	28.96538	-2.797142	0.0096
R-squared	0.982228	Mean dependent variance		171.104
Adjusted R-squared	0.978127	S.D. dependent variance		144.515
S.E. of regression	21.37299	Sum squared residual		11876.9
Long-run variance	180.6976			

Source: Author's computation from E-views 12

From the conintegrating result dipicts in Table 4.3, Money supply and interest rate have positive significant influence on exchange rate fluctuation. The finding suggest that an increase in money supply leads to a depreciation of the domestic currency, making imports more expensive and exports cheaper.This is consistent with the monetary model of exchange rate determination, which opines that an increase in money supply leads to decrease in the value of the value of the domestic currency. Similarly, the results indicate that an increase in interest rate leads to an appreciation of the naira, making imports cheaper and exports more expensive. This is consistent with the interest rate parity theory by Cassel Gustav (1918) which opines that an increase in interest rate leads to an appreciation of the domestic currency. The result also affims that level of import has a significant negative effect on exchange rate fluctuation, while, crude oil price and inflation rate have insignificant effect on exchange rate volitility during the sampled period. The coefficient of determination (R2) reveals that the proportion of the explained variation to the total variations of the exchange rate model is 0.98. This is suggestive that the explanatory power of the regressors is 98 percent. Thus, the model is considered as a good fit as the observations, on the avrage converge to the regression.

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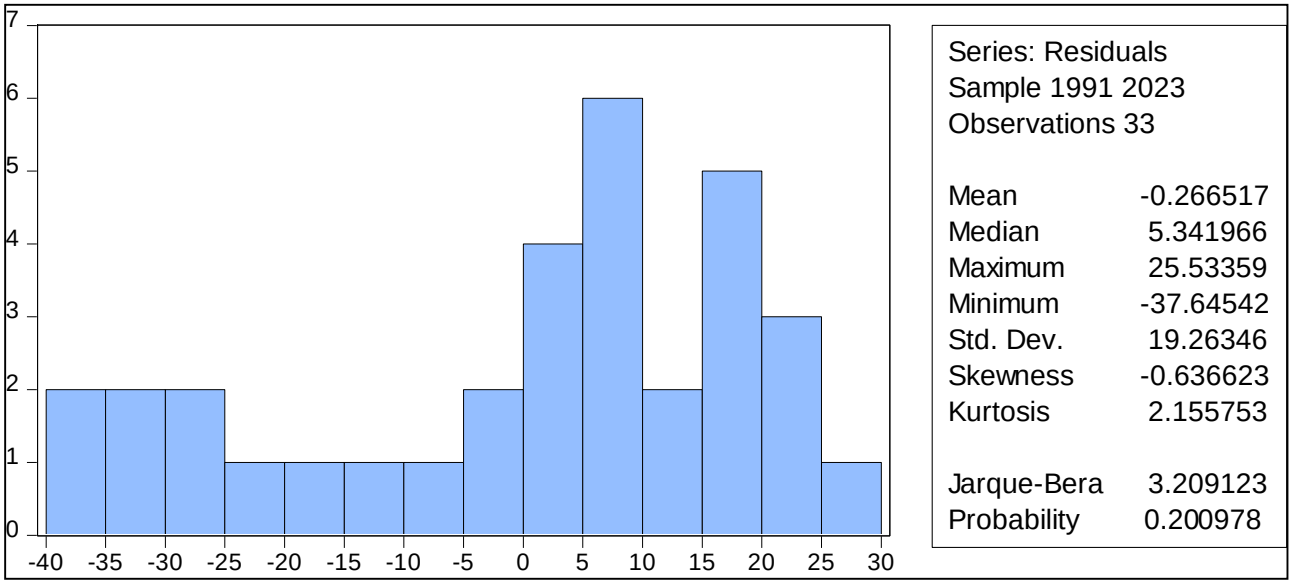
4.5 Post-estimation Diagnostics Tests

The post-diagnostic tests examined in this study include Normality test and Auto correlation test.

4.5.1 Normality test:

A normality test is a statistical test used to examine if a dataset follows a normal distribution outline. The normality test for this study is depicted Table 4.4.

Table 4.4: Plot of normality test for exchange rate model



Source: Author's computation from E-views 12

The normality test results shown in Table 4.4, reveals that the error in the models is normally distributed. This is because the associated probability value of the Jarque-Bera statistics is greater than 0.05 (5%) critical value.

4.5.2 Autocorrelation Test:

The autocorrelation result for this study is shown in Table 4.5 below:

Table 4.5: Autocorrelation test result:

Autocorrelation test result for the model						
Sample: 1990: 2023						
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
. | . |	. | . |	1	0.07	0.07	0.1699	0.68

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***| . |	***| . |	2	-0.361	-0.368	4.9054	0.086
.**| . |	. *| . |	3	-0.224	-0.191	6.7932	0.079
. |* . |	. |* . |	4	0.177	0.084	8.0116	0.091
. |* . |	. | . |	5	0.119	-0.044	8.5781	0.127
. | . |	. | . |	6	-0.044	-0.004	8.6592	0.194
. *| . |	. *| . |	7	-0.149	-0.083	9.6305	0.21
. | . |	. *| . |	8	-0.049	-0.068	9.7381	0.284
. |* . |	. | . |	9	0.09	0.012	10.118	0.341
. | . |	. | . |	10	0.053	-0.028	10.258	0.418
. | . |	. | . |	11	-0.028	0.003	10.3	0.504
. | . |	. | . |	12	-0.017	0.032	10.317	0.588
. *| . |	.**| . |	13	-0.17	-0.227	11.965	0.531
. *| . |	.**| . |	14	-0.203	-0.259	14.447	0.417
. | . |	. *| . |	15	-0.014	-0.175	14.459	0.491
. |* . |	. *| . |	16	0.174	-0.073	16.521	0.417

Source: Author's computation from E-views 12

From the results in Table 4.5, it shows the model is free from serial correlation at 5% level.

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The main goal of this study was to explore the impact of macroeconomic variables on exchange rate fluctuation in Nigeria using the fully modified ordinary least square regression. The results of the study showed various significant relationships between variables under examination. For instance, money supply and interest rate were seen to have positive significant influence on exchange rate fluctuation, while level of import have a significant negative effect on exchange rate. The result also shown that crude oil price and inflation rate have insignificant effect on exchange rate volitility. Based on the empirical findings, the study concludes that macroeconomic variables have significant influence on exchange rate volatility in the Nigeria within the sampled period.

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5.2 Recommendations

The recommendations provided for policy actions based on the findings are:

1. The CBN should use interest rate as a monetary tool to manage exchange rate volatility. A higher interest rate can attract foreign direct investment causing the Naira to appreciate.
2. Monetary authority should implement policy that will support effective management of money supply in the country in order to stabilize exchange rate and promote economic growth.

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