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Determinants of Real Exchange Rate in Nigeria: An Empirical Investigation

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Abstract: This paper empirically investigates the determinants of real exchange rate in Nigeria over the period 1981-2019. Co-integration and dynamic error correction model (ECM) techniques are utilized for the study. The empirical results reveal the existence of a short-run dynamic and a long-run equilibrium relationship between real exchange rate and its determinants in Nigeria. Output capacity, trade openness, net capital inflow, real interest rate, government expenditure and inflation are the principal determinants of exchange rate in Nigeria. In particular, increased output capacity, greater degree of openness, increased net capital inflows and high real interest rate lead to exchange rate appreciation. Increased government expenditure and high inflation rate on the other hand, would cause exchange rate depreciation. The paper further finds evidence that money supply is positively related to exchange rate, albeit a weak impact. Against the backdrop of these findings, it is necessary for the country to implement, policies that will increase her output capacity in terms of diversifying the productive base of the economy through increase production and trade capacities, in order to enhance a competitive value for the naira. Other policy measures include increased capital inflow, reduction of excessive liquidity in the economy, sound fiscal management and stable macroeconomic policies with respect to inflation and interest rates.

Keywords: Real exchange rate, Exchange rate appreciation, Exchange rate depreciation, Error correction Model

JEL Classification*:* F02, F31

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1. Introduction

The exchange rate is an important macroeconomic variable whose value has implications for external balance and international competitiveness. As a monetary concept, the nominal exchange rate (NER) is the price of one currency in terms of another. To this end, it facilitates the conversion of prices quoted in different currencies into a common denomination. The NER differs from the real exchange rate (RER) to the extent that the latter reflects the domestic NER adjusted for changes in price level differential between the domestic economy and the rest of the world. RER can also be seen as the price of tradable goods in relation to non-tradable goods. Changes in the nominal exchange rate affect the import and export trade as well as capital flows of a country and hence the

balance of payments. The real exchange rate (RER) which reflects the domestic NER adjusted for price level differential between domestic economy and the rest of the world is of even greater significance than the NER as it determines international competitiveness and resource allocation within the economy (Obadan & Ozekhome, 2015). It also affects investment, foreign trade flows, balance of payments, fiscal viability, external debt crisis, employment, productivity, and consumption. During periods of excessive fluctuations in exchange rates, foreign trade and investment could be negatively affected (Insah & Chiaara, 2013.

The use of real exchange rate as a real anchor began with the substantial variations in nominal exchange rate, which was due to inflation differentials between countries and the large misalignment. Considering Nigeria's exchange rate movements over the years, large fluctuations have been observable since the introduction of market-based rates under the Structural Adjustment Programme in 1986. The deregulation of the Nigerian foreign exchange market in 1986, as part of the implementation of SAP policies, marked the switch from the fixed exchange rate regime to the flexible regime, and since that time, the Naira- Dollar Exchange Rate has fluctuated widely and rapidly (Obadan & Ozekhome, 2015). For an open, mono-product and highly import-dependent developing economy like Nigeria, with poorly developed financial markets, and externally generated shocks, the effect of exchange rate fluctuation is pervasive and quite devastating (Aghion et al, 2006). There has also been a large disparity between the official and the parallel (free) market rates. The gaps have been accentuated by the fiscal and foreign exchange crisis experienced by Nigeria since the second half of 2014, with the sharp reduction in crude oil prices in the international market. The real exchange rate (RER) has also exhibited volatility. The standard deviation of the real exchange rate growth for 1981-90 was 7.2 per cent. For the period 1991-2000 – a period of greater liberalization, the standard deviation was 35 per cent, with Nigeria having one of the most volatile RER regimes among developing countries (Mayowa & Olushola, 2013). The standard deviation which fell sharply to 3.72 percent in the period 2001-2010 further rose to 11.5 percent in period 2011-2017 to external vulnerabilities in crude oil price prices in the international market and the resulting growth volatility (Ozekhome, 2018). The RER was more stable during the fixed nominal exchange rate regime (1961-1985). Significant volatility started with the emergence of sizable oil earnings and fiscal imprudence, surging domestic price inflation, and futile efforts to manage the nominal exchange rate. Misalignment in real exchange rate could distort production activities and consequently hinders exports growth and generate macroeconomic instability (Chowdhury, 1999).

In recent times, the Naira has witnessed abrupt and pronounced depreciation vis-a-vis other currencies, due mainly to poor meaningful diversification in production capacities; heavy reliance on the production and

export of single or few primary commodities, externally generated and transmitted shocks, unstable output patterns, high import dependence, and poor macroeconomic policies, particularly inappropriate exchange rate management policies. Added to this is the activities of some market operators (speculators) and banks who engage in 'round-tripping', a situation in which banks buy foreign exchange from the Central Bank of Nigeria (CBN) and sell to parallel market operators at prices other than the official prices.

