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Real Exchange Rate Misalignment: An Application of Behavioural Equilibrium Exchange Rate (BEER) to Nigeria

CENTRAL BANK OF NIGERIA

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CONTENTS

Pages

LIST OF TABLES

LIST OF FIGURES

REAL EXCHANGE RATE MISALIGNMENT: AN APPLICATION OF BEHAVIOURAL EQUILIBRIUM EXCHANGE RATE (BEER) TO NIGERIA

ABSTRACT

This paper seeks to estimate the long run behavioural equilibrium real exchange rate in Nigeria. The econometric analysis starts by analyzing the stochastic properties of the data and subsequently estimates a vector error correction model. Regression results show that most of the long-run behaviour of the real exchange rate could be explained by terms of trade, index of crude oil volatility, index of monetary policy performance and government fiscal stance. The results further suggest that deviations from the equilibrium path are eliminated within one to two years. Meanwhile, the coefficients of the fundamentals in the model are used to identify episodes of overvaluation and undervaluation of the real exchange rate. Large inflow of oil revenues into the country and stable macroeconomic performance, for instance, were discovered to account for undervaluation of the real exchange rate between 2003Q3 and 2004Q4 in Nigeria and overvaluation in 2005Q1 and 2006Q4. The paper, therefore, recommends the pursuance of a sound monetary policy and reduction in fiscal dominance as instruments for achieving real exchange rate and macroeconomic stability in Nigeria.

Keywords: real exchange rate equilibrium, stationarity, cointegration, Hodrick-Prescott decomposition, behavioural equilibrium exchange rate and permanent equilibrium exchange rate.

JEL Classification: F3; F4; F31; F40

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1.0 INTRODUCTION

There is growing agreement in the literature that prolonged and substantial exchange rate misalignment can create severe macroeconomic disequilibrium especially in the long-run. Although myriad of factors account for exchange rates misalignment, the hypothesis that has gained grounds since 1980's is that exchange rate of large and relatively closed economies tend to be more volatile than those of small and relatively open economies. The fundamental difficulty appreciated by researchers in the area is that equilibrium exchange rate is unobservable. Oblivious of when it strikes, we may be pursuing it even when it is too far away from us and chase it out even when it is there. There is, however, convergence on the fact that long run equilibrium exchange rate is associated with reasonable growth and sustainable internal and external balance, (Edwards, 1989).

The starting point for almost a decade now of many empirical studies on exchange rates has been the purchasing power parity (PPP) doctrine. According to Cassel (1916, 1918), under the condition of free trade, the nominal exchange rate between countries is equal to the ratio of two countries' price level. Two other approaches, the fundamental equilibrium exchange rate (FEER) and the permanent equilibrium exchange rate (PEER) have also been extensively applied in the analysis of exchange rate misalignment. While the former estimates equilibrium exchange rate using economic fundamentals: terms of trade, degree of openness, productivity, fiscal stance, among others, the latter focuses on the dynamic behavior of the exchange rate, including short-run movements and deviations and taking broader macroeconomic conditions into account.

Evidence has shown that studies carried out in Nigeria have applied both the PPP and the FEER approaches. These studies include: Akinuli (1997; 2002); Agu (2002); Omotosho and Wambai (2005); Obaseki (2001) and CBN (2007a&b). Although these studies were able to estimate and assess the empirical significance of fundamental variables in the PPP and the FEER models, they fall short of analyzing the dynamic behavior of the exchange rate movement. Against this background, this paper seeks to apply the BEER approach to

analyze the dynamic behavior of real exchange rate and to further decompose the long run equilibrium relationship into permanent and transitory or cyclical components. The rest of the paper is organized as follows: section two presents the literature review and theoretical issues with emphasis on studies that have applied the BEER approach, and section three provides a brief overview of the developments in the naira exchange rate management in Nigeria. Section four focuses the research methodology of the paper, while results and discussions are captured in section five. Conclusion of the paper comes up in section six and finally section seven contains the limitations of the paper.

2.0 LITERATURE REVIEW AND THEORETICAL ISSUE

There is no gain saying that exchange rate misalignment has serious implications for economic fundamentals, but what is particularly important is to know the nature and degree of the impact of the misalignment on efficient macroeconomic management. Misalignment is generally believed to be capable of reducing economic growth, export competitiveness, worsening terms of trade, lowering the flow of foreign investment, among others. A number of studies have found that the level of real exchange rate (*RER)* relative to an equilibrium *RER* and its stability, has strong influence on exports and private investment (e.g., Caballero and Corbo, 1989; Serven and Solimano, 1991, Ghura and Grennes, 1993; Rodrik, 1994 and Yotopoulos 1996). More seriously, Yotopoulos and Sawada (2005) discover that systematic deviations of nominal exchange rate from their purchasing power parity (PPP) levels may endanger serious instabilities of the international macroeconomic system.

Like it was briefly highlighted above, three distinct forms or definitions of exchange rate misalignment were identified in the literature, (see Williamson, 1994; Miles-Feretti and Raziun, 1996; and Hinkle and Monteil, 1999). *First*, the Price-based criteria, such as purchasing power parity (PPP) and its variants. *Second*, the model-based criteria based on the formal models of nominal exchange rates. *Third*, the solvency and sustainability based criteria, which make reference to trends in the current account and the external debt to GDP ratio. The relevance of each criteria and its application in a particular study is

informed by how uniquely a criteria models a given condition and on the availability of data.

The PPP approach basically relies on the law of one price (LOP). The law states that when measured in a common currency, freely traded commodities should cost the same everywhere under a perfectly competitive setting (i.e. no transaction costs, no tax, homogeneous goods and complete certainty). Thus, if prices deviate from each other, then the commodity arbitragers would capitalize by buying in one market and selling in another until the profitable opportunities cease to exist. This argument subsists for two countries and for the entire global commodity market. The PPP approach is otherwise called the flow model because it traces the flow of goods and services through the current account to determine the exchange rate. In the field of empirical application, there exists a monstrous body of literature which employs the PPP approach, but only a small portion of it is referred to here, which includes: Taylor (1988); McNown and Wallace (1989); Bahmani-Oskooee (1993); Sarantis and Stewart (1993); Moosa and Bhatti (1996) Baharumshah and Ariff (1997); Mollick (1999), Chinn (2000), Azali et al. (2001), Liew et al. (2004), and Choudhry (2005).

As a caveat, the PPP approach explains why exchange rate may diverge from its PPP equilibrium level in the short run due to: *a)* possibility of restrictions on trade and capital movements, which may distort the relationship between home and foreign prices; *b)* speculative activities and official intervention by monetary authorities; *c)* the productivity bias between the tradable and non-tradable sectors; which may result in systematic divergence of internal prices Balassa (1964), and Chinn (2000), and *d)* prices are in most cases sticky and do not move rapidly enough to offset frequent changes in nominal exchange rates. Therefore, the fact that these possibilities occur in most economies, especially in the developing ones, make the approach less attractive and undependable. The approach may identify a regime of overvaluation/ undervaluation whereas it is due to any or a combination of the above.

The FEER approach models equilibrium exchange rate as a function of real economic fundamentals. The underlying theoretical framework of this modeling is broadly consistent with the traditional macroeconomic balance approach. The FEER approach was first advocated by Williamson (1994). He estimated the FEERs of the G-7 countries and found that in the last quarter of 1989, the actual U.S. dollar was 14 percent overvalued, while the Japanese yen was 27 percent undervalued. According to MacDonald (1998), FEER models single out fundamental variables that affect the equilibrium current and capital account balances, such as domestic and foreign real incomes, and factors influencing national savings and investment, such as permanent fiscal consolidation. Specifically, variables such as terms of trade, index of openness, resource balance to gross domestic product, investment share, foreign price level, etc. Studies that have applied FEER approach used both time series and panel regression analysis. Elbadawi and Soto (1997) used single equation cointegration methodology and discovered that the RER for Mali was virtually in equilibrium on the average between 1987 and 1994. Devarajan (1997) used Computable General Equilibrium (CGE) estimates found that the RER for Burkina Faso was overvalued by about 9% in 1993.

