Is the Naira-US Dollar Real Exchange Rate Misaligned?

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Abstract

Policy makers are generally interested in knowing the degree of real exchange rate (RER) misalignment because of its connection to currency crises and other external sector imbalances. In Nigeria, the Naira-US Dollar RER appreciated by 81.3 per cent between 2000 and 2008 and depreciated afterwards by 10.10 per cent to close at an average of N150.72 in 2009, due to the impacts of the global financial crisis. The main thesis of this study is: Are the movements in Naira RER during Q1:2000 to Q2:2011 in line with the economic fundamentals or not? Based on the theory of cointegration and error correction models as well as calibrated values of relevant explanatory variables, the study obtained estimates of sustainable Naira equilibrium RER and computed the corresponding misalignment levels in a time series perspective. It was confirmed that the RER appreciation of 2002-2008 and depreciation of 2009 were consistent with the long run equilibrium trend. It was also found that the RER oscillated quite closely around its equilibrium path during the study period as it was misaligned by 0.29 per cent. Lastly, the study found a slight RER misalignment (0.03 per cent) during the RDAS/WDAS regimes and thus recommends that the current exchange rate policy in the country be retained while ensuring that official interventions in the foreign exchange market are guided by movements in relevant macroeconomic fundamentals.

Keywords: Real exchange rate, cointegration, misalignment, overvaluation, undervaluation

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I. Introduction

The nominal exchange rate refers to the rate at which the currency of one country trades against that of another. However, a country's level of economic activity depends more on its inflation-adjusted exchange rate often referred to as the real exchange rate (RER). Thus, the RER represents a key macroeconomic indicator in any country. Beyond the real exchange rate is also a crucial reference value called the equilibrium real exchange rate (ERER).

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This is an "ideal" real exchange rate, which prevails in the absence of price rigidities, frictions and other short run factors in an economy.

The equilibrium real exchange rate is not static and may vary over time subject to movements in other macroeconomic fundamentals. Therefore, we cannot say whether a movement of the observed real exchange rate is a change of the equilibrium exchange rate except an "ideal" exchange rate is established. If the observed real exchange rate deviates from its equilibrium level, the currency in question is often said to be misaligned.

After the collapse of the Bretton Woods system of fixed exchange rates in March 1973, many developed countries began to adopt the flexible exchange rate system. However, most developing countries sustained their fixed exchange rate parities. Increasingly with time, some of these developing countries abolished the fixed exchange rate system and embraced intermittent adjustments by implementing regimes such as the crawling pegs or the managed float. Consequently, exchange rate setting in those countries became the role and concern of monetary authorities rather than that of the market forces. This situation led to a restrictive foreign exchange policy and the emergence of active parallel markets in most of the developing countries, Nigeria inclusive. Consequently, it is often believed that the domestic currencies of these countries are misaligned, since they are deemed to be overvalued in most cases.

Exchange rate misalignment creates substantial macroeconomic imbalances such as current account problems and currency crisis. It also affects growth by undermining external competitiveness through overpriced exports, causing a misallocation of resources and adversely affecting domestic financial markets. Moreover, misalignment can be a corollary of inappropriate macroeconomic policies, and thus, indicates the necessity of a shift in either monetary or fiscal policy. In view of these, the achievement of an appropriate value of the nominal exchange rate becomes crucial to economic managers. In this context, economists have reached a consensus that the dominant objective of any exchange rate policy should be to avoid episodes of prolonged and substantial misalignment (Hinkle and Montiel, 1999).

Inspite of its negative consequences, the avoidance of exchange rate misalignment in an economy is not as simple as it sounds. This is because the formulation of a proper exchange rate policy, to a large extent, depends on a firm understanding of real exchange rate behavior as well as some objective inference about the value of the equilibrium RER. On the latter, many developing

countries resort to the use of Purchasing Power Parity (PPP) as an equilibrium condition[1], with its attendant weaknesses.

Exchange rate policy may be counter-productive, if policymakers misidentify the equilibrium rate. Therefore, recent empirical studies on RER misalignment focus on capturing relevant structural factors influencing the RER. Literature on the measurement of real exchange rate misalignment in Nigeria, especially following the occurrence of the 2008/09 global financial crisis is still quite sparse, with most of them failing to account for the effect of productivity changes on the equilibrium RER. Even though the work of Aliyu (2011) systematically modeled the Naira equilibrium RER and accounted for productivity changes, his estimation period of 1995-2006 excluded the period of the financial crisis. To bridge the gap, this study provides estimates of quarterly real exchange rate misalignment for the period 2000 – 2011 while also capturing the effect of productivity on the Naira equilibrium RER (the Balassa-Samuelsson effect). In addition, and unlike previous studies, this study computes an alternative measure of naira RER misalignment based on the Purchasing Power Parity (PPP) methodology for the purpose of comparison.

Therefore, the objective of this paper is to investigate the existence and extent of Naira RER misalignment during the period 2000:Q1 – 2011:Q2[2]. It also seeks to identify episodes of overvaluation and undervaluation during the study period. To achieve these objectives, the study proceeds in two steps: (i) estimation of a baseline model to derive estimates of Naira equilibrium RER and (ii) calculation of percentage deviations of the observed real exchange rate from the estimated equilibrium RER (estimates of RER misalignment).

The rest of the paper is structured as follows. The next section discusses Nigeria's exchange rate policies and trends from 1960 to 2011. Section III reviews related empirical literature, with particular attention to estimation methods and results. Section IV focuses on the estimation procedures adopted by the study. The empirical findings are presented and discussed in section V while the final section contains policy implications and conclusion.

II. Exchange Rate Policies and Trend in Nigeria

Exchange rate policies in Nigeria have been targeted at avoiding substantial misalignments and achieving a realistic Naira exchange rate that is capable of addressing the basic problems of the country's external sector. These ranged

[1] The shortcomings of the PPP are discussed in section four

[2] The choice of 2000 to 2011 was based on data availability, especially with regards to the included economic fundamentals

from a fixed exchange rate regime prior to 1986 to various forms of floating exchange rate system, following the liberalization of the foreign exchange market in 1986.

For instance, the Naira exchange rate (at N0.7143/$US) was adjusted in relation to the British pound with a one-to-one relationship between 1960 and 1967, while another fixed parity was maintained with the American dollar between 1967 and 1974, following the devaluation of the pound sterling in 1967. This system was later abandoned and replaced with an independent exchange rate management policy that pegged the Naira to either the U.S. dollar or the British pound sterling; depending on which currency was stronger in the foreign exchange market. Late in 1976, there was an unsystematic policy to depreciate the Naira with a view to realigning its value. This was done by pegging its exchange rate to a basket of seven currencies of Nigeria's major trading partner countries.

Towards the end of 1985, the government allowed the exchange rate to be determined by market forces in consonance with the tenets of the Structural Adjustment Programme (SAP)[3]. The Second-tier Foreign Exchange Market (SFEM) was introduced in September 1986 as a market-driven mechanism for foreign exchange allocation, while the first and the second tier markets were merged into an enlarged foreign exchange market in July 1987. During this period, various pricing methods such as marginal, weighted average, and Dutch Auction System were adopted. The average annual official exchange rate, which was N2.0 per US dollar in 1986 depreciated rapidly to N4.0 per US$ and N9.9 per US$ in 1987 and 1991, respectively. The naira further depreciated to N17.3 per US$ and N22.1 per US$ in 1992 and 1993, respectively.

There was a policy reversal in 1994 when the naira exchange rate was again pegged. This policy led to an appreciation of the exchange rate to N21.9 per dollar. However, another era of liberalization in the foreign exchange market began in 1995 when the Autonomous Foreign Exchange Market (AFEM) was introduced. Two exchange rates prevailed in the country during this era. The fixed exchange rate of N21.9 per dollar was applied to official transactions on debt service payments and national priority projects while the market determined AFEM rates were used for other transactions. This encouraged round tripping and other sharp practices associated with a subsidized official rate existing side by side a market determined AFEM rate. This made the monetary authority to abolish the fixed exchange rate system at the official segment of the market in 1999 and the AFEM rate remained the only recognized exchange rate.