According to Obadan, (2006), some of the factors that leads to the depreciation of the Naira include; weak production base, import-dependent production structure, fragile export base and weak non-oil export earnings, expansionary monetary and fiscal policies, inadequate foreign capital inflow, excess demand for foreign exchange relative to supply, fluctuations in crude oil earnings, unguided trade liberalization policy, speculative activities and sharp practices (round-tripping) of authorized dealers, over-reliance on imperfect foreign exchange market, heavy debt burden, weak balance of payments position, and capital flight. Weak domestic currency, reflected in exchange rate deterioration could induce inflation, unemployment, weak investment, an output capacities, balance of payments disequilibrium, inefficient resource allocation, and low standard of living.

Given the painful experience of Latin American and some Asian countries in the 1990s, reflected in the deceleration brought about by the financial and economic crises and the inglorious role played by the lack of a sound exchange rate in fueling the crisis, there is no doubt about the explicit importance of a sound exchange rate. In fact, the determination of a sound exchange rate is critical to sound macroeconomic performance and external balance. In this respect, policymakers are concerned with the determination of a coherent exchange rate that guarantees macroeconomic stability and attainment of long-run policy objectives. Inappropriate exchange rate not based on proper identification of the fundamental prevailing economic situation and the goal of the external sector, given the subsisting challenges faced, could obviate long-run policy goals and renders macroeconomic stabilization intractable (Ozekhome, 2017). Against the backdrop of the continued fall in the value of the Naira vis-a-vis other major currencies of the world, it becomes a matter of urgent empirical and policy issue to investigate the determinants of exchange rate movement in Nigeria. This is the focus of this study.

Following this introduction, the paper is organized as follows. Section 2 presents a review of exchange rate policy and some stylized facts on exchange rate movement in Nigeria. Section 3 consists of literature review, which considers key theoretical, empirical, and policy issues associated with exchange rate. Section 4 contains the methodology, model specification and data. The empirical results and analysis is presented in Section 5, and Section 6 concludes the paper, with some evidence-based policy recommendations.

2. Exchange Rate Policy and Stylized Facts on Exchange Rate Movement in Nigeria

The major objectives of exchange rate policy in Nigeria are to preserve the value of the domestic currency (i.e. the Naira), maintain a favourable external reserves position and ensure external balance without compromising the need for internal balance and overall goal of macroeconomic stability (CBN, 2012). The exchange rate policy in Nigeria is aimed at increasing domestic production, enhancing the rise in the level of non-oil exports improving export competitiveness while reducing the demand for imports. It also plays the crucial role of influencing the attainment of other macroeconomic goals of balance of payments stability, reduction in the level of unemployment, attainment of price stability and a sustained rate of economic growth (Akinuli, 1997) cited in Usman (2011).

At the initial stage, the Nigerian currency was pegged at par with pound sterling under a fixed exchange rate, which was in vogue from 1962 to 1986; but when the British pound was devalued, Nigerian government decided to peg the domestic currency to the dollar at an overvalued rate, in other to make imports cheaper for the import substituting industries. By 1985, the naira was quoted against the US dollar, which became the intervention currency to date. After 1986, the management of exchange rate became more market – oriented. This started by introducing the second tier foreign rate and foreign exchange allocation for private sector, and was freely determined by the forces of demand and supply; while the central bank determines the supplies of foreign exchange on a weekly basis.

The introduction of the Second-Tier Foreign Exchange Market (SFEM) was followed by the depreciation of naira to ensure efficient allocation of resources. It was envisaged that the depreciation of naira would increase local sourcing of raw materials and bring about growth in manufacturing sector while discouraging the excessive demand for imports as was experience during the fixed exchange era. The SFEM, which comprises of first tier and second tier exchange rate was merged into a unified foreign exchange market (FEM) on July 2, 1987, with all transactions guided by market forces. An autonomous foreign exchange market created in 1988 was highly destabilized due to its speculative tendencies and was subsequently merged with (FEM), when the interbank foreign exchange market (IFEM) segment in which authorized dealers were allowed to transact.

In spite of the various modifications such as the introduction of the Dutch Auction System (DAS), in December 1990, the foreign exchange rate continues to increase. In 1992, the IFEM was depreciated by the adoption of completely regulated exchange rate regime. CBN was unable to meet all the demands of authorized dealers. In 1994, the monetary authorities reverted to a fixed exchange rate regime where the naira was pegged at N21.9960: $1.This regime exacerbated the situation in FEM as naira depreciated sharply, and the demand

for foreign exchange skyrocketed. The authority later returned to the dual exchange rate regime in 1995, a combination of official market and autonomous foreign exchange transaction, until it was replaced by a new interbank foreign exchange market (FEM) in October 1999. Later, the Nigerian government re-introduced the Dutch Auction System (DAS) on July 2002 with the intention of narrowing the gap between the official market and parallel market rates, and to conserve the foreign exchange reserves. Since July 2002, the foreign exchange market became a little restricted by abolishing the interbank transactions, while transactions were made through Dutch Auction System (DAS), which was regarded as a better alternative (CBN 2012). Due to the shortfall in foreign reserves occasioned principally by the oil price fall in the international market and the negative impulses and reverberations on the Nigerian economy, the CBN adopted a flexible exchange rate in 2016.

