Macroeconomic Shocks and Exchange Rate Fluctuation in Nigeria: Evidence from Structural Vector-Auto Regression (SVAR)

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Abstract

This paper clarifies the concept of macroeconomic shocks affecting real exchange rate, by identifying four structural shocks; nominal, relative demand, supply and oil price shocks the period 1996q1-2013q4. The short run and long run impact of these shocks on relative output, relative price, real exchange rate fluctuations are broadly consistent with the implications of the Mundel - Fleming - Dornbusch type model that provide the necessary backdrop for the identification restrictions used in this work. The identified shocks suggest that long term movement in real exchange rate has been primarily driven by relative demand shock. The finding that real shocks are predominant in driving real exchange rate movements implies that policy makers need to focus more on the factors that drive the real side of the economy in order to stabilize the foreign exchange market.

Keywords: Macroeconomic Shocks, Exchange Rate Fluctuation, Structural VAR

INTRODUCTION

Ever since the findings by Meese and Rogoff (1983) that macroeconomic fundamentals and exchange rates are unrelated, research on the dynamics of exchange rate has recorded tremendous progress in terms of econometrics modeling effort. This has prompted some form of modeling strategy on the nexus between exchange rate and macro fundamentals. Basically, there are two distinct sources of exchange rate variability, one associated with disturbances in the financial market (nominal shocks) the other with shocks in

the real economy (real shock). The financial markets view has first been expounded in the disequilibrium approach of Dornbusch (1976), in which money market disturbances lead to excessive exchange rate volatility in an environment of sluggish price adjustment. Disturbance in financial market may include variety of sources such as different monetary policies, currency substitution effect or speculative short term capital transactions. By causing excessive fluctuations of exchange rates, such shocks are considered disruptive to the smooth operation of the real economy. In contrast, the real economy view originates from the work of Stockman (1980, 1987), Lucas (1982) and Hsieh (1987). In these models, the dynamics of exchange rate are considered to be the result of equilibrating responses to disequilibria in output markets caused by aggregate demand or aggregate supply disturbances. In other word, shock arising in the real sector, such as fiscal policy, changes in preferences or technological progress induce shift in relative prices between the domestic economy and the rest of the world. These can best be absorbed by appropriate adjustment of the nominal exchange rate (Kempa, 2005).

A number of studies have been conducted on the extent of naira exchange rate and its misalignment utilizing macroeconomic models. Different result were obtained based on the methodology utilized (see Akinuli, 1997; Ojameruaye, 1990; Ogun, 2004; Agu, 2002; Omotosho and Wambai, 2005; utilized the purchasing power parity approach (PPP)). On the other hand Obaseki, 2001) used the fundamental equilibrium exchange rate approach (FEER)). Other strand of literature like (Aliyu, 2011) utilized the behavioral equilibrium exchange rate approach (BEER). While a number of these equilibrium exchange rate has been applied to the Nigerian data to address a number of policy question regarding exchange rate misalignment, the problems with these equilibrium estimates is that they focused on real shock as the fundamental determinants of equilibrium exchange rate. To fill this gap this

paper constructs a structural vector autoregression (SVAR) model along the lines of Blanchard and Quah (1989) and Clarida and Gali (1994) to estimate the relative importance of different types of macroeconomic shocks to fluctuation in real exchange rate by identifying four types of shocks these includes; supply or technological shock, demand shock, monetary or norminal shock and oil price shock. Following this introduction, the paper is structured into five sections. Section one deals with the introduction, section two is concern with the literature review, comprising of the empirical and theoretical literature as well as stylized fact. In section three we presents the methodology of the study, while, four present the analysis of result and section five concludes the paper with recommendation.

2.0 LITERATURE REVIEW

2.1 Empirical Literature

A number of empirical studies on exchange rate fluctuations found that unstable exchange rate hampers growth in trade (Arinze et al 2000; Chowdhury, 1993; Cottani et al 1990). However, concern about fluctuations in real exchange rate is more worrisome, because it plays a central role as the principal equilibrating variable of a country's international trade and payment, (Harberger, 2004). According to (Razin and Collins, 1997) real exchange rate movements respond to both nominal and real disturbances and inconsistent macroeconomic policies tend to generate a real exchange rate overvaluation. However, Chadha & Prasad, (1997) found relative nominal and real shock as the main determinants of variation in real exchange rate. Other studies like Alexius, (2001), Moore and Penecost, (2006) found real shock as the predominant factor driving fluctuations in real exchange rate. While Bergvall, (2004) found terms of trade shock to be more important determinant of real exchange rate fluctuation. For studies in Nigeria, Olomola and Adejumo (2010) found oil price shock to significantly

affect real exchange rate fluctuation, Victor and Nathaniel, (2012) also confirm this result using different methodology.

