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

Shehu Usman Rano, Aliyu
Bayero University Kano, Nigeria

07. September 2008

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

Abstract

This paper seeks to estimate the long run behavioral equilibrium exchange rate in Nigeria. The empirical analysis builds on quarterly data from 1986Q1 to 2006Q4 and derives a Behavioral Equilibrium Exchange Rate (BEER) and a Permanent Equilibrium Exchange Rate (PEER). The econometric analysis starts by analyzing the stochastic properties of the data and found all the variables stationary at first level of differencing. Accordingly, the paper proceeds by estimating vector-error correction models. Regression results show that most of the long-run behavior of the real exchange rate could be explained by real net foreign assets, terms of trade, index of crude oil volatility, index of monetary policy performance and government fiscal stance. On the basis of these fundamentals, four episodes each of overvaluation and undervaluation were identified and the antecedents characterizing the episodes were equally traced to the archive of exchange rate management in the country within the review period. Among others for instance, large inflow of oil revenues into the country and stable macroeconomic performance were discovered to account for undervaluation of the real exchange rate between 2001Q1 and 2006Q4 in Nigeria. The results further suggest that deviations from the equilibrium path are eliminated within one to two years. The paper recommends the pursuance of sound monetary policy as an instrument for achieving real exchange rate cum macroeconomic stability in Nigeria.

Shehu Usman Rano Aliyu[1]*,*
Department of Economics,
Bayero University, Kano
susaliyu@yahoo.co.uk

Keywords: real exchange rate equilibrium, stationarity, cointegration, Hodrick-Prescott decomposition, BEER and PEER.

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 1980ôs 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).

[1] *The author is grateful to Dr. A. Englama, Head of External Sector Unit, Research Department, Central Bank of Nigeria for his comments.*

w of many empirical studies on exchange rates has been the purchasing power parity (PPP) doctrine. Cassel (1916, 1918) asserts that under the condition of free trade, the nominal exchange rate between countries is equal to the ratio of two countriesô price level. This suggests that the equilibrium real exchange rate remains constant with nominal exchange rate movement offsetting relative price change between the countries. This approach is obviously questionable because the equilibrium real exchange rate (RER) is not a static indicator and moves over time as the economyôs fundamentals move (Dufrenot and Yahuoe, 2005). As a consequence and as was rightly pointed out by Elbadawi (1994), the PPP approach runs the risk of identifying as a misalignment what may in fact be an equilibrium movement in the RER.

Another approach of estimating equilibrium exchange rate, which emerged in the 1980s tries to estimate the equilibrium exchange rate using economic fundamentals, the fundamental equilibrium exchange rate (FEER) approach. Since most of the macroeconomic variables - especially the real exchange rate - are nonstationary, the estimation requires some time series techniques. Hence in the 1980s and 1990s most country studies use time series data (e.g. Williamson, 1994). Driver and Wren-Lewis (1999) state that the FEER approach is characterized as normative in the sense that it delivers an equilibrium exchange rate consistent with óidealô economic conditions. It was however observed that most of these studies, especially those concerning developing countries where data availability goes back only to the 1960s or 1970s, have to use short time series data or a small sample for the estimation. However, findings from these studies run the risk of limited sample bias and therefore inappropriate for meaningful and dependable generalizations/applications.

Recently, the behavioral equilibrium exchange rate (BEER) approach focuses on the dynamic behavior of the exchange rate, including short-run movements and deviations and taking broader macroeconomic conditions into account. The approach was proposed by Clark and MacDonald (1999, 2000). Evidences show that strand of studies applied both the PPP and the FEER approaches in Nigeria and beyond (see Williamson, 1994; Cooper, 1994; Rogoff, 1996; Akinuli,1997; Taylor, 1988; Chinn, 1999; Ahmed *et al,* 2002; Agu, 2002; Qayyum, *et al,* 2004; and Omotosho and Wambai, 2005; all used the PPP approach. On the other hand Meese & Rogoff, 1983; Elbadawi, 1994; Elbadawi & Soto, 1995; Hinkle and Nsengiyumva, 1997, Baffes,

eki, 2001; CBN, 2007a & b; used the FEER approach). proach to analyze the dynamic behavior of real exchange rate in Nigeria by taking broader macroeconomic variables in the economy into consideration.

The BEER estimation is based on a reduced form specification, which links the naira real exchange rate to a broad set of economic fundamentals which include the real net foreign assets, terms of trade shocks, index of crude oil price volatility, government fiscal stance, level of foreign reserve and index of monetary policy performance. In addition, the paper applied the standard cointegration techniques and decomposes the cointegrated time series into their permanent and transitory components (PC and TC). 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, section three of the paper presents a brief overview of the developments in the naira exchange rate management in Nigeria. Section four is on research methodology of the paper while results and discussions are captured in section five. Finally, section six concludes the paper.

2.0 Literature Review and Theoretical Issues

There is no gain saying that exchange rate misalignment has serious implications on economic fundamentals, but what is particularly important is to know the nature and degree of the impact of the misalignment for 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, etc. A number of studies, for instance have found that the level of the 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 form or definitions of exchange rate misalignment were identified in the literature, (see Williamson, 1994; Miles-Feretti and Raziun,

First, the Price-based criteria, such as purchasing power 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 competitative 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 in other words 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 studies based on PPP approach, but just a few are referred to here which include: 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. This according to Balassa (1964) and Chinn (2000) may result in systematic divergence of internal prices and *d)* the prices are in most cases sticky and do not move rapidly enough to offset frequent changes in nominal exchange rates. 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.

rium 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 CGE estimates found that the RER for Burkina Faso was overvalued by about 9% in 1993.

Similarly, Baffes, Elbadawi, and OôConnell (1999) examined misalignment for Côte dôIvoire and Burkina Faso using single-equation time series. They found that for Côte dôIvoire the actual real exchange rate was overvalued by 34 percent on average during the period 1987ï93, but, contrary to the findings by Devajaran (1997) the Burkina Fasoôs currency does not seem to be overvalued; rather it was undervalued by 14% in 1987 - 1993. Dufrenot and Yehoue (2005) analyzed the relationship between real exchange rates and economic fundamentals in 64 developing countries; 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. Beside using fundamental variables, the BEER methodology according to Driver and Westaway (2001), categorizes as ñcurrent and cyclical equilibrium exchange rates", since their computation is based

l factors. Clark and MacDonald (1998) used fundamental tio 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% in 1984. Studies by Albarelo *et al* (1999) and Roeger and Hansen (2000) were heavily criticized by Maesofernandez, Osbat and Schnatz (2001) for lack of sufficient fundamental variables and poor statistical analysis. Elaborately, 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, Osbat and Schnatz (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 is unambiguously undervalued in 2000, although the extent largely depends 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 Botswanaôs 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 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 ï 2004). It may therefore suffer from limited sample bias.

Iossifov and Loukoianova (2007) estimated BEER model for Ghana and results show that most of the REERôs long-run behavior can be explained by real GDP growth, real interest rate differentials (both relative to trading-partner countries), and the real world prices of Ghanaôs main export commodities. The REER in late 2006 was found to be very close to its estimated

the equilibrium path are eliminated within two to three

The motivation for this study 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 Naira Exchange Rate Management

Until 1986 when the structural adjustment programme (SAP) was introduced in the country, 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 UKôs 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

re the introduction of structural adjustment programme in 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.

