



**Determinants of Real Exchange rate in Nigeria (1970-2011): A
Behavioral Equilibrium Exchange Rate Approach**

by

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Abstract

Real exchange rate (RER) is an important index that measures the competitiveness of an economy and provides a useful guide on the conduct of monetary and exchange rate policy of a nation. Persistent misalignment of RER could generate various undesirable effects on the economy. This paper investigated the drivers of RER in Nigeria under the Behavioral Equilibrium Exchange Rate (BEER) framework using annual data from 1970 to 2011. Deploying the Hodrick-Prescott (HP) Filter, the long-run values of the fundamentals of the RER were decomposed to obtain and estimate the misalignment in the RER. Our results showed that increase in trade openness, technological progress and government expenditure depreciate Nigeria's RER in the long –run. Increase in oil prices and net foreign asset were found to boost the RER. Index of RER misalignment in Nigeria reveals that it was overvalued between the periods: 1980-86 and 1994-98. Undervaluation was noticed between the period: 1975-78 and 1986-94, while relative stability was found in the later period:

1999-2011. Some policy lessons have been drawn, including the need to diversify the economy from crude oil as a major export commodity to the non-oil sector, adoption of an inter-temporal fiscal plan for the management of oil wealth, cautious trade liberalization and improving the productivity of government expenditure, especially in the tradable sector.

Key words: Real Exchange Rate, Misalignment, Nigeria.

JEL code: C22, F31, F41

1. Introduction

Exchange rate (also known as foreign exchange rate) is the rate at which a country's currency is exchanged for the currency of another. It is a key variable in the functioning of any economy. It performs a dual role of maintaining international competitiveness as well as serving as a nominal anchor for domestic prices. In the literature, two concepts characterize the exchange rate. They are the nominal and real exchange rate. Nominal exchange rate is purely a monetary concept which measures the price of foreign currency in terms of the domestic currency while real exchange rate measures the relative price of two goods – tradable goods (exports and imports) in relation to non-tradable goods (goods and services produced and consumed locally) (see Obadan, 1994). These concepts are however linked because fluctuations in the nominal exchange rate (NER) can cause changes in the real exchange rate (RER).

Although RER is rarely an explicit policy target, it has been recognized as a strong indicator of the competitiveness of an economy. Empirical studies have shown that RER volatility and misalignments is a major factor responsible for the poor growth performance in developing countries (Ghura and Grennes, 1993; Sekkat and Varoudakis, 1998; Edwards, 1989; Carrera and Restout, 2008). Recurrent and large misalignments are linked to lower growth rates and current account deficits in the long run and very frequently with currency and financial crisis (Carrera and Restout, 2008). With the recognition of the critical role of RER in the overall macroeconomic performance in an economy, policymakers have become increasingly concerned about how to manage and achieve RER stability. Specifically in Nigeria, the achievement of a stabled exchange rate for the naira has remained part of the recurring declared objectives of the Nigerian government over the years. However, attempts to manage and stabilize exchange rate in the country have undergone several transformations with limited success. In the immediate post-

independence period, the country maintained a fixed parity with the British pounds. During the “oil boom” era of the 1970s to 1980s, a market determined system was adopted with some form of guided regulation in the 1990s. In all, accomplishments, in terms of its stability and the attendant macroeconomic performance, have been less than satisfactory.

Ideally, to achieve the macroeconomic goal of exchange rate stability and enhance the overall performance of the Nigerian economy, it becomes crucial to first understand the drivers of exchange rate fluctuations in the country. Given the important link between RER misalignments and economic performance in developing countries, policy insights, through a thorough empirical analysis of the long run drivers of RER is crucial to achieving the macroeconomic objective of exchange rate stability in Nigeria. The focus of this paper was, therefore, to investigate the long run determinants of RER in Nigeria and consequently, estimate the degree of misalignment in the RER. Most studies in Nigeria(e.g. Ogun, 1995 and Obadan, 1994) have focused on the impact of RER volatility on the economy rather than on the source of such volatility and its impact on RER movements. It does appear that within the empirical literature on exchange rate determinants, only few (e.g. Olopoenia, 1992) focused on Nigeria. This paper provides current evidence on the subject for the Nigerian case and therefore represents an important contribution to the literature. Besides, the paper is timely given the current worsening fortunes of the Naira vis-à-vis the U.S. dollars and the unsuccessful struggle by the Central Bank of Nigeria (CBN) to stabilize it.

2. Overview of Exchange Rate Management in Nigeria

The management of exchange rate in Nigeria is one of the responsibilities of the Central Bank of Nigeria (CBN). Exchange rate policies in Nigeria, like in other developing countries, are often sensitive and controversial, mainly because of the kind of structural transformation required and the attendant transmission effect on the rest of the economy. For instance, policy option to reduce imports or expand non-oil exports through a devaluation of the nominal exchange rate are likely to have some short-run impacts on domestic prices and demand, which are sometimes perceived to be damaging to the economy. Ironically, the distortions inherent in an overvalued exchange rate policy are sometimes ignored in developing economies that are import dependent for production inputs and consumption.

Figure 1 portrays the direct and indirect effects of exchange rate depreciation on the domestic economy. A depreciation in exchange rate directly affects the prices of imported inputs or goods. Higher input costs results in higher cost of domestic production with attendant implications for consumer prices. However, the extent and speed of the pass-through depend on a number of factors, including the marginal propensity to import, demand conditions, the cost of price adjustments and agents' expectations as to the duration of the depreciation.

