

ECONOMETRIC ANALYSIS OF DETERMINANTS OF REAL EFFECTIVE EXCHANGE RATE IN NIGERIA (1960-2015)

Waheed IBRAHIM¹

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This study investigates the determinants of real effective exchange rate in Nigeria for the period between 1960 and 2015 using the vector error correction mechanism to separate long run from the short run fundamentals. The findings from the regression estimates revealed that; terms of trade, openness of the economy, net capital inflow and total government expenditure were the major long run determinants of real effective exchange rate in the country while variables such as; broad money supply (M2), nominal effective exchange rate, structural adjustment program dummy, June 12 crisis and change to civil rule dummies were revealed as the major short run determinants of exchange rate in Nigeria between 1960 and 2015. The study concludes by recommending that since the major variable of terms of trade (crude oil price) is out of the government control, the effect of shocks due to the fluctuations of crude oil price can be minimized by shifting the economy from a mono-product nation and diversify the economy to increase productive capacity. Also, the change to civil rule dummy used in the study revealed that the system has not been friendly with the country's real effective exchange rate, thus needing to review the system and bringing out all negative activities there in to ensure Nigeria's currency appreciation. Guided openness is also suggested to avert the danger that unguided trade liberalization may bring into the country.

Keywords: Exchange rate, Terms of trade, Openness, Civil rule, SAP, Government expenditure.

JEL Classification: O30, F32.

¹ PhD, Department of economics, Al-Hikmah University, Ilorin, Nigeria

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1. Introduction

One of the most challenging problems in the third world countries such as Nigeria is the exchange rate management, that is, 'getting the exchange rate right' especially in the context of exchange rate determination and major factors responsible for the exchange rate fluctuations (Williamson, 2008 and Abdelbaky, 2005). In particular, the exchange rate has been recognized to be an important link between the internal economy of a country and the international economy as such an important variable which must be gotten right at all time. According to Eichengreen (2007), given the very limited flexibility of internal prices, the nominal exchange rate is the key to the determination of the real exchange rate in the short and long term. Real exchange rates are in turn of key importance in determining macroeconomic stability and the incentive to engage in trade. As a result of this, much professional attention has been devoted to analyzing both what actually determines exchange rates and how a government that wants to ensure a sustainable growth rate should approach the issue of exchange rate determination (Dosse, 2007). Moreover, the country has been facing greater challenges in terms of exchange depreciation since the inception of the last democratic elected government, consequent from the down fall of crude oil price at international market and thus the need to investigate what factors actually determine the exchange rate in Nigeria. The outcome of which can be used to strengthening the naira by focusing on mainly those factors that significantly influenced Nigeria's exchange rate with its major trade partners and as such manage the exchange rate to a level that will minimize fluctuations.

Apart from this introductory section, the next section will review the relevant literature, section three deals with the methodology and the theoretical framework, in section four, results are presented and discussed while section five concludes the work.

2. Literature review

This section reviews the relevant literature on the basic concepts of exchange rate and determinants of real exchange rate.

2.1. Measurement of real exchange rate and real effective exchange rate

The task of deciding which measure of the exchange rate is the most appropriate is usually faced with two sets of issues. According to Chinn (2002), the first is between the theoretically applied measures and the real world counterparts. The second one is between using the most appropriate measure conceptually and using a measure based on the most readily available data. In short, the translation from the real exchange rate theory to real- world data is not straightforward, judgment is required when selecting or constructing an exchange rate measure for empirical research. For instance, at the empirical level, due to the problem of getting data on

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the relative price of tradable goods to the price of non-tradable goods many authors continue to proxy the real exchange rate by nominal exchange rate adjusted for movements in the prices of foreign and domestic countries (Sundararajan et al., 1999; Jimoh, 2006; Jongwanich, 2009). That is:

$$R_t = \frac{E_t P_t^*}{P_t} \quad (1)$$

where, R_t is the real exchange rate at time t , E_t is the nominal exchange rate, P_t is the domestic price while P_t^* is the foreign price at time t respectively.