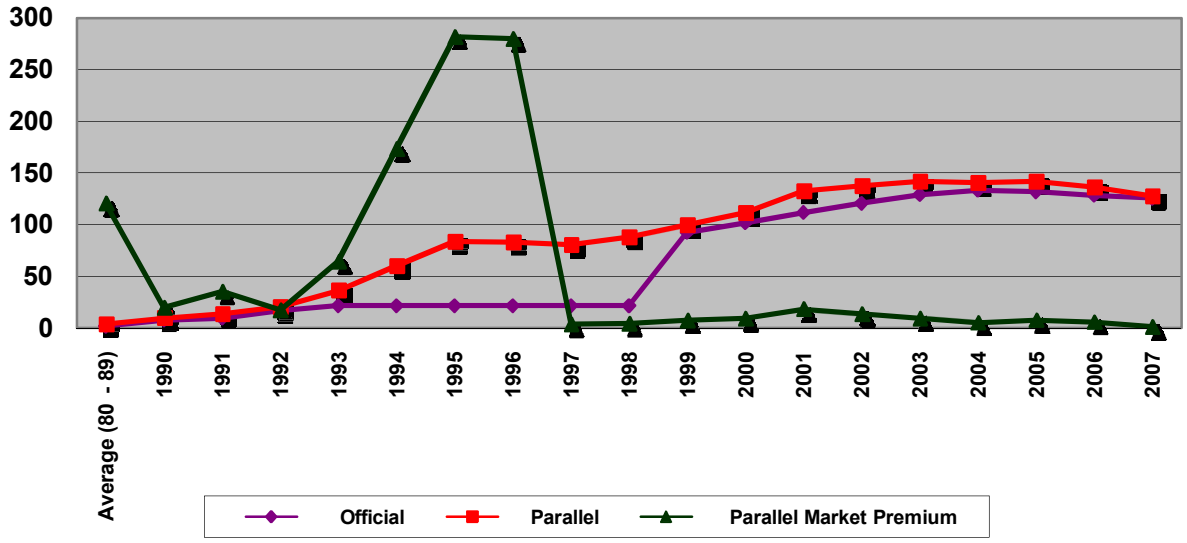
The first phase started with the introduction of SAP to 1994. The Second-Tier Foreign Exchange Market (SFEM) was launched on September 26, 1986. At the commencement of the SFEM, a dual exchange rate system for the allocation of foreign exchange was adopted. In order to introduce professionalism into the bidding system, the Dutch Auction System (DAS) was adopted in April 1987. Due to 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 to inter-bank foreign exchange market (IFEM). The Bureau de change (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 ₦0.8938 ≈ US$1 in 1985 by 55.9 percent, that is, to ₦2.0206 ≈ US$1 in 1986. With continued demand pressure on the foreign exchange market the exchange rate further depreciated to an average of ₦4.0179 ≈ US$1 in 1987. During the same period, the parallel market exchange rate averaged ₦5.5500 ≈ US$1, reflecting a premium of 38.1 per cent. The parallel market premium reached 38.7 percent when naira was sold at ₦7.5916 ≈ US$1 and ₦10.5333 ≈ US$1 in the official and parallel markets, respectively in 1990. The premium went as high as 64.3 per cent in February 1993 which by far exceeded the universally recommended limit of 5.0 per cent 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 problems, low FDI flow, low

sure. The concept of guided deregulation was introduced 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 ₦22.00 ≈ 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 ₦82.30 ≈ 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.

FIigure 1: Exchange Rate Movement



Adapted from "The Changing Structure of the Nigerian Economy and Implications for Development" published by the Research Department, Central bank of Nigeria

IFEM was reintroduced in the third phase in 1999 to promote inter-bank trading activities in the market through the privately sourced foreign exchange. Already, the AFEM rate has climbed up to an average rate of ₦91.80 ≈ US$1. By December 1999, the exchange rate of the Naira depreciated to ₦97.42 ≈ US$1 and to ₦111.94 a dollar in 2001. To stem this unhealthy trend and safeguard further depletion of external reserves the Dutch Auction System (DAS) of foreign

ed in July 2002. The measure helped in curtailing the rate parallel market premium. The rate as at December 2002 depreciated marginally by only 0.07 per cent to ₦120.97 ≈ US$1.

For the first time in 2005, the naira exchange rate appreciated by 1.0 and 2.7 per cent over its previous levels at end 2004 and 2005 to ₦132.2 and ₦128.65 ≈ 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 reports that for the first time in two decades of foreign exchange management, the official and parallel market rates converged. By the end December, 2006, the premium marginally fell short of the internationally acceptable limit of 5.0 per cent by only 0.08 per cent.

Further appreciation was witnessed by up to 2.2 percent in 2007, that is from ₦128.65 ≈ 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 ₦125.75 and ₦127.41 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 internationally, 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.

The econometric methodology employed in the paper uses Johansenôs 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, Elbadawi and OôConnell (1999), Maesofernandez, Osbat and Schnatz (2001), Dufrenot and Yahuoe (2005). Recently, 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*), governmentôs fiscal spending (*gov*), real foreign reserve (*rsv*) and index of monetary policy performance.

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

$$lne^{*} = \beta' F^{p} \qquad (1)$$

where e^{*} is the equilibrium real exchange rate, F^{p} is the vector of permanent values for the fundamentals. According to Baffes, Elbadawi and OôConnell (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 óparameters of interestô 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 ñnoiseò 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 ólong-runô, ósteady stateô or ópermanentô values of the economic fundamentals by decomposing the time series into a trend ε_t and stationary component, $x_t - \varepsilon_t$ by minimizing.

$$\varepsilon_t) - (x_t - \varepsilon_{t-1})]^2 \qquad (2)$$

where ∂ is an arbitrary constant which reflects the penalty of incorporating fluctuations into the trend. If ∂ = 0, the sum of squares is minimized when $x_t - \varepsilon_t$ and the trend is x_t itself. As ∂ Ÿ Đ, the trend approaches linearity. HP suggested a ∂ 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 < ∂ < 140,000), and much smaller when the data set is annual (6 < ∂ < 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:

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

To avoid 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:

$$\varphi y_t = \Upsilon y_{t-1} + \sum_{i=1}^{p-1} \breve{u}_i \varphi y_{t-i} + BX_{t-k} + \mathring{U} \qquad (4)$$

Equation (4) which gives the Grangerôs representation theorem asserts that if the coefficient matrix Υ has reduced rank $r < k$, then there exist k x r matrices α and β each with rank r such that $\Upsilon = \alpha \beta'$ and $\beta' y_t$ is I(0). r is the number of cointegrating relations (*the cointegrating rank*)

ng vector. The elements of α are known as the adjustment nsenôs method is to estimate the Ũ matrix from an unrestricted VAR and to test whether we can reject the restrictions implied by the reduced rank of Ũ. Lastly, Ů is the disturbance term distributed as N(0, q), where q *i* is the variance-covariance matrix of the elements of the residuals.