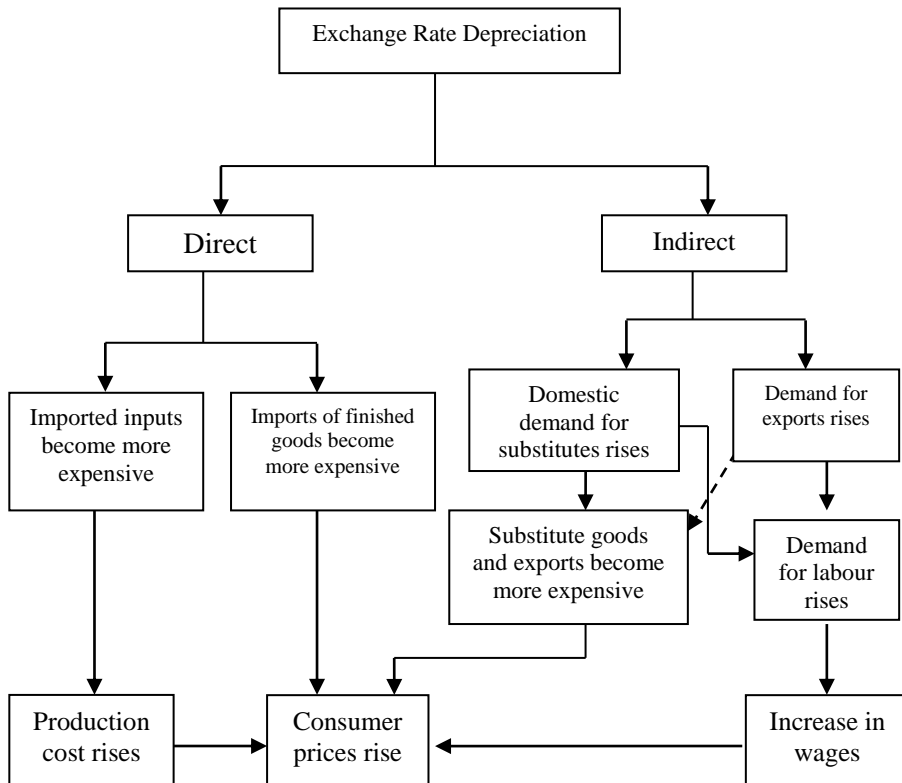


Figure 1: Direct and Indirect Effect of Exchange Rate Depreciation on the Domestic Economy

Source: Adapted from Laflechell (1996).

Indirectly, a depreciation of the exchange rate could change the composition of demand. Higher prices for imported goods lead to increased demand for domestic

substitutes. This, in turn, forces the prices of such products to rise. At the same time, domestic exports become more competitive on the world market. As demand rises, it brings an upward pressure on prices of domestic tradable goods which add to the pressure already affecting domestic prices through expensive imports. The increase in the demand for domestic product also leads to a higher demand for labour which potentially results in rising wages, which in turn contributes to higher consumer prices.

In Nigeria, development in exchange rate managements has gone through many changes but spanning through two major regimes: fixed and flexible exchange rate systems. While the former was chiefly adopted between 1960 and 1986, the latter was adopted in 1986 and continues till date, although with some series of modifications. A schema of events in exchange rate typology in Nigeria is presented in Table 1.

As shown in the table, attempts to achieve stability in Nigeria’s exchange rate have witnessed the adoption of various measures over the years. The management of exchange rate in the country has transited from a fixed regime in the 1960s to a pegged regime between the 1970s and the mid-1980s. Following the deregulation of the economy that trails the adoption of Structural Adjustment Programme (SAP) in 1986, a flexible exchange rate through the adoption of variants of the floating regime was employed from 1986. Among these include the Second-tier Foreign Exchange Market (SFEM), Inter-bank Foreign Exchange Market (IFEM), and the Autonomous Foreign Exchange Market (AFEM). Although the main features of these measures was the determination of the exchange rate by the vagaries of the market forces, they could at best be categorized as ‘managed’ or ‘dirty’ float whereby the monetary authority (CBN) intervene periodically in the market to achieve some strategic objectives.

Table 1: Exchange Rate Policy Episodes in Nigeria:

Year	Policy	Remark
1959-1967	Fixed Parity solely with the British pound Sterling (£)	Suspended in 1972
1968-1972	Included in the US dollar(\$) in the parity exchange	Aftermath of the 1967 devaluation of the pound (£) and the emergence of a strong US dollar (\$)
1973	Revert to Fixed parity	Devaluation of the US dollar (\$)

	with the British pound (£)	
1974	Fixed parity to both pounds (£) and the US dollar (\$)	To minimize the effect of devaluation of the individual currency
1978	Trade (import)-weighted basket of currency approach	Tied to seven currencies (British pound, US dollar, German mark, French franc, Japanese yen, Dutch guilder, and Swiss franc)
1985	Referenced on the US dollar	To prevent arbitrage prevalent in the basket of currencies
1986	Adoption of the Second-tier Foreign Exchange Market (SFEM)	Deregulation of the economy
1987	Merger of the First and Second-tier Foreign Exchange Markets	Merger of rates
1988	Introduction of the Inter-bank Foreign exchange Market(IFEM)	Merger between the Autonomous and the FEM rates
1994	Fixed exchange rate regime	Regulate the economy
1995	Introduction of Autonomous Foreign Exchange Market (AFEM)	Guided-deregulation
1999	Re-introduction of the Inter-bank Foreign Exchange Market (IFEM)	Merger of the dual exchange rate following the abolition of the official exchange rate from January 1, 1999
2002	Introduction of the Retail Dutch Auction System (rDAS)	Retail DAS was implemented at first instance with CBN selling to end-users through the authorized users (banks)
2006-2013	Introduction of Wholesale Dutch Auction System (WDAS)	Further liberalized the market. However, there was a shift from the WDAS to retail Dutch Auction System (rDAS) in October, 2013
2013-date	Relatively Fixed Exchange Rate (Foreign exchange controls)	Due to dwindling reserves occasioned by low oil prices, CBN imposed restrictions on commercial bank's foreign exchange trading, closed the official auction window and barred 41 items from access to

foreign exchange.

Source: *Compiled from CBN Statistical Bulletin (Various Issues), CBN Monetary Policy Circular No. 40, 2014.*

Following the failures of the exchange rate policies adopted between 1959 and 2001, the Retail Dutch Auction System (rDAS) was introduced in 2002. The key purposes were to serve the triple objective of reducing the parallel market premium, conserve the dwindling external reserves and achieve a realistic exchange rate for the naira. This was followed by the introduction of the Wholesale Dutch Auction System (WDAS) in 2006 which further liberalized the market. These diverse measures clearly illustrate the level of instability in exchange rate management in Nigeria over the years. The effect of this instability has led to high level of exchange rate fluctuations.

