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Real Exchange Rate Misalignment and Economic Growth in Nigeria

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This paper investigates the impacts of Naira real exchange rate misalignment on Nigeria's economic growth using quarterly data spanning the period 2000- 2014. We derive estimates of Real Exchange Rate Misalignment (RERMIS) by computing deviations of the actual real exchange rate from a sustainable equilibrium path that is determined using the Behavioural Equilibrium Exchange Rate (BEER) approach of Edwards (1989). Our modelling approach accounts for the possible effects of endogeneity and structural breaks in the estimated relationships. In terms of the extent of RERMIS, results show that the naira was on the average overvalued by 0.17 per cent during the study period. The Gregory and Hansen procedure provides evidence of cointegration between output and its determinants with a structural break in 2003Q2. Furthermore, we found empirical support for a negative impact of RERMIS on economic growth. In view of these findings, the study recommends the continued use of market-based exchange rate arrangements as a way of ensuring that the naira real exchange rate follows its path of sustainable equilibrium. This would complement other government policies aimed at promoting economic growth in the country.

1.0   Introduction

Nigeria is a country in dire need of high and sustained economic growth that is capable of engendering rapid economic development and reducing poverty. Though the economy witnessed an average growth rate of about 6.5 per cent over the period 2000 – 2013 (CBN Statistical Bulletin, 2013), a lot more is required if the Millennium Development Goals (MDGs) are to be achieved. In recognition of the fact that domestic policies play an important role in explaining economic growth, a number of macroeconomic policies have been put in place by the Nigerian government to achieve her growth objectives.

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One of such policies relate to the management of the naira exchange rate. This is based on the belief that economic policies influence price incentives through the real exchange rate and thus play a very important role in economic activities. The importance attached to exchange rate in an economy derives from both macroeconomic and microeconomic perspectives. For instance, the macroeconomic aspect concerns the issues of financial stability, as the exchange rate is used as an explicit and credible anchor for domestic price stability. Empirical findings suggesting a strong link between real exchange rate behavior and economic performance abound in Latin American, Asian and African countries. Domac and Shabsign (1999) argued that while stable real exchange rates led to the expansion of East Asian economies, their sustained misalignment stifled economic growth in African countries.

Exchange rate is a vital relative price in any economy and its effective management requires that policy makers have an idea of a crucial reference value called the Equilibrium Real Exchange Rate (ERER). This refers to an "ideal" real exchange rate, which prevails in the absence of price rigidities, frictions and other short run factors in an economy. The Behavioural Equilibrium Exchange Rate (BEER) approach expresses the equilibrium real exchange rate as a function of other macroeconomic fundamentals and defines Real Exchange rate Misalignment (RERMIS) as the deviations of the actual or observed real exchange rate from its equilibrium values[2]. In other words, the real exchange rate is said to be misaligned if it is not equal to the equilibrium exchange rate.

There are at least two possible channels through which RERMIS might affect economic growth. First, they could influence domestic and foreign investment (particularly, portfolio investments), thereby influencing the capital accumulation process. Second, a misaligned real exchange rate could affect the tradable sector and the competitiveness of the sector vis-à-vis the rest of the world (Razin and Collins, 1997). Thus, RERMIS creates serious distortions, which in turn impinge negatively on the different sectors of the economy. For instance, a misalignment in form of an overvaluation of domestic currency serves as a tax on prices of traded goods.

In view of the adverse consequences of RERMIS on economic growth, economic managers strive hard to achieve an appropriate value for the nominal exchange rate. In Nigeria, exchange rate policies over the years have been targeted at achieving a realistic, well aligned and growth propelling exchange rate for the naira. These ranged 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. To the best of our knowledge, only a few studies have been conducted to investigate the impact of real exchange rate on the Nigerian economy (Usman, 2007 and Anigbogu, *et al* 2014). However, these studies suffer two limitations; namely the failure to account for endogeneity and structural breaks in their modeling approach. In view of

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[2] For the purpose of this study, Real Exchange Rate (RER) misalignment shall be referred to as the percentage deviation of a country's actual RER from the equilibrium real exchange rate, and we could have a situation of overvaluation or undervaluation.

the fact that policy and exogenous shocks are capable of introducing structural breaks in the relationship between economic variables, we argue that the failure of the previous works to account for structural breaks in their models is counter-intuitive. This paper intends to bridge this gap. Thus, the main objective of this study is to determine the impact of exchange rate misalignment on Nigeria's economic growth during 2000Q1 - 2014Q2 while accounting for the possible effects of structural breaks.

The study is structured into five sections. Following this introduction is section 2, which reviews some relevant conceptual and empirical issues documented in the literature. Section 3 deals with the analytical framework adopted for the empirical analysis. The empirical findings of the study are presented in section 4 while the last section concludes.

2.0   Literature Review

2.1   Real Exchange Rate Misalignment

Quite a number of studies have focused on determining the extent of currency misalignments in different countries. However, the starting point in those studies is the determination of an equilibrium exchange rate, after which deviations of the actual exchange rate from its equilibrium are taken as the extent of misalignment. Thus, the review of literature in this section focuses on both the determination of the equilibrium exchange rate as well as the derivation of the misalignment levels. Williamson (1997) and Edward (1994) defined the equilibrium real exchange rate as the real exchange rate that is compatible with simultaneous achievement of internal and external balance in the medium term. According to them, internal balance represents a situation in which the non-tradable goods market clears in the current period and is expected to be in equilibrium in the future. On the other hand, external balance implies a satisfactory balance of payments position and the maintenance of a level of external reserves that is consistent with macroeconomic stability. A popular approach for the determination of the equilibrium exchange rate is the BEER approach, which models the exchange rate as a function of carefully selected macroeconomic fundamentals.

