Foreign Exchange Rate Management and Macroeconomic Performance in Nigeria: Autoregressive Distributed Lag (ARDL) Bound Testing Approach

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Abstract
This paper examined the impact of real exchange rate on economic performance in Nigeria for the period (1981-2021) using a modified and extended aggregate production model and Autoregressive Distributed Lag (ARDL) Bound Testing Approach for analysis. The results indicated that the real exchange rate had a positive and significant effect on economic performance in the long run and a negative but insignificant impact in the short run. As for the control variables, in the long-run capital stock, labour force and foreign direct investment had a positive and significant impact on economic performance, real interest rate and broad money supply exerted a positive but insignificant effect on economic performance, whereas inflation rate and trade openness displayed a negative but insignificant effect on economic performance. In the short-run, capital stock, inflation rate, foreign direct investment and broad money supply impacted positively on economic performance, while labour force, real interest rate, trade openness and government expenditure had a negative effect. It was recommended, among others, that government policies should be directed toward increasing productivity in Nigeria; and that Nigeria should refine a good chunk of crude oil locally, increase agricultural production and revive the manufacturing sector for increased manufacturing output to meet the country's need for petroleum, agricultural and manufactured products.

Keywords: Exchange rate management, macroeconomic performance, autoregressive distributed lag.

Introduction
Exchange rate management and macroeconomic performance in developing countries is increasingly emerging as a subject of interest to policymakers, economists and researchers. The interest arises from the crucial role of exchange rate and exchange rate policy in the management and functioning of the national economy. Exchange rate policy involves choosing an exchange rate system and determining the exchange rate at which international transaction takes place. The exchange rate, a price at which domestic currency purchases one unit of foreign currency, has direct and indirect effects on domestic economic activity and the performance of the economy. Ismaila (2016) avers that the exchange rate is an important relative price as well as a signal of a country's exchange power vis-à-vis the rest of the world in a pure market system. It influences the flow of goods, services and capital in a country as well as exerts strong pressure on the balance of payments, inflation, and other macroeconomic variables. In effect, the exchange rate affects the economy's aggregate demand, aggregate supply, relative price of domestic and foreign goods, interest rate, the strength of a country's external sector participation in international trade, volume of trade (imports and exports), balance of payments position, national output and the domestic general price level, especially in an open economy where imports form a significant component of a country's consumption

basket (Adeniran et al., 2014; Ikoku, 2017). Furthermore, the exchange rate affects the behaviour of wealth holders regarding the allocation of their wealth between the domestic economy and abroad, investment in physical assets and monetary assets, and even among the different categories of monetary assets (Jimoh, 2014). It has macroeconomic linkages which influence the allocation of resources between traded and non-traded sectors of the economy and in effect, resource allocation between sectors of the economy. Hence, the exchange rate is a very important macroeconomic variable that influences the overall outcome of macroeconomic performance as it concerns internal and external balances (Jimoh, 2014).

As an important price variable that affects all sectors of the economy and all economic agents, the exchange rate is crucial in the economic management of a country (Obadan, 2006), hence it is an important macroeconomic variable to the government and monetary authorities, the world over. Given its strategic role in economic management, monetary authorities in many countries, Nigeria inclusive, have been involved in the management of exchange rates to safeguard the international value of their domestic currencies and avoid overvaluation and misalignment of exchange rates which are detrimental to economic growth. Overvaluation of domestic currency hurts the competitiveness of the domestic industries and is often accompanied by the shortage of foreign currencies, balance of payment disequilibrium, boom and burst macroeconomic cycles, all of which are inimical to economic growth. The management of the exchange rate is further informed on the need to set an appropriate clearing price in the foreign exchange market that would guarantee the adequacy of supply concerning the demand for foreign exchange as well as reduce the exchange rate volatility and its adverse effects on the economy, thereby enhancing better macroeconomic performance.

A sound exchange rate policy coupled with credible exchange rate management and prudent national economic management are crucial conditions for improving the macroeconomic performance and economic growth of a country. Attesting to this assertion are the experiences of many Southeast Asian economies, including India and South Korea, where pragmatic exchange rate management strategies were among the major factors which contributed to their economic growth (Reserve Bank of India (RBI), 2013; Divakaran & Gireeshkumar, 2014). In addition, skilful exchange rate management in China was central in its ascendance on the global economic stage as the world's second-largest economy because its economic take-off was largely propelled by currency undervaluation, which boosted domestic industrial production and stimulated net export components. Notably, prudent economic management aided India, South Korea and China to reap the benefits of pragmatic exchange rate management.

For Nigeria to reap the benefits of exchange rate management, the Nigerian economy must be prudently managed. Secondly, most countries benefited from exchange rate management because of their strong industrial base through which manufactured goods were exported. On the contrary, Nigeria's industrial base is not very strong and its exports are mostly primary products (crude oil and agricultural produce) whose demand and prices are unstable in the international market. Bamidele (2001) posited that sustainable economic growth requires exports to be diversified and more value-added items than agricultural and mineral commodities.

Exchange rate management in Nigeria has been the responsibility of the Central Bank of Nigeria (CBN). So far, two exchange rate management approaches, the fixed exchange rate and the managed floating exchange rate policies, have been implemented, with each regime accompanied by different institutional and legal frameworks. The choice of each regime has been driven largely by the macroeconomic objectives of the government, problems confronting the economy, the structure of the economy and the conscientious desire of the monetary authority to maintain the external reserves and safeguard the international value of naira (Ikoku, 2017). Between 1960 and 1986, the fixed exchange rate policy was adopted. The inability of

the fixed exchange rate system to achieve the major objectives of exchange rate policy led to its replacement with the managed floating exchange rate policy in September 1986. Among its shortcomings was the over-valuation of the naira and resource misallocation (Obaseki, 2001). Overvaluation of the naira promoted imports and discouraged non-oil exports. The appreciation of the naira made foreign goods and services cheap to Nigerians and Nigeria's goods and services expensive to foreigners. Consequently, there was massive importation of consumer goods as well as inputs to sustain the import-substitution manufacturing firms and a drastic fall in exports except crude oil which became the mainstay of the Nigerian economy. The massive importations led to a reduction in domestic production, balance of payments deficit and external reserves depletion.