Figure 2 shows the trend in real exchange rate fluctuations in Nigeria from 1970 to 2011. From 1970 to 1978, the index of real exchange rate remained relatively fixed at about 100. Thereafter, it witnessed a sharp jump to 300 in 1979 and steadily increased to its peak (619.03) in 1984. In real sense, it means that the price of Nigerian goods were relatively costlier than those of her trading partners within these periods. The rising trend, however, was not sustainable as it fell sharply to 57.45 by 1992. Thereafter, the index of real exchange rate was crawling with moderate fluctuations, averaging 104.17 from 1993 to 2011. This poor trend underscores the weakening power of the Nigerian currency in terms of those of her trading partners.

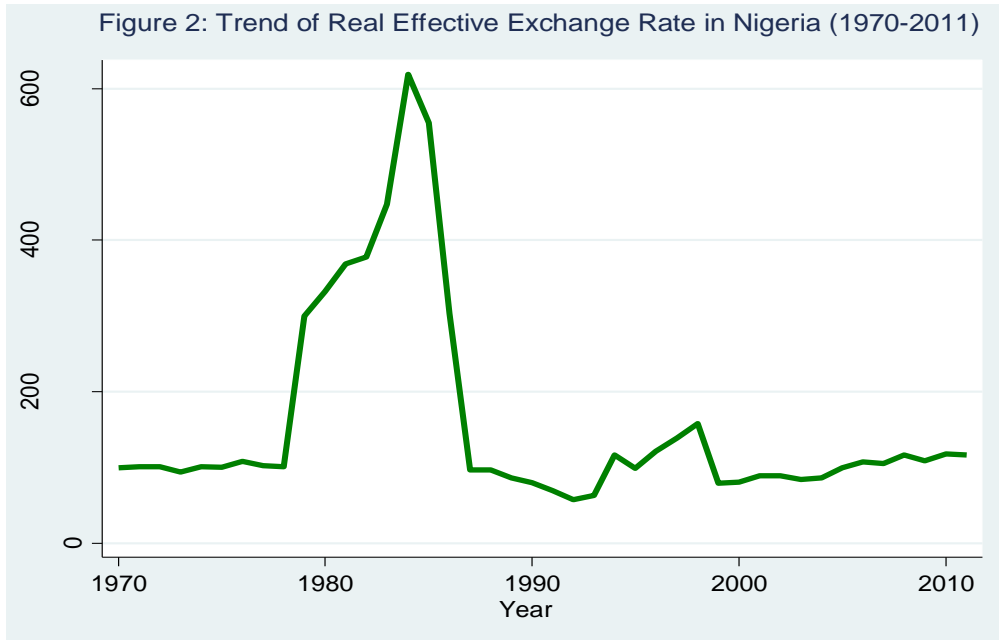


Figure 2: Trend of Real Effect Exchange Rate in Nigeria (1970-2011)

Source: Captured by the Authors from *International Financial Statistics CD-ROM 2012*

3.0 Literature Review and Theoretical Issues

The question: What are the determinants of RER has remained a subject of numerous theoretical and empirical studies. However, the results have remained intriguing and challenging. This difficulty arises from the fact that in the course of doing this, the actual and equilibrium real exchange rate have to be determined and yet the latter is an unobservable variable.

Several approaches and models of RER determination have been used in the literature. Most of the earlier studies carried out for a broad sample of countries used the purchasing power parity (PPP) approach. The PPP approach relies on the law of one price. In its *absolute* version, the PPP states that the equilibrium value of exchange rate between currencies of two countries will equal the ratio of the two countries' price levels. A deviation from PPP is viewed as a measure of a currency's over/undervaluation. When the prices of goods, in a common currency, are equalized across countries and the same goods enter each country's market with the same weights, the equilibrium RER (q^*) can be determined as follows:

$$q^* = eP^*/p = 1 \quad (1)$$

Where e is the nominal exchange rate (in units of foreign currency), P^* is the index of foreign prices, and P is the index of domestic prices. In this view, the PPP hypothesis is a monetary theory rather than an arbitrage condition. Thus, a monetary disturbance causes an equi-proportionate change in money, commodity prices and the price of foreign exchange, while relative prices remain constant. The law of one price upon which the theory is based always assumes an integrated competition markets. However, it has been noted that the spot price of a given commodity will not necessarily be equal in different locations at a given time because of the inability to shift commodities instantaneously from one location to another. The baskets of commodities tend to differ from one country to another and the price measures across countries are unlikely to be constructed in terms of absolute prices (Jongwanich, 2009). Such possibilities lead to the introduction of the *relative* version of the PPP, which takes the form:

$$q^* = eP^*/p = \theta \quad (2)$$

Where θ is the constant representing the obstacles to trade and the difference in (consumption) basket composition. Generally, the implication of both versions is that equilibrium RER will remain constant over time, with the nominal exchange rate (NER) movement offsetting relative price changes between countries.

However, despite its intuitive appeal and simplicity, the PPP approach has been widely rejected in the literature¹. As noted by Dufrenot and Yahuoe (2005), this approach is questionable because the equilibrium RER is not a static indicator but dynamic. It changes over time in response to changes in the economy's fundamentals. Jongwanich (2009) articulated two main reasons why the PPP theory is invalid. First, a given tradable good does not obey the law of one price. Several factors that can explain the variations in the price of tradable goods across countries include transportation costs, trade restrictions and taxes. Others include the presence of medium term labour contracts, the role of market segmentation and market specific costs. Second, there are major differences in the production function, consumer preferences and factor endowments across countries, so that the relative prices of non-tradable across countries can be different. Hence, the PPP approach as noted by Williamson (1997), is only applicable to the developed countries and useful

in the long run for comparing living standards, but provides serious misleading advice and a wrong basis to calculate equilibrium RER.