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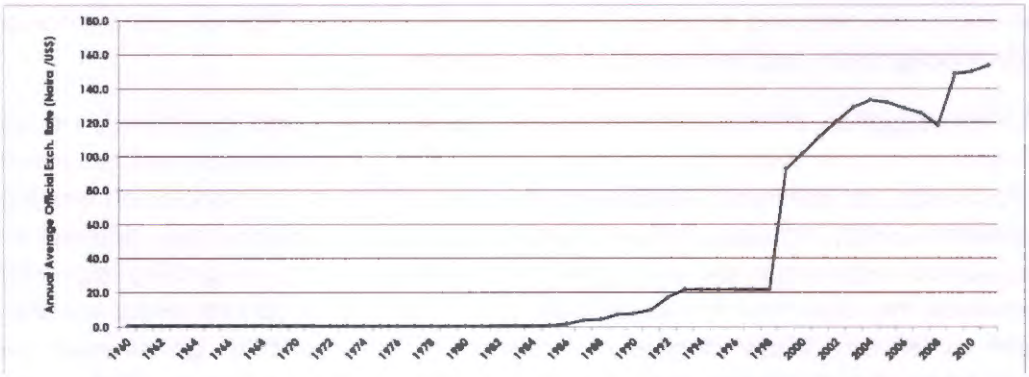
[3] *Nigeria's exchange rate regime since SAP could be strictly referred to as a managed float system.*

Figure 1: Time Series Plot of Annual Naira / Dollar Exchange Rate, 1960 - 2011



The Inter-bank Foreign Exchange Market (IFEM) was introduced on October 25, 1999 to deepen the foreign exchange market but was abolished in July 2002 following the reintroduction of Retail Dutch Auction System (RDAS). From N92.7 per dollar in 1999, the naira depreciated to N121.0, N129.4, N133.50 and N132.15 per US dollar in 2002, 2003, 2004 and 2005, respectively. The subsisting Wholesale Dutch Auction System (WDAS) was introduced on February 20, 2006 to further liberalize the foreign exchange market, reduce the dependence of authorized dealers on CBN for foreign exchange and achieve convergence in exchange rates. This led to an appreciation of the exchange rate from its level of N132.15/US$ in 2005 to N128.65/US$, N125.83/US$ and N118.57/US$ in 2006, 2007 and 2008, respectively. Following the impacts of the global financial crisis on the economy, depreciation pressures mounted on the naira as the exchange rate moved to N148.91/US$, N150.30/US$ and N153.90/US$ in 2009, 2010 and 2011, respectively.

III. Review of Empirical Literature

Hinkle and Montiel (1999) carried out a comprehensive review of the methodologies for estimating equilibrium RER and its associated misalignment levels. Basically, four different methodologies were identified and these are the operational approaches (which are based on relative purchasing power parity and the trade equations), the simple general equilibrium model approach (which is based on computable general equilibrium), the econometric model simulations approach (which is based on the work of Haque, *et. al* (1990)) and the single-equations estimation approach (which models equilibrium RER as a function of sustainable fundamentals). While the operational approaches have been criticized for its inability to effectively capture the effects of important fundamentals on the equilibrium RER, the application of econometric model simulations and general equilibrium model approaches have also been limited

due to their huge data requirements and computational complexity. This section reviews some selected empirical studies on the measurement of real exchange rate misalignment and its impact on the economy.

The investigation of real exchange rate misalignment and its impacts on the economy is a perennial topic in both international, monetary as well as growth economics. For instance, Goldfajn and Gupta (1999), in their inquiry on whether monetary policy stabilizes the exchange rate after a currency crisis defined the equilibrium exchange rate as a predicted value of the cointegrating regression between the observed real exchange rate and a set of fundamental variables such as terms of trade, degree of openness of the economy, government size and international interest rate. They however determined the equilibrium real exchange rate for 80 countries from a Hodrick-Prescott filtered series, which captures trends and allows for concentration on the cyclical behavior in the real exchange rate series used for their analysis. They found 99 cases in which the real exchange rate was overshot by 10 per cent. The average duration for which the real exchange rate remained misaligned (i.e. undervalued) after a currency crisis was also found to be about 30 months for cases with more than 15 per cent undervaluation.

In addition to the variables identified by Goldfajn and Gupta (1999), Rajan *et al.* (2000) while investigating misalignment of the Baht and the crisis in Thailand highlighted productivity (proxied by GDP per capita) as a major fundamental influencing the equilibrium real exchange rate in any economy. Using quarterly data spanning 1988-1999, they applied the standard Johansen cointegration test to the natural real exchange rate model developed by Stein (1994) and identified persistent and significant misalignment (overvaluation) of the Thai baht against the Japanese yen. The existence of misalignment was confirmed and the unrestricted VAR impulse-response and variance decomposition tests clearly underscored the contribution of the misalignment to large and growing trade imbalances in Thailand, particularly during the late 1980s until the mid-1990s.

In a similar study for Thailand, Lim (2000) identified the significance of two fundamental variables, which are the level of foreign debt and the cumulative sum of real interest rate differentials and his results revealed that the estimated long run equilibrium real exchange rate of the Thai bath tracked the observed real exchange rate quite well. Montiel (1997) had a similar conclusion when he empirically tested whether the behavior of the real exchange rate during 1960-1994 in Thailand, Indonesia, Malaysia, Philippines and Singapore aligned with equilibrium phenomenon. He employed a sequence of time-series testing, viz. the unit root test and the Johansen cointegrating test and failed to find any

significant and persistent misalignment during the period of late 1980s and early 1990s in those economies.

Razin and Collins (1997) also developed equilibrium exchange rates for 93 countries considering fundamentals such as labor productivity (used as a determinant of domestic output supply), annual money growth in excess of output growth (used as an indicator of the overall stance of monetary policy and interpreted as an underlying determinant of domestic demand), terms of trade, annual long-term capital inflows as a share of GDP and finally, annual resource balance also as a share of GDP. They found that misalignments were most pronounced in Sub-Saharan Africa, South & Central Asia and Europe.

Moosa (2000) examined the extent, possible causes and consequences of misalignment in intra-Arab exchange rates and found that misalignments in the bilateral exchange rates of six Arab countries namely, Bahrain, Egypt, Jordan, Kuwait, Morocco and Tunisia were extensive (some being misaligned by more than 100 per cent) and, in most cases, had no tendency to disappear even in the long run.

In his study on Sweden, Nilsson (2002) used the vector error correction model and found that the Krona was severely overvalued in late 1992, when the fixed exchange rate regime was abandoned. He also found that the Krona was undervalued by some 4 to 5 per cent at the end af 2000.

Baffes, *et al.* (1997) developed a single equation approach and used annual data from Cote d'Ivoire and Burkina Faso to estimate the degree of their exchange rate misalignment. He found out that the Ivorian currency was overvalued by 34 per cent during the period 1987-1993 while Burkina Faso's real exchange rate was undervalued by 1 per cent on average between 1980 and 1986 and by nearly 14 per cent during 1987-1993. Using a similar approach but in a study for Bangladesh, Rahman and Basher (2000) used variables such as terms of trade, degree of openness, resource balance, debt, government consumption, investment share and foreign price level and found that the country's RER was considerably overvalued until the late 1980s.

Chand (2001) used quarterly data from 1981 to 2000 to quantify the extent of the Austrian real exchange rate misalignment relative to its equilibrium value. His estimation revealed that the trade-weighted exchange rate was 7 per cent below its equilibrium value as at December 2000. For Estonia, Filipozzin's (2000) study concluded that an appreciation of the Estonian kroon in the study period occurred together with an appreciation of its equilibrium level. The latter appreciated slower, hence the initial undervaluation was corrected and the

difference between RER and its equilibrium level shrank, leading to a slight overvaluation after the Russian crisis.

Lahcen (2001) found that the currencies of Algeria, Morocco, Egypt, Tunisia and Turkey exhibited some level of overvaluation during the late 1990s and suggested that policy makers should react either through a nominal devaluation or by introducing some exchange rate flexibility to absorb exogenous shocks. In a similar study, Min (1999) used the concept of interest parity forward rate to estimate exchange rate misalignment of seven Asian countries relative to the Japanese yen and showed that before the crisis, all Asian countries' currencies were overvalued by about 30 to 40 per cent against the Japanese yen.

