DETERMINANTS OF REAL EXCHANGE RATE IN NIGERIA

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Abstract
The persuasive evidence that stable real exchange rate levels are positively associated with economic growth and the documented proofs that real exchange rate instability affects growth negatively have motivated renewed research interest on the drivers of real exchange rate. This paper contributes to the literature by examining the long-run and short-run macroeconomic determinants of the real exchange rate (RER), and the validity of the Balassa- Samuelson hypothesis in Nigeria for the period, 1981-2019. Variables for the study comprise fundamental, behavioural, nominal and real variables. Empirical evidence based on the autoregressive distributed lag (ARDL) bounds cointegration approach shows that in the long-run, the RER is influenced positively by commodity terms of trade, government expenditure, income per capita, and negatively by net foreign asset, money supply, and domestic investment. Current value of net foreign asset appears negatively significant in the short-run, while both the current and lagged values of nominal exchange rate, domestic investment, terms of trade, money supply, and the lagged values of net foreign asset appear with positive and significant coefficients. Current short-run government expenditure appears as a significant positive determinant of RER. The study also finds evidence of the Balassa-Samuelson hypothesis that increased productivity appreciates the real exchange rate in Nigeria. Overall, the study finds a strong cointegration between real exchange rate and its identified determinants in the long-run, in line with theoretical predictions. The findings suggest the need to devise and reinforce exchange rate policies that would sustain Nigeria's currency in equilibrium to enhance the country's global competitiveness.

Keywords: Real exchange rate, ARDL, Bounds cointegration, Error Correction Mechanism

Jel codes: C50 E52 E62 F31

1. Introduction

The real exchange rate (RER) is the relative price of tradables with respect to nontradables, and it is a good proxy of a country's international competitiveness. A decline in the RER, or a real exchange rate appreciation, reflects an increase in the domestic cost of producing tradable goods. Correspondingly, an increase in the relative price of tradables represents an improvement in international competitiveness (Edwards, 1989). For some years now, there have been renewed strong research interests on both the fundamental and behavioural determinants of the real exchange rate in both developing and developed countries. As noted by Jaffur, Seetanah, and Sookia (2020), research in this area has gathered more importance in the last years after the global financial crisis of 2007-2008.

The question of what determines real exchange rate can be relevant when the policymakers face currency crash, overvaluation or undervaluation of real exchange rate because using appropriate policy tools can decrease these impacts to the economy. Some studies have found that an overvaluation of real exchange rate has link with lower long-run economic growth (Aguirre & Calderon, 2006; Edwards, 1989), and can be a warning indicator of currency crash (Krugman, 1979); while instability of real exchange rate can affect macroeconomic performance (see, Hnatskova & Loayza, 2004; Aghion et al. 2006; Eichengreen, 2008; and Rapetti et al., 2012). Studies have shown that real exchange misalignments (especially overvaluations) are not favourable for economic growth (Rodrik, 2008). Real exchange misalignments, in the form of overvalued currencies can destabilize an economy through shortages of foreign currency, unsustainable current account deficits, balance-of-payment crises, corruption, and rent-seeking activities, among others (Rodrik, 2008). Developing countries are even more cautious about this because other factors are already inhibiting their growth prospects. Thus, the real exchange rate remains a crucial variable which has been at the forefront of many policy discussions in developing countries (Melvin, 1985; Collins, 1996; among others).

Despite the fact that different approaches (such as the purchasing power parity model, the flexible price monetary model, the portfolio balance model, the redux model, the behavioural equilibrium exchange rate model, the fundamental equilibrium exchange rate model, permanent equilibrium exchange rates, etc.) have been developed and employed to study the factors influencing the real exchange rate, there is still a lack of consensus concerning the use of particular factors for a particular country in exchange rate determination. The fundamental determinants of the equilibrium real exchange rate are those real variables that in addition to the real exchange rate, play a large role in determining the country's internal and external equilibrium. The most frequently used factors seem to include: terms of trade, trade openness, GDP per capita, investment, and net foreign assets.