Similarly, Baffes, Elbadawi, and O'Connell (1999) examined misalignment for Côte d'Ivoire and Burkina Faso using single-equation time series. They found that for Côte d'Ivoire the actual real exchange rate was overvalued by 34 percent on the average during the period 198793, but, contrary to the findings by Devajaran (1997) Burkina Faso's currency does not seem to be overvalued; rather it was undervalued by 14 percent from 1987 - 1993. Dufrenot and Yehoue (2005) analyzed the relationship between real exchange rates and economic fundamentals in 64 developing countries; the findings show that exchange rate dynamics are less likely to be explained by fundamentals such as productivity, terms of trade, and trade openness for middle-income countries than for low income countries.

The BEER models, on the other hand, emphasize variables that affect the relative prices of traded to nontraded goods at home and in foreign countries, such as differing trends in

productivity in traded goods sectors and asymmetric terms-of-trade shocks. In addition to using fundamental variables, the BEER methodology according to Driver and Westaway (2001), categorizes as "current and cyclical equilibrium exchange rates", since their computation is based on the current levels of the fundamental factors. Clark and MacDonald (1998) used fundamental variables such as terms of trade, the ratio of the domestic consumer price index to the producer price index and the stock of net foreign assets, as well as the relative supply of domestic to foreign government debt as a risk premium factor and discovered that the US dollar was overvalued by 35 percent in 1984. Studies by Albarelo *et al* (1999) and Roeger and Hansen (2000) were heavily criticized by Maesofernandez, et al(2001) for lack of sufficient fundamental variables and poor statistical analysis. In a very elaborate fashion, Lorenzen and Thygesen (2000) accounted for the Balassa-Samuelson effect among other variables in their study on empirical assessment of bilateral euro exchange rate against the US dollar. A similar study on the fundamental determinants of bilateral euro exchange rate was carried out by Clostermann and Schnatz (2000). Their results showed the existence of one cointegration vector and the standard statistical coefficients were significant and had the expected signs.

Maesofernandez, et al (2001) using quarterly data from 1975 to 1998 and up to four different specifications of BEER/PEER methodology arrived at results that show that the euro effective exchange rate was unambiguously undervalued in 2000, although the extent largely depended on a particular specification chosen. The driving fundamental variables in their models were long term real interest rates differentials, productivity, net foreign assets, relative fiscal stance, real price of oil, and relative total consumption differentials. Iimi (2006) used the BEER methodology and found that the Botswana's pula seems to have been undervalued in the late 1980s and overvalued by 5 to 10 percent in recent years, though the misalignment in the 1990s seems to have been very marginal. Although the researcher, Iimi (2006) used fewer fundamental variables for fear of loss of degree of freedom, it should still be recognized that these pieces of evidence were arrived at from a sample comprising of only 19 observations (1985 2004). It may therefore suffer from

limited sample bias.

Iossifov and Loukoianova (2007) estimated BEER model for Ghana and results showed that most of the REER's long-run behavior could be explained by real GDP growth, real interest rate differentials (both relative to trading-partner countries), and the real world prices of Ghana's main export commodities. The REER in late 2006 was found to be very close to its estimated equilibrium level and deviations from the equilibrium path were eliminated within two to three years.

The motivation for this paper is predicated on the fact that while earlier studies have used both the price-based PPP and FEER approaches in evaluating the degree of naira exchange rate misalignment in Nigeria, this paper, in view of the superiority of the BEER/PEER methodology, seeks to evaluate the degree of the naira exchange rate misalignment and decompose it into useful components for more meaningful analysis. Although the latter two methodologies assume real effective exchange rate to depend on a number of fundamental variables, it has been shown that after estimating the long-run relationships using the cointegration analysis, parameters are used to perform a permanent-transitory decomposition as suggested by Hodrick and Prescott (1997) which yields the PEER (permanent equilibrium exchange rate), while the cointegration analysis allows the construction of the BEER (behavioral equilibrium exchange rate). Other decomposition methods available include: Holt (1957) & Winters (1960) method, Beveridge-Nelson (1981) decomposition and Gonzalo and Granger (1995). According to Iimi (2006) macroeconomic time series are viewed as the sum of transitory and permanent components and the filtration captures the smooth path of the trend component by minimizing the sum of the squares of its second difference.

3.0 A BRIEF OVERVIEW OF THE NAIRA EXCHANGE RATE MANAGEMENT

Until 1986 when the structural adjustment programme (SAP) was introduced in Nigeria, the naira exchange rate, which represents one of the major external sector competitiveness indicators, remained fixed. That is, the rate was fixed vis-à-vis the US and UK's dollar and pound sterling respectively. Although this was in line with the global practice on exchange rate determination then, the system was found to be fraught with high distortions leading to inefficiencies and misallocation of resources. Evidence of this is seen in the external sector through protracted balance of payments disequilibrium, low export earnings coupled with high import bill, largely due to high overvaluation of exchange rate, unsavoring picture in the short term and long term capital account feeding into the monstrous body of foreign debt. The domestic economy is characterized by huge presence of government sector, low productivity in the real sectors, high inflation rate, decaying service sector, and shaky financial sector. These portray the picture of the economy before the introduction of structural adjustment programme in July 1986. From 1986 to date, the country's exchange rate has passed through various management options. Although with breath of stability here and there, the rate has, until recent years depreciated steadily. For completeness, post 1986 developments in the external sector can be categorized into three distinct phases.

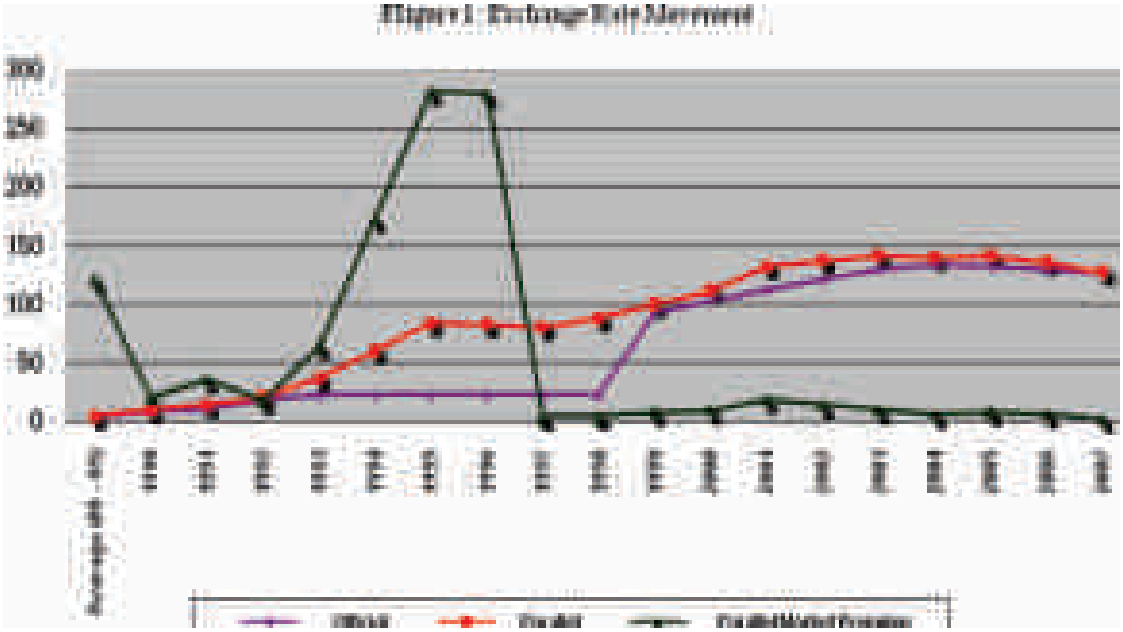
The first phase started with the introduction of SAP up to 1994. The Second-Tier Foreign Exchange Market (SFEM) was launched on September 26, 1986. At the commencement of the SFEM, a dual exchange rate system for the allocation of foreign exchange was adopted. In order to introduce professionalism into the bidding system, the Dutch Auction System (DAS) was adopted in April 1987. Due to the problem of multiplicity of rate and its failure to safeguard depreciation of the naira, the first and second-tier foreign exchange markets were merged into an enlarged Foreign Exchange Market (FEM) in July 1987 and all transactions were subjected to market forces. The system was further repackaged in January 1989 into inter-bank foreign exchange market (IFEM). The Bureau de changeb

(BDC) segment of the foreign exchange market was established the same year to cater for small end-users of foreign exchange. The IFEM procedures were modified with the re-introduction of DAS in December 1990 to achieve greater exchange rate stability.