Also, the empirical treatment of the real effective exchange rate typically abstract from how to measure exchange rates when countries engage in transactions with a number of partners. In such a case, equation (1) can be weighted to obtain the empirical measurement of the real effective exchange rate. Such that, using the arithmetic weighed method as used for the nominal exchange rate in equation above, the real effective exchange rate is measured as below:

$$REER_t = \sum_{i=1}^n w_{it} \frac{E_{it} P_{it}^*}{P_t} \quad (2)$$

Where, $REER_t$ is the real effective exchange rate at time t , E_t is the nominal exchange rate, P_t is the domestic price while P_t^* is the foreign price at time t respectively, w_{it} is the weight attached to each trade partner.

Using the geometric weighted method, the real effective exchange rates is measured as:

$$REER_t = \prod_{i=1}^n w_{it} \frac{E_{it} P_{it}^*}{P_t} \quad (3)$$

All definitions of variables are as given previously. The trade weight (w_{it}) of the trading partners is sum to 1(Chinn, 2006:122).

The weight to be given to each bilateral rate is commonly based on the share of total imports, exports or total exports and imports. When data from only major trading partners are used for the computation, the weight to be given to country's bilateral rate is computed as the country's total import and export to the domestic economy as a percentage of the domestic country's total export and import from all the selected trading partners.

Other issues involved in the measurement of effective exchange rate include the choice of price index and the choice of trade partners among others. In practice, the choice of prices to employ usually depends on the relative price that best reflect the relative price of tradable goods to non-tradable goods. The indices available are: the consumer price index (CPI), the producer price index

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(PPI), the wholesale price index (WPI), the export price index (EPI) and the GDP deflator (Chinn, 2006). The most commonly used price series are consumer price index. Although there are theoretical reasons to prefer other types of price index when measuring competitiveness (Koch, 1984), CPIs have the advantage of being timely and available for a wide range of countries over a long period of time. According to Chinn (2002), for the purposes of calculating the relative price of tradable goods, the preferred measure is the exchange rate deflated by PPIs or WPIs. One drawback of using these indices is that, there is considerably more variation in how these price series are constructed across countries, than for the corresponding CPIs (Chinn, 2002; 2006).

Concerning the choice of countries to include and their relative weights, in principle, all countries that trade with a domestic country should be included. In practice, data limitations tend to restrict the number of countries that can be considered. The actual selection is determined by practical considerations, efforts are made to ensure that the currencies included account for a high proportion of total trade of the country in question (Chinn, 2006).

2.2. Exchange rate fundamentals

Many studies have provided a detailed explanation of the real exchange rate fundamentals (Edwards, 1988a, Sundararajan et al. 1999; Clark and MacDonald, 1998, Agu, 2002; Raghuram, 2006).

According to Clark and MacDonald (1998), fundamentals can be classified into two groups: external fundamentals and domestic fundamentals. The external fundamentals include: terms of trade, and net foreign assets. Domestic real exchange rate fundamentals consist of variables that can be directly affected by policy decisions and those that cannot be affected by policy decisions. Policy-related fundamentals are, trade restrictions such as import tariffs, import quotas, export tax and the composition of government expenditure. Domestic non-policy real exchange rate fundamental such as technological progress is another important determinant established by the literature. Raghuram (2006) considered a few general cases in order to explain how the fundamental variables determine the equilibrium real exchange rate.

Terms of trade: This is defined as the ratio of export price index to import price index (P_X/P_M). Term of trade is one of the main fundamentals that influence the real exchange rate. If the term of trade increases it will raise the purchasing power of people and this results in an increase in the demand for domestic goods (Raghuram, 2006). An improvement in the terms of trade has both income and substitution effects. The income effect of such improvement is that due to increase in real income, more is spent on both tradable goods and non-tradable goods, resulting in higher prices of non-tradable goods leading to real exchange rate appreciation. On the other hand, the substitution effect of such improvement is that a change in the relative prices of the two goods (exportable and importable), lead to an increase in the domestic production of

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exportable goods, wages in the sector increase, and result in high demand for importable goods and fall in the demand for non-tradable goods. Thus, the real exchange rate depreciates. If the income effect associated with terms of trade improvement is stronger than the substitution effect, an appreciation of the real exchange rate will occur; otherwise, the real exchange rate will depreciate.