An alternative approach to analyzing the determinants of equilibrium RER is based on the concept of fundamental equilibrium exchange rate (FEER) advocated by Williamson (1985). The FEER is defined as the RER that is compatible with the simultaneous achievement of internal and external balances in the medium term (Williamson, 1997). Internal balance is said to be achieved when the economy is at full employment output and operating in a low inflation environment while external balance is characterized as a sustainable balance of payments position over the medium term, ensuring desired net flows of resources and external debt sustainability. The FEER tends to abstract from the short-run cyclical and speculative forces in the foreign exchange market (Jongwanich, 2009). Essentially, this approach holds that the equilibrium RER is long run driven by a set of foreign and domestic real variables called fundamentals. The determination of the FEER usually involves two sequential steps (See Clark and MacDonald, 1998 and MacDonald, 2000). First is to identify the external balance equation by equating the current account (CA) to the (negative of) capital account (KA):

$$CA = -KA \quad (3)$$

The key focus in the FEER approach is on the determinants of CA which is typically modeled as a function of real effective exchange rate (q) and full employment output of domestic and foreign economies, \bar{y}_d and \bar{y}_f , respectively. In most applications of this approach, the equilibrium capital account (\overline{KA}) over the medium term is exogenously determined. Thus transforming equation (3) into an equilibrium relationship between the current and capital accounts yields the following:

$$CA = f(q, \bar{y}_d, \bar{y}_f) = -\overline{KA} \quad (4)$$

Solving equation (4) for the real effective exchange rate (q), we obtain equation (5) as follows:

$$q^{FEER} = f(\overline{KA}, \bar{y}_d, \bar{y}_f) \quad (5)$$

However, the FEER approach is considered as a normative measure of ERER as it involves some notion of “ideal” economic circumstances of internal and external balances. As observed by Williamson (1997), while defining “internal balance” is fairly simple², despite old controversy about whether full employment is a useful

concept in a developing country with much disguised or under-employment, defining “external balance” tends to be controversial. In other words, what would be the desirable (sustainable) target for the current account (CA) balance is a difficult task. For instance, to determine FEER and the responses of export and import to relative price changes, an extra layer of judgment is imposed when calculating trade elasticity. Different forms of CA equations could lead to different values of the trade elasticity. Hence relying too much on trade elasticity may generate inaccurate estimate of the FEER trajectory (Jongwanich, 2009).

To avoid the normative measure of EREER, the behavioral equilibrium exchange rate (BEER) which is not subject to the explicit assumption of “sustainable external and internal balance” was proposed by Clark and MacDonald (1998). This approach focuses on the dynamic behavior of the exchange rate, including short-run movements and deviations and considering broader macroeconomic conditions. The BEER approach is based on the reduced form specification that links the RER to a broad set of economic fundamentals such that the EREER resulting from it becomes consistent with the prevailing level of economic fundamentals. Clark and MacDonald (1998) employed the theory of Uncovered Interest Rate Parity (UIP) in explaining EREER as follows:

$$E_t(e_{t+k}) - e_t = -(i_t - i_t^*) \quad (6)$$

Where $E_t(e_{t+k})$ denotes the expected value of nominal exchange rate (e) in period t for period $(t+k)$. i_t and i_t^* represent local and foreign nominal interest rates, respectively.

Rewriting equation (6) in real terms by subtracting the expected inflation differentials from the exchange rate and inflation differential, we can convert the nominal interest parity to real interest parity as in the following:

$$E_t(q_{t+k}) - q_t = -(r_t - r_t^*) \quad (7)$$

which after rearrangement gives:

$$q_t = E_t(q_{t+k}) + (r_t - r_t^*) + \varepsilon_t \quad (8)$$

Where r_t = the domestic real interest rate = $i_t - E_t(\Delta P_{t+k})$; r_t^* = the foreign real interest rate = $i_t^* - E_t(\Delta P_{t+k}^*)$; $E_t(q_{t+k})$ denotes the expected real exchange rate at time t for period $(t+k)$, q_t is the observed real exchange rate and ε_t is a disturbance term. Equation (8) describes the current equilibrium exchange rate as determined by two components: the expectation of the real exchange rate in period $t+k$ and the real interest differentials with maturity $t+k$. The basic problem in equation (8) is that the expected real exchange rate, $E_t(q_{t+k})$, is unobservable.

However, Clark and MacDonald (1998) made the assumption that $E_t(q_{t+k})$ is determined by a vector of long-run economic fundamentals namely terms of trade, productivity differentials, net foreign asset and government spending.

Quite a number of studies have applied the BEER approach for a broad sample of developed and developing countries. However, most of these studies differ in their choices of the underlying RER fundamentals, sometimes because of data availability considerations and their relevance for a particular country's economic condition. For instance, in addition to the basic fundamentals, Jongwanich (2008) estimated the BEER for Thailand by including capital inflows, disaggregated into portfolio and foreign direct investment for the period 1970 to 2000. In Singapore, Macdonald (2004) applied the BEER approach by adding output gap (i.e. output gap in Singapore relative to the output gap in the trading partner countries) and property prices to the five key economic fundamental variables in his model during 1983Q1 – 2003Q2. Output gap was used as an alternative measure of growth in the economy while property prices provide a measures of households' wealth effect. No obvious misalignment was found in the study, except a small undervaluation in the post 1998 period. Cheng and Orden (2005), used time series data for the period 1978-2002 and applied the same framework for Congo but included fiscal policy, capital flows and terms of trade in their model. They found that Congo's RER was undervalued in 2002 by 22.7%. Jongwanich (2009), provided an excellent review of other studies that have applied this approach in East and Southeast Asia. Similar studies in these mould in Africa include Limi(2006) for Botswana, and Iossifov and Loukoianova (2007) for Ghana. However, the focus of these studies tends to be on the determinants of exchange rate misalignment rather than the long run drivers of the variable.

4.0 The Model and Methods

In this paper, the behavioural equilibrium exchange rate (BEER) approach was adopted which is best suited for developing countries since large and complex models are often not suitable due to data limitations. Following our review above, we choose 6 economic fundamentals as variables in the vector Z_t . In other words, the relationship we propose to estimate is:

$$RER \equiv q_t = f(TECH, OPEN, NFA, GEXP, OILP, M2GDP)(9)$$

Where *TECH* is technological progress, *OPEN* is the degree of openness, *GEXP* is government spending, *NFA* is net foreign asset, *OILP* is oil prices, *M2GDP* is the

index of monetary policy measured as the ratio of money supply to GDP. All the variables are expressed in logs so that the estimated coefficients can be interpreted as elasticities.

The steps for the estimation of the BEER model can be summarized as follows. The first is to estimate the vector error correction model (VECM) and then calculate the actual and current values of misalignment. Next is to identify the long-run or sustainable values for the fundamentals which can be done by decomposing the series into permanent and transitory components. Thereafter, the long-run values of the fundamentals are substituted into the estimated relationship relating RER to the fundamentals. Total misalignment is then computed as the difference between the fitted and actual values of the RER when the sustainable values of the fundamentals are used.