Kemme and Teng (2002) while studying the dynamics of real exchange rate in Poland used the purchasing power parity measure and confirmed that the Zloty (the Polish currency) exhibited serious and persistent overvaluation from December 1990 to May 1999. The observed overvaluation was negatively correlated with their real export growth.

A category of empirical works on the determination of equilibrium real exchange rate in Nigeria is based on the PPP approach. For instance, Obaseki (1998) used the PPP-based measure of equilibrium RER and showed that the Naira was overvalued by about 4.7 per cent during 1995 – 1998. Also, Ononugbo (2005) investigated long run cointegration between naira exchange rate and relative price levels in Nigeria and the USA. He used the error correction model within the purchasing power parity (PPP) framework and found that the naira nominal exchange rate during 1970 to 2003 followed the long run path suggested by the PPP.

In terms of the single equations estimation approach, Soludo and Adenikinju (1997) applied the techniques of co-integration and error correction model to estimate equilibrium real exchange rate in Nigeria and thereafter calculated the misalignment values. They found that misalignment series have significant negative impact on the country's manufacturing investment, even though they failed to provide sufficient details about their computed misalignment values. In a similar study for Nigeria, Agu (2002) adopted the reduced form equation to assess exchange rate misalignment in Nigeria and found that the Naira was overvalued by an average of about 1.4 per cent between 1970 and 1998. He also found that real exchange rate misalignment and its volatility affects trade. These studies, however, did not capture the impact of productivity on Naira equilibrium real exchange rate. Also, they did not explicitly elucidate their methodologies for obtaining naira equilibrium real exchange rates and the associated misalignment levels.

Suleiman and Muhammad (2011) also modeled the naira equilibrium RER based on only two economic fundamentals which were real oil price and productivity differentials. Using data for the period 1980 - 2010 and based on the Johansen cointegration test and VECM, they found a positive relationship between oil price and the exchange rate (depreciation pressures) and a negative effect of productivity differential on the equilibrium RER (i.e. appreciation pressures). They, however, failed to investigate whether movements in the RER was in line with the long run equilibrium path. Nwude (2012) identified the factors that determine naira exchange rate to include gross domestic product, balance of payments, reserves, consumer price index, deposit rate and lending rate. Based on annual data from 1960 to 2011, he applied the simple OLS method and found that there was no statistically significant relationship between the RER and its fundamentals. Besides the fact that his exchange rate determinants were not theoretically selected, Nwude's work suffered from several methodological problems[4] as evident in his results.

In a quite rigorous work, Aliyu (2011) investigated RER misalignment in Nigeria using the single equation estimation approach. Applying the Johansen's cointegration approach and vector error correction model, he identified the significant determinants of the naira RER as terms of trade, crude oil price volatility, monetary policy performance and government fiscal stance. He showed that the Naira was undervalued between 2003Q3 and 2004Q4 and overvalued during 2005Q1 – 2006Q4. The sample period for the study, however, predated the 2008/09 global financial crisis.

IV. Estimation Procedure

IV.1 Model Based Approach

Based on the single equation methodology, this study adopted the behavioral equilibrium exchange rate approach to estimate Naira equilibrium value. The approach was enunciated by MacDonald (2000) and Clark & MacDonald (1998) and it provides a framework for relating real exchange rate to relevant economic fundamentals. Thus, this study selected seven economic variables to capture both transitory and structural movements in the naira real exchange rate RER[5] from 2000:Q1 to 2011:Q2. These are the degree of openness (DOO), productivity (PRO), terms of trade (TOT), capital inflow (FDI), nominal exchange rate (NER), total government expenditure (TGE) and interest rate differential between Nigeria

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[4] For instance, the study failed to test and account for non-stationarity in the included variables.

[5] RER was constructed as NER multiplied by the ratio of prices in the United States to prices in Nigeria.

and the United States (IRD). These variables are selected based on their theoretical, empirical and situational relevance[6]. The single equation methodology is preferred because it incorporates the effects of permanent change in the fundamentals and enables us to decipher the specific relationships between the equilibrium RER and its fundamentals for policy considerations.

Following Ofair and Susan (1997), the functional form of the Naira equilibrium real exchange rate model as well as the expected signs of the regressors (in parenthesis) is specified as

$$\underset{\quad}{LRER} = f\underset{(-)}{(LTGE}, \underset{(-)}{LPRO}, \underset{(+)}{LNER}, \underset{(-)}{IRD}, \underset{(-)}{LFDI}, \underset{(\pm)}{LDOO}, \underset{(\pm)}{LTOT}, \varepsilon_t) \qquad (1)$$

where LDOO is the log of degree of openness, LPRO is log of productivity, LTOT is log of terms of trade, LFDI is log of capital inflow, LNER is log of nominal exchange rate, LTGE is log of total government expenditure, IRD is the interest rate differential between Nigeria and the USA and ε_t is the random error.

In order to estimate equation 1, the theory of cointegration and error correction mechanism is applied. This concept provides a framework for testing for and estimating long run (equilibrium) relationships among economic variables According to this approach, a dependent variable Y_t and exogenous variables $X_{i,t}$ form a long term relationship as specified in equation 2 if all the variables are integrated of the same order and their residuals ε_t are stationary.

$$Y_t = \beta_0 + \sum_{i=1}^{n} \beta_i X_{i,t} + \varepsilon_t \qquad (2)$$

Y_t is the dependent variable (i.e. RER)[7], $X_{i,t}$ is a vector of regressors (i.e. economic fundamentals that affect RER), β_i is the vector of coefficients, β_o is the intercept and ε_t is the random disturbance term. In order to test for cointegration, the Augmented Dickey-Fuller (ADF) unit root test is applied on the regression residuals ε_t of equation (2) based on the critical values provided in MacKinon (1996).

The first step in an analysis of this nature is to subject the variables in equation (1) to stationarity test in order of to ascertain their correct order of integration. In this regard, the ADF unit root test is employed and the non-stationary series are purged by appropriately differencing them.

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[6] The expected theoretical impacts of the explanatory variables on the RER as well as data sources are presented in appendix A. The variables were converted to logs, except IRD.

[7] RER is defined in terms of the domestic currency (Naira) per unit of foreign currency (US Dollar).

The second step relates to the test for cointegration amongst the variables and this is accomplished using the Johansen's (1995) approach. Further evidence is sought using the Engle and Granger (1987)[8] cointegration test in order to ascertain that the linear combinations of the variables in equation (2) exhibit stable properties in the long run. When there is more than one cointegration relationships, Gonzalo (1994) recommends estimating with Johansen maximum likelihood procedure. In a similar argument, Hargreaves (1994) noted that the Johansen procedure only beats OLS if one can be sure there is more than one cointegrating relationship. Smallwood and Norrbin (2004) also cautioned that the Johansen technique relies heavily on the presence of unit roots in the variables. Thus, when there are near unit roots (which because of the lack of power of unit root test will not be detected) the Johansen maximum likelihood methodology can produce very misleading results. In view of these arguments, this study used the OLS method, having confirmed the existence of just one cointegrating equation.

The third step involves estimating the cointegrating equation. The Engle & Granger (1987) two-step approach is applied and an error correction model specified below is estimated.

$$\Delta Y_t = \alpha_0 + \sum_{i=0}^{s} \beta_i \Delta X_{t-i} + \sum_{j=1}^{q} \gamma_j \Delta Y_{t-j} + \rho \varepsilon_{t-1} + \mu_t \qquad (3)$$

Where Δ denotes the first difference operator, ε_t is the estimated residual from equation (2), s and q are the number of lag lengths[9], Y_t is the dependent variable (LRER) while X_t is the vector of exogenous variables. If the system is stable, the coefficient ρ will be negative and statistically significant. Moreover, the value of ρ measures the speed of adjustment of the dependent variable to the value implied by the long run equilibrium relationship.

The fourth stage of the empirical analysis relates to the computation of the equilibrium real exchange rate, which is based on sustainable values of the exogenous variables. As in Aliyu (2011), the Hodrick-Prescot filter was used to derive sustainable values of the exogenous variables which are then substituted into the cointegrating equation of stage three to obtain the medium term equilibrium RER.