In Nigeria, one of the cardinal objectives of the Government has been maintaining exchange rate stability, with the aim of promoting economic growth through export diversification. Unfortunately, despite various steps by the government to maintain exchange rate stability the Nigerian naira has been exposed to huge oscillations over the years. Data from Central Bank of Nigeria (CBN, 2019) shows that the naira per US exchange rate trend has been rising gradually from 1981 and mostly from 1998 to 2019 due to excessive foreign exchange demand pressure, round tripling by banks, and other developments in the external sector, due mainly to the crash of the crude oil price in the international market, . From 1986 to 2019, the Nigerian naira depreciated in thirty-four (34) years; appreciated in only six (6) years (1994, 2005 to 2008, 2013), and was stable in four years (1994 -1998) when the naira was pegged at ₦21.8861 to a dollar. The value of real exchange rate index (2010 = 100) which was 323.52 in 1981 became 123.1 in 2019. This indicator reached a maximum value of 541.46 in 1984 and a minimum value of 50.17 in 1992 (WDI, 2019). The graph of Nigeria's real exchange rate from 1981-2019 is depicted in Figure 1. The observed ups and downs trends of the naira have raised an empirical question: what are the main macroeconomic drivers of the real exchange rate in Nigeria?

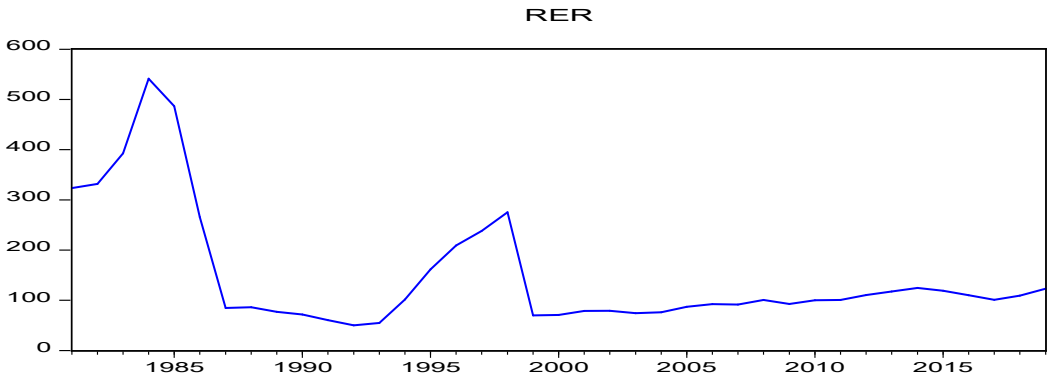


Figure 1: Trend of Nigeria's real exchange rate (1981-2019).

The empirical investigation on this question is ongoing, but the findings have been controversial and mixed. Studies (such as, Shehu & Aliyu, 2006; Ben, Obida, & Nurudeen, 2010; Aliyu, 2011; Nwude, 2012; Oriavwote & Oyovwi, 2012; Ibrahim, 2016; Oke & Adetan, 2018; Otapo, 2020) *have* reported divergent opinions, identifying balance of payments, external debt, external reserve, GDP, terms of trade, production and net foreign assets as key determinants of exchange rate in Nigeria. But, Nwude (2012) for instance, finds no statistical relationship between foreign exchange movement and other macroeconomic variables like GDP, Balance of payments, external reserve, inflation rate, deposit rate and lending rate. Otapo (2020) also reports that none of the exogenous variables (reserves, domestic credit, foreign inflation, real income, domestic bond and foreign bond) had significant effect on exchange rate in Nigeria for the period 1982-2018. *Besides, other* researches (e.g., Mustapha & Ogbeide, 2012; Ajoa & Igbekoyi, 2013) consider exchange rate volatility and dynamics, while Aliyu (2011) examines the real exchange rate misalignment based on behavioural exchange rate approach. Also, most of the studies used nominal exchange rate as the dependent variable. All these considered, create lacunae for further investigations.

The present study bridges the identified gaps and aims at further investigating both the long-run and short-run factors that drive the real exchange rate in Nigeria from 1981 to 2019. It also establishes the validity of the Balassa- Samuelson hypothesis in Nigeria. The proposition is that rapid productivity growth raises the price of non-tradable goods, which in turn appreciates the real exchange rate (Balassa, 1964; Samuelson, 1964). Unlike previous studies which examine the behavioural and nominal factors affecting exchange rate, the current paper assumes seven potential factors comprising fundamental factors, behavioural factors, real and nominal factors. Some of the variables **(**domestic investment, government expenditure, and monetary aggregates) are measured as percentage proportions of the GDP. The study also considers the dynamic nature in exchange rate determinant modelling, by applying an autoregressive distributed lag (ARDL) model. The findings of this study would no doubt, guide the policy decisions of the monetary authority in controlling the variables that have a direct effect on real exchange rate variations in Nigeria.