For further exposition, to compute the degree of REER misalignment, and following Clark and MacDonald (1998), the behavior of real exchange rate can be explained using the following reduced-form equation:

$$q_t = \beta'Z_t + \tau'T_t + \mu_t \quad (10)$$

Where q_t is the actual real exchange rate, Z_t is the vector of economic fundamentals that are expected to have influence on real exchange rate over the medium and long run, T is a vector of transitory factors affecting the real exchange rate in the short run, β, τ are vectors of reduced form coefficients and μ_t a random error term. According to Clark and MacDonald (1999), it is important to distinguish between the *actual* value of the real exchange rate and the *current* equilibrium exchange rate. The current equilibrium rate, q_t' , is assumed to be determined by the current values of the economic fundamentals. That is:

$$q_t' = \beta'Z_t \quad (11)$$

The related current misalignment (cm_t) is then defined as the difference between the actual real exchange rate and current real rate determined by the current values of economic fundamentals:

$$cm_t = q_t - q_t' = \tau'T_t + \mu_t \quad (12)$$

This implies that the current misalignment is simply the sum of the transitory and random errors. Since it is possible for the current values of economic fundamentals to deviate from their long run sustainable or desirable levels, Clark and MacDonald(1999) also defined the total misalignment (tm_t) as the deviation between the actual real rate and the real rate determined by the long run values of economic fundamentals, denoted by \bar{Z}_t as follows:

$$tm_t = q_t - \beta' \bar{Z}_t \quad (13)$$

By adding and subtracting q_t' of equation (11) from the right hand side of equation (13), we can decompose the total misalignment into two components as follows:

$$tm_t = (q_t - q_t') + \beta'(Z_t - \bar{Z}_t) \quad (14)$$

Equation (14) indicates that the total misalignment is composed of the current misalignment and the effect of deviations of the current economic fundamentals from their long run or sustainable values. Since $q_t - q_t' = \tau'T_t + \mu_t$, the total misalignment in equation (14) can be re-written as:

$$tm_t = \tau'T_t + \mu_t + \beta'(Z_t - \bar{Z}_t) \quad (15)$$

Thus it is clear from equation (15) that the total misalignment at any point in time can be decomposed into the effects of transitory factors, random disturbances, and the extent to which the economic fundamentals depart from their sustainable values. We therefore re-write equation (15) simply as:

$$y_t = g_t + c_t \quad (16)$$

Where y_t is the total misalignment, g_t is the growth or trend component and c_t is the cyclical (stationary) component³. Then the Hodrick-Prescott (HP) filter can be employed to carry out the decomposition by minimizing:

$$\sum_{t=1}^T (y_t - g_t)^2 + \lambda \sum_{t=2}^{T-1} ((g_{t+1} - g_t) - (g_t - g_{t-1}))^2 \quad (17)$$

Where λ is the penalty attached to the volatility of the trend component: the larger the value of, the higher is the penalty and hence the smoother the trend series. For annual data, the default option is to set $\lambda = 100$ (see Hodrick and Prescott, 1997).

Before estimation, preliminary diagnostic tests were carried out on the data used for the study. First, we tested for stationarity of the series using the traditional Augmented Dickey-Fuller (ADF) test under the three data generating process assumptions. Thereafter, we checked for the long-run relationships among the variables using the Johansen (1995) co-integration approach. Its advantage does not only lie in the robust results it provides compared to the traditional Engel and

Granger approach, but it also enables us to know the number of cointegrating relationships⁴.

4.1 Data Sources and Definition of Variables in the Model

The data are annual ones and spans 1970 to 2011. Due to unavailability of data, proxies were used for some of the variables in equation (9) above. The definition of the variables, a priori expectations and sources of the data are given below.

Real Exchange Rate (RER): This is measured (using consumer price index) as the real effective exchange rate of the naira against a weighted basket of the currencies its 12 major trading partners: Brazil, China, France, Germany, India, Indonesia, Italy, Japan, Netherlands, Spain, United Kingdom and the United States of America. The computation is of the form:

$$RER = \sum_{i=1}^{i=12} w_i \left(\frac{e_i cpi_i^*}{cpi} \right) \quad (18)$$

Where w_i is the weight of country i in the total export of Nigeria; cpi and cpi_i^* are domestic and foreign consumer price indexes respectively while e_i is Nigeria's nominal exchange rate. Data for this variable was extracted from the IMF *International Financial Statistics (2012)*.

Technological Progress (TECH): This refers to the productivity effect which follows the Balassa-Samuelson model (Balassa, 1964 and Samuelson, 1964). According to this hypothesis, an increase in the traded sector productivity relative to the non-traded sector should appreciate the real exchange rate. Theoretically or a priori, we expect this to hold for Nigeria. This variable is proxied by GDP per capita obtained from Penn World Trade Table, Version 8 developed by Alan, Summers and Aten (2012). The data is measured in 2005 constant dollars.

Degree of Openness (OPEN): Theoretically, trade openness is expected to depreciate RER in the long run. For instance, an increase in openness (e.g. through a reduction in tariff) leads to a decline in domestic price of imported goods (See Carrere and

Restout, 2008). In turn, this entails an excess demand for imported goods and a fall in the domestic demand for the non-traded goods. The resultant effect is for the RER to depreciate in order to restore the equilibrium in the non-traded market. Hau (2002) provided evidence of a negative relationship between RER and trade openness for a panel of 48 countries. This variable is measured in 2005 constant prices and its data were extracted from the Penn World Table by Alan, *et al.* (2012).

Oil Price (OILP). The inclusion of this variable is strategic given Nigeria's position as an oil producing and dependent economy. Amano and Norden (1998) have found that increase in oil prices account for RER appreciation. In Nigeria, oil revenue have contributed significantly to the current account balance and hence should exert a positive effect on the RER. This variable is measured as the simple average of four crude oil spot prices: Dated Brent, West Texas intermediate, Nigerian-Forcados(NF) and Dubai Fateh (measured in US\$ per barrel). The data was obtained from the BP Statistical Review of World Energy (2013).

Net Foreign Asset (NFA). The importance of this variable as a key determinant of RER has been documented in the literature (see MacDonald and Ricci, 2003; Lane and Milesi-Ferretti, 2004). This follows the portfolio-balance approach. The standard argument is that countries with net foreign liabilities need to run trade surplus to finance interests and dividend payments. Similarly, those with positive NFA must have trade deficits. Hence, the prediction is that debtor (creditor) countries would have more depreciated (appreciated) RER. Data on this variable was extracted from World Development Indicator-Global Development Finance (2012).