The naira depreciated from N 0.54:1$ in 1980 to N2.02 in 1986 and further to N7.901 in 1990 against the US dollar. The policy of guided or managed deregulation pegged the Naira at N21.886 against the US dollar in 1994. Further deregulation pushed it to N86.322 to $1.00 in 1999 (Aliyu, 2011). It depreciated further to 120.97/$ in 2002 and N135.5/$ in 2004. Thereafter, the exchange rate appreciated to N132.15/$ in 2005. Towards the end of 2009, during the global financial crisis the naira depreciated to N150.0124. In 2010 and 2012, it further depreciated to N153.26 and N158.5, respectively against the Dollar. The naira depreciated to N275.20:1$ in 2015, N295.20: 1$ in 2016, and a soaring N520:1$ in the first quarter of 2017, before declining to N472:1$ (CBN, 2017). The exchange rate appreciated to N362:1$ in 2018 and 2019 and currently exchanges at N410 to the dollar, following the global economic upheavals and vulnerabilities caused by the global pandemic, Covid-19.

3. Conceptual Issues

Real Exchange Rate (RER) is defined as nominal exchange rate corrected for inflation. It is the nominal exchange rate adjusted for changes in price level differential between the domestic economy and the rest of the world. Exchange rate is said to depreciate if the amount of domestic currency required to buy a foreign currency increases. On the other hand, the exchange rate appreciates if the amounts of domestic currency required to buy a foreign currency reduces. An appreciation in the real exchange rate may create current account problems because it leads to overvaluation. Overvaluation makes imports artificially cheaper while exports become relatively expensive, with the result of reducing international competitiveness (Takaendessa, 2006). Exchange rate depreciation results in high cost of production, particularly raw materials and capital goods-for an import-dependent economy like Nigeria. This has the effect of reducing profits and could fuel inflation through the cost-push channel when firm increase prices. Ultimately, production declines and unemployment increases. Added to these, are reduction in exports, accumulation of trade deficits and

deterioration of balance of payments, as well as decline in the welfare of the people (Obi et al, 2010).

The short-term equilibrium real exchange rate is the rate that equilibrates current foreign exchange supply and demand in the absence of official intervention. On the other hand, the long-run equilibrium real exchange rate is the rate that ensures that that the current account balance (current and future) is compatible with long-run sustainable capital flows for external equilibrium and that non-tradable goods market clears with employment at its natural level for internal equilibrium (Edward, 1989,c, cited in Krumm, 1993). In simplified terms, and in the context of tradable and non-tradable items, the equilibrium real exchange rate is the relative price which results in the simultaneous attainment of equilibrium in the external sector and in the domestic economy (i.e non-tradable sector) (Obadan, 1994).

Exchange rate Fluctuation refers to wide swings or gyrations of the exchange rate from its equilibrium value. The wide swings are more frequently associated with the floating/flexible exchange rate regime or system than with the fixed exchange rate regime. Flexible exchange rates, by their nature, are basically volatile. Friedman (1953), however, argued that the instability of exchange rate is a symptom of instability in the underlying economic structure and that a flexible exchange rate system needs not produce an unstable exchange rate; where it is unstable, it is primarily because there is underlying instability in the economic conditions. By implication, unstable economic development or output volatility is a major cause of exchange rate volatility (Morana, 2009). Furthermore, inappropriate macroeconomic policies and, increased international financial integration can cause exchange rate volatility. Misalignment of RER occurs when it deviates from the value that would have prevailed in the absence of price rigidities, frictions and other short-run distorting factors. It is a sustained departure of the real exchange rate from its long run equilibrium value (i.e gap between actual and equilibrium exchange rate). Misalignment of the exchange rate could increase economic instability and distort production and investment (Tarawalie, 2009). The existence of many parallel markets side-by-side the officially recognized foreign exchange market causes exchange rate misalignment.

3.1. Theoretical Literature

This section briefly examines two leading theories that explain real exchange rate behavior.