Edwards (1994) developed a model using pooled data on a panel of 12 developing countries and showed how both nominal and real factors play a role in determining the RER in the short run, while only real factors influence the (steady state) "equilibrium exchange rate". He confirmed that inconsistent macroeconomic policies generate real exchange rate overvaluation. In another panel analysis of the equilibrium exchange rate for 93 countries, Razin and Collins (1997) considered 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. It was also discovered that a 10.0 per cent overvaluation of a country's real exchange rate is associated with a decline in real per

capita output of 0.6 percentage points while moderate undervaluation appear to be associated with rapid economic growth.

Lim (2000) found the level of foreign debt and the cumulative sum of real interest rate differentials as the two significant fundamental variables determining Thailand's currency. He adopted the error correction model in his empirical analysis and found that the estimated long run equilibrium real exchange rate of the Thai baht tracked the actual real exchange rate quite well. Montiel (1997) had a similar conclusion when he empirically tested whether the behavior of the real exchange rate between 1960-1994 in Thailand, Indonesia, Malaysia, Philippines and Singapore was or was not an equilibrium phenomenon. He employed a sequence of time-series testing, viz. the Unit Root test and the Johansen co-integrating test and failed to find any significant and persistent misalignments during the period of late 1980s and early 1990s in those economies. However, Omerbegovic (2006) found that Malaysia's real exchange rate was overvalued by 11.5 per cent at the end of 1996.

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 misalignments (overvaluation) of the Thai baht against the Japanese yen. In addition, the results of the unrestricted vector autoregressive (VAR) impulse response and variance decomposition clearly underscored the contribution of the misalignment to the trade imbalances in Thailand, particularly during the late 1980s until the mid-1990s.

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 real export growth. In a study of real exchange rate behavior in Bosnia and Herzegovina between 2002 and 2005, Omerbegovic (2006) confirmed the existence of real exchange rate misalignment which stood at about 6 per cent in July 2005. He further explained that since RER is the single most important transmission mechanism that adjusts on the way towards achievement of equilibrium of goods and labor markets (termed as internal equilibrium) and external equilibrium (sustainable current account balances) the prolonged situation of RER misalignment in those countries resulted in misallocation of resources and real economic costs.

Terra and Valladares (2010) investigated episodes of real exchange rate appreciations and depreciations for a sample of 85 countries from 1960 to 1998 and used a Markov Switching Model to characterize real exchange rate misalignment series. They failed to find evidence of misalignment in some countries while in some other countries, there is no RER misalignment in one of the regimes and there is misalignment in the other state. For the countries with two misalignment regimes, the appreciated regime has higher persistence than the depreciated one.

Agu (2002) adopted a single equation procedure to estimate the time path of the naira equilibrium exchange rate between 1970 and 1998 using fundamentals such as trade policy, terms of trade, government consumption expenditure, capital flows, and debt to GDP ratio. His estimates were compared with the observed real exchange rate that prevailed during the same period and it was discovered that real exchange rate misalignment in Nigeria was irregular but persistent. The naira was found to be overvalued by an average of about 1.4 per cent during the period. He confirmed that real exchange rate misalignment and its volatility affects both the trade balance and the capital account.

Another strand of empirical works on real exchange rate determination in Nigeria relates to the assessment of the value of the naira vis-à-vis its Purchasing Power Parity (PPP) equilibrium level. For instance, using the PPP approach, Obaseki (1998) showed that the naira was overvalued by about 4.7 per cent during 1995 – 1998. However, Ononugbo (2005) investigated the long run cointegration between naira exchange rate and relative price levels in Nigeria and USA, while accounting for exchange rate regime change. He used the error correction model within the PPP framework and found that the nominal exchange rate during 1970 to 2003 followed the long run path suggested by the PPP. However, his results showed that the naira nominal exchange rate was overvalued by 9.48 per cent in 2003.

Suleiman and Muhammad (2011) applied the Johansen cointegration and vector error correction methodology on annual data for Nigeria to explain real exchange rate movements in Nigeria. They found that oil price impacted positively on the exchange rate while productivity differential impacted negatively during 1980 and 2010. Nwude (2012) included factors such as the gross domestic product, balance of payments, reserves, consumer price index, deposit rate and lending rate into his exchange rate model. Using annual data from 1960 to 2011, he applied the OLS method and found that there is no statistically significant relationship between the dependent variable and the RHS variables. He did not account for the time series properties of the data in his modelling approach.

Aliyu (2011) applied the Johansen's cointegration approach and vector error correction model to investigate RER misalignment in Nigeria. He adopted the behavioural equilibrium exchange rate approach and included variables such as terms of trade, crude oil volatility, monetary policy performance and government fiscal stance in his model. His study showed that the naira was overvalued by about 5.9 per cent in 2005Q4, prior to the introduction of WDAS in 2006Q1. In a similar but more recent work, Omotosho and Wambai (2012) found an exchange rate misalignment of 0.29 per cent for the naira during the period 2000-2011 and argued that the RER appreciation of 2002-2008 and depreciation of 2009 were consistent with the long run equilibrium trend.

The only paper found in the literature that accounted for endogenously determined structural breaks in the examination of the concept of naira real exchange rate determination in Nigeria was Omotosho (2012). He identified three endogenous break dates during his study period of 2000-2011. His results also showed that failure to account for structural breaks leads to an underestimation of the misalignment level. He simulated the impact of exchange rate policy in

and found that the nominal exchange rate (an indicator of exchange rate policy) was crucial in steering the RER towards its long run equilibrium path.

2.2   Exchange Rate Misalignment and Economic Growth

The past decade has seen an increase in focus on exchange rate policy, and the effects of real exchange rate misalignment on economic performance (Ikoba et al, 1996). This emphasis was evident in discussions about the causes of the debt crisis in Latin America, in which real exchange rate overvaluation was blamed for current account deficits and capital flight. The concern about real exchange rate misalignment has also featured in current debates about the causes of agricultural decline in sub-Saharan Africa. In all of these, real exchange rate misalignment and the associated balance of payments problems were attributed to policy mistakes, especially in the developing countries.