However, while these developments were taking place, the naira exchange rate depreciated from an average exchange rate of N0.8938 = US$1 in 1985 by 55.9 percent, that is, to N2.0206 = US$1 in 1986. With continued demand pressure on the foreign exchange market the exchange rate further depreciated to an average of N4.0179 = US$1 in 1987. During the same period, the parallel market exchange rate averaged N5.5500 = US$1, reflecting a premium of 38.1 per cent. The parallel market premium reached 38.7 percent when naira was sold at N7.5916 = US$1 and N10.5333 = US$1 in the official and parallel markets, respectively in 1990. The premium went as high as 64.3 percent in February 1993 which by far exceeded the universally recommended limit of 5.0 percent between the rates.

The second phase started with the introduction of guided deregulation by the then military regime in 1994, yet this could not shield the naira from further depreciation. In addition, this had other attendant consequences like worsening balance of payments problem, low FDI flow, low productivity and high inflationary pressure. The concept of guided deregulation was introduced and a dual foreign exchange market prevailed in 1995. These were the Autonomous Foreign Exchange Market (AFEM) for the allocation of privately sourced foreign exchange to end-users and the official exchange rate, which was pegged at N22.00 = US$1 for public sector use of foreign exchange and for the development of the real sector, especially such productive activities that depend on imported inputs. During this era of guided deregulation, CBN sells foreign exchange to end-users through authorized dealers at market determined exchange rate and because of enormous demand pressure, the exchange rate depreciated to N82.30 = US$1 at the end of 1995 in the autonomous segment of the market. These developments created very wide margin between the official and the parallel market and the flourishing of rent seeking activities. According to CBN (2000) the parallel market premium increased from 63.9 percent in

1993 to 297.7 percent in 1996. IFEM was reintroduced in the third phase in 1999 to promote inter-bank trading activities in the market through the privately sourced foreign



Adapted from "The Changing Structure of the Nigerian Economy and Implications for Development" published by the Research Department, Central Bank of Nigeria (2008) forthcoming

exchange. Already, the AFEM rate had climbed up to an average rate of N91.80 = US$1. By December 1999, the exchange rate of the Naira depreciated to N97.42 = US$1 and to N111.94 a dollar in 2001. To stem this unhealthy trend and safeguard further depletion of external reserves, the Dutch Auction System (DAS) of foreign exchange management was re-introduced in July 2002. The measure helped in curtailing the rate of naira depreciation and reduced the parallel market premium. The rate as at December 2002 depreciated marginally by only 0.07 percent to N120.97 = US$1.

For the first time in 2005, the naira exchange rate appreciated by 1.0 and 2.7 percent over its previous levels at the end of 2004 and 2005 to N132.2 and N128.65 ≡ US$1 respectively. This according to CBN (2008) was as a result of a combination of factors which included among others, the moderation in the demand pressure at the foreign exchange market owing to the non-accommodating monetary policy stance of the CBN, prudent fiscal policy measures adopted by the government and improvements in capital flow. This success was capped with further liberalization of the foreign exchange market in 2006 with the introduction of Wholesale Dutch Auction System (WDAS) to deepen the market and further close the market premium. Consequently, many parallel market operators were brought into the BDC segment. The naira exchange rate stabilized and the monetary authorities happily reported that for the first time in two decades of foreign exchange management, the official and parallel market rates converged. By the end of December 2006, the premium marginally fell short of the internationally acceptable limit of 5.0 percent by only 0.08 percent.

Further appreciation of up to 2.2 percent was witnessed in 2007, that is from N128.65 ≡ US$1 in 2006 to N125.83 ≡ US$1. In similar fashion, at the Inter-bank and BDC segments of the market, the naira appreciated by 2.3 and 7.6 per cent to N125.75 and N127.41 per dollar, over their levels in the preceding period, respectively. The average exchange rate of the naira in all the segments of the market appreciated throughout the year. The key drivers of these were the huge oil revenues coming into the country due to high crude oil price, increase in foreign direct investment, mushrooming of remittances flow and general improvement in the macro-economy following successful banking sector consolidation. Summary of these developments were aptly captured in figure 1 from 1980 to 2007 showing the movements in the official, parallel and the premium existing between the two rates.

4.0 RESEARCH METHODOLOGY

The econometric methodology employed in this paper uses Johansen's cointegration analysis to identify the long-run relationships among the variables. Meanwhile, the

stochastic properties of the data were assessed on the basis of a series of unit-root tests after which the long-run relationship was estimated. The cointegration parameters were used to perform a permanent-transitory decomposition using the Hodrick and Prescott (1997) filter. Similar methodology was applied by Clark and MacDonald (1998), Baffes, et al(1999), Maesofernandez, et al(2001), Dufrenot and Yahuoe (2005). Also, Iimi (2006) and Iossifov and Loukoianova (2007) applied similar approach in Botswana and Ghana, respectively**.** For the purpose of this paper, real exchange rate is assumed to follow the path dictated by economic fundamentals, that is, while real exchange rate (*rer*) remains the only endogenous cum exogenous variable, the exogenous variables include *net foreign assets (nfa),* terms of trade *shocks (tot), index of* crude oil price volatility (*iov*), government's fiscal spending *(gov),* index of openness (*opn*), index of monetary policy performance (*mop*) and index of productivity (*pro*).

The generic form of the long run relationship between the real exchange rate and its fundamentals delivered by theory can be depicted as:

$$Ln\overset{*}{e} = B'F^{p} \qquad (1)$$

where e^{*} is the equilibrium real exchange rate, F^{p} is the vector of permanent values for the fundamentals. According to Baffes, et al (1999) the task of estimating the equilibrium real exchange rate breaks into two pieces. The first is to estimate the vector β of the long run 'parameters of interest' and the second is to choose a set of permanent values for the fundamentals at period *t*. The rationale is that the fundamental variables may exhibit a substantial degree of short-term "noise" whereas the long-run equilibrium *rer* should not do so. The Hodrick-Prescott (H-P) filter was used to smooth out the estimated equilibrium *rer*.

The H-P filter helps to obtain the 'long-run', 'steady state' or 'permanent' values of the economic fundamentals by decomposing the time series into a trend μ_t and stationary component, $x_t - \mu_t$ by minimizing.

$$\sum_{t=1}^{T}(x_t - \mu_t)^2 + \lambda \sum[(x_{t+1} - \mu_t) - (x_t - \mu_{t-1})]^2 \qquad (2)$$

where λ is an arbitrary constant, which reflects the penalty of incorporating fluctuations into the trend. If $\lambda = 0$, the sum of squares is minimized when $x_t - \mu_t$ and the trend is x_t itself. As $\lambda \rightarrow \infty$, the trend approaches linearity. HP suggested a λ to be 1600 for quarterly data. However, different numbers should be used depending on the data frequencies. The number is much larger when the data set is monthly ($100{,}000 < \lambda < 140{,}000$), and much smaller when the data set is annual ($6 < \lambda < 14$).

The expected signs of our preferred fundamental variables in equation (1) which is consistent with theorization by MacDonald (1997) and MacDonald and Ricci (2003) are as follows:

$$rer = f(\overset{+}{nfa}, \overset{\pm}{tot}, \overset{+}{iov}, \overset{-}{gov}, \overset{+}{rsv}, \overset{+}{mop}, \overset{-}{opn}, \overset{+}{pro}) \qquad (3)$$

To avoid any incidence of spurious regression, the order of integration of the series was checked for all series of the variables from 1986Q1 to 2006Q4 using the conventional Augmented Dickey Fuller (ADF) and Phillips Perron tests in two regression specification; with constant only and with constant and trend. Appropriate lags were selected on the basis of information criteria in order to ensure uncorrelated residuals. The object of the test is to determine whether a group of nonstationary series is cointegrated or not and as a starting point, the presence of a cointegrating relation forms the basis of the VEC specification.