The Purchasing Power Parity (PPP)

The purchasing power parity (PPP) simply states that a unit of any given currency should be able to buy the same quantity of goods in all countries. Accordingly, the nominal exchange rate between two currencies must reflect the different price level on those countries. According to APP, a proportional

relationship exists between the exchange rate of the currencies of two countries and their relative inflation rates. The purchasing power parity (PPP) theory is used to explain changes in exchange rates in terms of differentials in inflation between countries, and it suggests that in a common currency arrangement, the rate of inflation of the dominant country should influence the inflation relates of small countries. In other words, it assumes that the prices of the trading countries should be the same when expressed in the common currency, with the differential being accounted for by tariffs and transport costs. In a fixed exchange rate regime, APP relates the price level in one country is that of another via the exchange rate, and can be expressed in terms of rate of changes as:

$$Pd=e+Pf$$

(Where; Pd=domestic price level, e=nominal exchange rate, and Pf = foreign price level).

The Fundamental Equilibrium Exchange Rate Approach (FEER)

The FEER provides an exchange rate that is consistent with the simultaneous achievement of internal and external equilibrium. Internal balance is attained when the economy is at full employment output consistent with low inflation environment. External balance is characterized by sustainable balance of payment position over the medium or long-term guaranteeing desired net inflow of capital and external debt sustainability. The FEER is associated with the key economic determinants that influence the real exchange rate over the medium term and disregard all short run economic vacillations.

The theoretical literature distinguishes between structural factors and short-run factors affecting real exchange rates. In an open economy, with foreign capital inflows and without quantitative restrictions, structural or fundamental factors determine the equilibrium real exchange rate over the medium and long-terms Such factors include international terms of trade, net capital flows and trade/commercial policy/, the latter being policy induced, import intensity and technical progress. On the other hand, short-run factors may influence the RER independent of the directions dictated by the underlying structural factors. Such factors are mainly macroeconomic and fiscal policy variables. Changes in the nominal exchange rate can also result to short-term fluctuation in the real exchange rate. The real exchange rate at any point in time is, nevertheless, determined by both structural and short-run factors (Krumm, 1993, cited in Obadan, 1994). For instance, in a fixed exchange rate regime, expansionary monetary policy results in strong upward pressure on domestic prices, leading to temporary real appreciation. The Structuralist macroeconomics posits that an expansionary monetary credit channeled into productive activities will raise domestic capacity to its optimal level. If this happens, the real exchange rate tend to appreciate. However, in

most developing countries, monetary expansion results from deficit financing not connected to output, leading to a rise in domestic price and real exchange rate appreciation (Ozekhome, 2018).

3.2. Review of Empirical Studies

A number of empirical studies have examined the factors that influence exchange rate movement both from developed and developing countries. These studies are briefly reviewed.

Edison and Klovland (1987) using the purchasing power parity as basis, find that productivity differentials lead to exchange rate appreciation, thus validating the Balassa-Samuelson effect. Obadan (1994) investigates the determinants of real exchange rate in Nigeria. He employed the Two Stage Least Squares (2SLS) and finds that improvement in terms of trade leads to appreciation in nominal exchange rate, while increases in net capital inflows results to real exchange rate appreciation. Furthermore, increases in monetary aggregates lead to real exchange rate depreciation. Patel and Srivastava (1997) examine the determinants of real exchange rate in India. The findings show that investment-GDP ratio, overall fiscal deficit and nominal exchange rate were the principal determinants of real exchange rate in India.

Aron, Elbadawi and Kahn (1997) investigated both the short-run and long-run determinants of the quarterly real exchange rate in South Africa. The empirical results show important findings. Firstly, capital flows lead to exchange rate appreciation. Secondly, trade openness, government expenditure; non-gold terms of trade and real price of gold have both short-run and long-run effects on real exchange rate. This implies that increase openness, deteriorating terms of trade and decreased capital flows lead to real exchange rate depreciation. However, an un-sustained government expenditure results in exchange rate overvaluation. The results further show that nominal devaluation has a significant negative effect on the real exchange rate, while the lagged nominal devaluation has a significant positive effect on real exchange rate. Excess domestic credit supply also has a significant positive influence on real exchange rate, implying that increases in domestic credit supply lead to exchange rate appreciation. Lastly, lagged growth differentials have positive and significant influence on real exchange rate.

Chowdhury (1999) examines the determinants of real exchange rate in Papua Guinea. The results show that nominal devaluation plays an important role in the real exchange rate determination. The results also show that net capital inflow, foreign aid, trade restrictions and macroeconomic policies lead to real exchange rate appreciation in Papua Guinea. Improvement in external terms of trade was however found to have an insignificant influence of on the real exchange rate.

Yu-Hsing (2006) investigates the determinants of short-term real exchange rates in Venezuela. The empirical results revealed that government deficit has

positive effect on the exchange rate, while broad money supply, world interest rate, county risk, and the expected rate of inflation have negative effects on the exchange rate. The author recommends that, authorities should avoid fiscal indiscipline in order to prevent the exchange rate from real appreciation since it will check the country's exports from declining.