Extant literature is replete with works, which have found correlations between exchange rate misalignment and growth in most developing countries since the 1970s. For instance, Naja (1998) argued that real exchange rate overvaluation is one of the most important factors responsible for weak economic performance globally. Abdelbaky (2003) argued that exchange rate overvaluation hurts exports of developing countries while Edwards (1994) also noted that real exchange rate misalignment promotes speculation and usually generates massive capital flight out of the economy. On the other hand, other works have found positive correlations between growth and undervalued currencies and such positive impacts are measured in terms of enhanced exports and the resultant accretion to external reserves.

In their study on the effect of real exchange rate misalignment on the collective economic growth of Egypt, Jordan, Morocco and Tunisia, Domac and Shabsigh (1999) constructed three measures of exchange rate misalignment based on Purchasing Power Parity (PPP), black market exchange rate and a structured model. It was found that real exchange rate misalignment adversely affects economic growth, using the three measures of misalignment. He further noted that the real exchange rate misalignment recorded by the countries stemmed from their inappropriate exchange rate policies.

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, has no tendency to disappear even in the long run. It was also noted that misalignment adversely affects international trade by distorting comparative advantages. He attributed misalignment to the nominal exchange rate arrangements practiced in those countries.

Mcpherson (2000) noted that an overvalued real exchange rate represents a persistent misalignment of prices between a particular country and the rest of the world. Such misalignment has an impact on the pattern and level of production, the allocation and level of expenditure, the distribution and level of factor payments, the composition and size of trade

flows, the levels of international reserves and external debt and the emergence of parallel foreign exchange market, currency substitution and capital flight. Persistent real overvaluation erodes business and consumer confidence which in turn affects the rate of savings and investment.

Abdelbaky (2003) noted that persistent misalignment of real exchange rate can impose severe losses of welfare and efficiency. He further observed that misalignments are usually accompanied by the imposition of restriction of exchange and trade controls to slow down the drainage of foreign exchange reserves that occurs when the real exchange rate is overvalued. Exchange and trade controls introduce large inefficiency costs and encourage the creation of strong lobbies that compete for the rents generated by protective measures.

Gala (2007) investigated the relationship between growth and real exchange rate misalignment (measured based on deviations from purchasing power parity) using panel data for a group of 58 developing countries. In line with other works in the literature, his results suggested a negative relationship between growth and overvaluations during his estimation period of 1960 to 1999.

Sallenave (2009) studied the growth effects of real effective exchange rate misalignments for the G20 countries over the period 1980-2006. He adopted the behavioural equilibrium exchange rate (BEER) approach to estimate real effective equilibrium exchange rates for the countries and thereafter computed the misalignment levels. His results showed that misalignments are more pronounced in the case of emerging countries than in industrialized ones. Based on the dynamic panel growth model estimated, he found that misalignments have negative effect on economic growth in the countries.

Obadan (1994) also argues that an overvalued exchange rate artificially raises the standard of living above the level of productivity. Such artificial standard of living is often financed by depleting foreign exchange reserves or incurring external debt. He argued that though an overvalued exchange rate may be popular politically, the financing of the ensuing deficits is very expensive. In a study on Nigeria, Soludo and Adenikinju (1997) applied the co-integration error correction methodology to the determination of the 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.

Usman (2007) also adopted the cointegration and error correction methodology to examine the relationship between real exchange rate misalignment and macroeconomic performance in Nigeria using annual data for the period 1970-2007. He found that real exchange rate misalignment was responsible for the country's dependence on imports in the 1970s and 1980s. In a similar but more recent study, Anigbogu *et al* (2014) investigated the impact of real exchange rate misalignment on Nigeria's agricultural sector using the single regression ordinary least squares approach. They also found that real exchange rate misalignment as well as its volatility impact on growth negatively.

An evaluation of the works reviewed above revealed that empirical work on the relationship between real exchange rate misalignment and economic growth is still sparse in Nigeria, while the few ones found failed to account for the effects of structural breaks in their modeling approach. This study seeks to address this gap by contributing to the debate on the impact of real exchange rate misalignment on economic growth in Nigeria using the Gregory and Hansen (1996) approach to cointegration.

2.3   Exchange Rate Policies and Trend in Nigeria[3]

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 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 (Table 1).

Table 1: Exchange Rate Regimes/Policy in Nigeria (1960 – 2015)

Exchange Rate Regime/Method of Exchange Rate Determination	Date
Fixed (Pegged to British pound sterling/US Dollars)	1960 - 1972
Managed float	1973 - 1978
Basket of currencies approach	1978
Dual exchange rate system (Introduction of Second Tier FEM)	September 1986
Dutch Auction System (DAS) of bidding	April 1987
Single enlarged Foreign Exhange Market with various pricing methods	July 1987
Creation of Interbank Foreign Exchange Market (IFEM)	January 1989
Pegged exchange rate system	1994
Autonomous Foreign Exchange Market (AFEM)	1995
Reintroduction of IFEM	October 1999
Retail Dutch Auction System (rDAS) of foreign exchange management	July 2002
Wholesale Dutch Auction System (wDAS)	Feb-06
Retail Dutch Auction System (rDAS) of foreign exchange management	October 2 - 31, 2013
Interbank Foreign Exchange Market (Closure of Official Window)	February 2015 to Date

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 US dollar between 1967 and 1974, following the devaluation of the pound sterling in 1967. Between 1974 and 1976, the naira exchange rate was pegged to either the U.S. dollar or the British pound sterling; depending on which of the two currencies was stronger in the foreign exchange market. Being conscious of the possibility of overvaluation, the government embarked on an unsystematic devaluation of the naira towards the end of 1976, with a view to realigning its value. Thus, the value of the naira was pegged to a basket of seven currencies of Nigeria's major trading partner countries.

Towards the end of 1985, the naira exchange rate was allowed to be determined by market forces in line with the requirements of the Structural Adjustment Programme (SAP)[4] of 1986.

[3] This section was extracted from an earlier paper by Omotosho (2012) with few modifications
[4] Nigeria's exchange rate regime since SAP could be strictly referred to as a managed float system.