The managed floating exchange rate approach was introduced in 1986 and is sustained to date with a series of modifications. However, there was a temporary suspension in 1994 when the official exchange rate was fixed at N22.00 to a dollar and "guided deregulation" was implemented in 1995. Among the objectives had been to achieve a realistic stable exchange rate for the naira, preserve the value of the domestic currency, promote the productive sector and export diversification, lessen import dependence, maintain favourable external balance and enhance the influx of foreign direct investment into the country (Obadan, 2006; Ikoku, 2017). So far, the accomplishment of these objectives, especially exchange rate stability and the attendant macroeconomic performance has been far from favourable.

The objective of this study is to examine the impact of exchange rate management on the performance of the Nigerian economy particularly, national output for the period (1981-2021) using the Autoregressive Distributed Lag (ARDL) Bound testing approach. This paper is timely given the current worsening fortunes of the Naira vis-à-vis the U.S. dollar and the unsuccessful struggle by the Central Bank of Nigeria (CBN) to achieve a realistic stable exchange rate, hence, represents an important contribution to the literature as it provides current evidence for the Nigerian case on the subject matter. The remaining part of this paper is organized thus: Section 2 reviews relevant literature. The methodological approaches adopted in the study are presented in section 3 while section 4 elaborates on empirical results. Finally, section 5 provides the summary, recommendations and conclusion.

2. Literature Review

2.1 Conceptual Literature

The foreign exchange market is the medium for the purchase and sale of foreign currencies as well as the determination of exchange rates. The exchange rate is the price of one currency in terms of another currency (Mordi, 2006). It is the domestic price of foreign currency (Rapetti, 2019). It is the rate at which a country's currency is exchanged for the currency of another country. The value of a currency in international exchange is determined by the quantity of goods and services it can purchase from other countries, hence the strength of a domestic currency against foreign currency depends on the productivity of the economy. The higher the output of the economy, the stronger its currency. However, other factors which affect the strength of a currency include the economic policy pursued, political and social instability, and the initial exchange rate level between two countries (Uchendu, 2001).

There is a nominal exchange rate (NER) and a real exchange rate (RER). The NER is the monetary concept that measures the price of foreign currency in terms of domestic currency while the RER is inflation-adjusted exchange rate. RER is a real concept which measures the relative price of tradable goods (exports and imports) with non-tradable goods (goods and services produced and consumed locally) (Rapetti, 2019). There is a link between NER and RER in that fluctuations in the NER can cause changes in the RER. There is also a crucial reference value known as the equilibrium real exchange rate (ERER). It is an ideal real exchange rate which prevails in the absence of price rigidities, frictions and other short-run

factors in an economy (Omotosho & Wambai, 2012). Rapetti (2019) posits that ERER is the exchange rate at which the economy is at macroeconomic equilibrium (i.e., full employment with low inflation and external balance). He asserts that ERER depends on deep economic fundamentals (for example, productivity), exogenous variables (for example, international interest rate) and policy variables (for example, public spending). If the observed RER deviates from the ERER level, the currency in question is said to be misaligned. RER misalignments and volatility are linked to poor growth performance in less developed countries (Carrera & Restout, 2008).

Exchange rate management involves choosing an exchange rate system by the monetary authority and exchange rate planning as well as manoeuvring the disbursement of foreign exchange resources to reduce destabilizing effects of short-term capital flows and influencing the determination of foreign exchange rate at which foreign transactions are carried out with the ultimate goal of achieving realistic stable exchange rate by the monetary authority. According to Argy (1984), exchange rate management is the use of official policies to influence the exchange rate that emerges in the foreign exchange market. The three principal techniques of managing exchange rates are foreign exchange intervention by the monetary authority through the buying and selling of currencies in the foreign exchange market, the use of monetary policy by the monetary authority to stabilize the long-run real exchange rate without associated reserve movements, and the use of capital control by the monetary authority as a means of stabilizing simultaneously the exchange rate and the volume of money (Argy, 1984; Patnak & Sengupta, 2021). Other methods of managing exchange rates, though less important, include the use of fiscal policy, administrative controls over imports and exports, special inducements to foreign central banks to hold reserves in a particular currency, and various devices intended to alter levels of official reserves without intervening or borrowing (Argy, 1984).

Fixed and pegged, managed floating and freely floating exchange rate regimes have been identified as the most common forms of exchange rate management regimes adopted globally (Patnak & Sengupta, 2021). Similarly, Obadan (1993) stresses that the options available to a country in the management of exchange rates include pegging to a single intervention currency and pegging to a basket of currencies, floating independently at the managed rate and floating freely without official management of the exchange rate. In a fixed exchange rate system, the exchange rate is pegged to a major currency or a basket of currencies or a Special Drawing Right (SDR). The peg exchange rate system is adjusted whenever the misalignment becomes unsustainable. On the other hand, in the free-floating exchange rate system, the exchange rate is determined absolutely by the market forces (the forces of demand and supply) in the foreign exchange market. The rate at which a currency exchanges for other currencies varies in response to changes in demand for and supply of foreign exchange in the foreign exchange market. An increase in foreign demand for a country's goods and services will raise the price of its currency in terms of other currencies while an increase in the demand for foreign goods and services by its residents will lower the price of its currency in terms of other currencies. A managed floating exchange rate system is a system where exchange rates are allowed to float but subject to occasional intervention of the monetary authority to control fluctuations of exchange rates around the normal rates. In other words, the forces of demand and supply are allowed to determine the long-run trend in the exchange rate but the monetary authority enters the foreign exchange market to influence the rates by buying or selling foreign currencies whenever it feels the fluctuations are generating instability in the system.