Petersson (2005) examines the factors behind exchange rate movements in Sweden, the United Kingdom and Japan vis-a-vis the US dollar for the period 1995 to 2004. The empirical findings reveal that interest rate differential is statistically significant in explaining changes in exchange rate in the three countries. In addition, interest rate has a negative effect on exchange rate in Sweden and the United Kingdom. However, the influence of money supply, industrial production, and inflation differential on exchange rate varies between the countries.

Odedokun (1997) using a sample of 38 African countries, examine the impact of macroeconomic policies, devaluation and fundamentals on real exchange rate movement. The findings show that public sector fiscal deficits, growth of domestic credit, domestic absorption-GDP ratio, government consumption-GDP ratio, private consumption-GDP ratio, improvement in terms of trade, income per capita and black market exchange rate premium lead to real exchange rate appreciation. On the contrary, devaluation, investment-GDP ratio, consumer-wholesale price ratio in trading-partner countries, and economic growth in industrial countries result in real exchange rate depreciation.

Beatrice (2001) employs co-integration technique to investigate the long-run determinants of the real exchange rates for imports and exports, and of the internal real exchange rate in Zambia. The findings show that the real exchange rate for imports is affected by terms of trade, government consumption, and investment share. In addition, terms of trade, central bank reserves and trade taxes have long-run impact on the real exchange rate for exports. The empirical findings also show that terms of trade, investment share, and the rate of growth of real GDP have long-run effect on the internal real exchange rate. Finally, foreign aid and openness have short-run influence on the real exchange rate indices.

Drine and Rault (2003) investigate the determinants of the real exchange rate in the Middle East and North Africa (MENA) countries. The empirical results show that output per capita, government consumption, real interest rate differentials, and the degree of openness of the economy influence the real exchange rate. MacDonald and Ricci (2003) estimate the equilibrium real exchange rate in South Africa. They findings show that terms of trade, real interest rate differential, net foreign assets, and GDP per capita have positive influence on real exchange rate in South Africa. On the other hand, the degree of openness and overall fiscal balance has negative impact on real exchange rate.

Faulkner and Makrelor (2008) employ the single Engel Granger techniques to examine the drivers of the manufacturing equilibrium exchange rate over the period 1995 to 2006 in South Africa. The results show that unit labour cost, productivity, government expenditure, and openness are the critical drivers of the manufacturing exchange rate. Speller (2006) investigates the determinants of exchange rate in a sample of industrialized economies. Employing error correction framework, the results show that the price of the commodity exports was an important determinant of the real exchange in the group of countries examined.

Frankel (2007) investigates the determinants of exchange rate behavior. The findings show that that real exchange rate is positively related to terms of trade, real interest differential and lagged real exchange rate. However, capital account liberalization, risk premium and per capita income have negative effects on real exchange rate. Gelbard and Nagayasu (2004) examine the determinants of Angola's real exchange rate. The findings show that the most important determinants of real exchange rate are oil prices and foreign interest rate. Nevertheless, their results did not support the argument that monetary growth influences exchange rate. Against this backdrop, they advised that a flexible exchange rate is more appropriate than a fixed exchange rate regime.

Takaendesa (2006) examines the behavior and fundamental determinants of real exchange rate in South- Africa. The empirical results show that terms of trade, real interest rate differential, domestic credit, openness and technological progress have long-run impacts on real exchange rate. Specifically, the findings show that terms of trade, domestic credit and openness have significant influence on the real exchange rate in the short-run and long-run.. Stancik (2006) examines the factors that explain real exchange rate movement among the new EU members. The results reveal that the level of output, openness of an economy, inflation, interest rates, domestic and foreign money supply, the exchange rate regime and central bank independence are the principal factors.

Obi, Gobna & Nurudeen (2010) investigate the determinants of exchange rate in Nigeria over the period 1970-2007 using co-integration and error-correction techniques. The empirical findings show that improvement in productivity, investment-GDP ratio, and high inflation leads to exchange rate appreciation. On the other hand, higher degree of openness, increase foreign exchange reserves, and interest rate differentials result in exchange rate depreciation. Overall, the findings confirm the Balassa-Samuelson hypothesis, which states that high productivity differentials lead to exchange rate appreciation. The authors recommend policies that would encourage and facilitate improvement in productivity in all sectors of the economy, raise investment and foreign exchange reserves, reduce inflation, stabilize and further liberalize interest rate, and increase the openness of the economy.

Oaikhenan and Aigheyisi (2012) empirically investigate the factors that influence exchange rate movement in Nigeria, using data that covers the 1970-2009. The empirical findings reveal that external debt and monetary expansion are significant factors.