In September 1986, the Second-tier Foreign Exchange Market (SFEM) was introduced as a market-driven mechanism for foreign exchange allocation, while the first and the second tier markets were merged 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 (Figure 2).

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.

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.

Figure 1: Time Series Plot of Annual Naira/Dollar Exchange Rate (1960 - 2014)
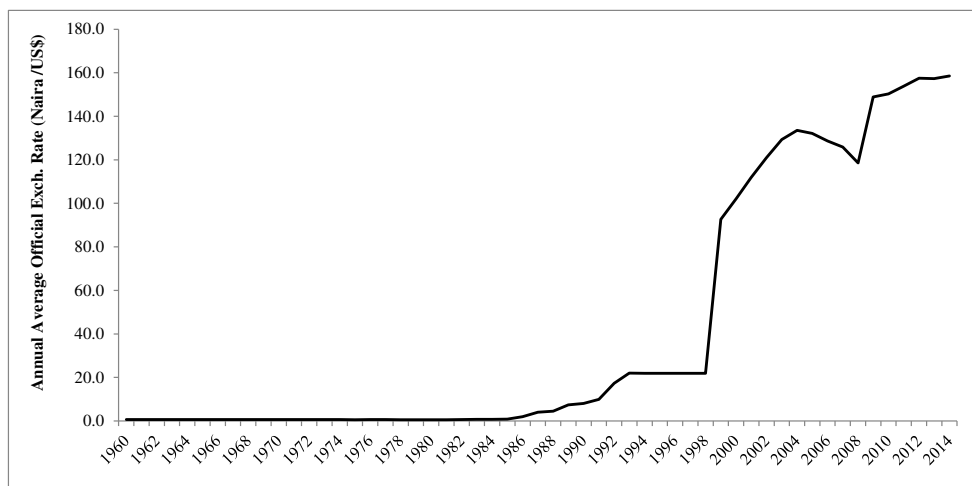
The Wholesale Dutch Auction System (WDAS) was introduced on the 20th of February, 2006 to further liberalize the foreign exchange market, reduce the dependence of authorized dealers on CBN for foreign exchange and achieve convergence in exchange rates. This led to an appreciation of the exchange rate 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 its exchange rate moved to N148.91/US$, N150.30/US$ and N153.90/US$ in 2009, 2010 and 2011, respectively. However, the CBN reintroduced the RDAS on October 2, 2013 owing to the need to engender discipline amongst market participants while the official window of the foreign exchange market was closed on February 18, 2015 in order to curb round tripping and speculative trading. The policy implies that requests for foreign exchange would be directed to the interbank market while the CBN would continue to intervene for legitimate demand.

3.0   Data, Econometric Models and Estimation Procedure

The models and data used to investigate the extent of misalignment as well as its impact on output growth are discussed in this section. Basically, we employed a co-integration and error correction methodology that accommodates structural breaks and possible endogeneity in both the real exchange rate model and the growth regression.

3.1   Data

For the real exchange rate model, seven variables were used. These include the log of real exchange rate (LRER), log of total government expenditure (LTGE), log of productivity (LPRO), log of nominal exchange rate (LNER), interest rate differential (IRD), log of foreign direct investment (LFDI), log of degree of openness of the economy (LDOO) and log of terms of trade (LTOT). On the other hand, six variables were included in the growth model, namely: growth in real gross domestic product (RGDPG), government expenditure growth (GEXPG), log of nominal exchange rate (LNER), log of real gross capital formation (LRGFC), prime lending rate (PLR), credit to private sector (CPS) and the computed real exchange rate misalignment (RERMIS). Apart from the RERMIS, which was computed, data on the remaining variables were sourced from the CBN Statistical Bulletin, the statistics portal of the CBN and the International Monetary Fund's International Financial Statistics (IMF-IFS). The estimation period spans 2000Q1 – 2014Q4. The choice of this period is due to data availability as well as the need to capture current developments in the economy, especially in the aftermath of the 2008/09 global financial crisis.

3.2   Econometric Models

3.2.1   Naira Equilibrium Real Exchange Rate (ERER) Model

Following Ofair and Susan (1997), Edwards (1989) and Cottani et al. (1990), the ERER of the naira was estimated as a function of carefully selected economic fundamentals. These fundamentals are selected based on their theoretical, empirical and situational relevance to the determination of the naira real exchange rate. The real exchange rate estimated, which includes factors influencing the RER both in the short run and long run, is stated as[5]:

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[5] The short run variables are GNER & EXL while long run variables are TOT, FDI, OPEN and PRO.

$$LRER_t = \propto_0 - \beta_1 LTGE_t - \beta_2 LPRO_t + \beta_3 LNER_t - \beta_4 IRD_t - \beta_5 LFDI_t +$$

$$\beta_6 LDOO_t + \beta_7 LTOT_t + \varepsilon_t \qquad (1)$$

where the variables are as earlier defined, $\propto_0$ is the intercept term, $\beta_i (for\ i = 1,2,.....7)$, are the coefficients of the independent variables and ε_t is the stochastic disturbance term.

The variable LTGE (sourced from the statistical bulletin) is a proxy for the fiscal stance of government. An increase in government expenditure on non-tradables is expected to increase the prices of non-tradable goods, which would cause the RER to appreciate. The LPRO represents the domestic supply side factor (often called the "Balassa-Samuelson effect") and the ratio of gross national product (sourced from the IMF's IFS) to the population (sourced from the IMF's IFS) is used as a proxy. LNER (sourced from the CBN statistics portal) is used as a proxy for government's exchange rate policy and a nominal depreciation/devaluation of the LNER is expected to induce RER depreciation. The interest rate differential (IRD) was computed as the difference between the domestic interest and that of the United States (sourced from the IMF's IFS). An increase in domestic interest rate is expected to attract foreign capital inflows, which would cause the RER to appreciate.