2.2 Overview of Foreign Exchange Rate Management in Nigeria

The management of the exchange rate in Nigeria has undergone a series of reforms over the years based on the influence of domestic and external economic conditions, especially issues

surrounding federation revenue (government fiscal operation) as well as developments around crude oil (prices and volume of crude oil export), which is the major foreign exchange earnings of the country. Specifically, from Nigeria's independence to date, two major exchange rate management regimes have been in operation. The fixed exchange rate policy was adopted from 1960 to August 1986 while the floating exchange rate policy with a series of modifications has been in operation from September 1986 till date. During the fixed exchange rate regime, the Nigerian pound was fixed at the bar with the British Pound Sterling (1959 -1967). When the British pound was devalued in 1967, the Nigerian pound was pegged to the US dollar (1968-1970). As a result of the financial crisis which affected the world payment system and the devaluation of the US dollar, the Nigerian pound was pegged again to the British pound (1971-1972). When the Nigerian currency was changed from the Nigerian pound to the Naira on January 1, 1973, the Naira replaced the Nigerian pound at the rate of N2.00 to one Nigerian pound (£1.00) and was pegged to the US dollar. From 1978 to 1984, the Naira was pegged to a basket of seven (7) currencies of Nigeria's major trading partners such as the US dollar, the British pound, the Japanese yen, the Dutch guilder, the German mark, the Swiss franc, the French franc (Jimoh, 2014) and in 1985, the US dollar was adopted as the currency of intervention. The fixing of the exchange rate was aimed at providing a mechanism for the maintenance of a balance of payments viability and to contain external inflationary pressures to create opportunities for rapid economic growth and stability in Nigeria.

With the adoption of Structural Adjustment Programmes (SAP) in September 1986 and subsequent deregulation of the foreign exchange market, the fixed exchange rate system was replaced by the floating exchange rate management regime. Foreign exchange policies employed under the floating exchange rate system included the adoption of the second-tier foreign exchange market (SFEM) in 1986, and the merging of the first and second-tier markets into a foreign exchange market (FEM) in 1987 which provided a dual trading platform: the official and free market. The interbank foreign exchange market (IFEM) was employed in 1988. The autonomous foreign exchange market (AFEM) was adopted in 1995, and by 1999, a daily IFEM was re-introduced; followed by the Dutch Auction System (DAS) in 2002. The Central Bank of Nigeria introduced the retail Dutch Auction System (rDAS) in 2002 and the wholesale Dutch Auction System (wDAS) in 2003. To restrain the excesses in the market and stabilize the foreign exchange market, rDAS was re-introduced in October 2013. The continued decline in crude oil prices lowered accretion to external reserves resulting in supply constraints in the foreign exchange market amidst increased demand pressure. In 2014, the monetary authority introduced new reforms in the foreign exchange market which include the realignment policy of the exchange rate band by 200 basis points from ±3% to ±5%, widening the midpoint exchange rate from N155 per US$ dollar to N165 as well as the exclusion of some invisible transactions from the official exchange widow (CBN, 2016). All eligible demand for foreign exchange was moved to the interbank segment of the foreign exchange market on February 18, 2015. In a circular issued on January 11, 2016, the CBN discontinued foreign exchange sales to Bureau-De-Change (BDC) operators and allowed DMBs to accept foreign currency deposits from their customers. Despite the measures, the demand pressure was still very high and foreign exchange reserves continued to deplete. To move the foreign market from the sticky exchange rate of N197.00 per US$ to a more market-determined rate, on June 20, 2016, the CBN adopted a more flexible exchange rate system.

2.3 Theoretical Framework

The theoretical bases for this study are the neoclassical growth theory, endogenous growth theory and Demand-Supply theory of exchange rate. The neoclassical growth model developed by Mankiw, Romer & Weil (1992) expresses output as a function of total labour productivity and capital stock. The endogenous growth theory, developed by Barro (1990) and Romer

(1990) emphasizes that economic growth is an endogenous outcome of an economic system. It posits that economic growth in the short-run and long-run is caused by endogenous factors, hence government policy can influence growth in the short-run and long-run. The exchange rate is an economic policy variable of the government.

The Demand-Supply theory of exchange rate also referred to as the Balance of Payment (BOP) theory, asserts that under free exchange rates, the exchange rate of a country's currency depends on its balance of payments position, which may be surplus or deficit. A surplus balance of payments causes exchange rate appreciation while a deficit in balance of payments results in exchange rate depreciation. This theory implies that the exchange rate is determined by the market forces of demand for and supply of foreign exchange. The demand for foreign exchange depends on the country's imports of goods and services plus loans and investments made abroad. On the other hand, the supply of foreign exchange depends on the country's exports of goods and services plus loans and investments made from abroad. This theory also postulates that Balance of Payment disequilibrium can be corrected by devaluation or revaluation of a country's currency. When the demand for foreign exchange is less than the supply of foreign exchange, the external value of the domestic currency rises concerning the foreign currency and consequently, the exchange rate appreciates. Also, when the demand for foreign exchange is greater than the supply of foreign exchange, the external value of the domestic currency falls with the foreign currency and consequently, the exchange rate depreciates. BOP theory is a more satisfactory theory than purchasing power parity (PPP) theory because it recognizes all items in the balance of payment and their significance, rather than a few selected under the PPP theory. One limitation of the BOP theory is that it is based on an unrealistic assumption of perfect competition in the foreign exchange market (Akrani, 2010).

2.4 Empirical Literature Review

Several cross-country and country-specific studies have been conducted to examine the impact of exchange rate movement on macroeconomic performance: national output (Ojo & Alege, 2014), output growth (Adeniran et al., 2014; Oladapo & Oloyede, 2014; Okorontah & Odoemena, 2016; Ismaila, 2016), industrial output growth (Usman and Adejare; 2012), sectoral output performance (Falana, 2019), domestic private investment (Bakare, 2011), foreign reserves (Khan, 2013), among others. The results of these studies are conflicting; while some showed a positive relationship, others revealed a negative effect of exchange rates while others showed that exchange rates have no effect.

Barguellil & Ben-Salha (2018) examined the impact of exchange rate volatility on the economic growth of a sample of 45 developing and emerging countries for the period (1985-2015) using the difference and system generalized methods of moments (GMM) estimators and found that nominal and real exchange rate volatility hurts economic growth. They stressed that the effect of exchange rate volatility is more harmful when countries adopt flexible exchange rate regimes and financial openness. Ojo & Alege (2014) employed dynamic generalized methods of moments (GMM) panel data framework using the xtabound 2 Difference/System GMM to investigate the implications of exchange rate fluctuations on output and other critical determining factors of exchange rate using a panel data set of 40 Sub-Sahara African (SSA) countries for the period (1995-2007). The result shows that there exists a long-run relationship between the variables in the model.