Trade Policy: The imposition of an import tariff will increase the domestic price of importable goods and generate both substitution and income effects. Using the price-specie mechanism, the income effect stems from the fact that, an imposition of import tariff leads to increase in the domestic price of importable goods and this can further result into an increase in the prices of domestic goods, real income falls and thus a reduction in the demand for both tradable goods and non-tradable goods. Since the price of tradable goods is determined exogenously (fixed), a proportionate fall in the price of non-tradable goods leads to real exchange rate depreciation. On the other hand, substitution effect results from the fact that, an imposition of import tariff leads to increase in the domestic price of imports. Due to higher price, demand for importable goods reduces and demand for non-tradable goods increases. As a result of higher demand for non-tradable goods, prices of non-tradable goods increase and this leads to real exchange rate appreciation. However, since the imposition of tariff results in both substitution and income effect, the real exchange rate can depreciate or appreciate. This depends on whether the income or substitution effect of trade restrictions dominates. Clark and MacDonald(1998) note that, in most cases, the substitution effect of trade restrictions dominates and thus, increasing restrictions leads to a higher relative rise in the price of importable goods and results in the real exchange rate appreciation. The reduction of trade restrictions results into the real exchange rate depreciation.

Net foreign asset: In a more general framework, both net foreign assets and the real exchange rate should be viewed as endogenous variables that influence each other and are determined simultaneously (Montiel, 1997). The transmission to the real exchange rate is based on the conclusion that at equilibrium, a country with negative net foreign assets must have a trade surplus to finance the stream of interest and dividend payments. The mechanism to generate this trade surplus is real exchange rate depreciation. Similarly, countries with positive net foreign assets must have trade deficits in equilibrium. Thus, a shock to net foreign assets has a long-run effect on the real exchange rate as long as goods produced in different countries are not perfect substitutes. While shocks to the real exchange rate have a well-defined short-run effect on net foreign assets, their long-run effect is ambiguous. Such shocks have no effect on net foreign assets unless they affect a country's saving rate permanently. In some simple models of trade and asset accumulation, exchange rate shocks have no long-run effect on net foreign assets, and net foreign asset shocks do have a long-run effect on the real exchange rate (Montiel, 1997).

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Government expenditure: Government expenditure is also another fundamental variable which determines the equilibrium real exchange rate. The effect of government expenditure on the equilibrium real exchange rate depends on the composition of the expenditure between tradable goods and non-tradable goods. If a greater share of the government expenditure is on non-tradable goods there will be an increase in the demand for non-tradable goods in the short run and that raise up the prices of non-tradable goods. This results in real exchange rate appreciation. On the other hand, if a large share of the government expenditure is directed towards tradable goods, the relative price of non-tradable goods will fall and the real exchange rate will depreciate (Edwards, 1988a).

3. Methodology and theoretical framework

In line with previous studies on the determinants of the real exchange rate in developing nations (Baffes et al., 1997; Dosse, 2007), the major characteristics of the economy (developing) usually modeled are that of an open economy that produces and consumes two types of goods – tradable and non-tradable goods. The tradable goods are composed of importable goods and exportable goods. It is assumed that the home country consumes but does not produce importable goods, while exportable goods are produced but not consumed domestically. The total demand for non-tradable goods is composed of private sector consumption (CNP) and government consumption (CNG) on non-tradable goods. The equilibrium real exchange rate is defined as the rate that prevails when the economy is in internal and external balance simultaneously.

3.1 Internal Balance

Internal balance occurs when the market for non-tradable goods is clear. That is when:

$$y_n(R) = C_{NP} + C_{NG} = (1 - \theta)RC_p + C_{NG} \quad (4)$$

$$R = \frac{P_T}{P_N}$$

Where y_n is the supply of non-tradable goods at full employment, C_p is the total private spending (measured in traded goods), θ is the share of this spending devoted to traded goods, and C_{NG} is government spending on non-traded goods.

3.2 External balance

External balance requires that changes in international reserve position (made up of current account and capita account) be zero in the long-run (Dosse, 2007:59). The current account balance (CAB) is expressed as the sum of the trade balance (TB), net unilateral transfer (v), and net investment income (NIY).