4.2 *Definition of Variables*

The description of variables used in this paper and the sources of the data are presented in this sub-section. As mentioned earlier, BEER models emphasize on 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, degree of openness, net foreign assets, government spending, etc. The fundamental variables as used in the paper are defined as follows:

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 OôConnell (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 Nigeriaôs major trading partners. In this paper we simply adopted the real exchange published in the CBNôs 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.

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 Nigeriaôs 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 tradeôs 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 OôConnell (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 Nigeriaôs 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 Nigeriaôs 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.

OV)

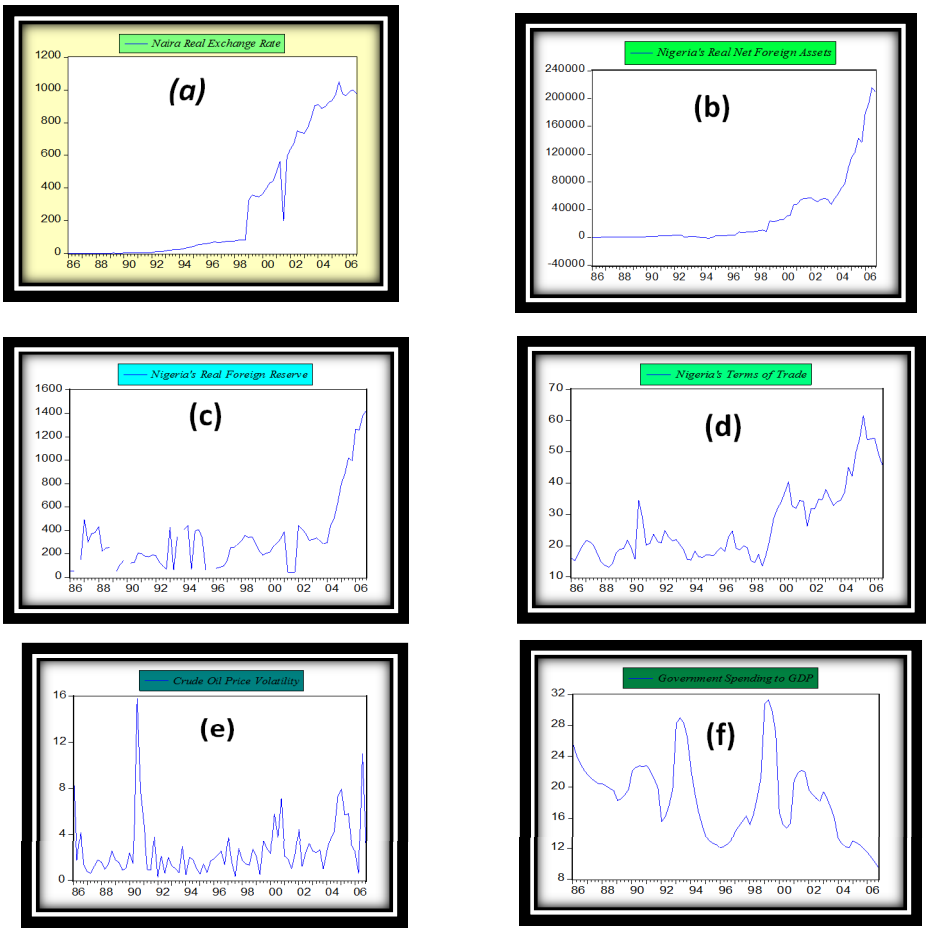
e oil price volatility on real exchange rate is very crucial, particularly for an oil producing country like Nigeria. Amano and Van Norden (1998) have studied the relationship between the real effective exchange rate of the dollar and the real oil price and found cointegration between them. In their 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.

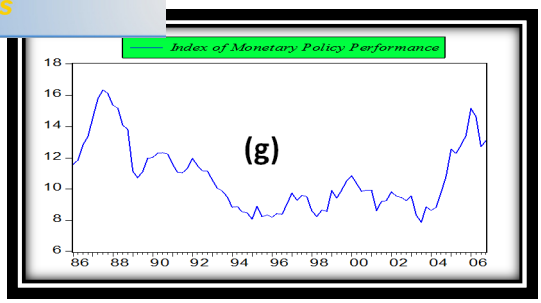
Government Fiscal Stance (gov)

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.

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 Bankôs 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.

Figure 1





5.0 Results and Discussion

This section presents the result of unit root test applied to the variables using data on quarterly basis. In the first step, the variables were tested for stationarity in their level and were all found to be nonstationary. The following results presented in table 1 showed 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.

Table 1

Unit Root Test Applied to Variables

	ADF- Test				Phillips- Perron Test			
	Constant		Constant & Trend		Constant		Constant & Trend	
Variable/ coefficient	t-Statistic	Decision Rule	t-Statistic	Decision Rule	t-Statistic	Decision Rule	t-Statistic	Decision Rule
lrer	-6.87*	I(1)	-7.09*	I(1)	-6.81*	I(1)	-7.09*	I(1)
lnfa	-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)
liov	-9.85*	I(1)	-10.3*	I(1)	-9.83*	I(1)	-10.3*	I(1)
lgov	-4.27*	I(1)	-4.27*	I(1)	-5.94*	I(1)	-5.90*	I(1)
lrsv	-11.2*	I(1)	-11.7*	I(1)	-11.2*	I(1)	-12.1*	I(1)
lmop	-5.24*	I(1)	-5.21*	I(1)	-5.22*	I(1)	-5.19*	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.

tant to mention is the case of *lnfa* which is stationary in the percent in other specifications. One good thing about the findings is that there is harmony 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 result of the unrestricted Johansen cointegration test applied to all the variables using the specification in equation (3) is presented in table 2. Note that the regression was conducted on first difference of all the series. The standard statistics used in the interpretation of the test are the eigenvalue and the trace statistic at given level of significance.

Table 2

Unrestricted Cointegration Test
Trend assumption: Linear deterministic trend
Series: lrer, lnfa, tot, liov, lgov, lrsv & lmop
Sample adjusted 1988Q1 2006Q4
Lags interval (in first difference): 1 to 4

Maximum Rank/ Number of Cointegrating Equations	Maximum Eigenvalue	Critical Value (Eigenvalue)	Trace Statistic	Critical Value (Trace Statistic)	Probability**
0*	151.13	46.23	343.85	125.62	0.000
1*	77.02	40.08	192.71	95.75	0.000
2*	54.02	33.88	115.69	69.82	0.000
3*	38.55	27.58	61.67	47.87	0.002
4	16.48	21.13	23.12	29.80	0.240
5	6.540	14.26	6.640	15.50	0.620
6	0.099	3.840	0.099	3.840	0.752

Trace test indicates 4 cointegrating equations at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

From table 2, the results showed the existence of four cointegration equations. The maximum eigenvalue and the trace statistic are both greater than their critical values. Thus, the null hypothesis of no cointegration is rejected and in its place, the alternative hypothesis for the four ranks is accepted at 5 percent level of significance. The presence of cointegration in the

rms the existence of long run relationship between real
he long run.