This study is organized in five sections. The section 2 which follows the introduction, focuses on the brief review of the existing literature while section 3 describes the data and methodology of the study. Section 4 provides the empirical results and discussions, while the last section concludes, highlighting policy implications and recommendations.

2. Literature review

Many macroeconomists hold the view that real exchange rate matters because higher and more stable real exchange rate can reduce macroeconomic instability thereby favouring capital accumulation and growth; stimulate capital accumulation in modern tradable activities, as well as facilitate structural change and economic development. As noted by Rapetti (2019), developing countries could target stable and competitive real exchange rate as a part of a development strategy that promotes the expansion of modern tradable activities.

The theory of real exchange rate states that, while the long-run equilibrium real exchange rate is determined by real variables, the actual or observed real exchange rate is influenced by real and nominal variables in the short-run. Movements of equilibrium real exchange rate from its original position does not necessarily represent disequilibrium, since its long-run equilibrium is affected by the real variables (Edwards, 1989, Chowdhurry, 1999). In his pioneering work, Edwards (1989) analysed the relative importance of real and nominal variables in the process of real exchange rate determination in 12 developing countries. A partial adjustment model was used, whereby the real exchange rate variable was expressed as a function of terms of trade, government consumption expenditure, capital controls, exchange controls, technical progress, domestic credit, real growth, and nominal devaluation. The study found that in the long-run only real variables affected the long-run equilibrium real exchange rate. In the short-run, however, real exchange rate variability was explained by both real and nominal factors. On the bases of these initial findings, many applied studies have been undertaken in both developed and developing countries to examine the determinants of exchange rate in order to provide an estimation of the equilibrium level of the real exchange rate.

Using a sample of 45 developing countries, Drine and Rault (2003) find that improvement in terms of trade, increase in per capita GDP and capital flows resulted in a long-run appreciation of the real exchange rate, while increase in domestic investment and degree of openness of the economy resulted in the real exchange rate depreciation. Using both single-country and panel estimation techniques for a sample of 36 sub-Saharan African countries, it was concluded that the equilibrium level of real exchange rate in these countries were affected by changes in GDP, openness, terms of trade and government consumption (Chudik & Mongardini, 2007). Findings from 29 SSA countries indicate that terms of trade, productivity, and foreign aid are positively correlated with the real exchange rates, while trade openness relates negatively (Elbadawi, Kaltani, & Soto, 2012). The use of VECM and GARCH models on Nigerian data from 1981 to 2008 revealed important factors influencing real exchange rate volatility to include openness of the economy, government expenditures, interest rate movements and the lagged exchange rate (Ajao & Igbekoyi, 2013).

Using an autoregressive vector model for four OECD countries, Monacelli and Perotti (2010) find that a rise in government spending causes a depreciation of the real exchange rate. Castro and Fernández-Caballero (2013) use a Structural Autoregressive Vector for 27 years found that a shock to government spending causes an appreciation of the real exchange rate in the case of Spain. Empirical result by Algieri (2013) suggests a positive long-run cointegration relationship between the Russian real exchange rate, oil price, productivity and government financial position and a negative relation with international reserves. Kia (2013) finds that none of the domestic fiscal variables had any statistically significant impact on the growth of the real exchange rate in Canada over the short-run during the period, 1972-2010. The change in interest rate and the growth of the money supply had negative impact on the real exchange rate.

Iyke and Odhiambo (2015a) apply the autoregressive distributed lag (ARDL) bounds testing procedure on South African data for the period 1975-2012. In the long-run, real exchange rate was affected by terms of trade, trade openness, government consumption, net foreign assets and real commodity prices. In Botswana, it was found that terms of trade and trade openness appeared as key determinants of real exchange rate both in the short-run and long-run (Iyke & Odhiambo, 2015b). Ibrahim (2016) finds that the major long-run determinants of real exchange rate in Nigeria between 1960 and 2015 consisted of terms of trade, trade openness, while net capital inflow and government expenditure constituted the major short run determinants of exchange rate in the country.

Utilising data from 1980 to 2016 and ARDL methodology, Sakanko and David (2017) indicate that changes in domestic price level, interest rate differentials, trade openness, government purchases of tradable and non-tradable goods and capital inflow are the major long-run determinants of exchange rate in Nigeria while changes in the domestic price level, interest rate differentials and capital inflow are the short-run determinants. Employing similar approach, Oke and Adetan (2018) conclude that gross domestic product, interest rate and inflation rate are the major determinants of exchange rate in Nigeria. Orji (2015) finds that interest rate differential and oil revenues constituted the major determinants of real exchange rate in Nigeria from 1981-2012. A study by Ben, Obida and Nurudeen (2010) confirms Balassa-Samuelson hypothesis in Nigeria from 1970 to 2007, contrary to Orji (2015) latter finding.