The long run relationship presented in equation (1) taking equation (3) into consideration can be expressed in the form of a dynamically stable steady state by incorporating the long run fundamentals in a vector autoregression *(VAR)* of finite order *p*, with an unrestricted vector error-correction representation of the following form:

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \delta_i \Delta y_{t-i} + BX_{t-k} + \varepsilon_t \qquad (4)$$

Equation (4), which gives the Granger's representation theorem, asserts that if the coefficient matrix Π has reduced rank $r < k$, then there exist k x r matrices α and β each with rank r such that $\Pi = \alpha \beta'$ and $\beta' y_t$ is I(0). r is the number of cointegrating relations (*the cointegrating rank*) and each column of β is the cointegrating vector. The elements of α are known as the adjustment parameters in the VEC model. Johansen's method is to estimate the Π matrix from an unrestricted VAR and to test whether we can reject the restrictions implied by the reduced rank of Π. Lastly, ε_t is the disturbance term distributed as $N(0, \Omega)$, where Ωi is the variance-covariance matrix of the elements of the residuals.

5.0 RESULTS AND DISCUSSION

This section presents the result of unit root test applied to the variables using data at quarterly level, that is, 1986:1-2006:4. In the first step, the variables were tested for stationarity in their level and were all found to be nonstationary. The results summarized in Table A1show that all the variables attained stationarity at first level of differencing. Therefore, the hypothesis of nonstationarity or presence of unit root is rejected at 99 percent level of confidence.

The only exception, though not so important to mention is the case of *nfa* which is stationary in the trend regression at 5 percent, but at 1 percent in other specifications. One good thing about the findings is that there is agreement between the conclusions from the two tests and across the two specifications, that is, both trend and trend and constant specifications. The existence of cointegration among the variables is indicative of the existence of a long run relationship among them. The next step is to proceed with estimation of the long run relationship between the real exchange rate and its fundamentals using the specification highlighted in equation 3.

5.1 Cointegration Results

The results of cointegration test using trace and eigenvalue statistics and the normalized Johansen cointegration coefficients are presented in table 1. The cointegration test results in the lower part of table reveal the existence of three and two cointegrating equations in

the first and second models respectively at 1 percent level. Thus, the null hypothesis of no cointegration is rejected. The presence of cointegration in the relationship among the variables confirms the existence of long run relationship between real exchange rate and its fundamentals in the long run.

Although it was observed that the existence of multiple cointegrating vectors complicates the interpretation of equilibrium condition (Johansen and Juselius, 1992; Dibooglu and Enders, 1995; Wickens, 1996; MacDonald and Nagayasu, 1998; Clark and MacDonald, 1999), however, neither is the case of a single cointegrating vector the most desired outcome because such makes it unclear if the vector represents a structural or reduced form relationship. In this circumstance according to Johansen and Juselius (1990) 'one would expect that the linear combination which is most canonically correlated with the stationary part of the model, namely, the first eigenvector, is of special interest'. A similar approach (simplification) has been utilized among others by Cerra and Saxena (2002) and Mathisen (2003).

In the upper part of the table, the cointegrating vectors and adjustment coefficients show that the variables enter significantly well in the long run vector both statistically and on a priori grounds. Result for the *rsv* variable was, however, not reported in any of the two specifications as it did not prove to be relevant there were a lot of gaps in the data. The first model, which is the most general specification, show four out of the six variables are significant with *rer* contemporaneously driving itself by itself. Given the Nigeria's dependence on oil revenue, an increase in the oil price volatility leads to *depreciation* of the *rer.* Oil price swings has, in the recent past brought huge fortune to oil producing nations, Nigeria inclusive and this provided impetus for sustainable intervention in the foreign exchange market by the Central Bank. Equally, monetary policy relates positively with real exchange rate and causes its *appreciation* by up to 0.84% for each unit change.

Table 1: Results of Cointegration Analysis

	Model 1				**Model 2**			
	C. Vector	Adj. coefficient	Test for W. Exog.	Test for Exclu.	C. Vector	Adj. coefficient	Test for W. Exog.	Test for Exclu.
Rer	1.000	-0.192	1.28	5.12	1.000	-0.281	3.69	4.38
nfa	-0.004	0.220	1.00	4.58				
tot	0.332*	0.204	2.18	1.2	0.344*	0.063	0.25	3.59
iov	0.137*	0.913	1.76	1.98				
mop	-0.838*	0.142	3.77	4.40	-0.658*	0.102	3.15	3.03
gov	0.715*	0.424*	43.64	200.4	0.757*	0.323*	35.83	118.6
opn	0.111	-0.278*	13.53	26.02	0.081	-0.078	0.84	20.2
pro					-0.019	-0.188	0.82	3.28
No. of CE(s)	Max. Eigenvalue	Critical Value	Trace Stat.	Critical Value	Max. Eigenvalue	Critical Value	Trace Stat.	Critical Value
r = 0	131.98**	51.57	296.5**	133.57	98.58**	45.1	191.0**	103.18
r = 1	86.41**	45.1	164.5**	103.18	56.19**	38.77	92.37**	76.07
r = 2	44.23**	38.77	78.13**	76.07	20.87	32.24	36.18	54.46
r = 3	15.35	32.24	33.91	54.46	12.47	25.52	15.31	35.65
r = 4	11.53	25.52	18.56	35.65	2.642	18.63	2.833	20.04
r = 5	5.38	18.63	7.03	20.04	0.192	6.65	0.192	6.65
r = 6	1.65	6.65	1.65	6.65				

* denotes rejection of the hypothesis at 1%

** Number of cointegrating equations at 1%

Moreover, increase in government spending relative to GDP and terms of trade conditions *depreciate* the real exchange rate by 0.72 per cent and 0.33 per cent respectively. According to Maesofernandez, et al (2001) increase in government spending undermines confidence in a currency thereby leading to distortions and consequently exerts a negative effect on the real exchange rate.

This is, however, not to deny the fact that an increase in government spending which increases the demand in the nontradable sector stimulates higher productivity, conserves foreign exchange, which otherwise would be used for imports, and improves real exchange rate. Perhaps this condition is not likely to hold for Nigeria given the low level of capacity utilization, high energy and other operating costs, among others, in the nontradable sector. The alpha adjustment coefficients in the first model show that significant adjustment in the model stem from *gov* and *opn* of 1.5 and 1.75 years respectively. Three variables; *rer, nfa* and *iov* are weakly exogenous in the model and the Wald statistic for *tot* and *iov* record are very low value of chi-statistic. To ensure uncorrelated residuals, the number of lags for each model was selected using Lagrange Multiplier (LM) tests for autocorrelation of order one and four.

The second model has six variables and three out of the four that are significant and correctly signed in the first model are also significant in this one, these are: *tot, mop* and *gov.* The others, *opn* and *pro* are correctly signed, although they statistically insignificant. The famous Balassa-Samuelson doctrine which states that relatively larger increases in productivity in the traded goods sector are associated with a real *appreciation* of the currency of a country is confirmed in model. However, *tot, opn* and *pro* remain weakly exogenous. Also, the fastest speed of adjustment comes from *gov* and *rer* of roughly 2 years each. These findings lie between those reported by Edwards (1989) of -0.19 for a group of developing countries and Baffes, et al (1999) of -0.45 and -0.51 for Cote d'Ivoire and Burkina Faso, respectively using an unrestricted ECM. Also, Iossifov and Loukoianova (2007) showed that deviations in the Ghanaian real exchange from the equilibrium path are eliminated within two to three years.