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. Therefore, while interpreting the cointegrating vectors obtained from the Johansen procedure as was pointed out by Cheng and Orden, 2005 and Ilimi, 2006; one need to note that what the reduced rank regression provides is information on how many unique cointegrating vectors *span* the cointegrating space, while any linear combination of the stationary vectors is itself a stationary vector. In this circumstance according to Johansen and Juselius (1990) ówe 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 interestô. A similar approach (simplification) has been utilized among others by Cerra and Saxena (2002) and Mathisen (2003).

The first cointegrating vector, therefore, is utilized as the long-run relationship, which subsist between real exchange rate and its fundamentals. Although a number of permutations of the long run variable in a number of regressions produced interesting results, however, only the preferred version is reported. The ordering of the variables was done using the correlation matrix where variables were arranged according to the size of their correlation coefficient.

Table 3 presents the results of long run behavioral cointegrating vector coefficient of the exchange rate model. It can be discerned from the results that all the coefficients were strong and statistically significant at 1 percent level. In particular, the coefficient of net foreign assets (*nfa*) is significant statistically and theoretically consistent. A unit change in Nigeriaôs foreign asset is associated with real exchange rate apperception by up to 8.02 percent. Similarly, the coefficients of index of crude oil price volatility (*iov*) and index of monetary policy performance (*mop*) all bear correct sign and are statistically significant. A unit change in any component of the two results in naira real exchange rate appreciation. The sign of *iov* variable is plausible although

l to real exchange rate. This is so because since the *11* the subsequent crises that engulfed one of the major oil producing states in the gulf region, the world has seen more oil price increases than decreases. This brings in more foreign exchange to the Nigerian economy and causes appreciation in the real exchange rate. Equally, the positive sign of the *mop* variable suggests that as monetary policy performance level rises, real exchange rate appreciates. The result implies that real exchange rate appreciates as the policy achieves mobilizing more savings in the economy which would be channeled into the nontradable sector of the economy.

Table 3

Normalized Vector Error Correction (VECM) Coefficients

Variables	*Vector Coefficient (β)*	*Error Correction – Adjustment Coefficient (α)*
RER(-1)	1.0000	0.08483
		(0.22763)
		[0.37269]
NFA(-1)	8.019999*	-0.001175
	-2.38827	(0.00512)
	[3.35808]	[-0.22933]
TOT(-1)	3.568169*	-0.100114*
	-0.36833	(0.02378)
	[9.68742]	[-4.20994]
IOV(-1)	3.836887*	-0.067705*
	-0.49262	(0.02523)
	[7.78878]	[-2.68394]
GOV(-1)	-9.0198*	0.026367
	-0.89364	(0.01556)
	[-10.0934]	[1.69475]
RSV(-1)	-0.32874*	0.470240
	-0.02102	(0.89856)
	[-15.6410]	[0.52332]
MOP(-1)	22.06763*	-0.016336*
	-1.37847	(0.00469)
	[16.0087]	[-3.48422]
C	-218.849	

( ) and [ ] report values of standard errors and t- ratios respectively
* indicate significance at 1% levels.

Furthermore, the coefficient of governmentôs fiscal stance (*gov*) is both correctly signed and significant statistically. The implication of the negative sign of the coefficient is that increase in government spending relative to GDP induces real exchange rate depreciation. This is because in the long run, higher government spending most likely according to Maesofernandez, Osbat and

ce in a currency thereby leading to distortions and n 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.

Theoretically, the sign of coefficient of terms of trade (*tot*) is ambiguous. It depends on whether the substitution or income dominates. Here, the positive income effect of a change in terms of trade dominates and hence the coefficientôs sign is positive. Although Nigeria is a price taker in the world economy, faces quantity restrictions from the organization of oil producing states (OPEC) and crises in the oil producing region, which adversely affect supply, yet changes in its terms of trade results in appreciation of real exchange rate. This development and indeed those in the above could, however, spur more imports into the economy.

Lastly, a change in the reserve level relative to GDP (*rsv*) was expected to impact positively on the level of real exchange rate. However, the sign turned out to be negative although very significant. It could be observed that except when excess reserve is monetized in the domestic economy, in which case it do happen in the country and used to finance government spending, this is untenable. Notwithstanding, 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.

The speed adjustment parameters of the coefficients of the VEC model were also reported and three out of the four that were correctly signed are statistically significant. The coefficients measure the average number of times that a given shock is corrected in the model. This is given as $(1 - \lambda)^t$, which is, $(1 - \lambda)$, where t is the number of years and λ is the absolute value of the adjustment parameter. From the results in table 3, the fastest speed of adjustment was recorded by the coefficient of *rsv* of 0.47 (roughly 5 quarters or one and a quarter of a year), although the coefficient is not correctly signed. This was followed by the coefficient of *tot* of -0.10 (9 quarters or two and a quarter of a year). These findings lie between those reported by Edwards (1989) of -

ies and Baffes, Elbadawi and OôConnell (1999) of -0.45 ina Faso respectively using an unrestricted ECM. More recently, Iossifov and Loukoianova (2007) showed that deviations in the Ghanaian real exchange from the equilibrium path are eliminated within two to three years.

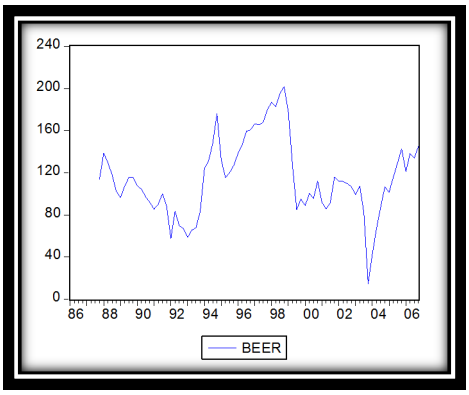
5.2 Real Exchange Rate Equilibrium and Misalignment

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. Because these variables may exhibit a certain degree of short term ñnoiseò 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 ñequilibriumò 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 present 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 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 very neither 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 show the interaction among

alignment based on PEER measure identified above

Figure 2 & 3



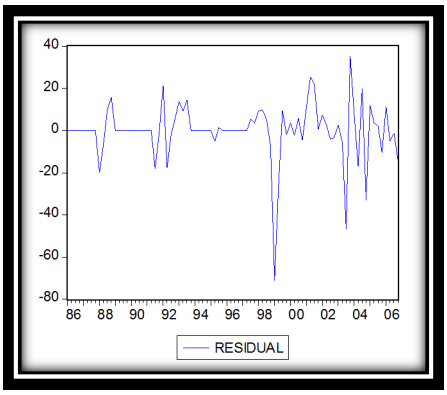
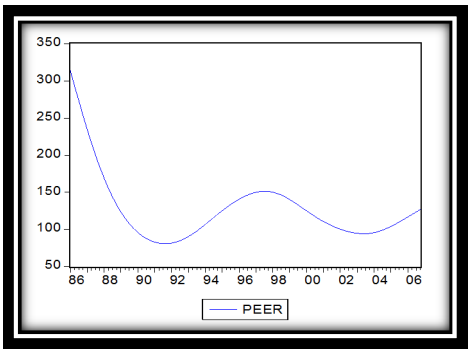