An increase in capital inflows (INFLOW) leads to higher expenditure on all goods, including nontradables and results in increased level of prices, which causes the RER to appreciate. The variable INFLOW was computed as the sum of net foreign direct investment and net foreign portfolio investment divided by the nominal GDP (all sourced from the CBN statistical bulletin). LDOO captures the impact of trade policy on the exchange rate and it is computed as the ratio of total trade to the nominal GDP (sourced from CBN statistical bulletin). The TOT (sourced from CBN statistical bulletin) was included in the model in order to capture the effects of external shocks. Edwards (1989) argued that the effect of TOT on the RER depends on whether the income effect dominates the substitution effect. If the income effect dominates, improvements in TOT will cause the RER to depreciate.

Once a co-integrating vector is established amongst the variables in equation 1, the estimated long run equilibrium model is used to construct naira ERER series based on the exogenous factors. In other words, the ERER series is simply obtained by substituting permanent values of the right hand side variables into the estimated co-integrating relationship. Permanent values of the fundamentals are obtained based on the Hodrick Prescott filter.

Having generated the equilibrium real exchange rate series, we proceed as in Hinkle and Montiel (1999) to compute RERMIS as the percentage difference between the actual real exchange rate (e) and the equilibrium RER (e*) at each point in time. This is measured as the difference between ERER estimated using sustainable values of fundamentals and the actual RER. As stated earlier, sustainable RER is the fitted RER in which the fundamentals have been replaced by their sustainable or permanent values.

In the context of the model-based measure of equilibrium exchange rate to be determined by this study, RERMIS shall consequently be computed using the formula given below:

$$RERMIS = \frac{e^* - e}{e^*} * 100 \qquad (2)$$

The above formula implies that the RER is overvalued if the computed RERMIS is positive, undervalued if the computed RERMIS is negative and in equilibrium if the computed RERMIS is zero.

3.2.2 Output Model

The analysis of growth in several countries have centered on the standard long run model based on the Harrod-Domar (H-D) growth theory (Nnanna, *et al*, 2004). However, the Solow's neoclassical growth model, the endogenous growth theory and the gap models have offered some improvements over the traditional H-D model. Several alternative growth models have been provided in the literature in response to policy needs and the need to accommodate the missing variables in the neoclassical paradigm (Bogunjoko, 2004). For instance, Levine and Renelt (1992) identified investment, population and human capital as prime explanatory variables for economic growth. In recognition of the influence of government policies on economic growth, recent empirical growth models also include some key policy variables. In this study, our growth model includes traditional variables affecting growth, such as gross capital formation (GCF) as well as policy variables such as government expenditure (LTGE), nominal exchange rate (LNER) and prime lending rate (PLR). In order to achieve the objective of this study, the computed naira real exchange rate misalignment (RERMIS) is included as a right hand side variable in the growth model. Thus, the estimated output model is of the form:

$$RGDPG_t = \propto_0 + \propto_1 GEXPG_t + \propto_2 LNER_t + \alpha_3 LRGFC_t - \alpha_4 PLR_t + \alpha_5 CPS_t -$$

$$\alpha_6 RERMIS_t + \varepsilon_t \qquad (3)$$

where the variables are as earlier defined and ε_t is the stochastic disturbance term. The a priori expectations regarding the signs of the different coefficients have been reflected in equation (2). A widening real exchange rate misalignment generates resource misallocation, which is expected to impact negatively on output growth.

3.3 Estimation Procedure

3.3.1 Gregory-Hansen (1996) Cointegration Test with Structural Breaks

In order to accommodate the effects of possible structural breaks in equations (1) and (3), we employ the Gregory and Hansen (1996) residual based test for cointegration. As noted by Harris and Sollis (2003), the Engle and Granger (1987) approach to testing for cointegration tends to under-reject the null of no cointegration if there is a cointegration relationship that has changed at some (unknown) time during the sample period, implying low power. The Gregory and Hansen approach is an extension of the Engle and Granger (1987) approach and it involves

testing the null hypothesis of no cointegration against an alternative of cointegration with a single regime shift in an unknown date based on extensions of the traditional *ADF-, Z*_α and *Z*_t – test types.

Gregory and Hansen developed four different models to test for cointegration with structural beaks. These are models of: (i) level shift, C (GH-1); (ii) level shift with trend, C/T (GH-2); (iii) intercept and slope shifts, C/S (GH-3); and (iv) intercept, slope and trend shifts, C/S/T (GH-4) and specified respectively as[6]:

$$y_t = \alpha_1 + \alpha_2 D_t + \delta X_t + \mu_t \qquad (4)$$

$$y_t = \alpha_1 + \alpha_2 D_t + \varphi t + \delta X_t + \mu_t \qquad (5)$$

$$y_t = \alpha_1 + \alpha_2 D_t + \delta_1 X_t + \delta_2 X_t D_t + \mu_t \qquad (6)$$

$$y_t = \alpha_1 + \alpha_2 D_t + \varphi t + \delta_1 X_t + \delta_2 X_t D_t + \mu_t \qquad (7)$$

Where y_t is a scaler variable, x_t is a vector of covariates, t is a time trend, parameters α_1 and α_2 are the respective intercept terms before and after the break, φ is the coefficient for time trend, δ_1 and δ_2 are the respective coefficients of the independent variables before and after the structural break and u_t is the disturbance term. The variables y_t and x_t are expected to be *I(1)* while μ_t should be *I(0)*. D_t is a dummy variable of the form:

$$D_t = \begin{cases} 0, if\ t \le [T\tau] \\ 1, if\ t > [T\tau] \end{cases} \qquad (8)$$