Chadha and Prasad, (1997) analyzes the relationship between the real exchange rate and the business cycle in Japan during the period 1975:1-1996:1. A structural vector autoregression is used to identify different types of macroeconomic shocks that determine fluctuations in aggregate output and the real exchange rate. Relative nominal and real demand shocks are found to be the main determinants of variation in real exchange rate changes, whereas relative output growth is driven primarily by supply shocks. Historical decompositions suggest that the sharp appreciations of the yen in 1993 and 1995 and its subsequent depreciation can be attributed primarily to relative nominal shock.

In an attempt to move beyond the purchasing power parity hypothesis, (Alexius, 2001) addresses two issues. The first concerns the causes of movements in real exchange rates. In contrast to the typical result, supply shocks are found to dominate the long-run variance decompositions for each of the four Nordic countries under study. This suggests that productivity developments are the most important determinant of long-run movements in real exchange rates. A second topic is the relative importance of stationary and non-stationary components of real exchange rates. Also in contrast to previous findings, transitory shocks are more important than permanent shocks for three of the four countries.

The study by Moore and Pentecost, (2006) examines the contributions of real (permanent) and nominal (temporary) shocks on the nominal and real exchange rates of the Indian Rupee against the US dollar in the period since 1993, using the long-run structural VAR technique for the period 1993:3-2004:1. The finding that real shocks are predominant in driving real exchange rate movements highlights that the Indian policy

makers need to focus more on the factors that drive the real side of the economy in order to stabilize the foreign exchange market. To the extent that these factors are changing in response to widespread liberalization of the macro economy, then it is to be expected that the Rupee will most likely behave in a non-stationary way for the immediate future.

The model derived by Bergvall, (2004) yields testable implications concerning the long-run co-movements of real exchange rates, relative labor productivity, the trade balance and terms of trade. Countries with relatively higher output growth, trade deficits or improved terms of trade are found to have more appreciated real exchange rates, with the main channel of transmission working through the relative price of non traded goods. Exogenous terms-of- trade shocks are found to be the most important determinant of long-run movements in the real exchange rate for Denmark and Norway, while demand shocks account for most of the long-run variance in the real exchange rate for Finland and Sweden.

Olomola and Adejumo (2010) examined the effect of oil price shock on output, inflation, the real exchange rate and the money supply in Nigeria using quarterly data from 1970 to 2003. The VAR method was employed to analyze the data. The findings were contrary to previous empirical findings in other countries; oil price shock does not affect output and inflation in Nigeria. However, they did find that oil price shocks do significantly influence the real exchange rates. The result implies that a high real oil price may give rise to wealth effect that appreciates the real exchange rate. This may squeeze the tradable sector, giving rise to the 'Dutch Disease'.

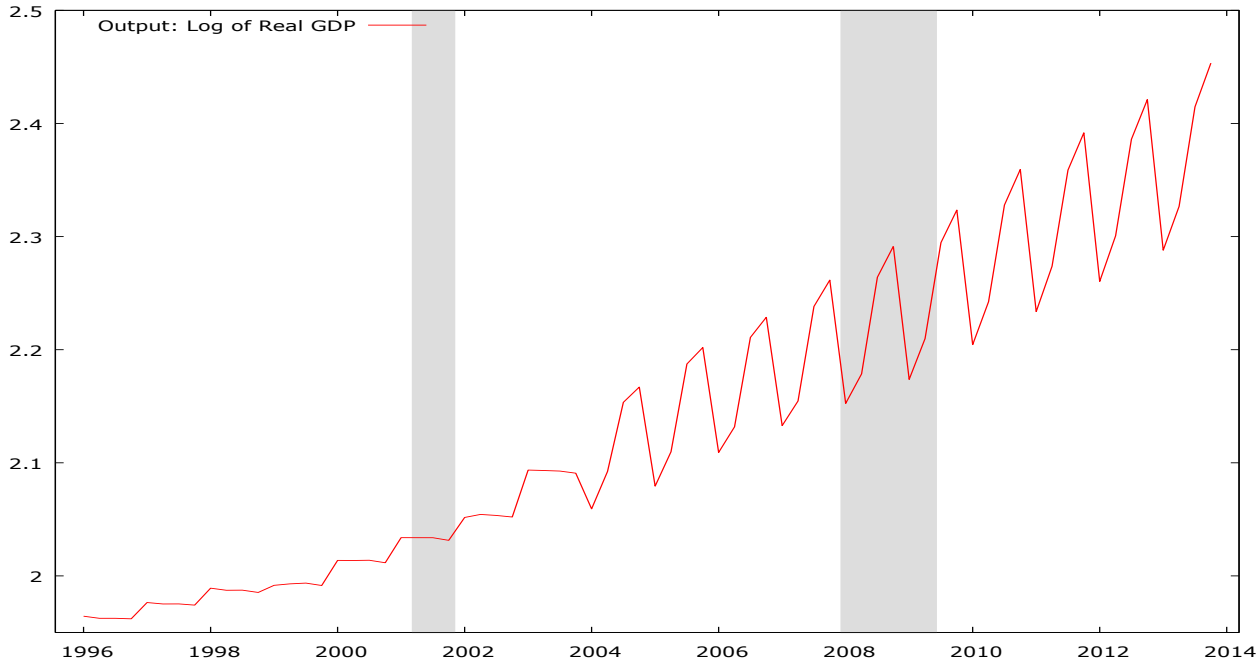
Victor and Nathaniel, (2012) examine the relationship between the real oil prices and the Real Exchange Rate. Using time series data covering the period between 1980 and 2010, the result of the Johansen cointegration test suggests a long run