Figure 4 & 5



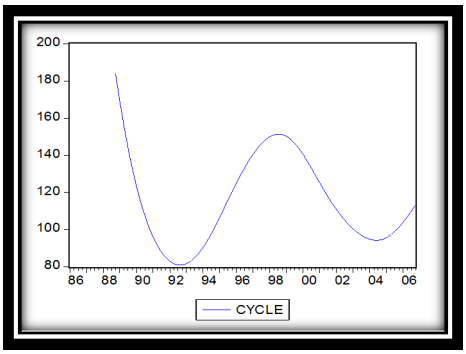
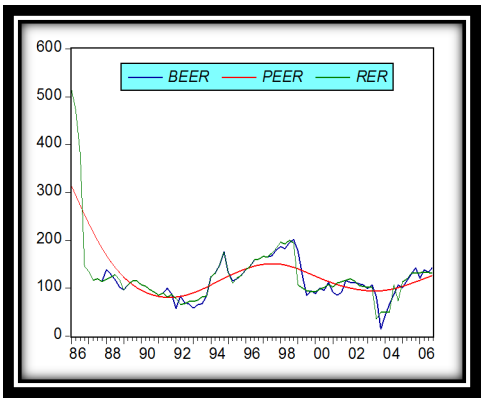
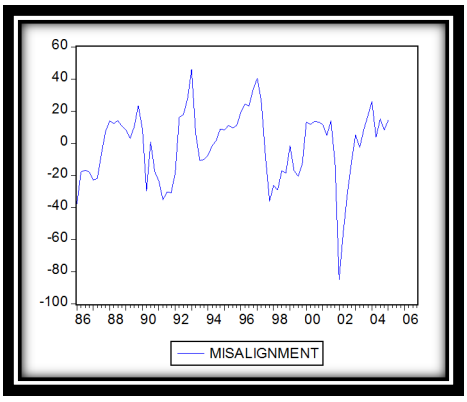


Figure 6 & 7





Meanwhile, the degree of misalignment computed based on the above formula is presented in Table A1 in the appendix covering the period of 1987Q4 to 2006Q4. Four distinct episodes each

the real exchange rate were found. Table 4 captures the

Table 4

Episodes of Real Exchange Rate Misalignment in Nigeria

Range	Outcome	Min	Max	Average	Narration
1987Q4 ï 1989Q2	Overvaluation	-6.6	-37.9	-20.3	*The period marked the beginning of deregulation of the economy in general and the exchange rate and payment systems in particular*
1989Q3 ï 1991Q4	Undervaluation	2.9	23.5	11.1	*Introduction of IFEM and BDC segment in the forex market help to strengthen the exchange rate*
1992Q1 ï 1993Q4	Overvaluation	-17.8	-35.2	-23.1	*CBN further deregulated the system of forex trading on March 5, 1992 with a view to narrow the parallel market premium which has reached 64.3% and enhance the operational and allocative efficiency in the market.*
1994Q1 ï 1995Q1	Undervaluation	5.9	45.8	22.7	*Marked the period of policy reversal and reintroduction of control and the pegging of the exchange rate by the then military regime.*
1995Q2 ï 1996Q1	Overvaluation	-1.6	-10.8	-7.5	*Impact of policy reversal which started in 1994 led to overvaluation of the rate*
1996Q2 ï 1999Q1	Undervaluation	1.8	40.5	18.1	*Retained the dual exchange rate system: official at N21.996 = $1.00, removal of subsidy on official exchange rate, which before breads round- tripping of forex to the parallel market, promoted operations in the 4 segments of the market; Official, Parallel, BDC and AFEM.*
1999Q2 ï 2001Q3	Overvaluation	-1.7	-35.9	-18.7	*Introduction of AFEM, the beginning of civil rule and rapid growth in govt. spending*
2001Q4 ï 2006Q4	Undervaluation	3.8	25.8	8.4	*Upsurge in the flow of oil revenue, post banking sector reform, introduction of WDAS and general improvement in the level of macroeconomic performance*

Note: No data on the level of real exchange rate was available for the period of 2003Q2 ï 2004Q1 and although they were generated, yet there was negative trend in the residual, which would have characterize another phase of overvaluation. This was however, simply ignored in the calculation in the last phase in view of the favorable trends in the economy in general and the external sector indicators in particular.

Although a short narration was provided, the results showed that the average misalignment lies between -7.5 and -23.1. These findings are similar to those reported by Baffes, Elbadawi and OôConnell (1999) for Cote dôIvoire and Burkina Faso, Dufrenot and Yahuoe (2005) and Ilimi (2006) for Botswana which are relatively smaller economies. Dufrenot and Yahuoe (2005), for

developing countries including Nigeria discovered that tion over 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 was the case in Ghana.

Other empirical studies by Agu (2002) and Omotosho and Wambai (2005), however, reported marginal degree of exchange rate misalignment of 1.4% and 3% respectively in Nigeria although the latter reported misalignment of up to 44.2% using the PPP approach. Generally, while the previous studies mentioned above employed similar approach to the one used in the paper, these two studies essentially used fundamental equilibrium analysis.

6.0 Conclusion and Recommendations

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 Johansenôs 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

y change. It however, depreciates with high government the direction of the causation in the case of government spending is very clear, that of reserve to real exchange rate is hazy. However, more often than not, marginal propensity of government spending in Nigeria significantly depends on the level of reserve hence this could be justified. The speed of adjustment in the model of one to two 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, four episodes each of overvaluation and undervaluation of the real exchange rate were identified and the paper traced some of the antecedents that characterized the episodes. In particular, RER was found to be overvalued from the beginning of the period of deregulation up to 1989Q2 and in the aftermath of policy reversal 1995Q2 to 1996Q1. Conversely, the real exchange rate was also particularly undervalued between 2001Q4 and 2006Q4 following gains from democratic rule, huge foreign exchange inflow due to increases in the price of crude oil and gains from banking sector consolation.

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 four regimes of overvaluation and undervaluation were discovered, 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 countryôs foreign assets would also be of great significance in this direction. The Nigeriaôs terms of trade condition and oil price volatility are exogenous to the economy and hence little could be done in that regard.

References

stortions and External Balance Position of Nigeria: Issues *Finance and Economic Development,* Institute of African-American Affairs, New York University, New York.

Ahmed, Eatzaz, and Farzana Naheed Khan (2002) Short Run Dynamics in Purchasing Power Parity: A Case of Selected Asian Countries. *The Middle East Business and Economic Review* 14:2.

Akinuli, O. M. (1997) Seasonal Adjustment of Naira Exchange Rate Statistics (1970 ï 1995), *Occasional Paper* No. 17, Research Department, Central Bank of Nigeria.

Alberola, E., S. G. Cervero, H. Lopez and A. Ubide (1999) ñGlobal equilibrium exchange rates: euro, dollar, ñinsò, ñoutsò and other major currencies in a panel cointegration frameworkò, *IMF Working Paper, 175*.

Amano, R. A. and S. Van Norden (1998) ñOil prices and the rise and fall of the US real exchange rateò, *Journal of International Money and Finance, 17, 299-316.*

Azali, M., M.S. Habibullah and A.Z. Baharumshah (2001) Does PPP hold between Asian and The Japanese Economies? Evidence Using Panel Unit Root and Panel Cointegration, *Japan and the World Economy*, 13, 35-50.