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[8] *The Granger's representation theorem described in Engle and Granger (1987) implies that if there exists cointegration amongst a group of variables, there must also exist an error correction representation.*

[9] *We included only two period lag in order to maintain reasonable degrees of freedom*

Finally, the percentage difference between the estimated equilibrium real exchange rates (e*) and the observed real exchange rate (e) is calculated in a time series perspective and this difference is taken to represent estimates of RER misalignment. Therefore, if:

$e^* - e > 0$ = Overvaluation (4)

$e^* - e < 0$ = Undervaluation (5)

$e^* - e = 0$ = No Misalignment (6)

Thus, the estimates for current (short-run) and medium term misalignments are derived based on current equilibrium RER and medium term equilibrium RER, respectively.

IV.2 Purchasing Power Parity Approach

For robustness of analysis, estimates of the real exchange rate misalignment based on the Purchasing Power Parity (PPP) are also computed. Balassa (1990), Agarwala (1983), Cottani et al. (1990) and other researchers have, in their various studies, used the Purchasing Power Parity (PPP) approach to explain exchange rate misalignments. However, Hinkle and Montiel (1999) argued that this method is only useful for initial detection of misalignment and for the identification of hypotheses for subsequent analysis. For such subsequent analysis, using more sophisticated techniques is preferred.

Adopting the November 2009[10] base period of the National Bureau of Statistics for the consumer price index, the naira/dollar purchasing power parity real exchange rate (i.e. PPP-based naira equilibrium RER) is computed as:

$$ERER(PPP)_t = NER_{base\ period(Nov\ 2009=100)} \times \left(\frac{USA's\ CPI_{t(Nov\ 2009=100)}}{Nigeria's\ CPI_{t(Nov\ 2009=100)}}\right) \quad (7)$$

To test the applicability of the purchasing power parity theory to the naira/US$ RER, unit root test is performed on the series to confirm mean reversion. This is based on the belief that the real exchange rate is constant at the level attained when there is macroeconomic balance and that deviations from the long run mean is short-lived. In this regard, the ADF test is used to test for unit root in the series.

[10] *This is seen as a period of relative calm in the economy*

This study admits that the PPP approach suffers from a number of defects. These include the difficultly in establishing a point at which currencies are in equilibrium, complications arising from comparison between prices in different countries since many goods are not traded goods, breakdown of the assumption of free flow of international trade between countries and the failure of the PPP approach to capture changes in the sustainable equilibrium exchange rate produced by changing economic fundamentals, among others.

V. Results and Discussion

V.1 Tests for Unit Root and Cointegration

Table 1 presents the results of the ADF unit root test conducted on the included variables. The lag structure was automatically determined based on the Schwarz criterion. The results revealed that all the variables are non-stationary at level but integrated of order one, implying the need to difference them once. It is noted that the purchasing power parity hypothesis does not hold for the RER, since the series is non-mean reverting and integrated of order 1. Therefore, the long run equilibrium RER of the Naira is not explained by the PPP theory and the application of an alternative model, based on relevant economic fundamentals is justified. This is in line with the consensus in the literature that PPP is not an appropriate measure for developing or transition economies' equilibrium real exchange rates.

Table 1: Results of Augmented Dickey-Fuller Unit Root Test

Variables	Levels		First Difference	
	ADF^{c}	ADF^{ct}	ADF^{c}	ADF^{ct}
LRER	-0.9876	-2.5742	-6.5929	-6.5132
LTGE	-1.9109	-2.1703	-6.5164	-6.4384
LPRO	-1.6119	-1.7734	-2.8192	-3.0884
LNER	-1.5260	-1.9052	-5.4876	-5.4398
IRD	-1.7888	-2.0663	-4.0889	-4.0597
LFDI	-2.3035	-2.2785	-5.6286	-5.5874
LDOO	-2.5895	-2.5650	-6.9789	-6.9095
LTOT	-2.9052	-3.4014	-11.5094	-11.3724

ADF^{c} represents unit root test with constant

ADF^{ct} represents unit root test with constant and trend

**MacKinnon (1996) critical values with constant are -3.5885 (1%), -2.9297 (5%) and -2.6031 (10%)*

**MacKinnon (1996) critical values with constant and trend are -4.1809 (1%), -3.5155 (5%) and -3.1883 (10%)*

Having confirmed that the variables are I(1), the presence of cointegration amongst the included variables was tested using Johansen (1995) technique. The maximum eigenvalue unrestricted cointegration rank test confirmed the presence of at most one cointegrating vector.

Table 2: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.6683	48.5587	46.2314	0.0277
At most 1	0.5517	35.2979	40.0776	0.1568
At most 2	0.4874	29.4076	33.8769	0.1558
At most 3	0.3189	16.9003	27.5843	0.5885
At most 4	0.2675	13.6941	21.1316	0.3907
At most 5	0.1485	7.0717	14.2646	0.4807
At most 6	0.0304	1.3571	3.8415	0.2440

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

** denotes rejection of the hypothesis at the 0.05 level*

***MacKinnon-Haug-Michelis (1999) p-values*

Furthermore, the results of the Engle & Granger residual test confirmed the existence of a highly significant cointegration among the variables as their linear combination was found to be I(0) at 1 per cent significance level[11].

Table 3: Result of Unit Root Test on the Residuals of the Static Model

Null Hypothesis: RESID01 has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.6934	0.0000
Test critical values:	1% level	-3.5847	
	5% level	-2.9281	
	10% level	-2.6022	

*MacKinnon (1996) one-sided p-values.

V.2 Model Results and Diagnostics

Results of the parsimonious error correction model (akin to equation 3) fitted to the data are presented in Table 4. The adjusted R^2 is 0.7811, implying that about 78.1 per cent of variations in the real exchange rate is explained by the included fundamentals. Model results revealed that the included variables are significant and have the expected signs. For instance, an increasing inflow of foreign direct investment, improving productivity (confirming Balassa-Samuelson effect) and widening degree of openness cause appreciation pressures in Naira real

[11] *The results of the static model is presented in appendix B*

exchange rate. However, increases in terms of trade and nominal exchange rate depreciate the real exchange rate.

The error correction term (resid01) is found to be negative and significant at 1 per cent significance level, further providing evidence of a long-run cointegrating relationship among the variables. The magnitude of the error correction coefficient is -0.8260 implying a high speed of convergence of the real exchange rate to its equilibrium. No evidence of serious first order autocorrelation was found in the model as the Durbin-Watson statistic is close to 2 (Table 4).

Table 4: Results of the Error Correction Model for the Naira Real Exchange Rate

Dependent Variable: D(LRER)
Method: Fully Modified Least Squares (FMOLS)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLFDI	-0.0460	0.013883	-3.311141	0.0021
DLNER	0.4754	0.063921	7.437291	0.0000
DLPRO	-0.1215	0.028764	-4.223791	0.0002
DLDOO(-1)	-0.0454	0.013636	-3.325958	0.0020
DLTOT(-2)	0.0456	0.016799	2.711827	0.0102
RESID01(-1)	-0.8260	0.070804	-11.66605	0.0000
C	-0.2452	0.076652	-3.19949	0.0029
R-squared	0.8124	Mean dependent var		-0.0138
Adjusted R-squared	0.7811	S.D. dependent var		0.0437
S.E. of regression	0.0205	Sum squared resid		0.0151
Durbin-Watson stat	1.8648	Long-run variance		0.0001

The results of parameter stability tests as well as tests for non-normality, autocorrelation and heteroscedasticity in the residuals of the error correction model show that the model is adequate (Table 5). For instance, the Jarque-Bera test for normality confirmed that the obtained residuals from the cointegrating regression are normally distributed. This suggests that the economic fundamentals that affect RER in a systematic manner were largely captured. Also, the Breusch-Godfrey test for serial correlation failed to reject the null hypothesis of no autocorrelation in the errors while the white test for heteroscedasticity also failed to reject the null hypothesis of homoscedasticty in the errors. A test for specification error was conducted based on the Ramsey RESET procedure and this revealed that the model is correctly specified as the associated p-value was 0.2656 (Table 5).