Using VEC model, Vural (2019) finds that GDP per capita, oil prices, fiscal expenditures, and international openness are fundamental determinants of Turkish real exchange rates. Net foreign assets did not exhibit a significant long-run relationship with real exchange rates. The study also finds that differences in GDP per capita relative to trading partners was an important component of short-term exchange rate adjustment mechanism. The outcome of using the fixed effects, random effects, and System GMM methodologies by Chavez (2020) indicate that lagged values of the real exchange rate, terms of trade, net foreign assets, tax revenue, monetary aggregates, savings rates and productivity, real interest rate differentials, relative price and economic growth were the main determinants of real exchange rate thirteen Latin American countries. Using statistical analysis and a dynamic panel fixed effects model approach, Goda and Priewe (2020) find that commodity prices are an important structural driver of real exchange rate movements in 15 emerging markets economies. The results confirmed the existence of the Harrod-Balassa-Samuelson effect.

The findings using ARDL approach showed that the determinants of real exchange rate in fifteen sub-Saharan African countries in the long-run were not the same for all the countries studied. The common determinants included terms of trade, GDP per capita, net foreign assets and trade openness (Jaffur et al., 2020). For Nigeria, in particular, terms of trade and government consumption were found to be positively significant, while trade openness, GDP per capita, net foreign assets, and money supply were negatively significant in the long-run. In the short-run estimates, government consumption was positively significant while net foreign asset appeared negative. Employing the ARDL cointegration approach, Mpofu (2021) finds that trade openness, volatility of output, commodity prices, money supply, government consumption, and the exchange rate regime significantly influenced real exchange rate instability in South Africa over the period 1986–2015.

3 Data and Methodology

3.1. Data

The study used Nigeria's annual time series data covering the period 1981–2019. The data needed for this study included the real exchange rate, nominal exchange rate (the ratio of the price of non-tradable to tradable, where an increase in the value of RER means an appreciation), GDP per capita, domestic investment as a percentage of GDP, government expenditureas a percentage of GDP, terms of trade, net foreign assets, and monetary aggregate as percentage of GDP. These data were extracted from the World Development Indicators database (2019), and the Central Bank of Nigeria's statistical bulletin (2019).

3.2. Model specification

The model specified for the present study is based on the theoretical and empirical evidences from previous empirical studies (e.g., Edwards, 1988; Drine & Rault, 2003; Chudik & Mongardini, 2007; Elbadawi et al., 2012; Nouira & Sekkat, 2015; Lartey et al., 2012; Iyke & Odhiambo, 2015a; Jaffur et al, 2020). The following relationship has been established for this study:

RER = F(FUNDAMENTALS) (3.1)

Where REER is Nigeria's real exchange rate, and FUNDAMENTALS consist of a set of potential determinants of exchange rate used in literature. The "fundamentals" consist of external and domestic fundamentals (policy and non-policy related variables). In this study, we postulate that the real exchange rate (dependent variable) will be explained by a set of variables, and by their own lagged values. This regression is compactly expressed in equation 3.2:

Where and are matrices containing the coefficients of the model. – is the lagging values of the real exchange rate up to t-1, is the error term, with normal stochastic assumptions. The explanatory variables are nested in Xs, and expressed as:

– = [(), (), , , (), (),]……(3.3)

Equation 3 is a vector of explanatory variables containing nominal exchange rate (NER), GDP per capita (GPC), domestic investment (KAY), government expenditure (GEY), terms of trade (TOT), net foreign assets (NFA), and monetary aggregates (MSY). In line with Edwards (1989), terms of trade is one of the most important external fundamentals that affect real exchange rate, government expenditure (consumption) relates to policy-related domestic fundamental or behavioural variable, while GDP per capita (technological progress and productivity proxy) is used as domestic non-policy fundamental variable. Since some of the variables **(**domestic investment, government expenditure , monetary aggregates) are measured as percentage proportions of the GDP, it becomes econometrically relevant to log-transform the other variables (real exchange rate, nominal exchange rate, terms of trade, net foreign assets) in order to provide better and consistent results**.** The logarithmic form does not only reduce the variability in the data sets (Boutabba, 2014) but also eases the interpretation and comparison of the results in terms of percentage change (Jaffur et al., 2020).