Baffes, J., I. Elbadawi, and S. O'Connell. (1999) "Single-Equation Estimation of the Equilibrium Real Exchange Rate." World Bank, Policy Research Department, Washington, DC.

Baharumshah, A.Z. and M. Ariff (1997) Purchasing Power Parity in South East Asian Countries: A Cointegration Approach, *Asian Economic Journal*, 11, 141-154.

Bahmani-Oskooee, M., (1993) Purchasing Power Parity Based on Effective Exchange Rate and Cointegration; 25 LDCs Experience with its Absolute Formulation, *World Development*, 21, 1023-31.

Balassa, B. (1964) The Purchasing Power Parity Doctrine: A Reappraisal. *Journal of Political Economy* 72, 584ï 596.

Berveridge, S. and Charles R. Nelson (1981) A New Approach to Decomposition of Economic Time Series into Permanent and Transitory Components with Particular Attention to Measurement of Business Cycles, *Journal of Monetary Economics,* Vol. 7, pp. 1515 ï 174.

Caballero, R., and V. Corbo, (1989) ñHow Does Uncertainty about the Real Exchange Rate Affects Exports?ò Policy Research Working Paper Series No. 221 (Washington: World Bank).

Cassel, G. (1916) The Present Situation of Foreign Exchange. *Economic Journal* 26, 62ï 65.

Cassel, G. (1981) Abnormal Deviations of International Exchanges. *Economic Journal* 28, 413ï 415.

Structure of the Nigerian Economy and Implications for Development" Published by the Research Department, Central bank of Nigeria.

CBN (2007*a*) ñBrief on the Determination of the Optimum Exchange Rate Band under the IFEM, *External Sector Division of the Research Department,* Central Bank of Nigeria.

CBN (2007*b*) ñThe Extent of Naira Exchange Rate Misalignmentò, Research and Statistics Department, Central Bank of Nigeria, October.

Cerra, V. and S. Saxena. (2002) ñWhat Caused the 1991 Currency Crisis in India?ò *IMF Staff Papers*, 49 (3).

Chang Fuzhi and Orden David (2005) ñExchange Misalignment and its Effects on Agricultural Producer Support Estimate: Empirical Evidence from India and Chinaò International Food Policy Research Institute (IFPRI), *MTID Discussion Paper,* No. 81. Washington DC.

Chinn, M. D. (1999) Measuring Misalignment: PPP and East Asian Currencies in the 1990s. International Monetary Fund, Washington, D. C. (IMF Working Paper WP/99/120.)

Chinn, M. D. (2000) The Usual Suspects: Productivity and Demand Shocks and Asian-Pacific Exchange Rates. *Review of International Economics* 8:1, 20ï 43.

Choudhry, T. (2005) Asian Currency Crisis and the Generalized PPP: Evidence from the Far East, Asian Economic Journal, 19(2), 137-157.

Clark, P. and R. MacDonald, (1998) ñExchange Rates and Economic Fundamentals: A Methodological Comparison of BEERs and FEERs,ò IMF Working Paper WP98/67 (Washington: International Monetary Fund).

Clark, P. B. and R. Macdonald (1999) ñExchange rates and economic fundamentals: A methodological comparison of BEERs and FEERs, *in R.. MacDonald and J. L. Stein: Equilibrium exchange rates, Norwell, MA., 285-322.*

Clark, P. B. and R. Macdonald (2000) ñFiltering the BEER: A permanent and transitory decompositionò, *IMF Working Paper, 144.*

Clostermann, J. & W. Friedmann (1998) ñWhat drives the real effective D-Mark exchange rate?, *Konjunkturpolitik, Applied Economics Quarterly, 44, 207-230.*

Clostermann, J. & B. Schnatz (2000) ñThe determinants of the euro-dollar exchange rate Synthetic fundamentals and a non-existing currencyò, *Konjunkturpolitik, Applied Economics Quarterly, 46, 3, 274-302.*

Devarajan, R. (1997) Real Exchange Rate Misalignment in the CFA Zone, *Journal of African Economies,* Oxford, Vol. 6, No. 1, pp. 35 ï 53.

Multiple Cointegrating Vectors and Structural Economic Models: An Application to the French Franc/U.S. Dollar Exchange Rate,ò *Southern Economic Journal*, Vol. 61 (April), pp. 1098ï 1116.

Dibooglu, S. (1996) ñReal disturbances, relative prices and purchasing power parityò, *Journal of Macroeconomics, 18, 69-87.*

Dornbusch, R., (1987) ñExchange Rates and Prices,ò *American Economic Review*, Vol. 77 (March), pp. 93ï 106.

Driver, R. and S. Wren-Lewis (1999) ñFeers: A sensitive analysisò, *in R. MacDonald and J. L Stein (ed) Equilibrium Exchange Rates, Kluwer Academic Publisher, UK, 135-163.*

Dufrenot, G., and E. Yehoue, (2005) ñReal Exchange Rate Misalignment: A Panel Co-Integration and Common Factor Analysis,ò IMF Working Paper 05/164 (Washington: International Monetary Fund).

Frenkel, J. A. and M. Mussa (1988) ñExchange rates and the balance of paymentsò, *in R. Jones and P. Kenen, eds, Handbook of International Economics, 2, Elsevier Science.*

Edwards, S., (1989) *Real Exchange Rates, Devaluation, and Adjustment: Exchange Rate Policy in Developing Countries* (Cambridge, Massachusetts: MIT Press).

Elbadawi, I., (1994) ñEstimating Long Run Real Exchange Rates,ò in *Estimating Equilibrium Exchange Rates,* ed by J. Williamson (Washington: Institute for International Economics).

Elbadawi, I. and R. Soto. (1997) ñReal Exchange Rate and Macroeconomic Adjustment in Sub-Saharan Africa and Other Developing Countries.ò in Elbadawi, I. and R. Soto, (eds.), *Foreign Exchange Market and Exchange Rate Policies in Sub-Saharan Africa*, Supplementary Edition of the *Journal of African Economies.*

Engle, Robert F. and C. W. J. Granger (1987). ñCo-integration and Error Correction: Representation, Estimation, and Testing,ò *Econometrica,* 55, 251ï 276.

Ghura, D. and T. J. Greenes (1993) ñThe Rea Exchange Rate and Macroeconomic Performance in Sub-Saharan Africa,ò *Journal of Development Economics.* 42: 155 ï 174.

Gonzalo, J., and C.W.J. Granger, (1995) ñEstimation of Common Long-Memory Components in Co-Integrated Systems,ò *Journal of Business and Economic Statistics,* Vol. 13, pp. 27ï 36.

Gujarati, Damodar N. (2003) *Basic Econometrics*, 4th Edition, New York: McGraw-Hill.

Hinkle, L. E. and P. J. Montiel (1999) *Exchange Rate Misalignment*. World Bank, New York: Oxford University Press.

ostwar U.S. Business Cycles: An Empirical
it and Banking, Vol. 29 (February), pp. 1ï 16.