Insah and Chiaraah (2013) employ the Auto Regressive Distributed Lag (ARDL) bound test approach to investigate the factors that influence exchange rate exchange movement for the period 1980-2012 in Ghana. The empirical findings indicate that government expenditure is the major determinant of real exchange rate movement. Danmola (2013) examine the relationship between exchange rate movement and selected macroeconomic variables that included trade openness and foreign direct investment in Nigeria. The results from the OLS estimation revealed a significant positive relationship between trade openness and exchange rate movement.

Mayowa and Olushola (2013) investigate the relationship between exchange rate fluctuation and macroeconomic variables in Nigeria, to include GDP, openness, inflation and FDI, using the error correction model. The empirical results revealed that openness of the economy, government expenditure and interest rate movement, as well as lag of exchange rate are significant variables that influence real exchange rate in Nigeria.

From the fairly large volume of literature, it appears that the findings of empirical studies on the determinants of real exchange rate are rather mixed and non-conclusive for developing countries, hence warranting further empirical investigations.

4. Methodology

4.1. Empirical Model

Following the theoretical and empirical review, the baseline estimation model for this study is captured as:

$$RER_t = f(RY_t, OPN_t, NCF_t, FD_{i,t}, MSG_t, GEXP_{it}, INF_t, RIR_t) \quad (1)$$

where

RER= Real Exchange Rate-measured as the Nominal Exchange Rate of the of the (N/$) /Consumer Price Index

RY= Real output capacity -measured as growth rate of real GDP

NCF=Net capital flows to GDP percent

OPN = Openness of the domestic economy

MSG= Money supply growth-measured as growth in M2 to GDP percent

GEXP= Government expenditure to GDP percent

INF= Inflation rate- measured as growth rate of consumer price index (CPI)

RIR= Real interest rate- measured as nominal interest rate/consumer price index

The empirical form of the model is specified as:

$$RER_t = \alpha_0 + \alpha_1 RY_t + \alpha_2 OPN_t + \alpha_3 NCF_t + \alpha_4 MSG_t + \alpha_5 GEXP_t + \alpha_6 INF_t + \alpha_7 RIR_t + \varepsilon_t \quad (2)$$

$\alpha_1 - \alpha_7$ are parameters to be estimated, t represents time, and å is the unobserved error term.

4.2. Estimation Technique and Data Sources

The estimation is done using annual data covering the period 1981–2019, employing cointegration and error correction techniques. This technique involves three steps. First, preliminary unit root test on the time series variables is conducted in order to determine their stationarity or otherwise. This is because the regression of a non-stationary series on another may produce spurious results (Engle and Granger, 1987). Next, we carry out co-integration test to determine if a long-run equilibrium relationship exists among the relevant variables. The presence of co-integration is tested using the Johansen (1988) approach. Finally, Error Correction Model (ECM) is estimated to represent the long-run (static) and short-run (dynamic) relationships between real exchange rate and its determinants, as well as measurement of the speed of adjustment to long run equilibrium, arising from short-run disequilibrium or temporary perturbation. Data used in empirical analysis are sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin (various issues) and the World Development Index (online).

5. Empirical Results and Analysis

5.1. Descriptive Statistics

Table 1 presents the descriptive statistics of the sample data on the variables used for the analysis. The descriptive statistics shows that the mean value of the naira exchange rate to the US Dollar ((/$) is 215.2 percent, with a median value of 220.5 percent. The maximum RER growth of 270.1 and the minimum value of 5.20 give clear indications that the rate of growth of exchange rate has moved rather apart over the period of the study. This wide dispersion is confirmed by the relatively high standard deviation value for the variable which is 5.40 percent. Apparently, real exchange rate has generally been unstable in the country, given its kurtosis value of -1.62.

Real output capacity has a mean growth of 4.82 percent, with a median value of 4.90 percent. Its maximum and minimum values are 17.21percent and -1.08percent respectively, while its standard deviation is 4.84. The mean value of net capital flow (a measure of international financial integration) is 9.72, with a median value of 7.84. Its maximum and minimum values are 15.21 and -1.02 respectively. Openness has a mean value of 52.2 percent, and a median value of 50.6 percent. The maximum and minimum values are 72.1 percent and 14.0 percent, respectively. The mean value of money supply growth for the period is 18.2 percent and a median value of 19.5 percent. The maximum

and minimum values are 45.1 percent and 6.3 percent respectively. Government expenditure has a men value of 17.4 percent and a median value of 13.24 percent. Its minimum and maximum values are 65.3 percent and -1.80 percent, respectively. Inflation has a mean value of 20.2, with maximum and minimum values of 72.9 percent and 4.7 percent, respectively. Its standard deviation value of 5.74, combined with a kurtosis of -1.45 is an indication of inflation variability during the period under focus. The mean value of real interest rate is 1.7 percent, while its maximum and minimum values are 7.2 and 0.3 percent, respectively.