Sankarkumar et al., (2020) employed the methods of correlation analysis and the Granger causality test to examine the linear and causal relationship between the exchange rate and macroeconomic performance in the South Asian Region (Afghanistan, Bangladesh, Bhutan, India and Sri Lanka). The results indicate that there was a unidirectional causal relationship between exchange rate and imports, government total expenditure and total investment in Bangladesh. The correlation analysis also confirmed that Bangladesh is the only

country which recorded a positive correlation between exchange rate and macroeconomic performance (except total investment) in the South Asian Region. Alagidele & Ibrahim (2016) employed a generalized auto-regression conditional heteroscedasticity technique to study the causes and the effects of exchange rate volatility on economic growth in Ghana for the period (1908 – 2013). The results show that in the short run, output is the most important driver of exchange rate volatility while in the long run, exchange rate volatility is significantly influenced by government expenditure, money supply growth, terms of trade and output shocks. It was also found that excessive exchange rate volatility is detrimental to economic growth.

In the case of Nigeria, Kenny (2019) examined exchange rate fluctuation during the different exchange rate regimes and its impact on economic growth for the period (1981- 2015). The Fully Modified Ordinary Least Square (FMOLS) technique was employed and the result revealed that exchange rate, external reserve, money supply and capital input have a significant impact on the economic growth of Nigeria; whereas labour had no significant impact on economic growth in the long-run. The dummy variable had a negative insignificant coefficient which suggests that the fixed exchange rate did not enhance the economic growth in the long run.

Falana (2019) adopted the modified Mundell- Fleming IS–LM framework in an open economy using the Structural Vector Autoregressive (SVAR) estimation technique to study the relationship between exchange rate regimes and the real sector performances in Nigeria for the period (1961 - 2017). The results reveal that the exchange rate channel is the most effective policy transmission channel to all the five real sectors considered and a long-run relationship exists between the exchange rate and the real sector output in Nigeria. The result also established the differential impact of the exchange rate regime on the dynamics of the output of the five disaggregated real sectors. In the same vein, Isibor et al., (2018) employed the Ordinary Least Square (OLS) technique of analysis to examine the effect of exchange rate management on the output performance of both the agricultural sector and the manufacturing sector in Nigeria for the period (1981 - 2015). The result showed that the exchange rate has a positive and significant effect on only the agricultural sector output.

Mesagan et al., (2018) used the autoregressive distributed lag (ARDL) bounds testing method to examine the macroeconomic implications of exchange rate depreciation in Nigeria for the period (1970 - 2015). The result showed that the Naira depreciation has a positive and significant impact on all indicators of macroeconomic performance except for output per capita, which was found to be insignificant. This implies that Naira depreciation stimulates trade balance, promotes price instability and increases the interest rate. Thus, currency depreciation does not benefit the Nigerian economy. Okorontah & Odomena (2016) investigated the effects of exchange rate fluctuations on economic growth in Nigeria for the period (1986-2012) using the Ordinary Least Square (OLS) technique and the error correction mechanism (ECM). The result showed that there is no strong relationship between the exchange rate and economic growth in Nigeria.

Isol et al., (2016) employed the autoregressive distributed lag (ARDL) model to study the impact of exchange rate fluctuation on economic growth in Nigeria using data which spanned from 1980Q1 to 2013Q4. The result showed that exchange rate fluctuation does not affect economic growth in the long run though a short-run relationship exists. In the same vein, Ismaila (2016) studied exchange rate depreciation and Nigeria's economic growth during the period of SAP and the post-SAP period (1986 - 2012) using the error correction model (ECM). The findings of the study reveal that broad money supply, net export and total government expenditure had a significant impact on real output performance in the long run while the exchange rate has a direct but insignificant effect on economic growth in both the short and

long run. This implies that exchange rate depreciation during the SAP period has no robust effect on economic performance.

Iyeli & Utting (2017) examined the effect of exchange rate volatility on economic growth in Nigeria for the period (1970 - 2011) using the Johansen Co-integration estimation techniques. The results show that exchange rate volatility contributes positively to GDP growth in the long run. Contrary to Iyeli & Utting (2017) findings, Ndu-Okereke & Nwachukwu (2017) studied the impact of exchange rate volatility on the Nigerian economic growth for the period (1987-2011) using Ordinary Least Square (OLS) regression analysis and vector autoregressive lag (VAR) models and found that exchange rate fluctuation has a negative and significant impact on GDP.

Adeniran et al., (2014) employed correlation and the Ordinary Least Square (OLS) method of analysis to examine the impact of the exchange rate on economic growth in Nigeria for the period (1986 - 2013). The findings reveal that the exchange rate had a positive but insignificant impact on economic growth. In the same vein, Ubah (2015) examined the impact of exchange rate volatility on economic growth in Nigeria for the period (1970 - 2012) using the generalized autoregressive conditional heteroscedasticity technique. The results show that both in the short run and the long run, economic growth is negatively impacted by exchange rate volatility. Bakare (2011) examined the impact of different exchange rate regimes on macroeconomic performance, particularly on private domestic investment in Nigeria using Ordinary Least Square (OLS) regression analysis. The finding of the study reveals a significant but negative relationship exists between floating exchange rate and private investment.

From the literature reviewed, there are gaps that this study intends to fill. Most of the previous studies that examined the effect of the exchange rate on macroeconomic performance in Nigeria did not include capital stock and labour force in their models, which based on economic theory are basic determinants of economic growth. Also, most of the studies were based on cross-country analysis. In addition, some previous studies employed the Ordinary Least Squares (OLS) estimation technique for the analysis which may not be appropriate where the data are non-stationary as it results in spurious regressions and long-run relationship could not be ascertained. In an attempt to fill the gaps, this study, in addition to the exchange rate, incorporated capital stock and labour force together with other variables such as government expenditure, inflation rate, interest rate, trade openness, foreign direct investment and money supply to make the model robust. The estimation technique for the analysis of this study is the autoregressive distributed lag (ARDL) approach.