Where the unknown relative timing of the break date is denoted as $\tau \in J$ and [:] denotes the integer part operator. The trimming region, J, may be any compact set of (0; 1). Since the change point or its date are unknown, the test for cointegration within this framework involves computing the usual statistics for all possible break points $\tau \in J$ and then selecting the smallest value obtained, since it will potentially present greater evidence against the null hypothesis of no cointegration. In this regard, the relevant statistics are the GH-ADF (τ), GH-$Z_\alpha(\tau)$ and GH-$Z_t(\tau)$. Once cointegration is established with regards to the variables in equations (1) and (3), appropriate error correction models are estimated for the respective equations. In the case of equation (1), the cointegration approach has been shown to be consistent with the assumptions of the theoretical models relating the RER and the fundamentals. In other words, it is considered appropriate econometric tools for estimating the relationship between the real exchange rate and its fundamentals, given their time series properties, which are found to be non-stationary. Besides, it places fewer requirements on time series data compared to general equilibrium or trade equation approach (Hinkle and Montiel, 1999). The estimated error correction model is of the form:

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[6] Due to software limitations, only equations (4) – (6) were estimated.

$$\Delta Y_t = \alpha_0 + \sum_{i=0}^{s} \beta_i \, \Delta X_{t-i} + \sum_{j=1}^{s} \gamma_j \, \Delta Y_{t-j} + \rho ECM_{t-1} + \mu_t \qquad (12)$$

Where Δ denotes the first difference operator, ECM is the estimated residual from the co-integrating regression, s is the maximum lag length, Y_t is the dependent variable (which is LRER in the case of the RER model and RGDPG in the case of the output model) while X is a vector of exogenous variables for the respective models. If the system is stable, the coefficient ρ will be negative and statistically significant. Besides, the value of ρ measures the speed of adjustment of the dependent variable to the value implied by the long run equilibrium relationship. Before proceeding with the methodology described above, the time series properties of the included variables are examined, and their order of integration determined.

4.0   Results

4.1   Exchange Rate Model

4.1.1   Test for Stationarity

The results of the Augmented Dickey-Fuller (ADF) unit root test conducted on the variables included in the RER model showed that the null hypothesis of a unit root cannot be rejected at level for seven of the variables, namely LRER, LTGE, LPRO, LNER, LIRD, LFDI, LDOO LRGDP, LGCF and LABFG (Table 2). However, they were stationary at first difference, implying the need to difference them once. On the other hand, LTOT was stationary at level.

Table 2: Augmented Dickey-Fuller Unit Root Test Results for RER Model Variables

Variables	Level		First Difference		Decision
	ADF^c	ADF^{ct}	ADF^c	ADF^{ct}	
LRER	-1.7265	-1.4018	-7.3659	-7.4125	I(1)
LTGE	-0.3255	-1.8738	-7.3863	-7.4519	I(1)
LPRO	-2.6049	-0.1962	-8.8130	-7.9881	I(1)
LNER	-1.2970	-2.0086	-6.1019	-6.0364	I(1)
LIRD	-2.0928	-2.1891	-4.7047	-4.6696	I(1)
LFDI	-2.6256	-2.7877	-7.4379	-7.3937	I(1)
LDOO	-2.4559	-2.8765	-5.9571	-5.8046	I(1)
LTOT	-5.6567	-6.8346	-7.3760	-7.4376	I(0)

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: -3.5576(1%) -2.9166(5%) and 2.5961(10%)

*MacKinnon (1996) critical values with constant and trend are: -4.1373(1%) -3.4953(5%) and 3.1766(10%)

4.1.2   Cointegration Test

The results of the G-H cointegration test conducted on model (1) are presented in Table 3. The G-H model that assumes a break in the intercept with trend presented the most plausible representation of the relationship between the LRER and the right hand side variables. In addition, the model has the least SIC, implying that it provided the best fit compared to the competing models. Based on the Z_t statistics, we established cointegration amongst the

included variables, albeit, with a structural break in 2009Q1. The structural break date coincided with the period of sharp depreciation in the naira-dollar exchange rate arising from the 2008/09 global financial crisis.

Table 3: Gregory-Hansen Cointegration Test with Structural Breaks

Model	ADF*	Break Date	Z_t*	Break Date	Z_a*	Break Date	SIC
GH-1 (Constant)	-6.5252	2010Q4	-6.6014	2010Q4	-50.5848	2011Q2	-3.1221
GH-2 (Constant and Trend)	-6.6515	2011Q2	-6.7596	2009Q1	-54.2032	2011Q2	-3.7757
GH-3 (Constant and Slope)	-7.0951	2011Q2	-7.2453	2009Q4	-56.5252	2010Q1	-2.6610

The 5 per cent critical values for ADF (and Z_t) are: -5.56(GH-1), -5.83(GH-2) and -6.41(GH-3)

The 5 per cent critical values for Z_a are: -59.40(GH-1), -65.44(GH-2) and -78.52(GH-3)

Having found evidence of cointegration, we employed the fully modified OLS approach to estimate the long run RER model and the results are presented in Table 4.

4.1.3 Long Run Estimates

The results of the long run RER model presented in Table 4 revealed that most of the variables included in the model were statistically significant in determining the RER in the long run. As expected, an improvement in productivity appreciates the real exchange rate. Other variables causing that have a negative relationship with the RER in the long run were IRD, FDI and LDOO. However, a nominal depreciation in the exchange rate, an increase in government expenditure and an improvement in the terms of trade lead to depreciation pressures on the RER in the long run.

Table 4: Fully Modified OLS Estimates

Dependent Variable: LRER

Variable	Coefficient	Prob.
LTGE	0.1308	0.0687
LPRO	-0.4906	0.0000
LNER	0.5345	0.0043
IRD	-0.2646	0.0052
LFDI	-0.1052	0.0012
LDOO	-0.2481	0.0044
LTOT	0.3074	0.0581
C	6.5832	0.0000
@TREND>51-2	-0.092681	0.0369
R-squared	0.9940	
Adjusted R-squared	0.9860	
S.E of regression	0.0257	

At 98.6 per cent, the adjusted R-squared indicated that most of the variations in the RER was captured by the model. The obtained residuals from the chosen above model were used to estimate the error correction model presented in Table 4.