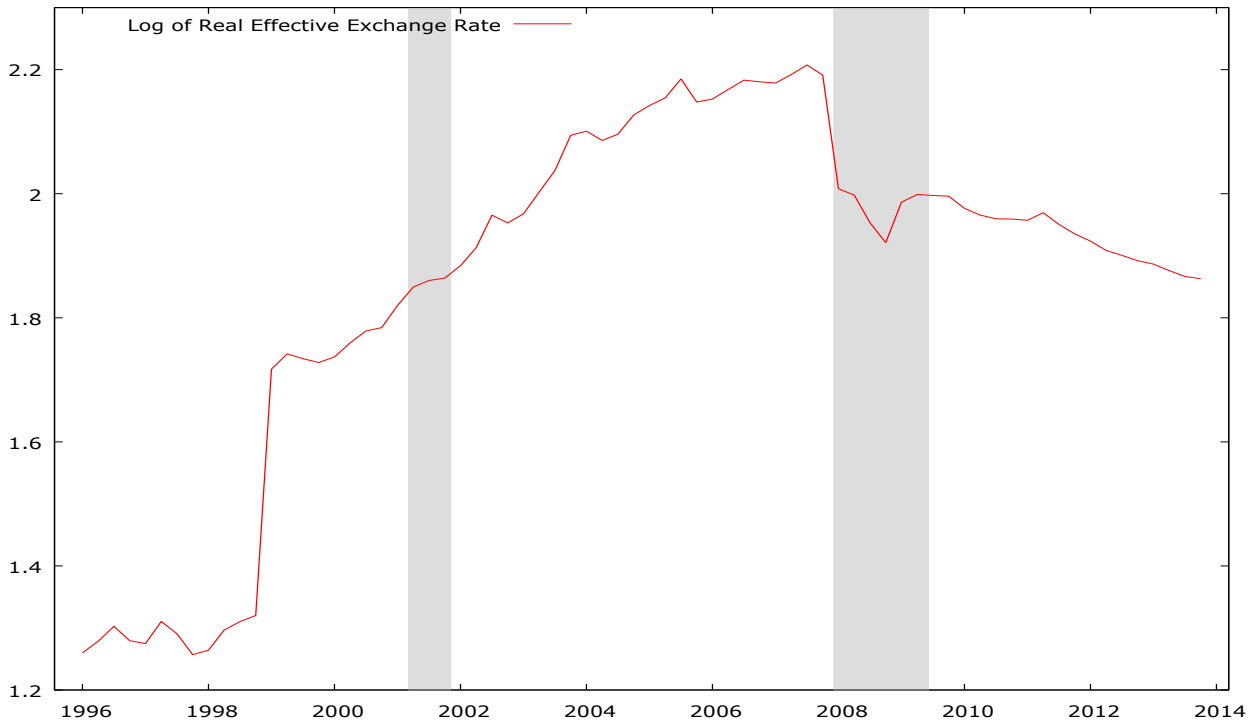
equilibrium relationship between the real oil prices and the real exchange rate. This relationship was supported by the Granger Causality test which validated the causal relationship from the real oil prices to the real exchange rate. The result from the Generalized Autoregressive Conditional Heteroskedasticity test suggests persistence of the volatility between the real oil prices and the real effective exchange rate. The implication of this is that government policies in tackling the impact of fluctuations in real oil prices are important source of stabilizing the movements in the real effective exchange rate.