It is worthy to mention here that the consistency in the significance of the alpha adjustment

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The coefficients measure the average number of times that a given shock is corrected in the model. This is given as $(1-\alpha)t$, which is, $(1-\alpha)$, where t is the number of years and α is the absolute value of the adjustment parameter.

coefficients of *gov* and *opn* underscores the fact that rebounding the *rer* to equilibrium position lie in these two key variables although others too are relevant. Government along side with the central monetary authorities have to conscientiously, control the level of liquidity in the economy due largely to excessive monetization of dollar in the economy, while unguarded openness of an economy which relies on a single commodity crude oil, is not good for long term stability in the *rer* equilibrium because of the highly volatile nature of oil prices.

5.2 Real Exchange Rate Equilibrium and Misalignment

This section presents how the estimated long run relationship between the RER, which yields the behavioral equilibrium exchange rate (BEER) and its determinants, is decomposed into permanent and transitory or cyclical components. This involves applying the long run elasticities or values of the VECM coefficients to the actual values of the macroeconomic fundamentals in a given period to obtain a consistent long run equilibrium value for the RER. These variables may exhibit a certain degree of short term "noise" or, according to Dufrenot and Yahoue (2005), the macroeconomic regressors that enter in the *BEER* equation are not necessarily at their equilibrium level, because they fluctuate around their "equilibrium" value. Consequently, a measure of misalignment which relies on the difference between the actual real exchange rate and the fitted using BEER model may not be realistic. Figures 2 and 3 in appendix 2 show the graphs of the BEER and its residual series. Although equilibrium condition could distinctly be seen from the residual graph, that is, when the value of residual series at any particular time is equal to zero, yet variability is very high and this renders the equilibrium unsustainable.

On the other hand, the HP filter was used to smooth out the BEER equilibrium to yield the permanent equilibrium exchange rate (PEER). A more realistic measure of misalignment is the one based on the *PEER* because this equilibrium concept is based on the sustainable or permanent values of the fundamentals. This is computed as *[(RER - PEER)/PEER]* * 100 (see Dufrenot and Yahuoe, 2005). Figures 4 and 5 in appendix 2 present the graph of

the permanent and cyclical series obtained using HP decomposition. As expected, the PEER is less volatile than the BEER and as documented by the simple correlation and the Granger causality tests, the differences between the actual series and its fitted and permanent values is neither very large nor persistent. Notwithstanding, the two models less often give conflicting signs on the direction of deviation of the real exchange rate from the computed equilibrium. More recurring are periods in which models point to the same direction of misalignment. Figures 6 and 7 in appendix 3 show the interaction among the three rates and the plot of misalignment based on PEER measure identified above respectively.

Table 2: Episodes of Real Exchange Rate Misalignment in Nigeria

Range	Outcome	Min	Max	Average
1986Q4 – 1989Q2	Undervaluation	-0.15	-7.90	-3.72
1989Q3 – 1990Q4	Overvaluation	0.43	3.09	1.92
1991Q1 – 1993Q4	Undervaluation	-0.08	-6.40	-3.39
1994Q1 – 1995Q1	Overvaluation	1.81	8.49	4.67
1995Q2 – 1995Q4	Undervaluation	-0.94	-2.65	-1.64
1996Q1 – 1998Q4	Overvaluation	0.28	2.38	3.85
1999Q1 – 2001Q1	Undervaluation	-0.15	-5.68	-3.36
2001Q2 – 2003Q2	Overval uation	2.15	5.69	4.22
2003Q3 – 2004Q4	Undervaluation	-4.01	-20.3	-14.9
2005Q1 – 2006Q4	Overvaluation	2.35	6.61	4.75

Note: Negative sign indicates undervaluation of the RER while positive sign denotes overvaluation of the RER. This is in line with Edwards and Montiel (1989) where they defined misalignment as the percentage deviation of the actual RER from the fitted.

From the short summary provided, the results showed that the average misalignment lies between -1.64 and -14.9. The peak degree of misalignment, occurred between 2003Q3 and 2004Q4 of 20.3% while the minimum of 0.28 was recorded between 1996Q1 and

1998Q4. One interesting thing about the result is that the real exchange rate was undervalued when it was thought to be overvalued which was the cry before implementation of SAP, and it remained so until 1989Q3 after 3 year since the implementation of SAP in the country. Also, during the guided deregulation introduced in 1994, the exchange rate remained overvalued an average of 8.49%. One would, however, expect the exchange rate to be undervalued upward of 2005 to 2006 due to influx of oil revenue and huge reserve over 20 months of imports, which together greatly help to stabilize the nominal exchange rate through timely intervention by the Central Bank of Nigeria, yet the *rer* remained overvalued.

Similar empirical studies carried out in Nigeria, although cited under literature review, reported mixed results. Agu (2002), for instance reported a marginal degree of misalignment of 1.4% between 1970 and 1998 in Nigeria, Omotosho and Wambai (2005) using both the fundamental and purchasing power parity approaches reported strikingly different degrees of real exchange rate misalignment of 2.8% and 5.2% in the former and 35.6% and 44.2% in the latter. Moreover, Baffes, et al (1999) found 35% degree of misalignment in Cote d'Ivoire and 31% in Burkina Faso. Ilmi (2006) reports 5 to 10% degree of misalignment in Burkina Faso. Panel cointegration results for group of 64 developing countries including Nigeria by Dufrenot and Yahuoe (2005) found that Ghana witnessed substantial overvaluation during the period 1979-85, with an average of about 54 percent and a peak of about 120 percent while the situation according to them in Nigeria is a bit close to that of Ghana. The only exception is that the peak occurred in 1985 for Nigeria. Their conclusion is that Nigeria between 1979 and 1999 has not succeeded in bringing the *RER* very close to the *BEER* and the *PEER,* as Ghana did.

6.0 CONCLUSION AND RECOMMENDATIONS

An estimation of the degree of exchange rate misalignment has been carried out using a number of empirical models/approaches over the years, the PPP, FEER, BEER, and more recently the use of PEER approach to identify permanent or sustainable long run

equilibrium condition. Applying Johansen's vector error correction procedure, this paper estimated the long run behavioral equilibrium of real exchange rate of the naira between 1986Q1 and 2006Q4 using well defined and most widely used macroeconomic fundamentals. Time series characteristics of the variables were tested using the ADF and the PP stationarity test. The series were all nonstationary at levels, but the hypothesis of the unit root was rejected at 1 percent at first level. The Johansen cointegration test revealed four cointegrating equations at 5 percent level using both the trace and the eigenvalue statistics.

The long run BEER model was estimated and evaluated, and results showed that real exchange rate in Nigeria is positively affected by the net foreign assets, terms of trade, index of crude oil price volatility and index of monetary policy performance. The results further showed that government spending relative to GDP and the level of foreign reserve were found to be inversely related to the real exchange rate. Important policy implication of these findings is that real exchange rate in Nigeria appreciates as the net foreign assets, oil price volatility, monetary policy and terms of trade conditions positively change. It however, depreciates with high government spending and foreign reserves. While the direction of the causation in the case of government spending is very clear and so is its alpha adjustment coefficient. The speed of adjustment in the model of 1.5 to 1.75 years is generally good and situates well within the bounds reported by earlier studies in the area.

Furthermore, the fitted values of long run BEER model was corrected using the HP smoothing filter to obtain the permanent equilibrium exchange rates (PEERs). Although emphasis was made on the PEER based misalignment measure, both the BEER and PEER based measures indicate that the naira was close to its predicted values dictated by the fundamental variables in the long run. However, five episodes each of undervaluation and overvaluation of the real exchange rate were identified. In particular, RER was found to be undervalued from the beginning of the period of deregulation up to 1989Q2 and in the aftermath of policy reversal 1995Q2 to 1995Q4. Conversely, the real exchange rate was

also particularly overvalued between 2005Q1 and 2006Q4 and overvalued between 2005Q1 and 2006Q although both were periods of sustained foreign exchange inflow into the economy.