3. Methodology

The Autoregressive Distributed Lag (ARDL) Bound testing method was employed to examine the long-run relationship between the dependent variables and the explanatory variables, as well as the short-run dynamics. The ARDL approach offers considerable advantages in that variables could have different orders of integration I(0) and I(1), varying lag orders and could provide estimates of both short-run and long-run coefficients simultaneously (Pesaran et al., 1999; Pesaran et al., 2001). In addition, the endogeneity problems and inability to test hypotheses on the estimated coefficients in the long run associated with the Engle-Granger cointegration method are avoided. Lastly, this technique is suitable for small or finite sample sizes (Pesaran et al, 2001). Error Correction Model (ECM) was also employed to ascertain the speed of adjustment from the short-run equilibrium to the long equilibrium state. The data collected were subjected to verification tests such as the unit root test using the Augmented Dickey-Fuller (ADF) test to examine the stationarity property of the time series data and the causality test using the Granger Causality test. To ascertain that the model satisfies some basic econometric assumptions, diagnostic tests such as auto-correlation (serial correlation) test

using Durbin-Watson statistics, normality test using the Jarque Bera test, and ARCH test to check for heteroscedasticity were conducted.

3.1 Model Specification

The economic model for this study is anchored on the neoclassical and endogenous growth theories framework. The modified and extended aggregate production function for this study is given as

$$RGDP = f(K, L, EXR, INT, INF, TOP, GEXP, FDI, M2) \quad - - - \ (1)$$

For econometric analysis, the functional equation is transformed into a log linear function as:

$$\ln RGDP = a_o + a_1 \ln K + a_2 \ln L + a_3 \ln REXR + a_4 INFR + a_5 INR + a_6 \ln TOP + a_7 \ln GEXP + a_8 \ln FDI + a_9 \ln M2 + U_t \quad - - - \ (2)$$

Where: RGDP, real gross domestic product (proxy for real national output) is used as the dependent variable while independent variables are gross capital formation (K) (capital accumulation enhances growth), labour force (L), real exchange rate (REXR), inflation rate (INFR) (moderate rate of inflation enhances economic growth but high rate of inflation adversely affects it), trade openness (TOP) (trade openness can promote growth by promoting specialization and facilitating imports of technological and capital goods) and public expenditure (GEXP) (on one hand, an increase in public spending is likely to have negative effect on growth through crowding-out effects on private investment. On the other hand, an increase in public spending may improve infrastructure and positively affect national output), foreign direct investment (FDI) and broad money supply (M2). Ut is the error term while a1 - a9 are parameters of the behavioural equation to be estimated. Apr iori expectation is as follows: a1, a2, a6, a7, a8 and a9 > 0 while a3, a4 and a5 < 0. This implies that all things being equal, domestic physical capital (K), labour force (L), trade openness (TOP), government expenditure (GEXP) and money supply (M2) are expected to have a positive effect on national output (RGDP). A country's level of economic activity depends more on its inflation–adjusted exchange rate often referred to as the real exchange rate. The proxy for exchange rate management in this study is the real exchange rate (REXCR). An increase in the real exchange rate (REXCR), inflation rate (INF) and interest rate will hurt the national output (RGDP).

The ARDL model contains the lagged value of the dependent variable (RGDP) and the current and lagged values of regressors (K, L, EXR, INT, INF, TOP, GEXP, FDI, M2) as explanatory variables. Therefore, equation (2) was rewritten in ARDL form as follows:

$$\Delta \ln RGDP_t = a_o + \Sigma^n_{k-1} a_1 \Delta \ln RGDP_{t-k} + \Sigma^n_{k-1} a_2 \Delta \ln K_{t-k} + \Sigma^n_{k-1} a_3 \Delta \ln L_{t-k} + \Sigma^n_{k-1} a_4 \Delta \ln REXR_{t-k} + \Sigma^n_{k-1} a_5 \Delta INT_{t-k} + \Sigma^n_{k-1} a_6 \Delta INF_{t-k} + \Sigma^n_{k-1} a_7 \Delta \ln TOP_{t-k} + \Sigma^n_{k-1} a_8 \Delta \ln GEXP_{t-k} + \Sigma^n_{k-1} a_9 \Delta \ln FDI_{t-k} + \Sigma^n_{k-1} a_{10} \Delta \ln M2_{t-k} + b_1 \ln RGDP_{t-1} + b_2 \ln K_{t-1} + b_3 \ln L_{t-1} + b_4 \ln REXR_{t-1} + b_5 INT_{t-1} + b_6 INF_{t-1} + b_7 \ln TOP_{t-1} + b_8 \ln GEXP_{t-1} + b_9 \ln FDI_{t-1} + b_{10} \ln M2_{t-1} + \varepsilon_t \quad - - - \ (3)$$

Where a_o represents the drift component, Δ is the first-difference operator, a_i is long-run multipliers, b_i are short-run dynamic coefficients and ε_t shows the white noise.

The real gross domestic product (RGDP) (a proxy for real output) and real exchange rate (REXR) (reflects the credibility of policies) were variables of interest. The control variables employed were gross capital formation (K) (reflect the level of investment), labour force (L), government expenditure (GEXP), inflation rate (INFR) (reflect macroeconomic stability), interest rate (INR), trade openness (TOP) (capture the openness of the economy), foreign direct investment (FDI) and money supply (M2). The data on these variables were obtained from the Central Bank of Nigeria Statistical Bulletin (2021) and the World Bank Development Indicator (WDI, 2021).