The commodity terms of trade and GDP per capita are considered as potential "structural determinants" of the real exchange rate. GDP per capita is intended to validate the existence of the Balassa-Samuelson proposition that rapid productivity growth raises the price of non-tradable goods, which in turn appreciates the real exchange rate (Balassa, 1964; Samuelson, 1964). GDP per capita has also been used by Edwards (1989), Chowdhurry (1999), Nassif et al. (2011), Lartey et al. (2012), Jaffur et al. (2020), etc. A nominal variable, namely, broad money supply as a percentage share of the GDP (MSY) was used as proxy for monetary aggregates. This variable is also used by Chavec (2020), Ojede and Lam (2017), Hnatkovska et al. (2016), Pham (2019). The studies find that monetary aggregates have depreciation effect on the real exchange rate.

3.3 Estimation Procedure

The study applies the ARDL and ECM based multivariate co-integration model analysis techniques to examine the long-run and the short-run determinants of real exchange rate in Nigeria during the period 1981 to 2019. The choice of the ARDL approach is based on its assumed suitability for a small sample size (like the current study); its applicability whether or not the underlying regressions are purely I(0) or I(I), or mutually co-integrated; and its accommodation of different optimal lags. These unique features make ARDL approach more advantageous over other conventional co-integration procedures (Pesaran & Shin, 1997; Pesaran et al., 2001; Ozturk & Acaravci, 2010).

The following ARDL model would be estimated to establish the existence or otherwise of long-run bond amongst the variables:

Where Δ indicates first-difference operator, is white noise error term, with the conventional statistical properties. *j* and (s = 1, 2, 3, 4) are the optimal lag lengths to be selected based on appropriate information criteria, are the long-run multipliers, while the parameters in the summation signs () are the short-run dynamic coefficients of the underlying ARDL model in the equation. The F-test which the ARDL-bounds testing procedure would be used to test the existence of long-run relationship between the variables. This requires a test of the null hypothesis of no co-integration (Ho: $_1 = _2 = _3 = _4 = 0$) against the alternative hypothesis of existence of cointegration (H_1: $_1 \neq _2 \neq _3 \neq _4 \neq 0$). Two sets of critical values [I(0) and I(1)] for a given significance level are reported in Pesaran et al. (2001) and Narayan (2004).The null hypothesis would be rejected, if F-statistic is greater than the upper bound critical value; the null hypothesis would be accepted, if otherwise. The test would be inconclusive, if F-statistic is between the lower and upper bound critical values. If the variables are co-integrated, then there will be at least one linear combination of the model variables.

The ARDL short-run parameters along with the speed of adjustment of real exchange rate to equilibrium would be obtained by estimating the error correction equation:

Where is the speed of adjustment, and is expected to be negative, less than one and significant. The error correction term () gives an estimate of the time it takes for the system to revert to its original equilibrium.

4. Results and Discussions

The augmented Dickey Fuller **(**ADF) unit root test results (Table 4.1) shows that our models consist of a mixture of both I(0) and I(1) variables, thus favouring the use of the ARDL approach. The existence of a long-run relationship among the variables in the

selected models is verified using the ARDL-bounds testing approach. The optimum lag lengths for the selected model are selected based on the Akaike information criterion (see Table 4.2). The selected model is ARDL(1, 3, 0, 3, 1, 3, 3, 3) in which LOG(RER), LOG(NER), LOG(GPC), KAY, GXEY, LOG(TOT), LOG(NFA), MSY, takes the lag length 1, 3, 0, 3, 1, 3, 3, 3, respectively.

Table 4.1: Results of the ADF Unit Root Tests

Variable	ADF Statistic		Lag length	Prob. Value		Order of Integration
	Level	1st difference		Level	1st difference	
LRER	-2.060911	-4.222161	1	0.2609	0.0020	I(1)
LNER	-0.80427	-4.119173	1	0.9444	0.0027	I(1)
LTOT	-1.719397	-5.769748	1	0.4137	0.0000	I(1)
LNFA	2.288978	-4.371802	1	0.9999	0.0081	I(1)
GEXY	-3.942527		1	0.0042		I(0)
MSY	-0.694224	-6.473632	1	0.8362	0.0000	I(1)
KAY	-3.626380		1	0.0097		I(0)
LGPC	-1.244598	-3.366417	1	0.6445	0.0188	I(1)

Source: Authors' compilation using E-views 10.0.