2.2 Stylized Fact

The historical relationship between exchange rate and real output shows fluctuation that mimick a business circle, from macroeconomic point of view such movement could be precipitated by shock to macroeconomic variables. Such shock could be the result of domestic macroeconomic policy or development in the external environment. Trend in figure 1, show fluctuation in real output and real effective exchange rate in their levels form, a rise in real effective exchange rate represent appreciation while a fall represent depreciation. The cyclical components of output and the real exchange rate as presented in the third panel of figure 1, shows the cyclical components of both series as obtained using the Hodrick-Prescott filter. The relative magnitude of permanent and transitory components of real exchange rates and real output is important because it contains information about the empirical relevance of models of short-run fluctuations around a constant equilibrium. In other word, the Hodrick-Prescott-filtered cyclical components of output and the real exchange rate can be interpreted as percentage deviations from trend. Insight on the theoretical relationship between different macroeconomic shocks would serve as a useful guide in understanding the observed movement in real effective exchange rate and output away from the trend in most of the period between 1996 – 2013.

Figure 1: Trend in Output and Real Effective Exchange Rate 1996-2013




Log of Real Effective Exchange Rate
2.2
2
1.8
1.6
1.4
1.2
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014

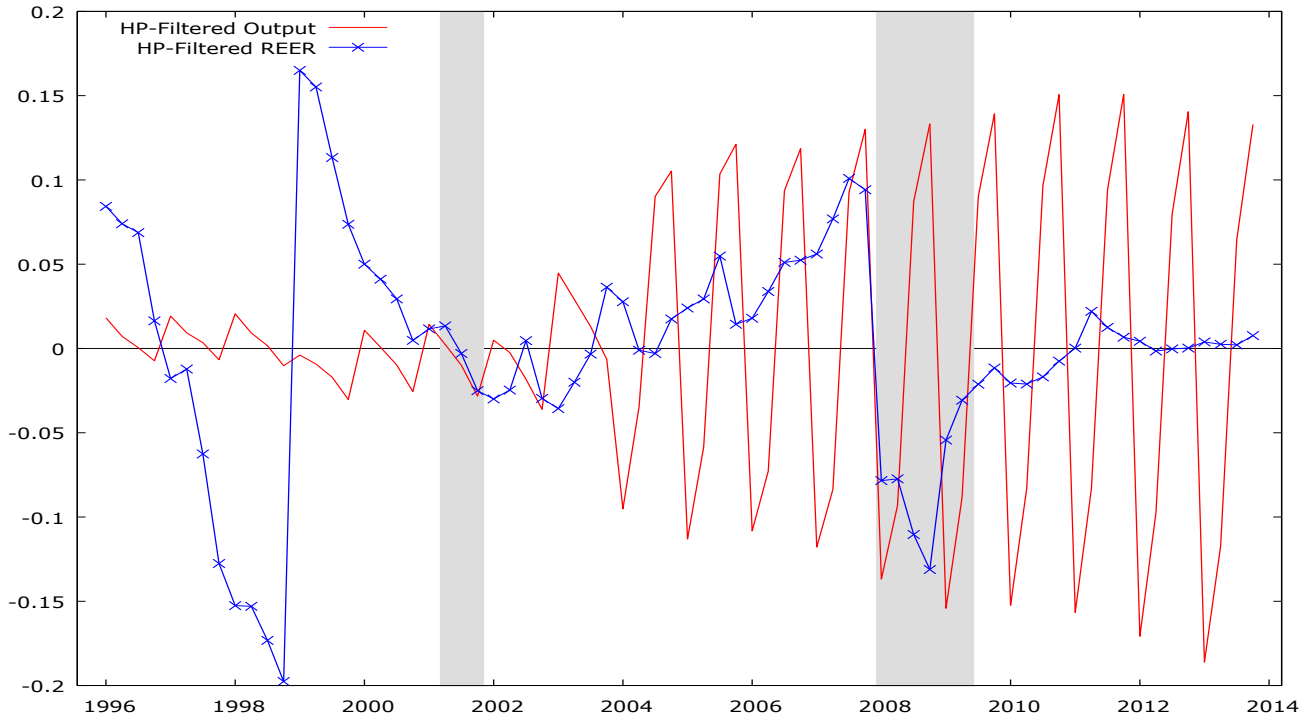
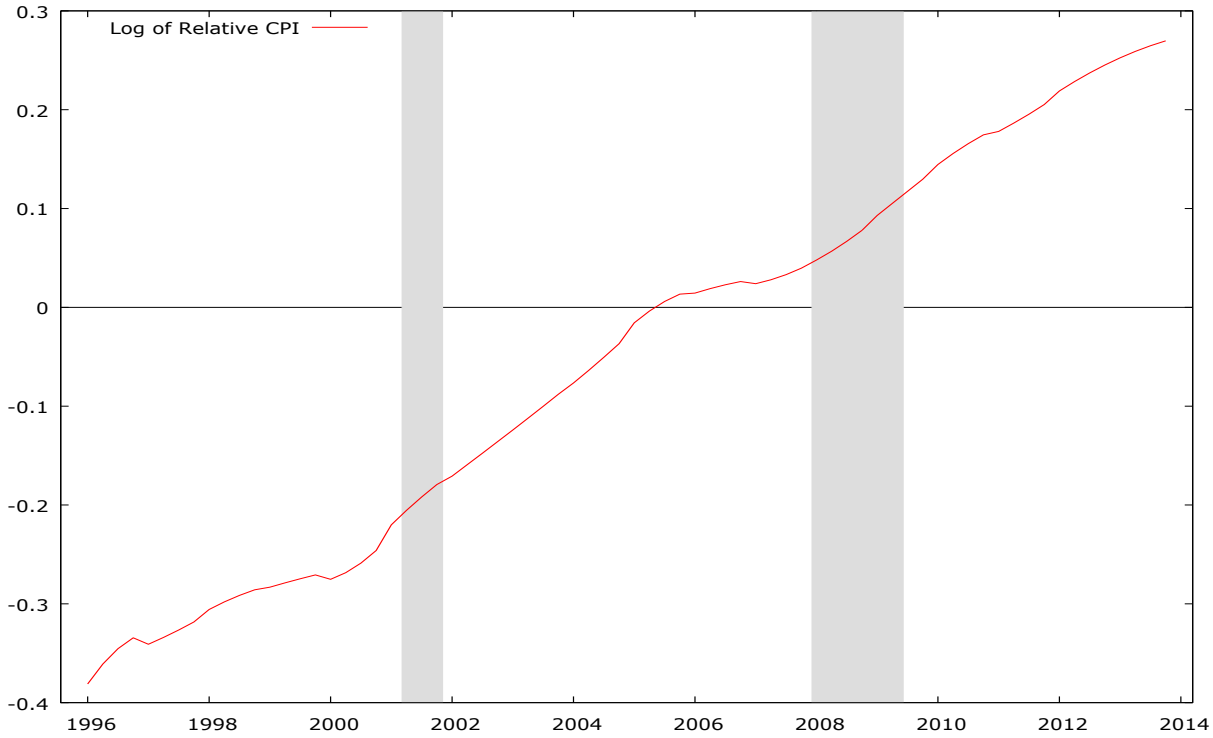
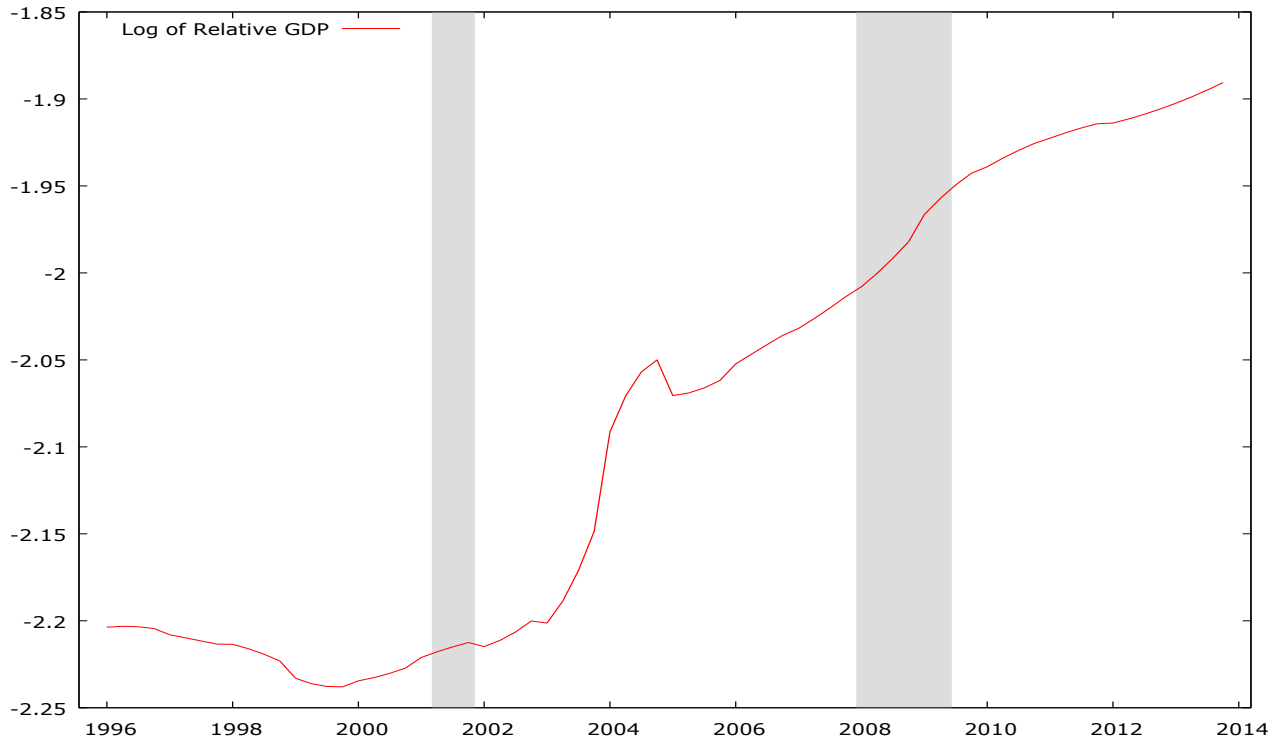
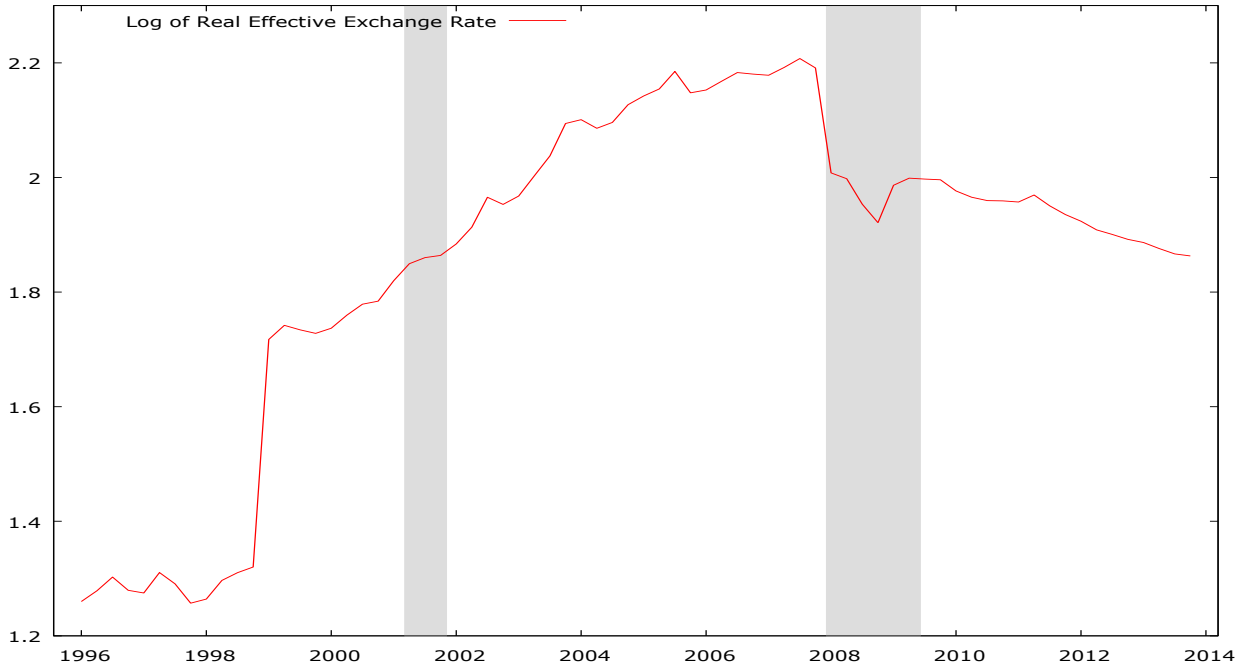