Government Spending (GEXP). The impact of GEXP depends on its distribution between tradable and non-tradable goods. If GEXP falls more on the non-tradable sector, this will exert pressure on the relative price of non-tradable goods following an increase in domestic demand, and hence causes RER to appreciate. It is also worthy of note that GEXP by causing both output and private consumption to expand, leads to a deterioration of the trade balance and depreciate RER. There is also the possibility that a higher government spending would leave a positive impact on the RER through its effect on inflation in the short-run. A priori, the sign of this variable is therefore ambiguous. The data for this variable was sourced from World Development Indicator-Global Development Finance (2012).

Monetary Policy (M2GDP) represents the index of monetary policy and is measured as the ratio of money supply to GDP. Theoretically, a sound monetary policy should be able to provide adequate incentives for channeling scarce financial resources from the surplus to the deficit unit. All things being equal, the ratio of domestic credit to domestic output, can be used to proxy the success of a good monetary policy. Citing Dufrenot and Yahuae (2005), Aliyu (2007) maintained that a high ratio of domestic credit to total money supply strengthens the Central Bank's balance sheet position, and is expected to lead to real currency appreciation. The data for this variable was gotten from CBN Statistical Bulletin (2013).

Tables A1 and A2 (see Appendix) report the summary statistics and correlation matrix of the variables. As shown in Table A1, the mean of the real exchange rate is approximately 5% with the minimum and maximum values of about 4% and 6% respectively. All the variables display moderate standard deviation not exceeding 1%, except net foreign asset (3.5%). Besides, net foreign asset has the highest mean value (about 24%) followed by technological progress (about 12%). In terms of correlation, Table A2 shows that technological progress, real oil price, monetary policy and government spending have positive correlation with real exchange rate. All, but government spending, were statistically significant. On the other hand, trade openness and net foreign assets exhibit significant negative correlation with real exchange rate. Tentatively, these results indicate that increase in both trade openness and net foreign assets depreciates the real exchange rate of the naira, while increase in technological progress, oil prices, monetary policy and government spending may cause real currency appreciation in the Nigerian case.

5. Results and Discussions

5.1 Data Diagnostic Results: Unit root and Co-integration

In order to test for the stationarity of the time series variables, the traditional Augmented-Dickey-Fuller (ADF) was employed. The analysis was done taking note of all the three alternative assumptions of the data generating process: pure random walk, random walk with drift and random walk with drift and deterministic time trend. Table 2 presents a summary of the results. Apart from net foreign asset and government expenditure that were shown to be stationary at levels, the rest of the variables attained stationarity at first level of differencing.

Table 2: Unit Root Test Results

Variable	ADF Statistic						Decision
	Level			First Difference			
	None	Drift	Drift & Trend	None	Drift	Drift & Trend	
RER	-1.594 (0.103)	-2.655 (0.091)*	-2.866 (0.184)	-4.636 (0.000)***	-4.573 (0.001)***	-4.535 (0.004)**	I(1)
NFA	-4.009 (0.000)***	-3.777 (0.007)***	-3.047 (0.136)	5.617 (1.000)	4.761 (1.000)	2.325 (1.000)	I(0)
OILP	0.081 (0.703)	-1.601 (0.473)	-1.649 (0.755)	-6.612 (0.000)***	-6.676 (0.000)***	-6.593 (0.000)***	I(1)
OPEN	0.159 (0.727)	-1.975 (0.296)	-1.939 (0.616)	-7.498 (0.000)***	-7.545 (0.000)***	-7.633 (0.000)***	I(1)
GEXP	-0.625 (0.441)	-3.714 (0.007)***	-4.783 (0.002)***	-9.570 (0.000)***	-9.447 (0.000)***	-9.383 (0.000)***	I(0)
TECH	0.778 (0.878)	0.0946 (0.962)	0.447 (0.999)	-2.927 (0.005)***	-2.905 (0.054)*	-5.472 (0.000)***	I(1)
M2GDP	-0.069 (0.654)	-2.268 (0.187)	-2.281 (0.434)	-4.241 (0.000)***	-4.258 (0.002)***	-4.184 (0.011)**	I(1)

Note: ***, **, * denote significance at 1%, 5% and 10% respectively. Values in bracket denote the P-values. The optimal lag length was automatically selected using the SIC criterion.

Table 3 displays the results of the co-integration test, using the Johansen methodology. As shown, the two test statistics, Max-Eigen and Trace statistics, returned conflicting conclusions about the number of co-integrating relations among the variables. While the Trace statistic indicated 3 co-integrating equations, only one was indicated by the Max-Eigen test criterion. Irrespective of this controversy regarding the exact number of co-integrating relations among the variables, it was safe to conclude that, at least, there was a long-run relationship among the variables. With this, the estimation of the long-run equilibrium RER is not expected to generate bias or spurious results.

Table 3: Johansen Hypothesized Co-integration Relations

Null Hypothesis	Eigenvalue	Trace Statistic	5% Critical Value (Trace Statistic)	Max-Eigen Statistic	5% Critical Value (Max-Eigen Statistic)
None	0.800085	193.2988 (0.000)**	150.5585	64.39461 (0.0011)**	50.59985
At Most 1	0.581415	128.9041 (0.0081)**	117.7082	34.83501 (0.3746)	44.49720
At Most 2	0.533615	94.06914 (0.0197)**	88.80380	30.50978 (0.2978)	38.33101

At Most 3	0.480860	63.55935 (0.0532)	63.87610	26.22329 (0.2209)	32.11832
At Most 4	0.411823	37.33606 (0.1616)	42.91525	21.22908 (0.1802)	25.82321
At Most 5	0.242607	16.10699 (0.4840)	25.87211	11.11492 (0.5016)	19.38704
At Most 6	0.117328	4.992061 (0.5975)	12.51798	4.992061 (0.5975)	12.51798

Note: ** denotes the rejection of the null hypothesis at the 5% level; values in bracket are the Mackinnon-Haug-Michelis (1999) P-values; Trend assumption: Linear deterministic trend (restricted); Lag interval (in first differences): I to 1.