Table 4.2: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	**AIC**	SC	HQ
0	-457.7915	NA	23.9125	25.8773	26.2292	26.0001
1	-208.3636	374.1418	0.0009	15.5758	18.7428	16.6811
2	-135.1963	77.2322	0.0009	15.0665	21.0486	17.1544
3	**24.3701**	**97.5128***	**3.19e-05***	**9.7572***	**18.5545***	**12.8277***

* indicates lag order selected by the criterion.
LR: sequential modified LR test statistic (each test at 5% level); FPE: Final prediction error
AIC: Akaike information criterion; SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion.

Due to our relatively small sample size (39 observations), the calculated F-statistic is compared with the Narayan (2004)'s lower critical bound, I(0), and the upper critical bound, I(1) to confirm whether cointegration between the included variables exists. The empirical evidence from Table 4.3 indicates that the computed F-statistic (15.18153) is greater than the I(1) values at the 10, 5, and 1 percent level, respectively. The null hypothesis of no cointegration is thus rejected, indicating that there is a long-run relationship among the variables. The ARDL long-run and short-run coefficient estimates are reported in Table 4.4 and Table 4.5 respectively.

Table 4.3: ARDL Bounds F-Test for Cointegration
(F-statistics = 15.18153; number of independent variables in the model =7)

	Narayan (2004) Critical values Bound (Case II: restricted intercept and no trend)	
Significance level	I(0) Bound	I(1) Bound
10%	3.846	3.306
5%	2.558	3.846
1%	3.468	5.057

Source: Authors' compilation using E-views 10.0.

Table 4.4: The long-run results of the selected model: ARDL (1, 3, 0, 3, 1, 3, 3, 3)
Dependent variable: LOG(RER)

Regressor	Coefficient	Standard error	T-ratio	Probability
LOG(NER)	-0.0679	0.048008	-1.414782	0.1848
LOG(PC)	1.4057*	0.234788	5.987197	0.0001
KAY	-0.0108	0.014066	-0.766772	0.4594
GXEY	0.0364**	0.012454	2.922690	0.0139
LOG(TOT)	0.7139*	0.143519	4.974301	0.0004
LOG(NFA)	-1.0671*	0.146340	-7.292142	0.0000
MSY	-0.0518*	0.014254	-3.634203	0.0039
C	-9.6573*	1.705113	-5.663756	0.0001

Note: Δ = first difference operator. *, ** denote 1%, and 5% significant level, respectively.
Source: Authors' compilation using E-views 10.0.

The estimated long-run coefficient in Table 4.4 shows a negative and insignificant relationship between real exchange rate and nominal exchange rate. The negative sign is contrary to economic a priori expectation. The growth rate in nominal exchange rate is expected to have positive partial sign (Mungule, 2004). A rise in the GDP per capita leads to the appreciation of the real exchange rate of the Nigerian naira. This result confirms the existence of the Harrod-Balassa-Samuelson effect in Nigeria, which is also reported by various previous studies that analyze the real exchange rate determinants (see, Nassif et al., 2011; Goda & Torres García, 2015, Goda & Priewe, 2019, Jaffur et al., 2020). However, our finding contradicts Habib et al. (2017) which find a negative relationship between GDP per capita and real exchange rate only for developing countries; and Razzaque et al. (2017) which find that in the short term, real depreciation can result in a decrease in GDP.

Improvement in government expenditure (GEXY) and terms of trade (TOT) are also associated with the appreciation of the real exchange rate of the naira, and are in consonance with a priori expectations. The findings differ from those of Kipyatich, Nasieku and OcholaIn (2020) where government expenditure as a ratio of GDP is found to have a negative influence on real exchange rate movement in Kenya. Increase in investment, net foreign assets, and money supply causes a depreciation in the real exchange rate of the naira. The signed coefficients are consistent with economic theory. This implies that commodity terms of trade is an important structural driver of real exchange rate movements in Nigeria in the long-run.

An in-depth analysis of the results shows that a 1 percent increase in GDP per capita, terms of trade, and government expenditure would cause the real exchange rate to increase by 1.4, 0.03, and 0.7 percent respectively. On the other hand, as can be observed from Table 4.4, on average a 1 percent increase in nominal exchange rate, capital accumulation (i.e., investment), net foreign assets, and money supply cause the real exchange rate to decrease by 0.068, 0.01, 1.067, and 0.05 percent respectively. The outcome of the money supply is in line with economic analysis on real exchange rate, which holds that excessive money supply would raise prices of domestic nontradables and make the real exchange rate to appreciate in the long-run. A similar result is obtained by Chowdhurry (1999) for Papua New Guinea.