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The trade balance (TB) is the difference between the supply of tradable goods ($Y_T(R_t)$), and the sum of private-sector consumption on tradable goods (θC_P) and government spending on tradable goods (C_{TG}). Net investment income is obtained by multiplying total net foreign assets (F) by the real yield on foreign assets (r).

Given that:

$$\Delta R = CAB + NKI \quad (5)$$

In the long run $\Delta R = 0$, this means:

$$CAB = -NKI \quad (6)$$

External balance is therefore expressed as:

$$CAB = TB + v + NIY = Y_T(R_t) - (\theta C_P + C_{TG}) + v + rF = -NKI \quad (7)$$

Where NKI is the net capital inflow and all other variables are as defined above.

Setting the right hand side of equation 7 to zero, the current account balance equation becomes:

$$CAB = Y_T(R_t) - (\theta C_P + C_{TG}) + v + rF + NKI = 0 \quad (8)$$

Combining equation 4 (internal balance) and equation 8 (external balance), the real exchange rate (R_t) that ensures equilibrium in the two sectors simultaneously is given as:

$$R_t = [C_{NG}, C_{TG}, v + rF, NKI] \quad (9)$$

where, R_t is the real exchange rate, C_{NG} is the government consumption of non-tradable goods, C_{TG} is the government consumption of tradable goods, v is the net unilateral transfers, r is the net investment income (return on foreign assets multiply by net foreign assets) and NKI represents net capital inflow.

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According to Jimoh (2006), the return on foreign assets(r) can be negligible for a country like Nigeria, because (F) is small. But for simplicity the variable (v) is removed. Thus, equation 9 is expressed as:

$$R_t = [C_{NG}, C_{TG}, NKI] \quad (10)$$

Incorporating the role of terms of trade and trade policies on real exchange rate, the expression is given as:

$$R_t = \left[C_{NG}, C_{TG}, NKI, \frac{P_x^*}{P_m^*}, t_x, t_m \right] \quad (11)$$

where, P_x^*/P_m^* is the terms of trade (captured by crude oil price at international market), t_x is export tax and t_m is the import tax. All other variable are as defined before.

The literature (Dosse, 2007) further stated that, due to non availability of data on some of the above fundamentals, acceptable proxies are used. For instance, t_x and t_m are proxy for by openness of the economy (OPEN), the combination of C_{NG} and C_{TG} are proxy for by total government expenditure (g_n).

In such a situation, the real exchange rate (equation 11) can be expanded to incorporate all these modifications and this is written as follows:

$$R_t = \left[g_n, NKI, \frac{P_x^*}{P_m^*}, OPEN \right] \quad (12)$$

where τ is the variable capturing productivity differentials, all other variables as defined before.

On a final note for this framework, the work of Jimoh (2006) included among other fundamentals of the real exchange rate, the variable of monetary shocks (M_2) and the lagged of nominal effective exchange rate(e_{t-1}) to determine the expression for real effective exchange rate in the short-run. This is stated as:

$$R_t^* = \left[g_n, NKI, \frac{P_x^*}{P_m^*}, OPEN, M_2, e_{t-1} \right] \quad (13)$$

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where, R^* is the real effective exchange rate over time, M_2 is the broad money and e_{t-1} is the lagged of nominal effective exchange rate. All other variables are as defined before.

3.3 Estimation Techniques

As a pre-whitening process, this study adopts a log-linear transformation of the long-run equation. Thus, equation 13 is written as:

$$\text{Log}R_t = \alpha'H_t + \mu_t \quad (14)$$

Where H_t is the vector of the values for the fundamentals, μ_t is the disturbance term. According to the theory, the shocks that cause the exchange rate to diverge from its equilibrium in the short-run should produce eventual convergence to the relationship. A specification that captures this notion is the dynamic error correction model. This thus, expresses equation 13 as follows:

$$\Delta \text{Log}R_t = \theta(\log R_{t-1} - \alpha'H_{t-1}) + \sum_{i=1}^p \beta_i \Delta \text{Log}R_{t-i} + \sum_{i=0}^p \eta_i \Delta H_{t-j} + v_t \quad (15)$$

where $H_t = \left[g_n, NKI, \frac{P_x^*}{P_m^*}, OPEN \right]$ is the vector of fundamentals, and v_t is the error term with mean zero and stationary over time. However, in the short-run variables such as broad money supply (M_2) and one period lagged value (e_{t-1}) of nominal effective exchange rate are usually included in the estimation of equation 15.