4. Empirical Results

4.1 Descriptive Statistics

Table 1: Descriptive Statistics for the Variables
Source: Author Computation

	lnTOP	lnRINT	lnRGDP	lnREXR	lnM2	lnLF	lnK	lnINFR	lnGEXP	lnFDI
Mean	-3.256919	1.849042	10.07643	4.898441	6.694920	17.46876	29.77709	2.681151	5.258092	21.03488
Median	-2.375676	1.813914	9.901162	4.609204	6.962203	17.46507	29.73598	2.560465	5.253477	21.08755
Maximum	-0.757153	4.187531	11.18982	6.303187	9.847006	17.96224	30.48510	4.288210	9.181410	22.90267
Minimum	-7.013116	-0.010050	9.530920	3.906608	2.672078	16.95217	29.36601	1.683060	2.265921	19.05421
Std. Dev.	2.293339	0.873635	0.527155	0.716451	2.565301	0.294580	0.246717	0.684104	2.266654	1.171343
Skewness	-0.455203	-0.016057	1.074807	0.542157	-0.196501	0.055367	0.854596	0.870181	0.216146	-0.010385
Kurtosis	1.589659	3.513603	2.786113	1.932482	1.572816	1.853724	3.806926	2.927374	1.751488	1.832965
Jarque-Bera	4.696501	0.441366	7.777644	3.858887	3.652176	2.210352	5.954114	5.056885	2.909434	2.270671
Probability	0.095536	0.801971	0.020469	0.145229	0.161042	0.331153	0.050943	0.079783	0.233466	0.321314
Sum	-130.2767	73.96169	403.0571	195.9376	267.7968	698.7504	1191.083	107.2460	210.3237	841.3950
Sum Sq. Dev.	205.1167	29.76631	10.83780	20.01878	256.6500	3.384315	2.373904	18.25193	200.3711	53.50975
Observations	40	40	40	40	40	40	40	40	40	40

The descriptive statistics of the database used in this study are presented in Table 1. The mean of the REXR is approximately 5 with minimum and maximum values of about 4 and 6 respectively. The highest standard deviation was about 2.6, displayed by broad money supply (M2). Besides, gross capital formation (K) has the highest mean value (about 30) followed by foreign direct investment (about 21).

4.2 Unit Root Test Results

To avoid spurious results due to non-stationarity of data and also ensure that none of the variables are integrated of order two, I(2), since the ARDL model is based on the assumption that the variables were l(0) or l(1) series and the presence of l(2) series renders the calculated F-statistic invalid thereby crashing the ARDL procedure, test for the stationarity status of the variables was conducted using Augmented Dickey-Fuller (ADF). The test statistics were done for two alternative specifications. First, it was tested with intercept but no trend, and then it was tested with both intercept and trend. The results are presented in Table 2. The results show that the dependent variable, lnRGDP was stationary at the first level of differencing, l(1). As for explanatory variables, lnINFR, lnK, lnRINT and lnTOP were stationary at levels, l(0) while lnFDI, lnGEXP, lnLF, lnM2 and lnREXR were integrated at the order one, l(1). The results show that the variables have mixed order of integration, thereby lending support to the use of the ARDL method of co-integration test.

Table 2: ADF Unit Root Test Result

Variable	ADF test				Order of integration
	Levels		1st difference		
	I	T & I	I	T & I	
lnFDI	-1.812987	-2.543286	-9.262732*	-9.188652*	I(1)
lnGEXP	-1.360387	-1.117414	-98.81507*	-3.148740	I(1)
lnINFR	-3.496497**	-3.554168**	-7.036822*	-6.932681*	I(0)
lnK	-0.839757	-3.734822**	-4.342523*	-5.047757*	I(0)
lnLF	-1.087027	-3.075012	-9.309863*	-9.343250*	I(1)
lnM2	-1.766396	1.706095	-2.612353***	-3.119919	I(1)
lnREXR	-2.151753	-2.050012	-13.61997*	-13.46783*	I(1)
lnRGDP	-0.565575	-1.680252	-3.500775**	-3.216965***	I(1)
lnRINT	-7.644659*	-7.523400*	-12.45660*	-12.27366*	I(0)
lnTOP	-2.886941**	-5.513899*	-8.195086*	-8.090176*	I(0)

Note: I = Intercept, T & I = trend and Intercept. ADF test was performed using the Schwarz information criterion and the automatic lag selection set as 9 lags. Note: *** and *** imply statistical significance at 1%, 5% and 10% levels respectively.
Source: Author Computation.

4.3 Co-integration Test Results

The Autoregressive Distributed Lag (ARDL) Bound testing procedure was employed to examine the cointegration relationship between the dependent variables and the explanatory variables, as well as the short-run dynamics. The ARDL procedure involves comparing the computed F-statistic with the critical values provided by Pesaran and Shin (1998) for hypothesis testing. The null hypothesis for the ARDL bound test for cointegration is that there is no long-run relationship. Hence, if the computed F-statistic is less than the lower bound value, the null is not rejected. On the contrary, if the computed F-statistic is greater than the upper bound value, it implies the existence of a long-run relationship among the variables. Lastly, if the computed F- statistic lies between the lower bound and upper bound, the long-run association between the variables becomes inconclusive.

The bound test co-integration result is presented in Table 3. The result shows that there is a long-run relationship between the macroeconomic variables estimated, evidenced by the calculated F-statistic value of 3.071344 being greater than the upper bound critical value of 2.08 and 2.8 at 5% and 10% levels of significance respectively. This implies that the series are related and can be combined in a linear fashion. That is, even if there are shocks in the short run, which may affect movement in the individual series, they would converge in the long run. Hence, the study estimated both long-run and short-run models.

Table 3: ARDL Bound Test Result

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	3.071344	10%	1.8	2.8
K	9	5%	2.04	2.08
		2.5%	2.24	3.35
		1%	2.5	3.68

Source: Author's Computation

4.4 Long-run ARDL Estimated Results

The long-run ARDL result is presented in Table 4. The results reveal that the real exchange rate (lnEXCR) exerts a positive and significant effect (at a 10% level) on economic performance (lnRGDP) in the long run. It indicates that a percentage increase in one year lagged value of real exchange rate (lnREXR(-1)) will result in a 0.053737 per cent increase in economic performance (lnRGDP) in the long run. As for control variables, lnK, lnLF and lnFDI have positive and significant effects on economic performance (lnRGDP) while lnINT and lnM2 exert positive but insignificant effects on economic performance (lnRGDP). On the other hand, lnINFR and lnTOP displayed a negative but insignificant effect on economic performance (lnRGDP) in the long run. The coefficient of determination (R2) and adjusted coefficient of determination are 0.979 and 0.972 respectively. This meant that the independent variables jointly explain 97% of the total variation in the dependent variable (lnRGDP). Furthermore, the F-statistic (135.6316) which is used to measure the overall significance of the estimated model shows significance.