From the results of the short-run estimates shown in Table 4.5, nominal exchange rate and its lagged values are found to be positive and significant. This accords with a priori expectation, and marches with the finding of Mungule (2004) for Zambia, and that of Oriavwote and Oyovwi (2012) for Nigeria. A one percent increase in nominal exchange rate would depreciate short-term real exchange rate by 0.11, 0.18, and 0.19 percent in the current, first and second lagged periods respectively. The result implies that an increase/decrease in the nominal exchange rate would lead to a rise/fall in the real exchange rate. However, as noted by Mungule (2004), the ability of the nominal exchange rate variations to affect the real exchange rate will depend on the extent to which macroeconomic policies are consistent with the objective of the nominal exchange rate, such as domestic price stabilization.

The short-run impact of an increase in investment seems to be relatively muted, because a 1% increase in the current real investment causes an increase in the real exchange rate of 'only' 0.007%. Similar situation are observed with the lagged values of the variable. However, the positive relationship between investment and the real exchange rate could be explained by the fact that investment could have captured the GDP per capita as highlighted by Chudik and Mongardini (2007) when estimating the determinants of the exchange rate for a sample of developing countries.

A rise in government expenditure also leads in the short-term to a depreciation of the naira, as a 1 percent improvement in productivity leads to increase in real exchange rate by 0.01 percent. Though the coefficient is significantly small, the signed outcome aligns with economic theory, as well as confirms the validity of Balassa- Samuelson hypothesis, even in the short-term. A positive impact of government spending on the real exchange rate in the short term could stem from demand-side effects (Maesofernandez et al., 2001).

Table 4.5: The short-run results of the selected model: ARDL (1, 3, 0, 3, 1, 3, 3, 3)

Dependent variable: ΔLOG(RER); Case 2: Restricted Constant and No Trend

Regressor	Coefficient	Standard error	T-ratio	Probability
ΔLOG(NER)	0.118067*	0.031622	3.733717	0.0033
ΔLOG(NER(-1))	0.180023*	0.030368	5.928023	0.0001
ΔLOG(NER(-2))	0.192097*	0.028840	6.660880	0.0000
Δ(KAY)	0.007990***	0.003800	2.102711	0.0593
Δ(KAY(-1))	0.019500*	0.005242	3.719830	0.0034
Δ(KAY(-2))	0.016874*	0.005074	3.325957	0.0068
Δ(GXEY)	0.012636**	0.004067	3.107134	0.0100
ΔLOG(TOT)	0.308031**	0.138018	2.231823	0.0474
ΔLOG(TOT(-1))	0.683707*	0.092812	7.366606	0.0000
ΔLOG(TOT(-2))	0.589800*	0.092264	6.392517	0.0001
ΔLOG(NFA)	-0.283718*	0.054331	-5.222063	0.0003
ΔLOG(NFA(-1))	0.353516*	0.058534	6.039448	0.0001
ΔLOG(NFA(-2))	0.097897***	0.047719	2.051536	0.0648
Δ(MSY)	0.020741***	0.010075	2.058664	0.0640
Δ(MSY(-1))	0.078496*	0.010887	7.209938	0.0000
Δ(MSY(-2))	0.063674*	0.011851	5.372693	0.0002
CointEq(-1)*	-0.985469*	0.064148	-15.36241	0.0000

R-squared = 0.96 Adjusted R-squared = 0.93 Durbin-Watson stat = 1. 84
Akaike info criterion -1.51 Schwarz criterion -0.76

Note: Δ = first difference operator. *, **, and *** denote 1%, 5% and 10% significant level, respectively.
Source: Authors' Compilation using E-views 10.

Although the short-run net foreign assets and its lagged values are statistically significant, the coefficients appear with mixed signs: the current value is negative while the both the first and second period lagged values are positive. Our result is similar to other studies which show that net foreign assets and government expenditure prove to have a positive effect on real exchange rate (e.g., Baak, 2012, for Korea; Jayaraman & Choong, 2011, for Fiji). Generally, the results of this paper strongly refute Oriavwote and Oyovwi (2012) which find that in the short-run, the ratio of government spending to GDP, terms of trade, and technological progress are not important determinants of the real exchange rate of Nigeria for the period 1970-2010.