Hoffmann, M. and R. Macdonald (2000) ñA real differential view of equilibrium real exchange rates and misalignmentsò, *CFS Working Paper No. 2000/8, Center for Financial Studies, Frankfurt am Main.*

Holt, C., (1957) ñForecasting Seasonals and Trends by Exponentially Weighted Moving Averages,ò ONR Research Memorandum 52 (Washington: Carnegie Institute).

Iimi, A., (2006) ñExchange Rate Misalignment: An Application of the Behavioral Equilibrium Exchange Rate (BEER) to Botswana,ò IMF Working Paper WP/06/140 (Washington: International Monetary Fund).

Iossifov, P. and E. Loukoianova (2007) Estimation of a Behavioral Equilibrium Exchange Rate Model for Ghana, *IMF Working Paper WP/07/155* (Washington: International Monetary Fund).

Johansen, S., (1988) ñStatistical Analysis of Cointegration Vectorsò, *Journal of Economic Dynamics and Control,* Vol. 2 (June-September), pp. 231-54.

Johansen S. and K. Juselius, (1990) ñMaximum Likelihood Estimation and Inference on Cointegration, with Application to the Demand for Moneyò, *Oxford Bulletin of Economics and Statistics*, Vol. 52 (may), pp. 169-210.

Johansen S. and K. Juselius, (1992) ñTesting Structural Hypotheses in a Multivariate Cointegration Analysis of the PPP and the UIP for UK,ò *Journal of Econometrics*, Vol. 53 (July/September), pp. 211ï 44.

Liew, V. K., A.Z. Baharumshah, T. T. Chong (2004) Are Asian real exchange rates stationary?, *Economics Letters*, 83, 313-316.

Macdonald, R. (1995) ñLong run exchange rate modeling; A survey of the recent evidenceò, *IMF Staff Papers, 42, 437-489*.

MacDonald, R., (1997) ñWhat Determines Real Exchange Rates? The Long and Short of Itò, IMF Working Paper WP/97/21 (Washington: International Monetary Fund).

MacDonald, R. (1999) ñExchange Rate Behavior: Are Fundamentals Important?ò *The Economic Journal*, 109, pp.673-91.

MacDonald, R., and P. B. Clark, (1999) ñExchange Rate and Economic Fundamentals: A Methodological Comparison of BEERs and FEERsò, Chapter 10, *Equilibrium Exchange Rates,* Macdonald and J. L. Stein (eds), Kluwer Academic Publishers, London, UK.

MacDonald, R., and J. Nagayasu, (1998) ñOn the Japanese Yen-U.S. Dollar Exchange Rate: A

ı Real Interest Differentials,ò *Journal of the Japanese* March), pp. 75ï 102.

Macdonald, R. and L. Ricci, (2003) ñEstimation of the Equilibrium Real Effective Exchange Rate for South Africa,ò IMF Working Paper WP/03/44 (Washington: International Monetary Fund).

Maesofernandez, F.C. Osbat, B. Schnatz (2001) Determinants of the Euro Real Effective Exchange Rate: A BEER/PEER Approach E u r o p e a n C e n t r a l B a n k (ECB) *Working Paper Series,* No. 85.

Mathisen, J. (2003) ñEstimation of the Equilibrium Real Exchange Rate for Malawi.ò *IMF Working Paper*, WP/03/104.

Meese, R. A. and K. Rogoff (1983) ñEmpirical exchange rate models of the seventies: Do they fit out of sample?ò, *Journal of International Economics, 14, 3-24*.

Milesi-Ferretti, G. M., and A. Razin (1996) Current Account Sustainability: Selected East Asian and Latin American Experiences. (NBER Working Paper No. 5791.)

McNown, R. and M. Wallace, (1989) National Price Level, Purchasing Power Parity, and Cointegration: A test of Four High Inflation Economies, *Journal of International Money and Finance,* 8, 533-45.

Mollick, A.V., (1999) The Real Exchange Rate in Brazil: Mean Reversion or Random Walk in the Long run? *International Review of Economics and Finance*, 8, 115-126.

Moosa, I. A., and R. H. Bhatti (1996) Does Purchasing Power Parity Hold between Japan and Other Asian Countries. *Journal of International Economic Studies* 10, 85ï 94.

Mussa, M., (1986) Nominal Exchange Rate Regimes and the Behavior of Real Exchange Rates: Evidence and Applications, *Carnegie Rochester Series on Public Policy*, 25, 117-213.

Obaseki, P. J. (2001) ñThe Purchasing Power Parity (PPP) Measure of Nairaôs Equilibrium Exchange Rateò, *CBN Economic and Financial Review,* Vol. 36, No. 1. Pp 1 ï 21.

Omotosho, B. S. and M. U. Wambai (2005) ñIs the Naira Misaligned? *Central Bank of Nigeria*

Phillips, P.C.B. and P. Perron (1988). ñTesting for a Unit Root in Time Series Regression,ò *Biometrika*, 75, 335ï 346.

Qayyum, Abdul, Khan, Arshad and Zaman, Kair-u (2004) Exchange Rate Misalignment in Pakistan: Evidence from Purchasing Power Parity Theory, *The Pakistan Development Review* 43: 4 Part II (Winter 2004) pp. 721ï 735.

s Godzilla: The World Bank and the East Asian Miracle,ò
phan Haggard, Dani Rodrik and Robert Wade, eds.,
Miracle or Design? Lessons from East Asian Experience, Washington, DC, Overseas Development Council, 15 ï 53.

Rogoff, K. (1996) ñThe Purchasing Power Parity Puzzleò, *Journal of Economic Literature* 34(2), pp. 647 - 668.

Roeger, W. and M. Hansen, J. (2000) ñEstimation of real equilibrium exchange ratesò, *Economic Papers No. 144.* European Commission, Brussels.

Sarantis, N., and C. Stewart (1993) Sea-Sanality, Cointegration and the Long-run Purchasing Power Parity: Evidence for Sterling Exchange Rates. *Applied Economics* 25, 243ï 250.

Taylor, M. P. (1988) ñAn Empirical Examination of Long run Purchasing Power Parity using Cointegration Techniquesò, *Applied Economics,* 20(10), pp. 1369 ï 81.

Tule, M. K. and O. O. Duke (2007) Computation of Nigeriaôs Real Exchange Rate Indices, *Economic and Financial Review,* Central Bank of Nigeria, Vol. 45, No. 1, pp. 1 ï 34

Wickens, M. (1996) ñInterpreting Cointegrating Vectors and Common Stochastic Trends,ò *Journal of Econometrics*, Vol. 74 (October), pp. 255ï 71.

Winters, P. (1960) ñForecasting Sales by Exponentially Weighted Moving Averages,ò *Management Science*, Vol. 6 (April), pp. 324ï 42.

Williamson (1994) ñEstimates of FEERsò, *in J. Williamson: Estimating Equilibrium Exchange Rates, Washington, D.C., 177-244.*

Yotopoulos A. Pan and Sawada Yasuyuki (2005) ñExchange Rate Misalignment: A New Test of Lung-Run PPP Based on Cross-Country Dataò, *CIRJE Discussion Paper*, February.