Finally, the relevance of any empirical study lies in plausibility of its findings, accuracy of its predictions and its simplifications of measures to be taken to achieve desired outcomes. Although the degree of real exchange rate misalignment was established, it is worthy to note that neither overvaluation nor undervaluation is desirable for attainment of long run real exchange stability in particular and macroeconomic stability in general. In view of this, the paper recommends the promotion of a stable macroeconomic environment via monetary policy in the domestic economy especially taking the pattern of fiscal spending by the three tiers of the government as given; effective utilization of foreign exchange earnings and diversification of the country's foreign assets would also be of great significance in this direction. Nigeria's terms of trade condition and oil price volatility are exogenous to the economy; hence little could be done in that regard.

7.0 LIMITATIONS OF THE PAPER

The paper tries to estimate and appraise the degree of exchange rate misalignment in Nigeria. By specifically choosing the period between 1986Q1 and 2006Q4, the paper targets the era of deregulation of the exchange rate in Nigeria, however, violent fluctuations in both the level of the country's trade and foreign exchange earnings occasioned by oil price volatility that have occurred outside the sample cannot be adequately explained by the paper. Furthermore, some of the variables used in the paper were indirectly measured; the index of monetary policy performance and productivity index, coefficients of these variables should therefore be treated with caution.

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Appendix 1

Definition of Variables

Real Exchange Rate (rer)

This is simply described as the domestic relative price of traded to nontraded goods, Dornbusch (1987). While traded goods price was observed to be exogenously determined, the domestic price of nontraded goods is endogenously determined. According to Baffes, Elbadawi and O'Connell (1999) long run equilibrium exchange rate prevails when the economy is in internal and external balance for sustainable values of policy and exogenous variables. Tule and Duke (2007) computed real effective exchange rate of the naira using basket of currencies of the Nigeria's major trading partners. In this paper we simply adopted the real exchange published in the CBN's Statistical Bulletin covering the study period. This was converted into natural log and was tested for stationarity and was found to be I*(1)*. Figure 1(*a*) presents the graph of the series on quarterly basis from 1986Q1 to 2006Q4.

Net Foreign Assets (nfa)

The inclusion of the outstanding stock of foreign assets as a determinant of the real exchange rate has been documented in the literature (see: MacDonald (1997) and MacDonald and Ricci (2003). and the basis follows portfolio-balance considerations. For instance, a deficit in the current account creates an increase in the net foreign debt of a country, which has to be financed by international financial institutions or foreign investors. Detken et al (2001) argue that an accumulation of net foreign reserves can be associated with a depreciation of the domestic currency in the medium run, but trigger an appreciation in the long run. Data on this variable was obtained on quarterly basis from the publication of CBN and was converted into real terms by dividing by the US wholesale price index and then into natural log. The variable was tested for stationarity and was found to be I(1). A corollary to net foreign asset is the level of foreign reserve. This was also included among other independent variables. The Nigeria's foreign reserve data was obtained from the publication of CBN on quarterly basis from 1986Q1 to 2006Q4. It was converted into real reserve by dividing by the US wholesale price index and then into

natural log. It was tested for stationarity and was found to be stationary at first level of differencing. Figures 1(b) and 1(c) show the graph of the series on quarterly basis from 1986Q1 to 2006Q4.

Terms of Trade Shocks (tot)

Theoretically, the terms of trade's influence on the *RER* cannot be signed a priori, as this depends on whether income or substitution effects dominate. The former leads to real currency appreciation (increase in *RER)* while the latter to real currency depreciation (decrease in *RER).* Baffes, Elbadawi and O'Connell (1997) developed a measure of terms of trade and trade policy as the ratio of export price index to import price index. To measure this, the ratio of export price of Nigeria's major export commodity (crude oil price index, 2005 = 100) to commodity (non-fuel price index, 2005 = 100, includes food and beverages and industrial inputs price indices) was used as a proxy for the Nigeria's terms of trade. Data was obtained from World Economic Outlook (WEO) database published by the IMF. The series was converted into log and was tested for stationarity and was found to be stationary at first level. Figure 1(*d*) presents the graph of the series on quarterly basis from 1986Q1 to 2006Q4.

Index of Crude Oil Price Volatility (iov)

The determination of the effect of crude oil price volatility on real exchange rate is very crucial, particularly for an oil producing country like Nigeria. Amano and Van Norden (1998) have studied the relationship between the real effective exchange rate of the dollar and the real oil price and found cointegration between them. In their study an increase in the price of oil leads to a real appreciation of the dollar. While in the short term a partial correlation test could help establish the nature of the relationship, in the medium and long term, however, what is of great importance is the pattern of variability in the oil prices and how it affect real exchange rate. This paper measures exchange rate volatility as the standard deviation of each series of quarterly observation from the average nominal exchange rate of the naira vis-à-vis the US dollar. Data on crude oil price (simple average of three spot prices; Dated Brent, West Texas Intermediate, and the Dubai Fateh, US$ per barrel) was collected from WEO published by the IMF. The series in log form was tested

for stationarity and was found to be I(*1*). Figure 1(*e*) presents the graph of the series on quarterly basis from 1986Q1 to 2006Q4.

Government Fiscal Stance (gov)

It was established in the literature that the impact of the fiscal stance on the rer would depend on how an extra fiscal stimulus is spent on tradable and nontradable goods. If it goes toward purchases of nontradables/ tradables, it would tend to appreciate/depreciate the rer, (Dibooglu, 1996; and Iossifov and Loukoianova, 2007). Frenkel and Mussa (1988) argued that fiscal tightening causes a permanent increase in the net foreign assets position of a country and, consequently, an appreciation of its equilibrium exchange rate in the longer term, provided that the fiscal consolidation is considered to have a permanent character. In the longer term, however, higher government spending most likely undermines confidence in a currency, because it could be accompanied by distortions and is thus expected to have a negative impact on economic growth and the real exchange rate, Maesofernandez, Osbat and Schnatz (2001). The variable was measured as the ratio of government spending to nominal GDP. Data was collected from the CBN. This was then converted into natural long and was also tested for stationarity and was found to be I(1). Figure 1(f) presents the graph of the series on quarterly basis from 1986Q1 to 2006Q4.

Monetary Policy (mop)

A sound monetary policy is capable of freeing and directing resources from surplus units to investment units at affordable and market consistent rates. All things being equal, the fraction of saving in total money supply in the economy is a good measure of the success of monetary policy in this regard. To measure this variable, therefore, domestic savings was deflated by lagged money supply in the economy between 1986Q1 and 2006Q4. According to Dufrenot and Yahuoe (2005) a high ratio of domestic credit to lagged money supply strengthens the Central Bank's balance sheet position, and is expected to lead to a real currency appreciation. Data was obtained from the CBN, was converted into natural log and was differenced at first level to attain stationarity. Figure 1(*g*) presents the graph of the series on quarterly basis from 1986Q1 to 2006Q4.

Productivity (pro)

The impact of the productivity differential on the real exchange rate is expected to follow the well-known Balassa-Samuelson doctrine, which states that relatively larger increases in productivity in the traded goods sector are associated with a real appreciation of the currency of a country. If a country experiences an increase in the productivity of the tradable sector (relative to its trading partners), its real exchange rate would tend to appreciate, because the productivity gains would push up the wages in the tradables sector, which would lead to a demand-driven faster increase in the price of nontradables in the domestic economy relative to its trading partners (MacDonald and Ricci, 2003). According to Maesofernandez, F.C. Osbat, B. Schnatz (2001) productivity can be measured in two ways; direct and indirect. The direct measure uses ration of total employment to GDP, while the indirect one uses the relative price differential between traded and non-traded goods at home and abroad. It is widely used to simply capture the effect of productivity increases in the traded goods sector. Due to lack of comprehensive data on level of employment in Nigeria, the indirect approach was used. Data was obtained from World Economic Outlook (WEO) table and publication of the CBN. The series was converted into log and was tested for stationarity.

Openness

An increase in the openness variable is assumed to be arising from a decline in tariff rates, leading to a fall in the domestic prices of importables. This will lead to high demand of foreign currency (to take advantage of cheap imports), and less demand for domestic currency. Hence an increase in the degree of openness is expected to lead to the depreciation of the equilibrium real effective exchange rate. As a result, the openness variable is expected to carry a negative sign. The variable is measured as the sum of total trade, imports and exports divided by gross domestic product. Data was obtained from various issues of Statistical Bulletin published by the Central Bank of Nigeria. The series was converted into log and was tested for stationarity.