The short-run results of Table 4.5 indicate that the ECM coefficient is negative and significant at a 1 percent significance level. Its absolute value is also smaller than one. This further validates the established long-run relationship between the variables and implies that real exchange rate can return to its equilibrium following a shock to all the independent variables in the model. The estimated coefficient of the ECM(-1) means that on average, 98.5 percent of the adjustment in the real exchange rate would take place within one year. This is a rather high speed of convergence to the equilibrium. The coefficient of determination (R-sqd) is found to be 0.96, meaning that about 96 percent of the variations in real exchange rate is jointly explained by all the explanatory variables included in the estimation. The adjusted R-sqd (0.93) is quite high and suggests that the model has a very good fit. This further confirms that the estimated real exchange rate of the naira is significantly explained by the variables estimated.

The post-estimation diagnostic test results reported in Table 4.6 indicate that the ARDL

model is stable and has no problems of serial correlation and functional specification. The computed value of the Lagrange multiplier test of residual serial correlation is smaller than the critical value, indicating no serial correlation among the residuals in the estimated real exchange model. The Breusch-Pagan-Godfrey heteroscedasticity tests results indicate that the data series are homoscedastic and the errors independent of the regressors. Similarly, the Jarque-Bera test (p = 0.4282) indicates that the residuals are normally distributed.

Table 4.6: Diagnostics Test Results

Test	F-statistic	Degree of Freedom	Prob.
Serial Correlation (Breush-Godfrey Serial Correlation LM Test)	1.188007	F(2,9)	0.3484
Heteroskedasticity Test (Breush-Pagan Godfrey)	1.163638	F(24, 11)	0.4119
Model Specification Test (Ramsey RESET Test)	0.029776	(1, 10)	0.8664
Normality Test (Jarque-Bera Statistics)	1.696		0.4282

Source: Authors' compilation using E-Views 10.

The plots of CUSUM and CUSUMSQ statistics presented in Figure 2a, b are well within the critical bounds at the 5% significance level, implying that all coefficients in the error-correction model are stable and reliable. This indicates that the selected model can be used for policy decisions.

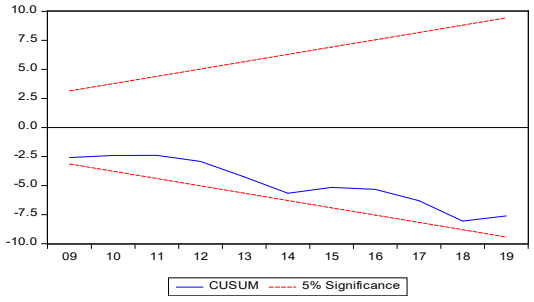


Figure 4.2a: Plot of CUSUM

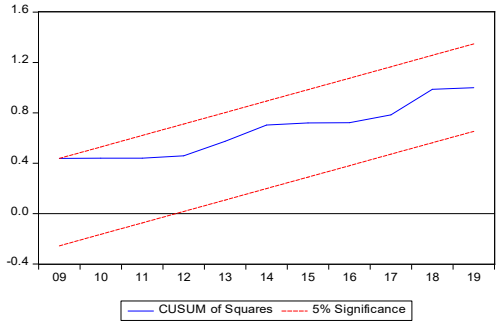


Figure 4.2b: Plot of CUSUMSQ

5. Conclusion and recommendations

The results of the study generally show that the estimated results of the real exchange rate model strongly corroborate the predictions of the theoretical model, in which the fundamentals are found to be associated in the long-run. The real exchange rate in Nigeria is influenced in the long-run by commodity terms of trade, net foreign asset, government expenditure, domestic investment, GDP per capita, and money supply. Apart from current value of net foreign asset which is negatively significant, the positive and significant determinants of real exchange rate in the short-run are the current and lagged values of nominal exchange rate, domestic investment, terms of trade, money supply, lagged values of net foreign asset, and current government expenditure. The study also finds evidence of the Balassa-Samuelson increased productivity-real exchange rate appreciation nexus in Nigeria. These findings are supported by other empirical studies as indicated in the discussions of the results. The real exchange rate appreciation supported by increased productivity means that the Nigerian economy has reached a certain stage of economic development, but this should be interpreted with caution in view of the

prevailing negative development indices in the country.

The findings are relevant to policy makers as they shed light on the various macroeconomic determinants of and their interplay with the real exchange rates, thus increasing the understanding of real exchange rate determination in Nigeria. The findings also suggest that the country should devise and reinforce exchange rate policies that would sustain its currency in equilibrium, and hence, enhance the country's global competitiveness. Future research may look at other country-wise cases for more specific research and compare with other countries. Further studies should also include those variables that are not captured in the current study.

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