5.2 The Equilibrium Real Exchange Rate Results

The establishment of co-integration in the preceding section confirmed the existence of long-run relationship between real exchange rate and its fundamentals in the long run. However, the observation of multiple co-integration vectors (as contained in Table 3) complicated the interpretation of the equilibrium condition. It must be noted that neither the case of a single co-integrating vector the most desired outcome as such situation would make it unclear whether the vector represented a structural or reduced form relationship. However, following Cheng and Orden (2005), the reduced rank regression only provided information on the number of unique co-integrating vectors that span the co-integrating space, while any linear combination of the stationary vectors is itself a stationary vector. In this circumstance, one would expect that a linear combination which is most canonically correlated with the stationary part of the model, that is, the first co-integrating vector, is of special interest (Aliyu, 2007). Following from the above, the first co-integrating vector was utilized, which subsist between real exchange rate and its fundamentals, as the long-run relationship. Table 4 contains these results.

Table 4: Normalized Co-integrating Coefficients for the long-run Equilibrium RER⁵

Variables	Vector Coefficients (β)	Standard error	t-statistics
Log(REER(-1))	1.0000	-	-
Log(TECH(-1))	-10.29073***	1.75300	-5.87037
Log(M2GDP(-1))	-7.995052***	2.33681	-3.42135

Log(GEXP(-1))	-2.208649	2.37101	-0.93152
Log(NFA(-1))	1.544906***	0.52858	2.92272
Log(OILP(-1))	9.562778***	9.562778	5.22035
Log(OPEN(-1))	-20.03859***	4.98392	-4.02065
Constant	153.3282	-	-

Note: *** indicates significance at 5%.

Interestingly, most of the fundamentals in the model were significant at the conventional 5% level. The equilibrium RER model showed that trade openness is associated with long-run depreciation of the RER in Nigeria. A 1% rise in the variable causes RER to depreciate by 20%. This satisfied the theoretical expectation and confirmed the role of trade openness in depreciating the long-run RER in Nigeria. This was an insightful result which underscored the fact that given the weak production base of the Nigerian economy, a more liberal trade orientation may be harmful for the economy. Generally, countries with liberalized trade are thought to have lower prices for domestically produced traded goods, corresponding to a real depreciation.

Government expenditure also accounted for long-run depreciation of the RER, though its impact was insignificant. This finding was however, contrary to theoretical expectation which suppose that the impact of government spending should fall more on the non-tradable sector than the tradable sector, thereby exerting pressure on the relative price of non-tradable goods following an increase in demand and hence stimulates higher productivity and appreciates the RER. This could also be a pointer to the fact that public expenditure in Nigeria falls more on unproductive activities. Apart from various forms of government fiscal distortions, another possible explanation could be the fact that Nigeria's capacity utilization is still very low coupled with other high operating cost of doing business in the country.

Furthermore, the coefficient of oil price (OILP) beared the correct positive sign and was statistically significant. On the average, a percentage increase in oil prices lead to about 9.6% appreciation of RER in the long-run. The recent fall in oil prices and the corresponding dwindling fortunes of the naira was thus supported by the data. This finding was consistent with the results of Aliyu (2007) for Nigeria and Jongwanich (2009) for Indonesia. Unfortunately, Nigeria, although a major oil exporting nation, is a price taker in the international world oil market. The

vulnerability of the Nigeria to oil price shocks vis-à-vis the volatility of its RER is an issue of serious concern for alternative policy direction.

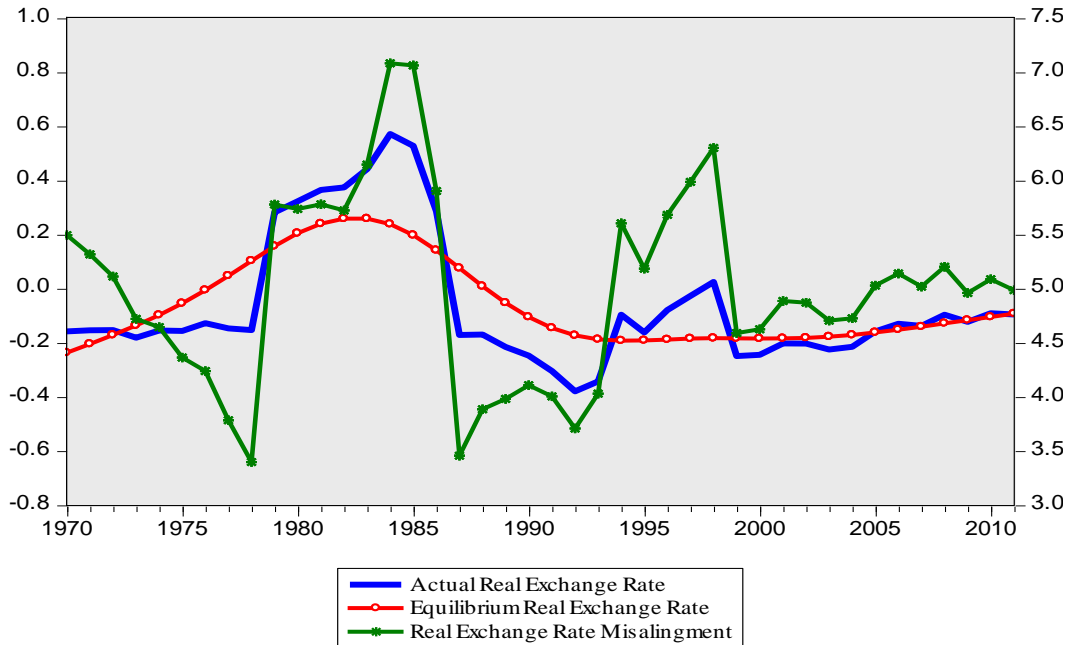
Equally, the long-run equilibrium RER appreciated with increase in net foreign asset (NFA). The coefficient of the variable was significant at 5% level. This result tended to confirm a significant transfer effect of net foreign asset and is in line with the findings of Carrera and Rostout (2008) for Latin America. It showed that improving net external position by 1 % will appreciate RER for Nigeria by about 1.5%. The finding was theoretically plausible because an increase in NFA represents increase in net wealth and therefore should be associated with an appreciated real exchange rate. Equivalently, a net creditor country will eventually need to run trade deficits to satisfy its intertemporal budget constraints, which is facilitated by real appreciation.