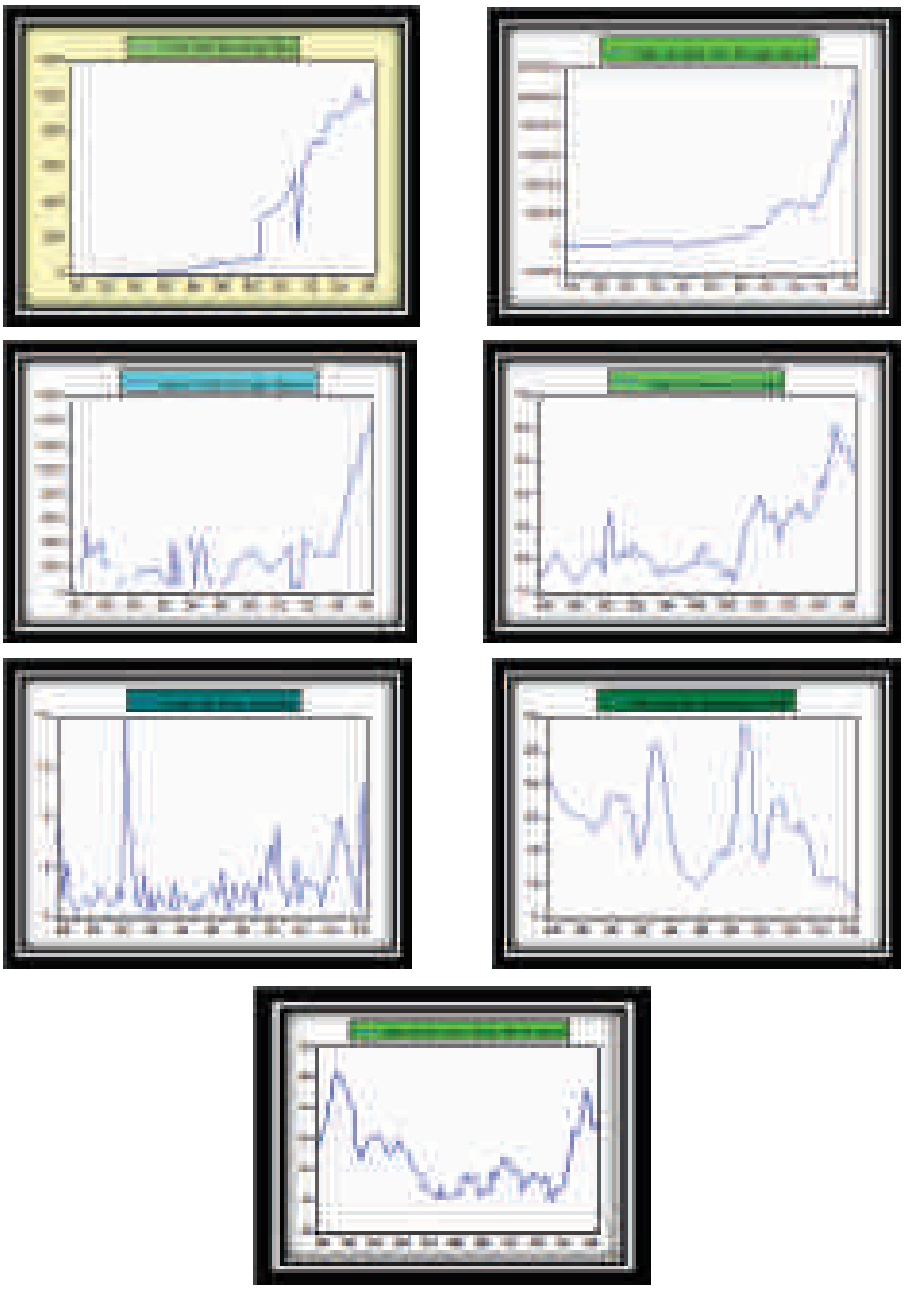
Table 1A Unit Root Test Applied to Variables

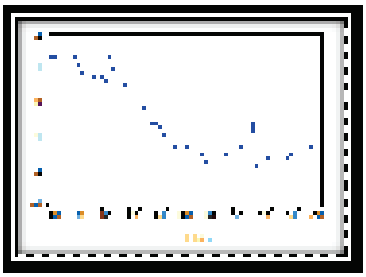
	ADF - Test				Phillips - Perron Test			
	Constant		Constant & Trend		Constant		Constant & Trend	
Variable/ coe fficient	t-Statistic	Decision Rule	t-Statistic	Decision Rule	t-Statistic	Decision Rule	t-Statistic	Decision Rule
rer	-6.87*	I(1)	-7.09*	I(1)	-6.81*	I(1)	-7.09*	I(1)
nfa	-3.03**	I(1)	-3.94*	I(1)	-7.84*	I(1)	-9.27*	I(1)
tot	-9.80*	I(1)	-9.77*	I(1)	-9.80*	I(1)	-9.76*	I(1)
iov	-9.85*	I(1)	-10.3*	I(1)	-9.83*	I(1)	-10.3*	I(1)
gov	-4.27*	I(1)	-4.27*	I(1)	-5.94*	I(1)	-5.90*	I(1)
rsv	-11.2*	I(1)	-11.7*	I(1)	-11.2*	I(1)	-12.1*	I(1)
mop	-5.24*	I(1)	-5.21*	I(1)	-5.22*	I(1)	-5.19*	I(1)
opn	-4.63 *	I(1)	-4 .84 *	I(1)	-5.3 2*	I(1)	-5. 54 *	I(1)
p ro	-5.92 *	I(1)	-6 .2 0 *	I(1)	-12 .44 *	I(1)	-12 .68 *	I(1)

Note: One and two asterisks denote rejection of the Null hypothesis of no cointegration at 1%, and 5%, respectively, based on MacKinnon critical values.

Appendix 2

Figure 2





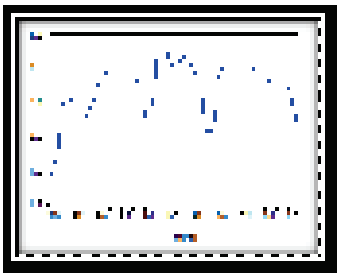


Figure 3 & 4

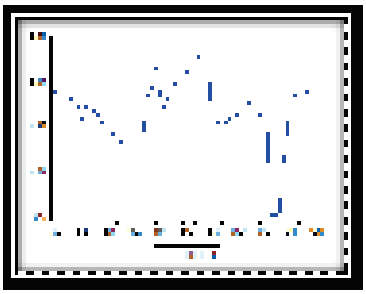
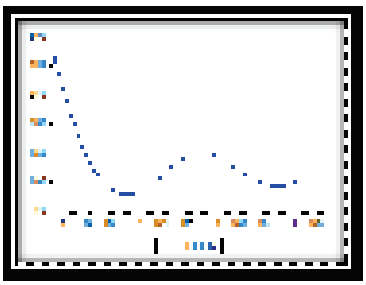


Figure 5 & 6



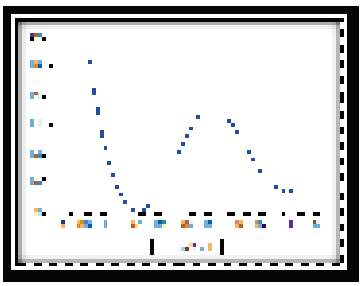
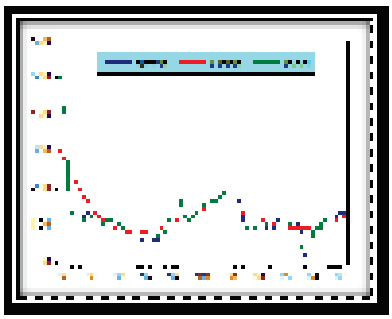
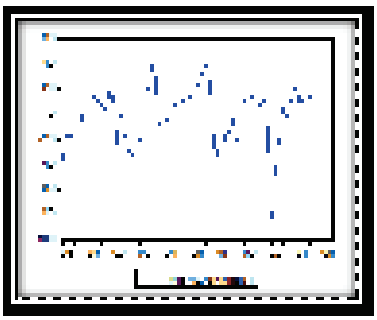