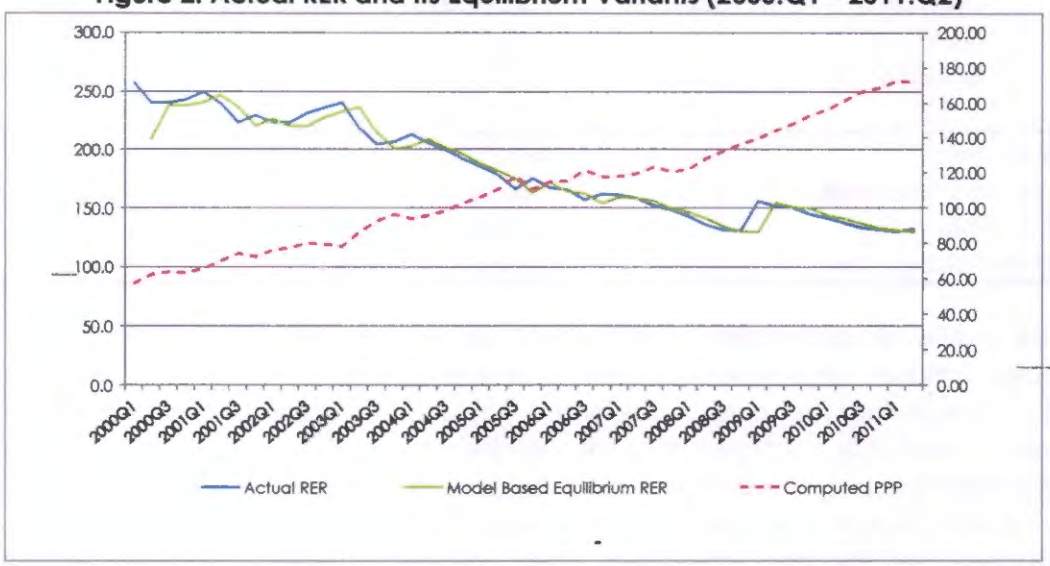
Table 5: Model Diagnostics Results

Test	F-statistic	P Value
Jarque-Bera (Normality)	2.1822	0.3359
Breusch-Godfrey (Serial Correlation LM Test)	1.4694	0.2435
White Test (Heteroskedasticity)	0.3707	0.9867
Ramsey RESET Test (Stability)	1.2775	0.2656

V.3 Estimates of Real Exchange Rate Misalignment in Nigeria

The estimated variants of the equilibrium RER as well as the computed misalignment levels are presented in Appendix B3. The PPP approach, bearing in mind its inherent deficiencies, indicated a 33.01 per cent undervaluation of the naira during the study period. It is quite revealing to note that estimates based on the PPP approach responded to the undervaluation pressure of 2009:Q1 (though in a milder form compared to the model based approach), corroborating the finding of the model based estimates (Chart 3).

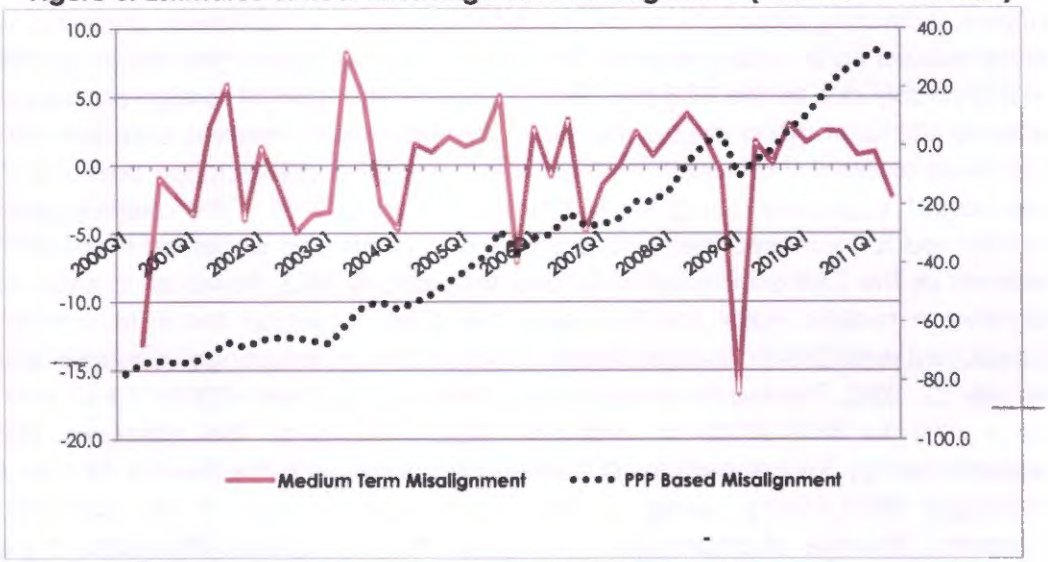
Figure 2: Actual RER and Its Equilibrium Variants (2000:Q1 - 2011:Q2)



On the other hand, the model-based approach revealed that the observed real exchange rate tracked the estimated equilibrium real exchange rate of the Naira fairly well (Figure 2). This suggests that real exchange rate movements in Nigeria are, broadly speaking, in line with relevant economic fundamentals. The approach revealed that the observed RER was undervalued by an average of

0.29 per cent during the study period. In all, 19 quarters of undervaluation and 25 quarters of overvaluation were identified. The episodes of overvaluation were more than offset by the large magnitudes of undervaluation recorded, especially during 2000:Q2, 2005:Q4 and 2009:Q1 (Figure 3).

Figure 3: Estimates of Real Exchange Rate Misalignment (2000:Q1 - 2011:Q2)



The periods of significant misalignments (i.e. overvaluation or undervaluation) are related to identifiable government policy shifts and prevailing macroeconomic circumstances in the country. For instance, the CBN responded to the depreciation pressure[12] of late 1999 by introducing the interbank market (IFEM) on October 25, 1999. This policy was aimed at deepening the foreign exchange market and enabling the naira to achieve a realistic exchange rate. The end period exchange rate, which was N95/US$ in October 1999 (when IFEM was introduced) depreciated by 13.7 per cent to N110.05/US$ at end-December 2000. The actual RER averaged N245.60/US$ as against N228.31/US$ suggested by prevailing economic fundamentals during 2000, implying an undervaluation of 5.5 per cent during the year (Appendix B3). This coincided with a period in which the foreign exchange market was bedeviled with supply-side rigidities, excess liquidity in the system and speculative demand by operators. Armed with significant increase in reserves, the CBN continued to meet all effective demand of end users and sold US$7.26 billion in 2000, an increase of 4.0 per cent above the US$6.98 billion sold in 1999.

[12] *This was due to demand pressures and sharp practices by market operators.*

Although there was a correction to equilibrium during the second quarter of 2001, the rate of appreciation (4.13 per cent) in the observed RER was higher than the level (3.94 per cent) suggested by the equilibrium path. Thus, the real exchange rate was overvalued by an average of 0.27 per cent during the year. The appreciation in the ERER was driven largely by increased foreign investment inflows, increasing productivity and widening degree of openness (implying a more relaxed trade policy regime). The excess appreciation in the observed RER was probably due to the 38.3 per cent increase in the level of foreign exchange sales to US$10.04 billion during the year. The increase in reserves coupled with improved external sector performance also generated appreciation pressures in the market, especially during the first three quarters of 2001[13]. The overvaluation of 2001 led to increased demand pressure and continued depletion in external reserves as the CBN continued to defend the naira till 2002. However, in order to achieve a realistic value for the naira, the CBN abolished the IFEM and re-introduced retail Dutch Auction System (DAS) of foreign exchange management on July 22, 2002. This led to a sharp naira depreciation from N120.0/US$ at end-June 2002 to N131.0/US$ at end-July, 2002[14]. However, the observed RER appreciated by 3.0 per cent in 2002 when compared with the level in 2001 as it averaged N228.98/US$ owing to the higher inflation rate in the domestic economy. This rate of appreciation was lower than an appreciation rate of 5.6 per cent suggested by economic fundamentals, resulting in an undervaluation of 2.22 per cent (Appendix B2)[15].