HP-Filtered Output
HP-Filtered REER
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014

Figure 2 shows that the entire variables exhibit trend over the sample period, to derive the appropriate econometrics specification of the econometrics model, it is necessary to determine whether this variables are stationary around stochastic or deterministic trend.

Figure 2: Log of ROILP, RCPI, RGDP and REER


Log of Relative CPI
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014


Log of Relative GDP
-1.85
-1.9
-1.95
-2
-2.05
-2.1
-2.15
-2.2
-2.25
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014


Log of Real Effective Exchange Rate
2.2
2
1.8
1.6
1.4
1.2
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014

2.3 Theoretical Consideration

To provide a framework for interpreting the observed relationship between real effective exchange rate and output fluctuation, an important starting point is the theoretical relationship between different macroeconomic shocks. Following the work of Blanchard and Quah (1989) and Clarida and Gali (1994), three different types of macroeconomic shock can be identified in relation to fluctuation in output, real exchange rate and aggregate price level. These shocks are nominal shock, demand shock and supply shock. In the framework of the traditional IS-LM macroeconomic model, these shocks can be thought of as shocks to goods and money markets (that shift the IS and LM curves), respectively, and shocks that affect the long-run level of capacity output. Shocks to goods markets are referred to as real demand shocks; shocks to money markets, as nominal or monetary shocks; and shocks affecting the long-run level of capacity output, as supply shock (Chadha and Prasad, 1997).