The study estimates equation 15 by first testing for the unit root properties of all variables using ADF statistic, then, test for the existence of co-integration relationship between the set of fundamentals and the real effective exchange rate using the Johansen co-integration approach.

The study then estimates the co-integrated equation using the Johansen's maximum-likelihood methodology. Criteria such as; Akaike information criteria (AIC), Schwartz criteria (SC) and Likelihood ratio (LR) are used to determine the optimal lag-length of variables of the model.

In addition, the study included in its estimation of equation 15 appropriate dummies that may account for possible shocks to the real effective exchange rate in the short-run and shifts in the intercept parameter. Three dummies were included; the first two major dummies included are the Structural Adjustment Programme (SAP) and June 12 crisis dummies. The SAP dummy is expected to account for the structural adjustment programme's shock of 1986/87 while June 12 crisis dummy indicates the effect of various crises associated with transition to civil rule

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between 1992 and 1994. The choice of these two dummies (SAP and June12 crisis) were guided from the work of Jimoh (2006) where it was observed that the two dummies constitutes significant shocks to the real effective exchange rate in Nigeria between the year 1960 and 2000. SAP dummy takes the value of one in 1986-1987 and zeros otherwise while June12 crisis takes the value of ones in 1992-1994 and zeros otherwise. The third dummy included is the transition to civil rule shocks in 1999 after a long period of military ruling of the country. Thus, the civil rule dummy takes a value of one in 1979- 1983 also 1999-2015 and zeros otherwise.

3.4 Definitions of Selected variables and Measurements

The Nominal Effective Exchange Rate (NEER): This is measured as the weighted average of all bilateral exchange rates between Nigeria and its 17 selected trade partners. This study uses 1960, the starting period of the study, as the base year and the computation take cognizance of US dollar to which all countries currencies are related. In this study, NEER is computed as follows:

$$NEER_t = \left[\frac{r_j}{r_{j0}} - \sum_{i=1}^{17} w_i \frac{(E_i - E_{i0})}{E_{i0}} \right] * r_{j0} \quad (16)$$

where:

r_j = nominal exchange rate (N/\$)

r_{j0} = N/\$ in the base period (1960)

E_i = Bilateral exchange rate of each trade partner per US dollar

E_{i0} = Bilateral exchange rate in the base period (1960)

w_i = weight attached to each trade partner

In order to convert the above formula to index, equation 16 is written as follows:

$$NEER_t = \left[\frac{r_j}{r_{j0}} - \sum_{i=1}^{17} w_i \frac{(E_i - E_{i0})}{E_{i0}} \right] * 100 \quad (17)$$

All variables are as defined before for equation 16.

The real effective exchange rate (REER): This is measured as the nominal effective exchange rate adjusted for relative price differentials between Nigeria and its major trading partners. In this study the arithmetic weighted average method is employed, this is due to its relative simplicity and its application by various authors in the field. Symbolically it defined as follows:

$$REER_t = \left[NEER_t + \sum_{i=1}^{17} w_i \frac{(P_i^* - P_{i0}^*)}{(P_j - P_{j0})} \right] * r_{j0} \quad (18)$$

where:

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- NEER_t = Nominal effective exchange rate over time
 REER_t = Real effective exchange rate over time
 P_i* = Trade partner's price index (CPI)
 P₁₀ = Trade partner's price index in the base period (1960)
 P_j = Nigeria's consumer price index (CPI)
 P_{j0} = Nigeria's consumer price index in the base period (1960)

In order to convert the above formula to index, equation 18 is written as follows:

$$REER_t = \left[NEER_t + \sum_{i=1}^{17} w_i \frac{(P_i^* - P_{i0}^*)}{(P_j - P_{j0})} \right] * 100 \quad (19)$$

All variables are as defined for equation 18.