4.1.4 Error Correction Model

Table 5 presents the results of the error correction model estimated to investigate the short run dynamics of the RER. At the 5 per cent significance level, five variables were found to

statistically significant determinants of the RER in the short run. An improvement in productivity appreciates the RER while depreciation in the LNER depreciates the RER. As expected, increased capital inflows lead to the appreciation of the RER. The coefficient of the error correction term was negative and statistically significant. It indicated that about 58.5 per cent of disequilibrium error is corrected within a quarter. At 60.0 percent, the adjusted R-squared indicated that about 60.0 percent of variations in the RER were explained by the model. In terms of model diagnostics, the Jarque-Bera statistics for the residuals of the estimated error correction model was 3.6276 and the probability value associated with the statistics was 0.1630, implying that the model is adequate.

Table 5: Results of the Error Correction Model for RER

Variable	Coefficient	Prob.
D(LPRO)	-0.1901	0.0001
D(LNER)	0.7587	0.0000
D(IRD(-1))	-0.0955	0.0200
D(LFDI)	-0.0816	0.0013
D(LDOO(-2))	-0.0475	0.0217
ECM(-1)	-0.5854	0.0015
C	-0.0110	0.0013
R-squared	*0.6437*	
Adjusted R-squared	*0.6001*	
S.E. of regression	*0.0250*	
Model Diagonistics (Normality Test of Resduals):		
Jarque Bera	3.6276	0.1630

4.1.5   Computed Real Exchange Rate Misalignment

Figure 2 presents a time series plot of the estimated RER misalignment levels during the study period. Based on the methodology outlined earlier, an average misalignment level of 0.17 per cent was estimated for the period 2000Q1 – 2014Q4. Overall, there were 24 episodes of undervaluation and 35 episodes of overvaluation. This indicates that exchange rate policies during the estimation period may have been more accommodative of real exchange rate overvaluation than undervaluation. In other words, policies are promptly put in place to arrest undervaluation episodes.

Figure 2: Time Series Plot of the Computed Real Exchange Rate Misalignment

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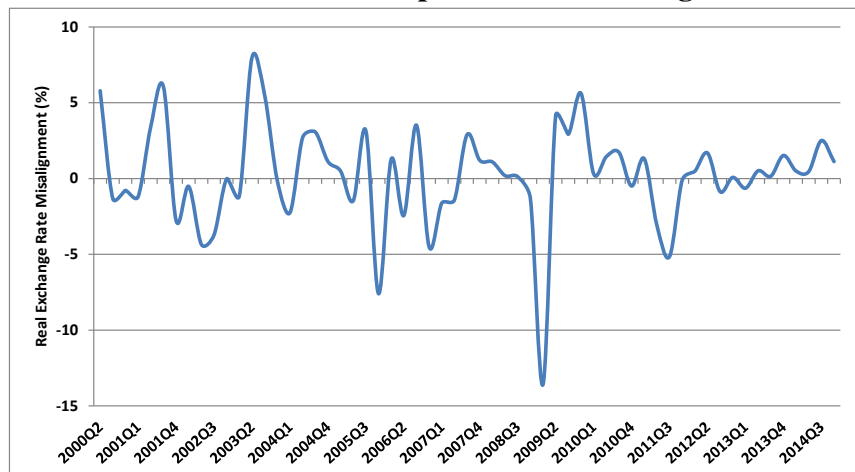
The movement in the level of RER misalignment is reflective of changes in exchange rate policy as well as effects of external shocks. For instance, the reintroduction of retail Dutch Auction System in July 2002 succeeded in reasonably correcting the extent of real exchange rate misalignment as it declined to about -3.7 and 0.0 per cent in 2002Q3 and 2002Q4, respectively. Also, the introduction of the w-DAS led to some impressive outcomes during the years 2006-2008 as the estimated of RER misalignment averaged zero per cent during the period. However, the effects of the global financial crisis led to depreciation pressures which caused a substantial undervaluation of about 13.6 per cent in the RER in 2009Q1. There, however, seems to be an increasing trend in RER overvaluation during 2012 and 2014. In the next sub-section, the impact of the computed RER misalignment on Nigeria's output performance is investigated.

4.2   Output Model

4.2.1   Test for Stationarity

The results of the unit roots test conducted on the seven variables included in the output model are summarized in Table 6. At the 5 per cent significance level, three of the variables were stationary at levels while the remaining ones were stationary at first difference. Consequently, the non-stationary variables; namely: LNER, LRGFC, PLR and CPS were differenced once before being included in the short run error correction model.

Table 6: Augmented Dickey-Fuller Unit Root Test Results for Output Model Variables

Variables	Level		First Difference		Decision
	ADF^c	ADF^{ct}	ADF^c	ADF^{ct}	
RGDPG	-6.2653	-6.9177	-8.9735	-8.8694	I(0)
GEXPG	-11.8479	-16.0976	-7.8819	-7.8032	I(0)
LNER	-1.2970	-2.0086	-6.1019	-6.0364	I(1)
LRGFC	-1.6518	-1.8314	-8.2922	-8.2928	I(1)
PLR	-1.6412	-2.2205	-8.1358	-8.1065	I(1)
RERMIS	-7.1449	-7.0834	-12.4868	-12.3759	I(0)
CPS	-1.1482	-2.2468	-5.4920	-5.4623	I(1)

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: -3.5576(1%) -2.9166(5%) and 2.5961(10%)

MacKinnon (1996) critical values with constant and trend are: -4.1373(1%) -3.4953(5%) and 3.1766(10%)

4.2.2   Cointegration Test

The results of the Gregory-Hansen cointegration test conducted on the variables included in the output model based on equations (4) - (6) are reported in Table 7. The three test statistics provided evidence of cointegration with structural break points located at 2003Q1, 2003Q2 and 2004Q3. Based on the SIC, the G-H model with intercept break was chosen for the

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cointegration test. The test indicated that the included variables in the output model are co-integrated but with a structural break in 2003Q2.