The idea that real exchange rate fluctuate stationarily around a constant equilibrium constitute the building blocks of long run purchasing power parity (PPP). Since long-run monetary neutrality ensures that monetary shocks only cause transitory deviations from equilibrium, PPP holds if all permanent shocks to real exchange rates are monetary. Since the abandonment of fixed exchange rate system (Post-Breton Wood), there has been substantial deviations from PPP (see e.g. Rogoff 1996). However, the fact that, many empirical studies cast doubt on the validity of this theory (see for instance Frankel 1981, Adler and Lehman 1983, Krugman 1978, Obi 1987), suggests the influence of real shocks with large permanent effects. If movements in real exchange rates are instead caused by permanent real shocks, such as shocks to relative productivity, it implies that movements in equilibrium real exchange rates are non-stationary unit root processes.

The apparent controversies trailing the applicability of PPP in empirical work suggest that it is more likely that some movements in real exchange rate are transitory while other movements are permanent. As long as permanent shock are present in the data, the all or nothing PPP hypothesis will be rejected in empirical test, the behaviour of the real exchange rate is then broadly consistent with models were changes in real exchange rate are equilibrium movement as in Balasa (1964), Samuelson (1964) or Stockman (1988). The relative magnitude of permanent and transitory components of real exchange rate gives useful insight about the empirical relevance of models of short run fluctuations around a constant equilibrium versus models were the equilibrium varies over time. Beyond the classification of shocks to exchange rate into permanent and transitory components is the identification of several structural shocks that affect long run movement of real exchange rate. For instance, Balassa-Samuelson model emphasized supply side shocks emanating from relative productivity between tradable and non tradable sectors; Dornbusch sticky price model emphasized that monetary shocks have temporary but no permanent effects on the real exchange rate; most authors allows monetary shock to have permanent effect on real exchange rate, among these class of authors includes Clarida and Gali (1994), Rogers (1991), Chinn and Johnston (1996) among others.

The empirical analysis used in this work is based on a stochastic open economy macroeconomic model that is set forth in Clarida and Gali (1994). The model stands in the Mundel-Fleming-Dornbush tradition and captures the primarily short and medium term output and price dynamics. The simplification of two-country setting is adopted (home country versus aggregate of all trading partners), however, in this study we used the US variables as a proxy for our trading partners and it is assumed that the structural parameters are identical in both countries. This assumption will greatly facilitate the

model's formal exposition as all interesting variables can be simply expressed as the difference between the two country's macroeconomic aggregates (Meurers, 2006). For instance, the output variable is given by; RGDP = y – y*, RCPI = p – p*, real oil price is given by oil price divided by the cpi (Roilp =oil price/cpi). RGDP is the relative GDP; where y is domestic real GDP, y* is US real GDP. RCPI is the relative consumer price index, where p is domestic cpi and p* is US cpi. All variables are expressed as logarithms of the levels of the time series.

3.0 METHODOLOGY

The Data

The study employs quarterly data for the period 1996q1-2013q4. Real GDP data for Nigeria and the US are taken from the World Development Indicators via the World Bank database (www.worldbank.org). Data for oil price, consumer price index are obtained from UNCTAD statistics, while the data for real effective exchange rate is obtained from Central Bank of Nigeria statistical bulletin. To specify stochastic processes for the macroeconomic shock implies that rgdp, rcpi, roilp, reer ought to be non-stationary in levels, but stationary in first difference. To verify this assumption, both Augmented-Dickey-Fuller-tests and Philip-Perron test have been carried out.

The unit root result as presented in table 1, shows that in all the variables in the model there is strong evidence that the variables are not stationary at levels. On the basis of this result is seemed justified to treat all variables as integrated of order one, I(1).

Table 1: Result of Unit-Root-Test

Augmented Dickey Fuller Test					**Philips Peron Test**				
Variables	**Levels**		**First Difference**		**Levels**		**First Difference**		
	With C	With C & T	With C	With C & T	With C	With C & T	With C	With C & T	OOI
RCPI	0.1091	-2.8005	-4.5501	-4.5202	-0.2796	-2.0602	-4.6756	-4.6406	I(1)
REER	-2.2111	-0.9233	-7.4215	-7.8823	-2.1821	-0.9233	-7.4183	-7.8732	I(1)
RGDP	-0.0225	-2.7525	-2.6361	-2.6281	0.3069	-2.3970	-4.2136	-4.2870	I(1)
ROILP	-2.0230	-1.9942	-3.4520	-3.4229	-2.5477	-2.7677	-4.6279	-4.5958	I(1)