Table 1: Descriptive Statistics

	Mean	*Median*	*Max.*	*Min.*	*Std. Dev.*	*Skewness*	*Kurtosis*	*J-B*
RER	215.2	220.5	270.1	5.2	5.40	1.30	-1.62	3.22
RY	4.82	4.90	15.21	-1.08	4.50	4.84	2.43	3.73
OPN	52.2	50.6	72.10	14.03	3.45	1.72	2.16	4.04
NCF	9.72	7.84	15.21	-1.02	3.50	1.71	2.60	3.12
MSG	18.2	19.5	45.13	6.32	2.16	1.90	3.14	4.82
GEXP	17.4	13.24	65.30	-1.80	4.04	1.70	-1.02	9.50
INF	20.2	-0.44	72.92	4.70	4.24	1.74	-1.45	4.90
RIR	1.70	1.32	7.20	0.33	2.70	1.83	-1.02	3.82

Source: Author's computation

5.2. Unit Root Analysis

The Augmented Dickey Fuller (ADF) test was employed in order to analyze the unit roots.

The results are presented in levels and first difference forms in Table 2. In the Table, the

ADF test statistic for each of the variables is shown in the second column, while the ADF statistic (in first difference) is shown in the third column. The result indicates that the variables are initially non-stationary at levels. However,

Table 2: Unit Root Stationary Test for Variables in levels and First Difference

Variables	*ADF Statistic (in Levels)*	*ADF Test Statistic (in First Difference)*	*Order of Integration*	*Remark*
RER	-1.144	-6.023**	I(1)	Stationary
RY	-1.023	-5.225*	I(1)	"
OPN	-1.150	-5.806**	I(1)	"
NCF	-0.975	-5.991**	I(1)	"
MSG	-1.652	-4.902*	I(1)	"
GEXP	-1.406	-5.332*	I(1)	"
INF	-1.011	-4.887*	I(1)	"
RIR	-1.121	-5.220*	I(1)	"

*(**) denotes significance at 5% (1%) level
Source: Author's computation

following Box and Jenkins (1978) that non-stationary time series in levels may be made stationary by taking their first differences, the first differences of the respective variables is conducted and the resultant unit root test that the variables are now stationary. Therefore, the variables are stationary in their first differences. The variables are thus integrated of order one (i.e. I [1]).

5.3. Co-integration Test

Having established that the series in the analysis are all I(1) variables, possessing unit roots, the co-integration test is conducted on them. The results from the Johansen multivariate cointegration test are presented in Table 3.

Table 3: Johansen Multivariate Cointegration Tests Results

Trace Test			*Maximum Eigenvalue Test*			
Null Hypothesis	*Test Statistic*	*Critical Value*	*Null Hypothesis*	*Test Statistic*	*Critical Value*	*Hypothesized No of CE(s*
r = 0*	164.0	96.43	r = 0*	82.28	62.80	None**
r ≤ 1 *	115.3	78.21	r = 1*	60.10	45.40	At most 1**
r ≤ 2*	80.12	50.01	r = 2*	50.80	26.13	At most 2**
r ≤ 3*	48.22	37.70	r = 3*	29.02	10.92	At most 3**
r ≤ 4*	27.02	19.84	r = 4*	13.40	4.82	At most 4**
r ≤ 5*	12.23	7.02	r = 5*	6.99	0.32	At most 5*
r ≤ 6*	1.42	1.50	r = 6*	1.01	0.09	At most 6
r ≤ 7*	0.07	0.08	r = 7*	0.07	0.08	At most 7

*(**) denotes rejection of the hypothesis at 5% (1%) significance level.
Source: Author's computation

As can be seen from the Table, both the ë-max and the trace test statistics indicate that there is at least six significant co-integrating vectors among the variables, since the hypothesis of no co-integrating vector (r=0) is to be rejected. Apparently, the number of cointegrating vectors (indicated by r) is at least five. This implies that a long-run equilibrium relationship between real exchange rate and its determinants in Nigeria.

5.4. Error Correction Model

The results of the short-run dynamic error correction model showing the response of real exchange rate (RER) to its determinants is shown in Table 4.