In 2003, the external sector witnessed a moderate pressure owing to the improved foreign exchange earnings from crude oil exports. The overall balance of payments resulted in a lower deficit of N162.84 billion from N565.35 billion in 2002. However, the impact of financing the BOP deficit through drawdown of external reserves[16] manifested in the naira exchange rate during the fourth quarter of the year as it depreciated by 6.3 per cent to close at N137 per dollar at end-December 2003. The observed RER was N217/US$ as against the equilibrium level of N221.14/US$ resulting in an overvaluation of 1.71 per cent during the year.

The observed RER appreciated by 7.52 per cent in 2004 amidst moderation in demand pressure at the foreign exchange market due to the relative effectiveness of monetary policy complemented by prudent fiscal policy. In

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[13] *The real exchange rate was overvalued by 5.9 per cent during the quarter (Appendix B3).*

[14] *This represents a depreciotion of 8.4 per cent*

[15] *During the year, the country's balonce of payments wos under severe pressure as a result of adverse external shocks resulting from the reduction in Nigeria's crude oil production quota by the OPEC and the external debt service burden.*

[16] *The level of external reserves fell by 2.8 per cent to US$7.47 billion as at end-December 2003.*

addition, the increase in the stock of external reserves discouraged speculative tendencies that could mount demand pressure on the market. However, the level of appreciation suggested by relevant economic fundamentals was 7.69 per cent leading to a slight undervaluation of 0.07 per cent during the year. This coincided with a period of increased net foreign portfolio investment[17].

The real exchange rate was, on the average, overvalued by 0.29 per cent in 2005. Although the appreciation in the observed RER during the year was justified by economic fundamentals, the level of appreciation (14.90 per cent) recorded was a little higher than the rate suggested by the equilibrium path (Appendix B2). The appreciation in the observed RER was due to increased supply of foreign exchange to the market preparatory to the introduction of WDAS and this might be responsible for the overvaluation witnessed in the year[18]. The end period WDAS rate appreciated from its level of N136.86 per dollar in 2004 to N129.00 per dollar in 2005. The stock of external reserves was US$28.3 billion, which was 59.8 per cent higher than its level in the previous year. Capital inflows (FDI and FPI)[19] increased substantially during the year owing to the banking sector consolidation programme and an improved investment climate (CBN, 2005).

In 2006, the real exchange rate was largely in line with the levels implied by the fundamentals as the RER was slightly overvalued by 0.09 per cent indicating the fact that the introduction of WDAS as a foreign exchange management strategy was quite successful in evolving a realistic exchange rate for the naira. This coincided with a period in which demand pressure moderated[20] owing to the tight monetary policy stance of the CBN, fiscal consolidation, increased surveillance over the activities of the authorized dealers by the CBN as well as increased depth of the foreign exchange market. During the year, a total of US$11.3 billion was sold in 95 trading sections compared with US$10.7 billion in 102 trading sessions in 2005. The increased level of intervention during the year reflected deliberate efforts by the CBN to protect the value of the currency and this drive was in alignment with the dictates of the relevant fundamentals during the period. Other developments that led to the realignment of the RER were increased foreign investments (by 31.77 per cent above the level in 2005), appreciation of the average WDAS rate (by 2.72 per cent) and increased productivity. The observed RER was N162.67/US$ during the year as against the

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[17] FPI (net) rose by 146.3 per cent to N46.8 billion in 2004 due to the bank recapitalization policy initiated by CBN in 2004.

[18] During the year, a total of US$10, 824.4 million was sold in 102 sessions at the DAS representing over US$1.2 billion sales above the previous year's level.

[19] For instance, foreign direct investment rose by 21.7 per cent to N303.3 billion.

[20] Demand for foreign exchange amounted to US$11.9 during the year, indicating a decline of US$0.8 billion (or 9.9 per cent) from the level in 2005

equilibrium level of N162.81/US$. Thus, the divergence of the observed RER from the ERER narrowed substantially during the year (Appendix B2).

There was increased funding of the WDAS and BDC segments of the market in 2007 as total sales of foreign exchange by the CBN to the two segments totaled US$16.1 billion as against US$12.6 in 2006. This coincided with a period of increased foreign exchange earnings, substantial capital inflows, robust external reserves[21] and strong macroeconomic fundamentals. Thus, the steady appreciation in the end period nominal exchange rate from N128.28 per dollar in January to N117.97 per dollar at end-December 2007 reflected in the observed RER, which appreciated by 4.96 per cent to close at an average of N154/US$ in the year. The appreciation in the observed RER during the year was in line with the economic fundamentals as the ERER also appreciated due to pressures from increased foreign investment inflows (13.32 per cent), appreciating nominal exchange rate, increasing productivity and widening degree of openness. The level of appreciation in the observed RER was higher than the rate implied by developments in the relevant fundamentals during the period leading to a RER overvaluation of 0.39 per cent.

The external sector of the economy witnessed some turbulence towards the end of 2008 as the impacts of the global financial crisis began to hit the country. For instance, FPI witnessed a capital reversal of about US$1.33 billion (owing to divestments in the Nigeria capital market and higher dividend repatriation by non-residents). These developments, alongside speculative demand and panic buying[22] at the foreign exchange market put pressure on the foreign exchange market and the CBN allowed the naira to find its natural level leading to a depreciation in the WDAS rate from N117.79/US$ at end-November to N132.56/US$ at end-December 2008. However, the average official exchange rate appreciated from N125.83/US$ in 2007 to N118.57/US$ in 2008. Thus, the observed RER appreciated consistently from N148.61/US$ in Q4 2007 to N130.99/US$ in Q4 2008 (Appendix B3). As shown in Appendix B3, the rate of appreciation in the observed RER (annual average) between 2007 and 2008 was 14.38 per cent as against a lower appreciation rate of 12.21 per cent required for the RER to be in equilibrium. The appreciation in the equilibrium RER during the year was driven by an increase in total foreign investment inflows (9.49 per cent), appreciation of the nominal exchange rate (6.13 per cent), a rise in the degree of openness of the economy, an increase in productivity and decline in terms of

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[21] Reserves grew by 21.3 per cent from its level in the previous year to US$51.33 billion in 2007.

[22] This was caused by expectation of possible decline in external reserves due to the global economic crisis (CBN, 2008)

trade. The increased inflow of foreign exchange through the economy[23] also led to appreciation pressure. During the period, a total of US$21.5 billion was sold at the WDAS and BDC segments of the market, representing a significant increase of 32.7 per cent over the US$16.2 billion sold in the previous year. Thus, the CBN continued to defend the naira owing to the availability of robust external reserves, which peaked at US$60.34 billion in July 2008. However, as shown in Appendix B2, the 14.38 per cent appreciation in the observed RER was higher than the 12.21 per cent suggested by the model for the RER to be in equilibrium leading to an overvaluation of 1.90 per cent during the year.

As the impact of the global financial crisis persisted in 2009, the observed RER depreciated by 10.10 per cent during the year reflecting movements in the nominal exchange rate, which depreciated by 11.38 per cent from its level of N132.56/US$ at end-December 2008[24]. The movement in the observed RER was in line with the long run equilibrium path as the equilibrium RER also depreciated, by 7.18 per cent. The depreciation in the equilibrium RER was explained by the decline in foreign investment inflows (4.7 per cent), nominal exchange rate depreciation (11.38 per cent), increasing terms of trade and declining productivity. During the year, foreign exchange inflow through the economy also declined by 37.0 per cent to US$67.3 billion while external reserves declined by 20.0 per cent below the level of US$53.0 billion at end-December 2008. However, the depreciation in the observed RER was higher than the rate implied by the long run equilibrium resulting in a RER undervaluation of 2.98 per cent during the year (Appendix B2).

The degree of openness, a proxy for trade policy, rose from 0.54 in 2009 to 0.66 in 2010 while total foreign investments (FDI and FPI) rose from US$9.1 billion to US$9.9 billion, representing an increase of 8.8 per cent[25]. However, depreciation pressures were mounted by movements in the nominal exchange rate and the terms of trade. For instance, the average WDAS rate depreciated by 0.94 per cent to close at N150.30/US$ in 2010 when compared to its level in 2009. Also, the terms of trade fell from its level of 108.63 in 2009 to 104.30 in 2010. Thus, the appreciation in the long run equilibrium RER during the year was largely explained by enhanced capital inflows and increased trade. In line with the dictates of

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[23] The amount of inflows through the CBN was US$106.8 billion during the year, representing an increase of 44.2 per cent above its level in the previous year. The increased inflow was attributable to the favorable crude oil prices in the international market up till the third quarter of the year (CBN, 2008).