The formula used for calculating the trade weights is given as follows:

$$w_{it} = \frac{M_{it} + X_{it}}{\sum_{i=1}^n X_{it} + \sum_{i=1}^n M_{it}} \quad (20)$$

where:

w_{it} = time varying weight of country i in the overall trade volume of the country.

M_{it} = imports of Nigeria from country i at time t

X_{it} = exports of Nigeria to country i at time t

$\sum_{i=1}^{17} X_{it}$ = Exports of Nigeria to the 17 selected trading partners at time t

$\sum_{i=1}^{17} M_{it}$ = Imports of Nigeria from the 17 selected trading partners at time t.

Choice of Trade Partners: In computing Nigeria's exchange rate indices, the study used data from 17 countries; United States, India, Spain, France, Italy, Brazil, Netherlands, China, Germany, United Kingdom, Belgium, Japan, Denmark, Norway, Sweden, Canada and Switzerland. The choice of trade partner countries was guided by the fact that these countries accounted for at least 80 per cent of trade with Nigeria within the period of study (IMF direction of trade statistics).

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Term of trade (P^*_x/P^*_m): The variable used in this study is the crude oil prices at different periods of analysis. This is used because oil and gas constitute the bulk of the country's export. The implication of this is that, most of the variation in Nigeria's terms of trade will correspond to changes in world oil prices. The country is thus vulnerable to external shocks in the price of oil.

Openness of the economy (OPEN): This is measured as a ratio of exports and imports to GDP. The variable serves as a proxy of trade policies. Trade protection leads to higher domestic prices and a more appreciated real exchange rate index.

3.5 Data source

The external data especially those of Nigeria's major trading partners were obtained from International Financial Statistics (IFS) and IMF direction of trade statistics. Data used to obtain the terms of trade were also sourced from (IFS). All other data are sourced from the Central Bank of Nigeria Statistical Bulletin (various issues).

4. Results

This section presents and discusses the results of all tests and regression equation of 13. It starts with the presentations of unit root and co-integration tests.

Table 1. ADF unit root test

Exogenous: Constant

Variable	Level	1st Diff	Decision
log (real effective exchange rate - REER)	-1.7639	-14.8436*	I (1)
log (openness of the economy - OPEN)	-2.2399	-10.1637*	I (1)
log (total govt. expenditure - TGE)	-1.5691	-8.0051**	I (1)
log (broad money supply - M2)	0.5009	-6.4681**	I (1)
log (terms of trade - TT)	-1.0759	-6.4835**	I (1)
log (nom. effective exchange rate - NEER)	-2.3049	-6.7784*	I (1)
log (net capital flow - NKI)	-1.1889	-13.3132*	I (1)

Critical: 1% = -4.16115% = -3.5164

10% = -3.1830

The result of the unit root tests as shown in Table 1 indicates that all variables are not stationary at levels. Thus, variables such as logREER, logTT, logOPEN, logTGE, logM2, logNEER and NKF were confirmed to be I(1). Following this result, the study is prompted to test for co-

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integration between the dependent variable and those variables that were integrated of order one. The result is presented in Tables 2 and 3.

Table 2. Unrestricted co-integration rank test

Lag interval (in first differences): 1 to 1

Hypothesized No of CE(s) (Null Hyp)	Eigen value	Trace statistic	0.05 Critical value
$r = 0$	0.88	239.73	187.47
$r \leq 1$	0.64	138.86	150.56
$r \leq 2$	0.47	89.78	117.71
$r \leq 3$	0.33	60.24	88.80
$r \leq 4$	0.27	41.17	63.88
$r \leq 5$	0.25	26.35	42.915
$r \leq 1$	0.88	239.73	187.47

Trace test indicates 1 co-integrating equation at the 0.05 level

From Table 2, it could be observed that the trace statistic is significant when the unrestricted co-integration rank equal one ($r=1$), thus, indicating one co-integrating equation among the variables. Furthermore, the result of max-eigen value test supported the trace test. This is presented in Table 4.