Table 7: Gregory-Hansen Cointegration Test with Structural Breaks

Model	ADF*	Break Date	Z_t*	Break Date	Z_α*	Break Date	SIC
GH-1 (Constant)	-5.1850	2004Q3	-8.4496	2003Q2	-59.6949	2003Q2	-1.8276
GH-2 (Constant and Trend)	-5.5333	2004Q3	-8.3981	2003Q2	-59.4732	2003Q2	-1.5579
GH-3 (Constant and Trend)	-6.0223	2004Q3	-8.1793	2003Q1	-57.8832	2003Q2	-1.0361

The 5 per cent critical values for ADF (and Z_t) are: -5.56(GH-1), -5.83(GH-2) and -6.41(GH-3)

The 5 per cent critical values for Z_α are: -59.40(GH-1), -65.44(GH-2) and -78.52(GH-3)

The results of the G-H model with intercept break estimated using the fully modified OLS are presented in the next sub-section

4.2.3   Long Run Estimates

In the long run, the computed RER misalignment impacts negatively on output growth (Table 8). Also, depreciation in the nominal exchange rate seems to hurt growth, though its impact is not statistically significant. On the other hand, an increase in government expenditure and real gross capital formation impact positively on output. Contrary to expectation, the coefficient of the PLR turned out positive.

Table 8: Fully Modified OLS Estimates

Dependent Variable: RGDPG

Variable	Coefficient	Prob.
GEXPG	0.1499	0.0121
LNER	-0.1474	0.2534
LRGFC	0.0569	0.0676
PLR	0.0224	0.0189
RERMIS	-0.0104	0.0299
CPS	0.0451	0.4865
C	-0.2666	0.6845
@TREND>47-2	0.0510	0.0525
R-squared	0.7320	
Adjusted R-squared	0.4058	
S.E. of regression	0.0656	

4.2.4   Error Correction Model

Table 9 presents the results of the short run model estimated based on the fully modified OLS estimation procedure and using the residuals obtained from the model presented in Table 8. At 0.6144 per cent, the obtained adjusted R-squared is satisfactory as it indicates that about 61.4 per cent of variations in output are explained by the model. Also, the results of the normality test conducted on the residuals of the error correction model showed that the model is adequate. The coefficient of the error correction term is negative and statistically significant. At -0.4634,

the error correction coefficient indicates that about 46.3 per cent of disequilibrium error in the previous quarter is corrected within the subsequent quarter.

Table 8: Results of the Error Correction Model for Output

Dependent variable is RGDPG

Variable	Coefficient	Prob.
GEXPG(-1)	0.0211	0.0061
D(LRGFC(-4))	0.0541	0.0000
RERMIS(-3)	-0.0026	0.0188
D(CPS)	-0.2371	0.0026
D(LNER(-2))	0.2206	0.0013
RGDPG2(-2)	-0.5506	0.0624
ECM(-1)	-0.4634	0.0000
C	0.0235	0.0000
R-squared	0.6695	
Adjusted R-squared	0.6144	
S.E. of regression	0.0483	
Model Diagonistics (Normality Test of Resduals):		
Jarque Bera	0.0430	0.9787

In line with a priori expectation, the results indicated that our variable of interest (RERMIS) impacted negatively on output growth during the period 2000 – 2014. This implies that a 100 per cent increase in RERMIS would lead to a reduction in output by about 0.2 per cent. On the other hand, a unit increases in GEXPG and LRGFC lead to increases of 0.02 and 0.05, respectively. In the short run, depreciation in the nominal exchange rate produces a positive impact on output.

5.0   Conclusion

The primary objective of this study was to obtain reliable estimates of real exchange rate misalignment in Nigeria and investigate its impact on the country's economic growth. In this regards, two models were estimated; namely: RER model and the output model. In order to avoid the problems of parameter bias and endogeneity in these models, they were estimated using the fully modified ordinary least squares procedure while the possible effects of structural breaks were also accounted for. Thus, the Gregory and Hansen (1996) cointegration test with structural break was employed to test for the existence of long run relationships amongst the included variables in our models. The short run dynamics of the models were also investigated based on the estimated error correction models.

The results of the cointegration test conducted on the RER model showed that the variables were co-integrated, albeit, with a structural break in 2009Q1. An appropriate error correction was estimated and the results indicated that five variables affect the real exchange rate in the short run; namely, productivity, nominal exchange rate, interest rate differential, capital inflows and degree of openness. Based on the estimated RER model, the extent of RER misalignment was computed and the results showed that, on the average, the RER was overvalued by 0.17 per cent during the period 2000Q1 – 2014Q4. It was also observed that shocks emanating from

exchange rate policy changes and global developments contributed to the computed misalignment levels of the naira. Overall, more episodes of real exchange rate overvaluation were recorded than episodes of undervaluation. Literature has documented that misalignment of exchange rate could have adverse impacts on economic growth due to the resulting deterioration in the external competitiveness of the economy and the misallocation of domestic resources.

In the case of the output model, the Gregory and Hansen cointegration test indicated that the variables in the model were co-integrated but with a structural break in 2003Q2. After accounting for the identified structural break, an appropriate error correction model was estimated to investigate the impact of the computed RER misalignment on output growth. The results showed that five variables impacted on output growth during the study period.

The study found empirical support for a positive and statistically significant impact of variables such as government expenditure, real gross capital formation and nominal exchange rate on output growth while credit to private sector impacts negatively on output (contrary to expectation). The negative impact of CPS on output growth is worrisome and deserves further investigation. However, this seems to suggest a weak credit channel of monetary policy.

The coefficient of RERMIS was negative and statistically significant, implying that a unit increase in RERMIS would lead to a reduction in output by about 0.003. In keeping the extent of RER misalignment within tolerable limits, there is need for regular assessments of the actual RER vis-à-vis its equilibrium level. A time series plot of the computed RER misalignment showed that periods of substantial misalignments were associated with significant exchange rate policy changes as well as periods of global shocks. Also, the period of w-DAS was associated with relatively minimal levels of RER misalignment. In order to avoid episodes of large RER misalignment and its consequences on output growth, the study advocates a more liberalized exchange rate policy framework that ensures that real exchange rate moves in tandem with relevant macroeconomic fundamentals in the economy.

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