[24] End period WDAS rate

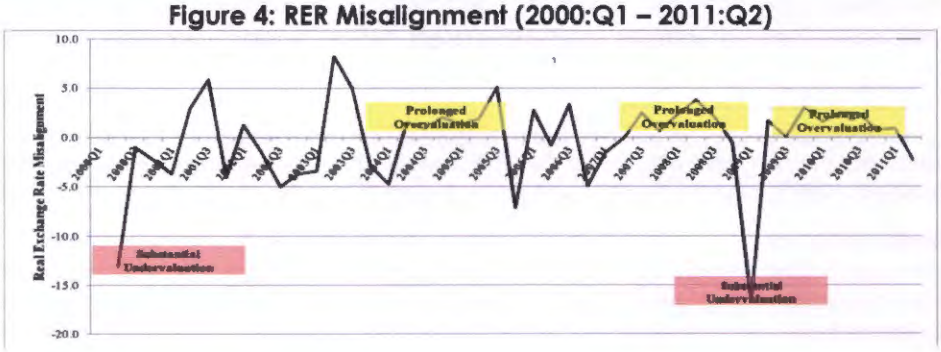
[25] This was due to increased investor confidence in the financial markets following various reforms entrenched to sonitize the system. There was an inflow of US$3.16 billion into the stock market by way of purchase of shares during the year

economic fundamentals, the observed RER appreciated. However, the rate of appreciation in the observed RER was higher than the level implied by the relevant fundamentals leading to a RER overvaluation of 1.82 per cent during the year, on the average. This implied an average subsidy of N2.49 per US$ sold (Appendix B2).

In the first half of 2011, the RER was undervalued by 0.7 per cent, on the average. During the period, the CBN sold US$16.46 billion as against the US$14.15 billion supplied to the market in the first half of 2010. The observed RER appreciated by 3.60 per cent to close at N131.42/US$, even as inflation rate in the domestic economy remained relatively higher than the level in the United States. The appreciation in the observed RER was justified by movements in relevant economic fundamentals during the period. For instance, total foreign investment inflows was US$7.38 billion in the first half of 2011 representing an increase of 31.5 and 74.4 per cent above its levels in the previous and corresponding periods, respectively. Also, the degree of openness rose from 0.63 in the second half of 2010 to 0.72 in the first half of 2011. Coupled with increasing productivity, these developments mounted appreciation pressure on the RER in the first half of the year even though the WDAS rate depreciated by 1.82 per cent compared to its level in the second half of 2010. However, the rate of appreciation in the observed RER was lower (3.60 per cent) than the rate implied by the equilibrium path leading to a slight undervaluation of 0.66 per cent during the period (Appendix B2).

A careful examination of the estimated misalignment levels during the various exchange rate regimes in the sample period showed that the RER was undervalued by 1.73 per cent on the average between 2000 and June 2002, prior to the introduction of the RDAS. However, the extent of misalignment was reduced substantially during the RDAS regime as the difference between the observed real exchange rate and its equilibrium level shrank, leading to a marginal undervaluation of about 0.07 per cent (Appendix B2).

Figure 4: RER Misalignment (2000:Q1 – 2011:Q2)



Between 2006:Q1 when the subsisting WDAS was introduced and 2011:Q2, there was a correction to equilibrium, after which the real exchange rate became overvalued to the tune of 0.16 per cent on the average. Overall, three episodes of prolonged overvaluation (i.e. periods lasting 5 quarters or more) were identified and these are 2004:Q2 to 2005:Q3, 2007:Q3 to 2008:Q3 and 2009:Q2 to 2011:Q1 (Figure 4).

However, identified episodes of undervaluation were generally short-lived (i.e. periods lasting 4 quarters or less). This seems to suggest that government was more reactive towards undervaluation during the study period and was able to accommodate overvaluation probably due to the country's inflows from crude oil sales, which is largely in the hands of government[26]. While no episode of substantial overvaluation (i. e. overvaluation in excess of 10 per cent) was found during the sample period, two cases of large undervaluation were identified (i.e. 2000:Q2 and 2009:Q1).

VI. Policy Implications and Conclusion

As much as this study was not aimed at appraising the country's various exchange rate policies in terms of achieving a realistic value for the Naira, it provided an answer to the important question of whether the naira RER suffered from sustained misalignments over the sample period. Drawing from empirical literature, two approaches were adopted to provide answers to the above question. These are the purchasing power parity approach and the model-based approach. Real exchange rate misalignment of 33.01 and 0.29 per cent were found for the former and the latter, respectively. However, preference was given to the latter as it allows the equilibrium RER to vary consistently in response to changes in economic fundamentals as well as domestic macroeconomic and trade policies. Thus, the model-based approach revealed varying degrees of real exchange rate misalignment during the study period, with an average undervaluation of about 0.29 per cent.

The study showed that productivity, degree of openness (trade policy), capital inflow, nominal exchange rate and terms of trade are some of the important determinants of the Naira RER. While the first three variables entered the model with a negative sign, the last two exhibited positive linear relationship with the real exchange rate. Understanding the nature of the relationship between each of these identified variables (fundamentals) and the real exchange rate is a crucial ingredient for successful monetary and exchange rate policy formulation/execution in the country. The established relationships between the

[26] or for political reasons

RER and its fundamentals should be borne in mind in implementing efforts towards avoiding episodes of prolonged RER misalignment in the country.

Since exchange rate policy (proxied my movements in the nominal exchange rate) plays an important role in the emergence or otherwise of misalignment, the study recommends the continued use of a market-driven, flexible and dynamic exchange rate arrangement in Nigeria, such as the current WDAS. Since the current exchange rate regime (WDAS) has been found to be quite successful in realigning the naira towards its sustainable equilibrium path, the study advocates its sustainability and recommends that Interventions in the foreign exchange market should be guided by movements in and feedbacks from relevant economic fundamentals in order to avoid cases of overshooting the long run equilibrium exchange rate.

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Appendix A: Data Description[27]

Real Exchange Rate (RER): This is computed as the Naira/Dollar nominal exchange rate (NER) multiplied by the ratio of Consumer Price Index in the United States to that of Nigeria. A decrease in RER indicates an appreciation while an increase denotes depreciation. The NER was sourced from the CBN statistical bulletin while the CPI for Nigeria and the United States were sourced from the IMF's International Financial Statistics (with a base period of November 2009).

Degree of openness (DOO): This variable is used as an indicator of the country's commercial/trade policy and computed as the ratio of Exports plus Imports to Gross Domestic Product. Data on these variables are sourced from the CBN Statistical Bulletin. The impact of DOO on RER is ambiguous. However, literature opines that a more liberalized trade regime leads to depreciation in the equilibrium RER. How? A reduction in tariff for instance reduces the domestic price of tradable (imports), leads to increased impartation, especially in a country where marginal propensity to import is high, and eventually shift demand from nontradables to tradables. If we assume cross elasticity of demand, prices of nontraded goods will fall and the equilibrium real exchange rate depreciates in real terms.

Productivity (PRO): This represents the domestic supply side factar, often referred to as the "Balassa-Samuelson effect". Though it is difficult to have a comprehensive measure of this variable, this study, like some other studies on real exchange rate misalignment in developing countries uses Gross National Product over population as a praxy. Data on GNP and population were saurced fram the CBN Statistical Bulletin. This proxy has also been used by Razin and Callins (1997), Obadan and Odusola (2000), Rajan, *et al* (2000), Chand (2001), Tule (2004) and Zalduendo (2006). An increase in productivity translates to an appreciation of the equilibrium real exchange rate. When there is an increase in productivity in the tradable sector relative to the non-tradable sector, the higher wages in the tradable sector will increase the price of non-tradables and appreciate the equilibrium real exchange rate (since the price of tradables is given).