Figure 7 & 8





Appendix 3

Table 1A: Computation of BEER, PEER and Real Exchange Rate Misalignment

Year	RER	BEER	PEER	Residual	Misalignment	Outcome
1986Q4	4.985132854	4.985132854	5.334111247	0	-6.542391	**Under valuation**
1987Q1	4.902753083	4.902753083	5.250025547	0	-6.614681	
1987Q2	4.760719887	4.876907897	5.169206 579	-0.116188	-7.902309	
1987Q3	4.785431288	4.502721039	5.092354072	0.1413551	-6.02713	
1987Q4	4.736961315	4.799440891	5.019912453	-0.031239	-5.636575	
1988Q1	4.777382483	4.955264001	4.952134321	-0.088940	-3.528819	
1988Q2	4.811289646	4.611141605	4.889 095433	0.100074	-1.591415	
1988Q3	4.855594218	4.898313096	4.830762324	-0.021359	0.5140368	
1988Q4	4.773113875	4.602483185	4.777052899	0.0853153	-0.082457	
1989Q1	4.569128415	4.672766352	4.727900587	-0.051819	-3.358196	
1989Q2	4.676280813	4.440358431	4. 683236351	0.1179612	-0.14852	
1989Q3	4.748577649	4.845120381	4.642891923	-0.048271	2.276290889	Over valuation
1989Q4	4.74892415	5.011717283	4.60669469	-0.131396	3.087451396	
1990Q1	4.679748762	4.543191876	4.574538089	0.0682784	2.299919041	
1990Q2	4.6483 54189	4.780663736	4.546404452	-0.066154	2.242425577	
1990Q3	4.576945593	4.610320954	4.522341869	-0.016687	1.207421422	
1990Q4	4.521647263	4.510457537	4.502462145	0.0055949	0.426102802	
1991Q1	4.448481288	4.791502538	4.486911217	-0.171510	-0.85649	**Under valuation**
1991Q2	4.50077587	4.276103334	4.475847008	0.1123363	0.5569641	
1991Q3	4.407535987	4.6708142	4.469403426	-0.131639	-1.384244	
1991Q4	4.46414795	4.375386498	4.467729957	0.0443807	-0.080175	
1992Q1	4.370497934	4.587494873	4.470937422	-0.108498	-2.246497	
1992Q2	4.192635145	4.792663007	4.479134402	-0.300013	-6.396309	
1992Q3	4.216222904	2.961811422	4.492366703	0.6272057	-6.146956	
1992Q4	4.286203823	2.531061097	4.510501069	0.8775714	-4.972779	
1993Q1	4.28362794	0.805336865	4.533231656	1.73914 55	-5.506088	
1993Q2	4.317088034	2.421428715	4.560112432	0.9478297	-5.329351	
1993Q3	4.408705079	3.811549414	4.590541364	0.2985778	-3.961108	
1993Q4	4.423612337	4.179295625	4.623764527	0.1221584	-4.328771	
1994Q1	4.821675755	4.821675755	4.658914351		3. 493547888	Over valuation
1994Q2	4.877507629	4.877507629	4.694998168		3.887316986	
1994Q3	4.99912261	4.99912261	4.731125039		5.66456327	
1994Q4	5.171125834	5.171125834	4.76651809		8.488538938	

1995Q1	4.88741249	4.88741249	4.800567949		1.809047213	
1995Q 2	4.704771147	4.704771147	4.832918121		-2.651544	**Under valuation**
1995Q3	4.799230902	4.799230902	4.86326639		-1.316718	
1995Q4	4.845052853	4.845052853	4.891230447		-0.94409	
1996Q1	4.930343111	4.930343111	4.916387964		0.283849584	Over valuation
1996Q2	4.9 85590953	4.9187093	4.938287749	0.0334408	0.957886757	
1996Q3	5.071228543	5.151322897	4.956487332	-0.040047	2.31497033	
1996Q4	5.080347907	4.94942136	4.970573809	0.0654633	2.208479382	
1997Q1	5.116033809	5.341926746	4.980205988	-0.112946	2.727353468	
19 97Q2	5.108953068	5.037274515	4.985111288	0.0358393	2.484233006	
1997Q3	5.155756762	4.947836471	4.985102017	0.1039601	3.423294931	
1997Q4	5.213777478	5.140573429	4.980067887	0.036602	4.692899716	
1998Q1	5.280000635	5.033694128	4.970005267	0.1231533	6.237 324731	
1998Q2	5.26134213	5.223253882	4.955056597	0.0190441	6.181272153	
1998Q3	5.299980982	5.178530313	4.935558062	0.0607253	7.383621383	
1998Q4	5.272317275	5.018976069	4.912037275	0.1266706	7.334634875	
1999Q1	4.668238877	4.9701354	4.885249617	-0.150 948	-4.442163	**Under valuation**
1999Q2	4.612314604	4.625679356	4.85617564	-0.006682	-5.021668	
1999Q3	4.551769409	4.345792485	4.825660266	0.1029885	-5.675718	
1999Q4	4.53450091	4.724724286	4.794396003	-0.095111	-5.42081	
2000Q1	4.527889494	4.651808826	4.7 62904179	-0.061959	-4.934273	
2000Q2	4.586629362	4.241688795	4.731543685	0.1724703	-3.062728	
2000Q3	4.620915574	4.493007147	4.700526531	0.0639542	-1.69366	
2000Q4	4.679191726	4.728762363	4.669974153	-0.024785	0.1973795	
2001Q1	4.632590782	4.704794867	4.63995823	-0.036102	-0.158783	
2001Q2	4.710007565	4.556899371	4.610556204	0.0765541	2.1570360	Over valuation
2001Q3	4.734178867	4.389258152	4.581840911	0.1724604	3.324819	
2001Q4	4.761173434	4.708888844	4.553947345	0.0261423	4.5504717	
2002Q1	4.7845457 41	4.776493959	4.527105709	0.0040259	5.6866361	
2002Q2	4.743687876	4.753424535	4.501675726	-0.004868	5.3760458	
2002Q3	4.661172376	4.687584809	4.478178015	-0.013206	4.0863574	
2002Q4	4.641569615	4.680211862	4.457284455	-0.019321	4.1344716	
2003Q1	4.623 864356	4.200365881	4.439781297	0.2117492	4.146219	
2003Q2	4.627420795	4.358684177	4.426569968	0.1343683	4.5373918	

2003Q3	3.573945481	4.967087257	4.418666949	-0.696570	-19.11711	**Undervaluation**
2003Q4	3.521985781	3.133939895	4.417214251	0.1940229	-20.26681	
2004Q1	3.547355192	3.859662507	4.422825935	-0.156153	-19.79437	
2004Q2	3.565390272	3.533584792	4.435542805	0.0159027	-19.61772	
2004Q3	4.167289356	2.025675574	4.454828894	1.0708069	-6.454559	
2004Q4	4.300097774	5.666367647	4.479563525	-0.683134	-4.006322	
2005Q1	4.731274063	3.703407629	4.508762545	0.5139332	4.9350908	Overvaluation
2005Q2	4.782621569	4.759165764	4.541329632	0.0117279	5.3132442	
2005Q3	4.878603729	4.906531843	4.576307537	-0.013964	6.6056792	
2005Q4	4.885276132	4.90182531	4.612889817	-0.008274	5.9048953	
2006Q1	4.887585916	5.270187557	4.650458964	-0.191300	5.0990011	
2006Q2	4.894049042	4.993000433	4.688567711	-0.049475	4.3826034	
2006Q3	4.888090941	4.94627509	4.726916997	-0.029092	3.4097054	
2006Q4	4.877180089	4.828061906	4.765336185	0.0245591	2.3470307	