The adjusted R2 value of 0.91 indicates that 91 percent of the systematic variations in real exchange rate movement is explained by the explanatory variables, suggesting a good fit of the model. The F-value of 72.4 is highly significant at the 1 percent level, validating the hypothesis of the existence of a significant linear relationship between real exchange rate and its explanatory variables. The Durbin Watson statistic of 1.82 shows that there is no serial correlation in the model. This implies that the model can be used for structural and policy analysis. The coefficient of the first lag of real exchange rate is

Table 4: Error Correction Model Results
Dependent Variable: RER

Variable	*Coefficient*	*T-ratio*
D(RER(-1))	0.118	1.771
D(RY)	-0.312	-3.182
D(OPN)	-0.214	-2.517
D(NCF)	-0.102	-2.403
D(MSG)	0.174	1.504
D(GEXP)	0.272	2.450
D(INF)	0.085	2.271
D(RIR)	-0.04	-2.120
C	0.117	1.194
ECM(-1)	-0.48	-2.724
R-squared	0.97	
Adjusted R-squared	0.91	
F-statistic	72.4 (0.000)	
Durbin-Watson stat	1.82	

Source: Author's computation

positively signed and significant at the 10 percent level. Thus, current exchange is positively influenced by past exchange rate fundamentals. The coefficient of real output capacity is consistent with theoretical projections and significant at the 1 percent level. Thus, increase production capacity in terms of real output leads to exchange rate appreciation, although the Nigerian economy currently lacks meaningful diversification. The result buttress the findings of Drine and Rault (2003) and Obi *et al.* (2010). Accordingly, a 1 unit percent increase in real output capacity will lead to a 0.3 unit percent appreciation in the real exchange rate.

The coefficient of openness is negative in line with apriori expectation and statistically significant at 1 percent level. Therefore, increase trade openness engenders a reduction in the real exchange rate. Invariably, diversification in production capacities has the potential to stimulate the value of the domestic currency vis-a vis other foreign currencies. Accordingly, a one-unit percent increase in output capacity will generate an appreciation in the RER by 0.2 unit percent. The coefficient of net capital flow is appropriately negative in line with theoretical expectation and passes the significance test at the 5 percent level. Thus, increase in net capital inflow leads to an appreciation of the naira, since capital inflows will translates to inflows of foreign currencies (the dollar, in this case). The result corroborates the findings of Obadan (1994), Drine, Rault (2003), contrast Takaendesa (2006), and Obi et al (2010). In line with the estimates, a unit percent increase in net capital inflow will lead to an appreciation of the real exchange by 0.1 unit percent. The coefficient of government expenditure is positively signed in line with apriori expectation and passes the significance test at the 5 percent level. Invariably, rising

government expenditure and the resultant fiscal deficits tend to have a dampening effect on the value of the domestic currency. This finding is in line with the results of Insah and Chiaraah, (2013) that an exogenous increase in government expenditure induces exchange rate depreciation. Its coefficient indicates that a unit percent increase in government expenditure will lead to a real exchange rate depreciation by 0.27. The coefficient of money supply is positive and statistically insignificant. Since its t-value is greater than unity, we may infer that money growth (monetary expansion) leads to exchange rate depreciation, particularly through an increase in the propensity to import, but the impact is weak. The result is, in sync with findings of Mcgibani and Nourzad (1995) and Insah and Chiaraah (2013).

The coefficient of interest rate is negative in line with the theoretical expectation and is statistically significant at the 5 percent level. The finding corroborates the findings of Stancik (2006) and contrast the findin of Petersson (2005)\. Its coefficient indicates that a unit percent increase in real interest rate will cause exchange rate to appreciate by 0.04.

Finally, the coefficient of inflation has the right sign in line with economic theory and is significant at the 5 percent level. Invariably rising inflation has an outright destabilizing effect on the real exchange rate. Thus, a high inflation rate reduces international competiveness of exports, reduces foreign exchange earnings and put pressure on the current account and exchange rate. Its coefficient indicates that a unit increase in inflation rate induces exchange rate depreciation by about 0.09 unit percent. The result is however in contrast to the findings of Obi et al (2010).

Apart from the diagnostic statistics, the coefficient of the error term is appropriately negative and significant at the 5 percent level. Its coefficient of 0.70 indicates that the contemporaneous speed of adjustment of real exchange rate to long-run equilibrium after temporary disequilibrium and perturbation is 48 percent. The rather weak adjustment capacity is due to the exchange rate instability in Nigeria.

6. Conclusion

This paper has empirically examined the determinants of real exchange rate in Nigeria over the period 1981-2019. The period is instructive as it characterizes noticeable exchange movement in Nigeria. The empirical results show that output capacity, degree of openness, net capital flows, government expenditure (a measure of fiscal policy), inflation and real interest rate differentials, influence the real exchange rate in Nigeria. Specifically, increase output capacity, greater openness of the domestic economy, increase net capital flows and rising real interest rate leads lead to exchange rate appreciation, while increase government expenditure and rising inflation rate cause change rate depreciation..

Given the importance of sound exchange rate in Nigeria, is important for the country to put in place appropriate policies measures to increase real output

capacity that will facilitate economic diversification in Nigeria. This would be through increase production and trade capacities, increase net capital inflows and sound and stable monetary, fiscal and institutional policies/ frameworks that will tame domestic inflationary pressures and control arbitrary increase in money supply. These, and others, if implemented will enhance the value of the Naira, vis-à-vis other world currencies.

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