Terms of Trade (TOT): This variable takes cognizance of the changes in the international economic environment. An improvement/increase in the TOT increases relative domestic prices, improves the trade balance and thus leads to real exchange rate appreciation. It is also argued that the impact of TOT on the RER also hinges on whether the income effect dominates the substitution effect

[27] The Augmented Dickey-Fuller (ADF) test will be employed to test for unit roots in the time series data in order to determine the proper order of differencing for them. All variables will subsequently be converted to stationary time series.

(see Edwards, 1989 and Obadan, 1994). If the substitution effect outweighs the income effect, improvements in TOT will lead to a depreciation of the RER and vice versa[28]. Data on this variable is sourced from the CBN statistical bulletin.

Capital Inflow (FDI): Increased international capital inflow leads to higher current expenditure on all goods, including nontradables, which in turn results in an increase in the price of nontradables, or real exchange rate appreciation. This was computed as the sum of net foreign direct investment and net foreign portfolio investment divided by the nominal GDP. The time series were sourced from the CBN statistical bulletin.

Nominal Exchange Rate (NER): This represents a policy instrument often used by policy makers to influence real exchange rate in a particular direction and it is sourced from the CBN Statistical Bulletin. A nominal depreciation/devaluation of the nominal exchange rate will depreciate/devalue the real exchange rate and vice versa, depending on the extent to which macroeconomic policies are consistent with the objective of the changes in the nominal exchange rate.

Interest Rate Differential (IRD): Computed as the difference between interest rate in Nigeria and the United States. An increase in domestic interest rate attracts foreign capital inflows, thereby appreciating the domestic currency. Data on interest rate in Nigeria is sourced from the CBN statistical bulletin while that of the US was got from the IMF International Financial Statistics.

Total Government Expenditure (TGE): This represents the fiscal stance of government and it is computed as the ratio of total government expenditure to nominal GDP. An increase in government expenditure especially in the area of non-tradables increases the prices of non-tradable goods, causing the RER to appreciate. Data on the variables were sourced from the CBN statistical bulletin.

[28] *See Obadon (1994) and Hinkle & Montiel (1999) for further discussion on this.*

Appendix B1: Results of the Static Model for the Naira Real Exchange Rate

Dependent Variable: LRER Method: Least Squares Variable	Coefficient	Std. Error	t-Statistic	Prob.
LTGE	-0.1546	0.0508	-3.0442	0.0042
LPRO	-0.4649	0.0229	-20.2739	0.0000
LNER	0.4300	0.1111	3.8718	0.0004
LIRD	-0.0372	0.0463	-0.8025	0.4272
LFDI	-0.0528	0.0221	-2.3938	0.0217
LDOO	-0.0968	0.0425	-2.2777	0.0285
LTOT	0.0403	0.0552	0.7307	0.4695
C	7.1693	0.3440	20.8438	0.0000
R-squared	0.9822	Mean dependent var		5.1888
Adjusted R-squared	0.9789	S.D. dependent var		0.2239
S.E. of regression	0.0325	Akaike info criterion		-3.8567
Sum squared resid	0.0402	Schwarz criterion		-3.5386
Log likelihood	96.7032	Hannan-Quinn criter.		-3.7375
F-statistic	299.0841	Durbin-Watson stat		1.6765
Prob(F-statistic)	0.0000			

Appendix B2 Naira Real Exchange Rate Misalignment (2000:Q1 – 2011:Q2)[29]

Period	Actual RER	Equilibrium RER	Computed PPP	Model Based Misalignment	PPP Based Misalignment
	[1]	[2]	[3]	Diff Btw [1] & [2]	Diff Btw [1] & [3]
2000Q1	257.98		57.27		-77.80
2000Q2	240.50	208.96	62.19	-13.11	-74.14
2000Q3	240.41	238.12	63.69	-0.95	-73.51
2000Q4	243.49	237.86	63.12	-2.31	-74.08
2001Q1	249.94	240.73	65.47	-3.69	-73.81
2001Q2	239.92	246.92	69.82	2.92	-70.90
2001Q3	223.67	236.84	73.88	5.89	-66.97
2001Q4	229.88	220.63	72.19	-4.02	-68.60
2002Q1	223.66	226.59	75.90	1.31	-66.07
2002Q2	223.84	220.29	77.35	-1.59	-65.44
2002Q3	231.77	220.31	79.97	-4.95	-65.49
2002Q4	236.64	227.95	79.23	-3.67	-66.52
2003Q1	240.86	232.58	78.11	-3.44	-67.57
2003Q2	218.66	236.60	86.33	8.20	-60.52
2003Q3	204.52	214.68	92.63	4.97	-54.71
2003Q4	206.71	200.69	96.27	-2.91	-53.43
2004Q1	212.85	202.75	93.97	-4.75	-55.85
2004Q2	205.59	208.68	95.76	1.51	-53.42
2004Q3	199.66	201.50	98.40	0.92	-50.72
2004Q4	191.72	195.63	102.50	2.04	-46.53
2005Q1	185.33	187.81	106.03	1.34	-42.79
2005Q2	178.17	181.53	110.29	1.89	-38.10
2005Q3	166.10	174.52	117.82	5.07	-29.07
2005Q4	175.22	162.71	110.24	-7.14	-37.09
2006Q1	167.16	171.69	114.62	2.71	-31.43
2006Q2	165.17	163.84	115.04	-0.80	-30.35
2006Q3	156.70	161.96	121.14	3.36	-22.69
2006Q4	161.65	153.74	117.39	-4.89	-27.38
2007Q1	161.05	158.70	117.78	-1.46	-26.87
2007Q2	158.30	158.23	119.28	-0.05	-24.65
2007Q3	151.95	155.66	123.22	2.44	-18.91
2007Q4	148.61	149.57	120.31	0.64	-19.04
2008Q1	143.18	146.45	121.94	2.28	-14.83
2008Q2	136.13	141.27	128.04	3.77	-5.94
2008Q3	131.69	134.48	132.26	2.12	0.43
2008Q4	130.99	130.25	136.24	-0.56	4.01
2009Q1	155.73	129.71	139.52	-16.71	-10.41
2009Q2	151.74	154.36	144.03	1.72	-5.08
2009Q3	150.42	150.53	148.41	0.07	-1.34
2009Q4	145.00	149.34	153.07	2.99	5.57
2010Q1	141.73	144.06	156.49	1.64	10.41
2010Q2	137.46	140.90	161.56	2.50	17.53
2010Q3	133.49	136.74	166.73	2.43	24.90
2010Q4	131.92	132.87	168.92	0.72	28.05
2011Q1	130.15	131.38	172.80	0.94	32.77
2011Q2	132.68	129.68	172.14	-2.26	29.74
Period Ave.	***183.70***	***181.12***	***110.42***	-0.29	-33.01

[29] *A positive value signifies an overvaluation while a negative value signifies an undervaluation.*

Appendix B3: Summary of Naira Real Exchange Rate Misalignment (2000:Q1 – 2011:Q2)

Period	Observed RER (Annual Average)	Equilibrium RER (Annual Average)	Appreciation/Depreciation in Observed RER	Appreciation/Depreciation Suggested by Economic Fundamentals	Misalignment Level (Annual Average)	Remarks
2000	245.60	228.31	1.86	-5.57	-5.46	Undervaluation
2001	235.85	236.28	-4.13	-3.94	0.27	Overvaluation
2002	228.98	223.78	-3.00	-5.39	-2.22	Undervaluation
2003	217.69	221.14	-5.19	-3.55	1.71	Overvaluation
2004	202.46	202.14	-7.52	-7.69	-0.07	Undervaluation
2005	176.21	176.64	-14.90	-14.61	0.29	Overvaluation
2006	162.67	162.81	-8.32	-8.23	0.09	Overvaluation
2007	154.98	155.54	-4.96	-4.59	0.39	Overvaluation
2008	135.50	138.11	-14.38	-12.21	1.90	Overvaluation
2009	150.72	145.98	10.10	7.18	-2.98	Undervaluation
2010	136.15	138.64	-10.70	-8.71	1.82	Overvaluation
2011	131.42	130.53	-3.60	-4.31	-0.66	Undervaluation