Appendix 1A

Computation of BEER, PEER and Real Exchange Rate Misalignment

Year	RER	BEER	PEER	Residual	Cycle	Misalignment
1987Q4	114.087	114.087	183.76035	Residual	-69.67334832	-37.91533318
1988Q1	118.793	138.669	169.16542	-19.877	-30.49549365	-18.02702565
1988Q2	122.890	129.662	155.8397	-6.773	-26.17704616	-16.79741821
1988Q3	128.457	118.199	143.78234	10.257	-25.58270325	-17.79266024
1988Q4	118.287	102.615	132.97613	15.671	-30.36040124	-22.83146694
1989Q1	96.4600	96.46	123.38787	0.000	-26.92787251	-21.82375947
1989Q2	107.370	107.37	114.96539	0.000	-7.595392603	-6.606677393

			107.63969	0.000	7.780313102	7.228108262
			101.337	0.000	14.12299548	13.93666169
1990Q1	107.743	107.743	95.988457	0.000	11.75454272	12.24578773
1990Q2	104.413	104.413	91.53398386	0.000	12.87901614	14.07020168
1990Q3	97.2170	97.217	87.92086956	0.000	9.296130441	10.5732922
1990Q4	91.9870	91.987	85.10444902	0.000	6.882550976	8.087181169
1991Q1	85.4970	85.497	83.045867	0.000	2.451132995	2.951541219
1991Q2	90.0870	90.087	81.71056984	0.000	8.376430161	10.25134224
1991Q3	82.0670	100.101	81.06553582	-18.034	19.03588673	23.48209573
1991Q4	86.8470	87.9963	81.08297853	-1.149	6.913375267	8.526296632
1992Q1	79.0830	57.475	81.74700894	21.607	-24.27147214	-29.69096051
1992Q2	66.1970	83.6579	83.04605892	-17.461	0.611934636	0.736861742
1992Q3	67.7770	69.8378	84.95339065	-2.061	-15.1155814	-17.79279353
1992Q4	72.6900	66.9985	87.44264878	5.691	-20.44412785	-23.38004182
1993Q1	72.5030	58.6187	90.47803071	13.884	-31.8592689	-35.21215996
1993Q2	74.9700	65.6300	94.01095626	9.340	-28.38093188	-30.18896202
1993Q3	82.1630	67.7353	97.97293323	14.428	-30.23759155	-30.86320941
1993Q4	83.3970	83.397	102.2777313	0.000	-18.8807313	-18.46025626
1994Q1	124.173	124.173	106.8202217	0.000	17.35277832	16.24484395
1994Q2	131.303	131.303	111.4834751	0.000	19.81952487	17.77799342
1994Q3	148.283	148.283	116.1614079	0.000	32.12159212	27.65255063
1994Q4	176.113	176.113	120.7603234	0.000	55.35267665	45.83680725
1995Q1	132.610	132.61	125.206601	0.000	7.403399001	5.912946236
1995Q2	110.473	115.445	129.4612157	-4.972	-14.01599172	-10.82640206
1995Q3	121.417	119.953	133.4897693	1.463	-13.53588002	-10.14001304
1995Q4	127.110	127.11	137.249104	0.000	-10.139104	-7.387373544
1996Q1	138.427	138.427	140.6876017	0.000	-2.260601706	-1.606823685
1996Q2	146.290	146.29	143.7473076	0.000	2.542692417	1.768862638
1996Q3	159.370	159.37	146.3688539	0.000	13.00114613	8.882454008
1996Q4	160.830	160.83	148.494462	0.000	12.335538	8.30706939
1997Q1	166.673	166.673	150.0744791	0.000	16.59852089	11.0601889
1997Q2	165.497	165.497	151.0669621	0.000	14.43003794	9.552080575
1997Q3	173.427	168.0104521	151.4403418	5.417	16.57011031	10.94167519
1997Q4	183.787	180.0457636	151.172068	3.741	28.87369565	19.09988799
1998Q1	196.370	186.9805831	150.2499466	9.389	36.73063644	24.44635573
1998Q2	192.740	182.9529823	148.6798299	9.787	34.27315241	23.05164892
1998Q3	200.333	195.2854164	146.4905265	5.048	48.79488993	33.30924607
1998Q4	194.867	201.8731755	143.7322658	-7.006	58.14090974	40.45084061
1999Q1	106.510	177.5789289	140.4857741	-71.069	37.0931548	26.40349532
1999Q2	100.717	126.3949151	136.8681158	-25.678	-10.47320069	-7.652038335
1999Q3	94.8000	85.22969106	133.0195384	9.570	-47.7898473	-35.92693817

			129.0737436	-1.790	-34.10648961	-26.42403378
			125.1345647	3.737	-36.30826083	-29.01537311
2000Q2	98.1630	100.388824	121.2845181	-2.226	-20.89569412	-17.2286574
2000Q3	101.587	95.73650525	117.583428	5.850	-21.8469227	-18.57993348
2000Q4	107.683	112.1977012	114.0780582	-4.515	-1.880356988	-1.648307323
2001Q1	102.780	91.87654887	110.8015187	10.903	-18.92496983	-17.08006357
2001Q2	111.053	85.51238778	107.785744	25.541	-22.27335621	-20.66447323
2001Q3	113.770	91.65199163	105.0508405	22.118	-13.39884891	-12.75463275
2001Q4	116.883	115.9501151	102.602994	0.933	13.34712113	13.00851039
2002Q1	119.647	112.2069167	100.4400156	7.440	11.76690111	11.71535174
2002Q2	114.857	111.8342785	98.56805867	3.023	13.26621983	13.45894401
2002Q3	105.760	109.800171	97.00063084	-4.040	12.79954021	13.19531646
2002Q4	103.707	106.9191342	95.75953106	-3.212	11.15960313	11.65377796
2003Q1	101.887	99.40694405	94.87455803	2.480	4.532386023	4.777240724
2003Q2	102.250	107.5176776	94.38248519	-5.268	13.13519236	13.91698082
2003Q3	35.6570	82.33698399	94.32291873	-46.680	-11.98593474	-12.70734080
2003Q4	50.0000	14.50506534	94.74367434	35.495	-80.238609	-84.69020181
2004Q1	50.0000	42.56842575	95.68507648	7.432	-53.11665073	-55.51194887
2004Q2	50.0000	66.88237459	97.1373005	-16.882	-30.25492591	-31.14655828
2004Q3	107.047	87.25837214	99.05732384	19.789	-11.79895169	-11.91123608
2004Q4	73.7070	106.6187112	101.3832146	-32.912	5.235496654	5.164066532
2005Q1	113.440	101.4717447	104.0456665	11.968	-2.573921826	-2.473838567
2005Q2	119.417	115.8604203	106.9786456	3.557	8.881774736	8.302380990
2005Q3	131.447	128.9933437	110.1145091	2.454	18.87883463	17.14472942
2005Q4	132.327	142.7376752	113.3911652	-10.411	29.34650994	25.88077288
2006Q1	132.633	121.1521071	116.7583218	11.481	4.393785344	3.763145339
2006Q2	133.493	138.2914966	120.1840279	-4.798	18.10746873	15.06645188
2006Q3	132.700	133.9273523	123.6390789	-1.227	10.28827347	8.321214912
2006Q4	131.260	145.437346	127.1055872	-14.177	18.3317588	14.42246498