Table 4: Long-Run ARDL Estimate

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-23.09569	6.339416	-3.643189	0.0010
LOGRGDP(-1)	-0.952328	0.097283	-9.789271	0.0000
LOGK(-1)	0.315807	0.075701	4.171749	0.0003
LOGLF(-1)	1.796496	0.359597	4.995858	0.0000
LOGREXR(-1)	0.053737	0.027086	1.983936	0.0568
LOGINFR(-1)	-0.013999	0.023541	-0.594671	0.5567
LOGRINT(-1)	0.000872	0.018843	0.046261	0.9634
LOGTOP(-1)	-0.005517	0.011831	-0.466276	0.6445
LOGGEXP(-1)	-0.028709	0.026605	-1.079053	0.2895
LOGFDI(-1)	0.064816	0.028228	2.296214	0.0291
LOGM2(-1)	0.076374	0.051246	1.490341	0.1469

R-squared	0.979066	Mean dependent var	10.08608
Adjusted R-squared	0.971848	S.D. dependent var	0.522337
S.E. of regression	0.087641	Akaike info criterion	-1.802711
Sum squared resid	0.222749	Schwarz criterion	-1.338269
Log likelihood	47.05422	Hannan-Quinn criter.	-1.634 784
F-statistic	135.6316	Durbin-Watson stat	1.795985
Prob(F-statistic)	0.000000		

Note: *** and *** imply statistical significance at 1%, 5% and 10% levels respectively.
Source: Author's Computation

4.5 Short-run ARDL Estimated Results

The short-run ARDL result is presented in Table 5. The coefficient of real exchange rate (lnREXCR) had a negative but insignificant impact on real economic performance (lnRGDP). A one-year lagged value of real exchange rate (D(lnREXR(-1)) had a negative but insignificant effect on economic performance (lnRGDP) in the short run. This implies that an increase in the exchange rate deters economic performance in Nigeria in the short run. As for control variables, lnK, lnINFR, lnFDI and lnM2 positively influenced economic performance (lnRGDP) while lnLF, lnREXR, lnINT, lnTOP and lnGEXP adversely affected lnRGDP. The lagged error correction term (ECM) was included in the model to capture the long-run dynamics between the co-integrating series and was found to be negative and significant at a 5% level confirming the existence of a long run relationship among variables. Its coefficient, -0.318130, shows the speed of adjustment rate of 31.81 per cent from the short-run to the path of long-run equilibrium. Both the coefficient of determination (R2) and adjusted coefficient of determination are 0.997 and 0.995 respectively. This shows that the independent variables jointly explain 99.7% of the total variation in the dependent variable (lnRGDP). The F-statistic (729.4041), which measures the overall significance of the estimated model, shows significance. This reinforced the goodness of fit.

Table 5: Short- Run ARDL Estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.059333	0.020795	2.853189	0.0082
D(lnRGDP(-1))	-0.942828	0.031939	-29.51964	0.0000
D(lnK(-1))	0.191880	0.059988	3.198638	0.0035
D(lnLF(-1))	-0.815867	0.506735	-1.610044	0.1190
D(lnREXR(-1))	-0.003689	0.014858	-0.248272	0.8058
D(lnINFR(-1))	0.002977	0.013554	0.219627	0.8278
D(lnRINT(-1))	-0.008500	0.007309	-1.162843	0.2551
D(lnTOP(-1))	-0.009207	0.004864	-1.892947	0.0691
D(lnGEXP(-1))	-0.022416	0.007992	-2.804806	0.0092
D(lnFDI(-1))	0.002687	0.018765	0.143188	0.8872
D(lnM2(-1))	0.089144	0.077543	1.149604	0.2604
ECM(-1)	-0.318130	0.138977	-2.289094	0.0301

R-squared	0.996646	Mean dependent var	0.039922
Adjusted R-squared	0.995280	S.D. dependent var	0.693021
S.E. of regression	0.047613	Akaike info criterion	-3.003749
Sum squared resid	0.061210	Schwarz criterion	-2.491884
Log likelihood	70.57311	Hannan-Quinn criter.	-2.820096
F-statistic	729.4041	Durbin-Watson stat	1.625538
Prob(F-statistic)	0.000000		

Note: *, ** and *** imply statistical significance at 1%, 5% and 10% levels respectively.
Source: Author's Computation

4.6 Granger Causality Test

The result of the pairwise granger's causality test is presented in Table 6. The rule states that if the probability value lies between 0 and 0.05, there is a causal relationship. The result shows that lnREXR had a probability value of 0.1927 which is greater than 0.05, hence it does not granger cause lnRGDP. Similarly, lnRGDP does not granger cause lnREXR since it has a probability value of 0.5271 which is greater than 0.05. Hence, there is no causality between lnRGDP and lnREXR.

Table 6: Pairwise Granger Causality Tests

Null Hypothesis	Obs	F- statistics	Probability
LogREXCR does not Granger cause LogRGDP	39	1.72927	0.1927
LogRGDP does not Granger cause LogREXCR		0.65261	0.5271

Source: Author's Computation

4.7 Diagnostic Test Results

Serial Correlation Test Result: The model was checked for autocorrelation using the Breusch-Godfrey Serial Correlation LM Test. The results, presented in Table 7, show that there is no serial correlation as the p-value of the model (0.2931) was greater than the 0.05 level of significance.

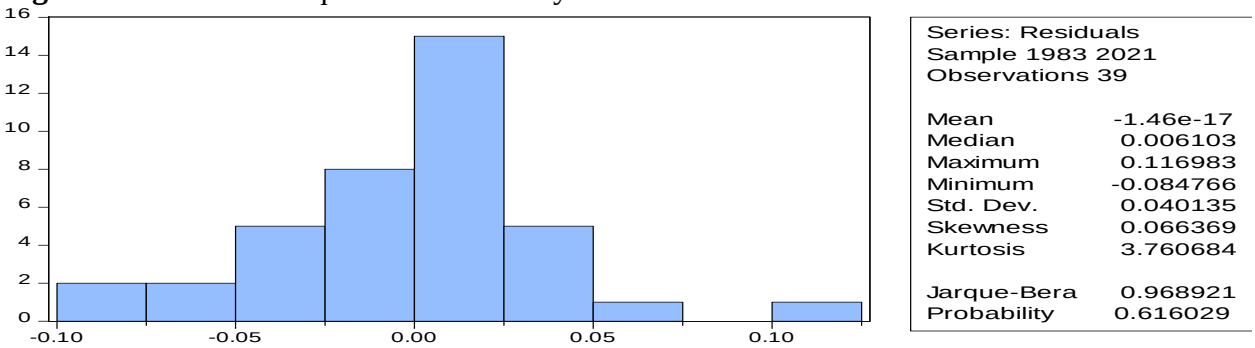
Table 7: Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.284791	Prob. F(2,27)	0.2931
Obs*R-squared	3.475980	Prob. Chi-Square(2)	0.1759

Source: Author's Computation

Normality Test Results: The Jarque-Bera normality test was carried out to ascertain the distribution of the residuals in the model using histogram-normality test. The result is presented in Figure 1. The results show a probability value of 0.616029 which is greater than 0.05. The result indicates that the residual of the model is normally distributed.