The relationship between RER and technological progress (TECH) implied that the Balassa-Samuelson effect does not hold in Nigeria. Theoretically, given prices for traded goods which are fixed on world markets, productivity growth in the traded goods sector is expected to be associated with higher wages, which in turn leads to higher prices in the non-traded sector. Consequently, it is expected that countries with higher productivity growth or technical progress in the traded than in the non-traded sector should experience a real appreciation in their exchange rate. Our result thus indicated that, for Nigeria, the opposite was the case – a reflection of low productivity growth in the traded sector.

5.3 The Real Exchange Rate Misalignment

Real exchange rate misalignment is calculated as the percentage deviation of equilibrium RER from the actual RER. As earlier outlined, to calculate the RER misalignment, we utilized the Hodrick-Prescott (HP) Filter to decompose the fundamentals of the equilibrium RER into their permanent and cyclical components. Figure 3 shows the graph of the equilibrium RER and the actual RER and hence the misalignment. It revealed that the RER of Nigeria was undervalued between 1975 and 1978 but overvalued between 1980 and 1986. Precisely, it was over-valued by as much as 83% in 1984.

Figure 3: Misalingment, Equilibrium, and Actual RER in Nigeria (1970-2011)



From 1986, following the adoption of structural adjustment programme and deregulations, the RER witnessed a sharp undervaluation between 1986 and 1994. The highest undervaluation (62%) was recorded in 1988. There was an overvaluation throughout the period: 1994 and 1998. This period corresponded to the introduction of the Autonomous Foreign Exchange Market (AFEM) and the introduction of the Inter-bank Foreign Exchange Market (IFEM) respectively. This latter policy measure followed by the introduction of the Wholesale Dutch Auction System (WDAS) in 2006 had managed to keep the RER relatively stable in line with its long-run equilibrium value.

6. Conclusion, Lessons for Policy and Agenda for Further Research.

Real exchange rate (RER) is an important indicator of a country’s competitiveness in international trade. This paper investigated the drivers of RER in Nigeria by applying the Behavioral Equilibrium Exchange Rate (BEER) framework to Nigeria’s annual data from 1970 to 2011. Using the Hodrick-Prescott (HP) Filter, the fundamental of the RER were decomposed to obtain and estimate the

misalignment in the RER. Generally, the normalized equilibrium RER model showed that in the long run, increase in trade liberalization or openness, technological progress, and government expenditure depreciated the RER in the Nigerian case. On the other hand, increase in oil prices and net foreign asset were found to appreciate the RER. The RER misalignment index showed that while exchange rate was overvalued between 1980 to 1986 and 1994 to 1998, it was undervalued within the period 1975 and 1978 as well as between 1986 and 1994. Some form of relative stability was recorded between 1999 and 2011.

Given that increase in oil prices were shown to appreciate RER in Nigeria, a variable that Nigeria has no control, calls for diversification of the country's productive base away from oil to enhance the country's trade competitiveness. The current worsening economic fortunes following the global fall in oil prices and the corresponding steady fall in the value of the local currency, underscores the vulnerability of the country to external shock. From a policy perspective, it calls for an inter-temporal fiscal plan where current surplus in oil revenue is saved to cushion the effect of a future slump in the price. Also, there is the need to re-assess the productivity of government fiscal activities and ensure that they are utilized in key sectors that would improve local productivity, especially in the traded sector. Correspondingly, leakages of government spending into unproductive activities and private consumption must be checked. Unfettered trade liberalization policies, when the country's productive base of tradable goods is regrettably weak, should be discouraged. One implication of RER misalignment is that persistent misalignment could generate undesirable impacts on the economy. Persistent real overvaluation could adversely affect export performance since it reflects a loss in a country's competitiveness. Meanwhile, persistent real undervaluation could result in an economic overheating thereby putting pressure on inflation and generating expected currency appreciation. The insight from this analysis is for the monetary authority to formulate credible policies that will keep RER close to its equilibrium value. In view of the findings, the Wholesale Dutch Auction System (WDAS) policy adopted from 2006 to 2011 was found to be well placed and should be sustained. This, however, must be consistent with other fiscal measures aimed at achieving a diversified economic structure and improving the productivity of public spending. Also future studies may consider incorporating other fundamentals such as the terms of trade, external reserves and interest rate differentials in the analysis.

6. References

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Appendix

Table A1: Summary Statistics of the Variables

Variables	Obs.	Mean	Std. Dev.	Min	Max	Sources
Real Exchange Rate	42	4.847	0.600	4.051	6.428	IMF-IFS 2012
Trade Openness	42	3.985	0.418	2.977	4.578	Penn World Table, Version 8
Technological Progress	42	11.780	0.676	10.607	12.682	Penn World Table, Version 8
Real Oil Price	42	3.674	0.595	2.313	4.590	BP Statistical Review, 2013
Net Foreign Asset	42	24.358	3.472	18.850	29.783	WDI-GDF, 2012
Monetary Policy	42	2.971	0.374	2.215	3.641	CBN Statistical Bulletin, 2013
Government Spending	42	2.898	0.282	2.346	3.406	WDI-GDF, 2012

Note: All variables are expressed in their natural logarithms.

Table A2: Correlation Matrix of the Variables

Variables	1	2	3	4	5	6	7
1 Real Exchange Rate	1.000						
2 Technological Progress	0.268* (0.086)	1.000					
3 Trade Openness	-0.477*** (0.001)	-0.501*** (0.001)	1.000				
4 Net Foreign Asset	-0.349** (0.025)	-0.053 (0.744)	0.783*** (0.000)	1.000			
5 Real Oil price	0.429*** (0.005)	0.507*** (0.001)	0.165 (0.297)	0.333** (0.034)	1.000		
6 Monetary Policy	0.491*** (0.001)	0.209 (0.185)	0.143 (0.365)	0.291* (0.065)	0.684*** (0.000)	1.000	
7 Government Spending	0.122 (0.442)	-0.073 (0.644)	-0.225 (0.151)	-0.536*** (0.000)	-0.036 (0.819)	0.068 (0.668)	1.000

Note: All variables are expressed in their natural logarithms; *, **, *** denotes significance at 10%, 5% and 1% respectively.