Table 3. Unrestricted co-integration rank test (Max-Eigen)

Lag Interval (in first difference): 1 to 1

Null Hypothesis	Eigen value	Max-eigen statistic	0.05 Critical value
$r = 0$	0.88	100.86	56.71
$r \leq 1$	0.64	49.08	50.55
$r \leq 2$	0.47	29.53	44.49
$r \leq 3$	0.33	19.06	38.33
$r \leq 4$	0.27	14.83	32.12
$r \leq 5$	0.25	13.98	25.82
$r \leq 1$	0.88	100.86	56.71

Max-eigenvalue test indicates 1 co-integrating equation at the 0.05 level of significance.

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These results confirmed a long-run relationship between Nigeria's real effective exchange rate (REER) and its major fundamentals. Having established co-integration among the I(1) variables and the existence of one co-integrating vector as confirmed by both trace statistic and max-Eigen value, an error correction model based on equation 13 was estimated in order to obtain short and long run determinants of real effective exchange rate in Nigeria.

The result of the long-run co-integration regression is presented in Table 4.

Table 4. Long-run estimates**Dependent Variable: logREER**

Variable	Coefficient	t-values
Constant	42.367	-
log (openness(OPEN))(1)	0.015*	8.13
log(terms trade(TT))(1)	0.045*	5.77
log(total govt. exp(TGE))(1)	0.004*	11.32
log(net capital inflow(NKI))(1)	-0.0012*	-6.733

* indicates significance at 1% level.

Going by the long-run regression estimates of the Table 4 the coefficient estimates obtained corroborate the prediction of the theoretical models. All effects have the expected signs and are statistically significant. The variable openness produces a significantly depreciating effect on the real effective exchange rate, an indication that a more liberalized and open trade regime, depreciates the real effective exchange rate. Precisely, the result shows that a 5 per cent increase in the openness will lead to approximately 1.5 per cent depreciation in the real effective exchange rate. This result corroborates the outcome of Ogun (2004), Jimoh (2006) and Aliyu (2008) about the long run effect of openness of the economy on the real effective exchange rate in Nigeria. Another important variable within the model is the terms of trade which was captured by the price of crude oil. The result obtained indicates that declined terms of trade will lead to real effective exchange rate depreciation. An unfavorable terms of trade will have a negative effect on the current account balance (other things being equal), the real income of the individual decreases and less is spent on both tradable goods and non-tradable goods causing the real effective exchange rate to depreciate. According to the result, the rate of depreciation is not proportionate, for instance, a 5 per cent improvement in the terms of trade will lead to approximately 4.5 per cent depreciation of the real effective exchange rate. The

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result though with different magnitude supports what was obtained in Elbadawi (1994) for some selected developing countries (Ghana, Chile and India) and the work of Ogun (2004), Jimoh (2006) for Nigeria.

Also, the total government expenditure came out positive and statistically significant at the 1 per cent level. The implication of this result is that, within the period of analysis, the Nigerian government expenditures are proportionately more on imported goods and as a result an increase in such expenditures leads to real effective exchange rate depreciation. This result goes against what was obtained in the work of Edwards (1989) for selected LDCs and Elbadawi (1994) for Chile and India where he obtained for these countries an appreciation effect of government expenditure on the real effective exchange rate. Net capital inflows have been favorable to the real effective exchange rate but the extent of that effect was minute as indicated in the result of Table 4. The result is such that a 1 per cent increase in net capital inflows leads to 0.1 per cent appreciation of the exchange rate in the country. This may be as a result of the nature of major capital inflows that come to the country, most of which are into oil and gas and no tangible investment in the real sector of the economy.

The error correction estimation gives the short-run dynamic specification of the real effective exchange rate determination (equation 13). The result of this specification is presented in the Table 5:

Table 5 shows the analogous short run estimation of what is presented in the long-run regression model (Table 4). The choice of lag length (lag 1) was guided by different criteria such as LR, AIC and SC. All other statistics, such as R^2 (0.87), adjusted- R^2 (0.76) and F-statistics (14.40) show that the model is of good fit. The results evidently supported the error correction model with the coefficient of error correction term, less than one, negative and statistically significant. The coefficient obtained was 0.74 approximately. This reflects the dynamic self-correcting mechanism of the error correction model. Apart from this, the additional variables introduced in the dynamic model (broad money supply (M2) and one lagged period of nominal exchange rate) both came out positive but the coefficient of broad money proves statistically insignificant. The implication of its positive sign is that, an increase in money supply can tend to increase the price of domestic goods relatively to the imported ones, demand shift to the later, current account worsen and the real effective exchange rate depreciates. The result indicates that civil rule dummy and the June 12th crisis were significant determinants of the real effective exchange rate within the period of analysis, but, the former served as a depreciating factor while the latter leads to the exchange rate appreciation. SAP dummy also proves significant within the period of study. The policy also leads to the real effective exchange rate depreciation as revealed in the result.

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*Econometric analysis of determinants of real effective exchange rate in Nigeria (1960-2015)***Table 5. Short-run Vector error Correction Estimates**Dependent Variable: $\Delta \log REER$

Variable	Coefficient	t-values	Other statistics
Constant	-1.06**	-2.46	R ² = 0.87
			R ² = 0.76
			F = 14.40
$\Delta \log(\text{real effective exch. rate (REER)}-1)$	-0.13	-0.63	
$\Delta \log(\text{openness (OPEN)}-1)$	1.15***	1.55	
$\Delta \log(\text{total govt exp. (TGE)}-1)$	0.001**	3.43	
$\Delta \log(\text{net capital inflow (NKI)}-1)$	0.009	0.55	
$\Delta \log(\text{terms of trade (TT)}-1)$	-10.71	-0.44	
Error correction term(-1)	-0.74*	-3.81	
$\Delta \log(\text{broad money)}-1)$	0.143	0.96	
$\Delta \log(\text{nominal effective exchange rate (NEER)}-1)$	0.149**	2.28	
SAP	0.362***	1.72	
Civil rule dummy	0.537**	2.43	
June12 crisis	-0.054***	-1.87	

*, **and *** denotes significance at 1%, 5% and 10% levels respectively.

Table 6. Estimates of Parsimonious Error- Correction ModelDependent Variable: $\Delta \log REER$

Variable	Coefficient	t-values
Constant	1.94*	9.04

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$\Delta \log(\text{openness (OPEN)}-1)$	1.06**	2.56
$\Delta \log(\text{total govt exp. (TGE)}-1)$	0.24**	2.78
$\Delta \log(\text{nominal effective exch rate(NEER)}-1)$	1.65***	1.98
Error correction term(-1)	-0.81*	-4.23
SAP	0.22*	4.65
Civil rule	1.02*	3.42
June12 crisis	-0.03***	-1.77

*,**and*** implies significant at 1%,5% and 10% levels respectively
 $R^2= 0.89$, Adjusted $R^2= 0.77$, $F= 18.67$

Table 6 indicates a more parsimonious error correction estimate of Table 5. In Table 6, the coefficient of error correction term increased (0.81) as a result of removing all variables that were not statistically significant from estimation. All other variables also prove more significant and efficient the analysis still stand.

5. Conclusion

The paper investigates the determinants of the real effective exchange rate in the Nigeria spanning from 1960 to 2015. In the study, many empirical analyses were carried out ranges ranging from the computation of the real effective exchange rate itself using 17 Nigeria's trading partners to the computation of the parsimonious error correction estimates where major determinants of the subject matter were revealed. At the end, the terms of trade, the openness of the economy, net capital inflow, the total government expenditure, the nominal effective exchange rate and the three dummies employed served as major determinants of the real effective exchange rate in Nigeria between the period of 1960 and 2015. The following policy prescriptions emerges from the findings of this study:

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A guided trade liberalization is needed to minimize the depreciating effects of the openness on the real effective exchange rate in the country

Since the price of oil plays a significant role in the determination of the exchange rate in Nigeria, a more realistic effort should be made towards a real diversification of the economy to avoid the continuous external shocks' effect of the fluctuations in crude oil price

Government expenditure should be directed on the investible goods and spending on imported good should be drastically reduced to avoid the danger of worsening the current account balance that may cause exchange rate depreciation

There is also the need to check the type of democracy the country is currently running as revealed in this study that the system has not been favorable to the exchange rate determination in the country.

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