Figure 1: Results of Jarque-Bera Normality Test



Stability Test Results: The cumulative sum of recursive residuals (CUSUM) and CUSUM of square tests were also conducted to assess parameter stability. Figures 2 and 3 plot the results for CUSUM and CUSUMSQ of squares tests. The results indicate the absence of any instability of the coefficients because the plot of the CUSUM and CUSUMSQ statistic fall inside the critical bands of the 5% confidence interval of parameter stability.

Figure 2: The Result of CUSUM Test

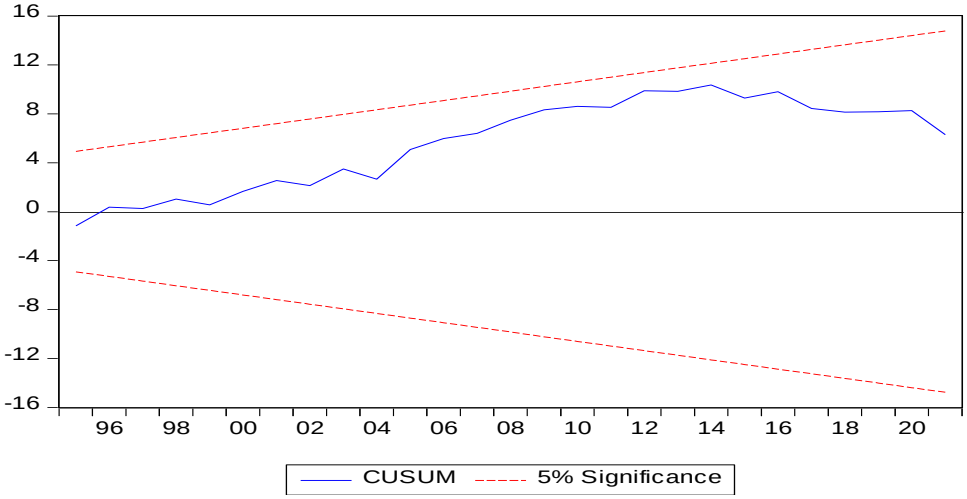
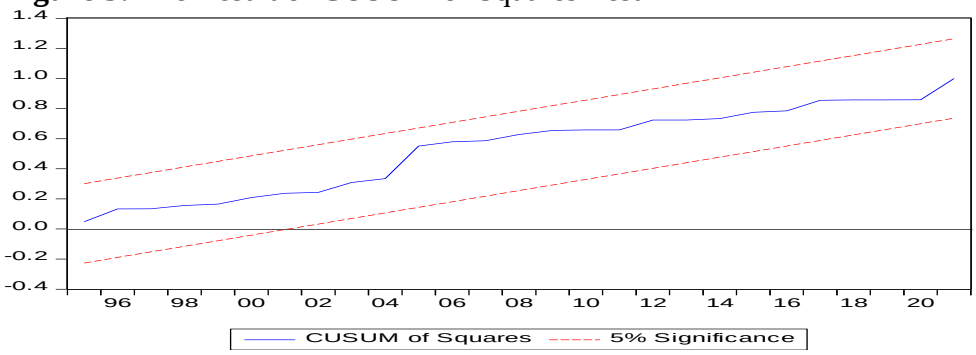


Figure 3: The Result of CUSUM of Squares Test



5. Conclusion and Recommendations

This study examined the impact of the real exchange rate on macroeconomic performance in Nigeria for the period (1981-2021) using a modified and extended aggregate production model and the Autoregressive Distributed Lag (ARDL) Bound Testing Approach of analysis. The results of the analysis indicated that the real exchange rate exerted a positive and significant effect on economic performance in the long run and a negative but insignificant effect in the short run. As for control variables, capital stock, labour force, and foreign direct investment had positive and significant effects on economic performance while real interest rate and broad money supply exerted positive but insignificant effects on economic performance in the long run. On the other hand, inflation rate and trade openness displayed a negative but insignificant effect on economic performance in the long run. In the short-run, capital stock, inflation rate, foreign direct investment and broad money supply impacted positively on economic performance while labour force, real interest rate, trade openness and government expenditure exerted negative influence. This study, therefore, concluded that the exchange rate influenced domestic economic activity and the performance of the economy negatively in the short run.

Based on the findings of this study, it is recommended that:

(i) The government should formulate and implement policies that will engender an increase in productivity in Nigeria.

(ii) Nigeria should refine a good chunk of her crude oil locally, involve more in agriculture to become agriculturally self-sufficient and revive the manufacturing sector for increased manufacturing output to meet the country's needs for petroleum resources, agricultural and manufactured products as well as for exports. This will reduce the country's imports and pressure on foreign exchange demand.

(iii) Frantic efforts should be made toward the diversification of the Nigerian economy and its export base.

(iv) An official policy should be directed toward increasing the share of processed agricultural products, refined petroleum products, manufactured goods, and secondary and tertiary services in Nigeria's exports to diversify the foreign exchange earnings as well as boost growth in the nation's external reserves.

(v) There should be continuous improvement in the level of development of the financial sector since the effectiveness of exchange rate policy to a large extent depends on it, especially in terms of reduction in population/bank density and diversification of financial services.

(vi) The Nigerian economy should be prudently managed and exchange rate management should be carried out innovatively to ensure relative stability of exchange rate.

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