The unit root test implies that the empirical model should be estimated as a vector auto-regression model in first differences. Hence, defining $\Delta Xt \equiv (\Delta op, \Delta y, \Delta r, \Delta p)$ where the four variable VAR includes; oil price (op), relative output (y), real effective exchange rate (r) and relative prices (p) in which case four structural shocks can be identified; real demand shocks (η_D), nominal shocks (η_N), aggregate supply shocks (η_S) and oil price shocks (η_{OP}). By employing a matrix of polynomial in the lag operator following Meurers, (2006) gives the following expression

$$L: B(L) = B_0 + B_1L + B_2L^2 + \ldots., \qquad 1$$

The reduce form of the VAR which has to be estimated can be expressed as

$$B(L)\Delta X_t = \varepsilon_t \qquad 2$$

Where $var(\varepsilon_t) = \Omega$ is the corresponding variance –covariance matrix of the error term. This VAR can be inserted into the following moving average representation:

$$\Delta X_t = D(L)\eta \qquad 3$$

where $C(L)D_0=D(L)$, the η_t 's are normalized so that they all have unit variance. If D_0 is identified, the MA representation of eqn.2 can be derived. Since D_0 is a (4*4) matrix with 16 elements. If the model above actually generated the data, then the four variable endogenous variables depends on four types of structural shock which includes; demand shock (η_D), supply shock (η_S), nominal shock (η_N), and oil price shock (η_{OP}). However, a four variable system imposes ten restriction on the system imposed ten restrictions on the elements in D_0 , six more restrictions are then needed to identify D_0, which will be achieved from restriction on the long run multipliers of the

D(L) matrix[1]. The long run expression of eqn. 3 can simply be written as

$$\begin{bmatrix} \Delta_{OP} \\ \Delta_Y \\ \Delta_R \\ \Delta_P \end{bmatrix} = \begin{bmatrix} D_{11}(I) & D_{12}(I) & D_{13}(I)\, D_{14}(I) \\ D_{21}(I) & D_{22}(I) & D_{23}(I)\, D_{24}(I) \\ D_{31}(I) & D_{32}(I) & D_{33}(I)\, D_{34}(I) \\ D_{41}(I) & D_{42}(I) & D_{43}(I)\, D_{44}(I) \end{bmatrix} \begin{bmatrix} \eta_{OP} \\ \eta_S \\ \eta_D \\ \eta_N \end{bmatrix} \qquad 4$$

As Blanchard and Quah (1989) have shown, the restriction can be imposed on D_0 by a lower triangular Cholesky decomposition of the estimated long-run variance-covariance matrix $C(I)\Omega C(I)'$:

$$HH' = C(1)\Omega C(I)' \quad 5$$

where H is a unique lower triangular matrix. The identification scheme utilized in this work is based on the standard open economy model as presented in Bjornland (2004).

Firstly, the restriction that the nominal shock can have only short term effects on the real exchange rate is consistent with most models of short run exchange rate variability, but long run PPP (see Clarida and Gali 1994). In other words, PPP is preserved in the long run with respect to monetary changes, so that nominal shock will increase price and depreciate the exchange rate proportionally. Thus:

$$D_{34}(1) = 0$$

[1]The identification restriction utilized in this work is based on the Blanchard and Quah (1989), to fully identified the system, the data only provide information on the canonical innovations, and some additional assumptions have to be placed to identify the structural shocks. In doing so, we set out k(k+1)/2 constraints out of the k^2 needed to completely identify D_0. Imposing the remaining k(k-1)/2 identifying constraints usually requires restriction borrowed from economic theory. In this case a four variable VAR imposes 10 constraints and 6 restrictions to fully identified the 16 elements contained there-in.

Second, the key (long run) identifying assumption that distinguishes between the demand and supply shocks, asserts that in the long run, the level of production will be determined by supply side factors (aggregate supply and real oil price shocks) only (see Blanchard and Quah1989). However, in the short run, due to nominal and real rigidities, all four disturbances can influence production. Hence:

$D_{23}(1)=D_{24}(1)=0$

Finally, the oil price shock itself is identified as the only shock that can have a long run effect on the real oil price. However, in the short run, all shocks are allowed to influence real oil prices:

$D_{12}(1)=D_{13}(1)=D_{14}(1)=0$

However, close examination of the impulse response function will reveal some over identifying restriction based on the standard IS-LM framework. For instance, a positive real demand and nominal shocks (that increase production only temporarily) shall increase price permanently. With these six long run restrictions, the matrix $D(I)$ will be lower triangular that can be used to recover D_0. Finally, the resulting historical decomposition of ΔX_t into the time part generated by the individual structural shocks, are given by the following expression

Historical path generated by oil price shocks:

$$\Delta X_t = C(L)\begin{bmatrix} D_{11}\,\eta_{OP} \\ D_{21}\,\eta_{OP} \\ D_{31}\,\eta_{OP} \\ D_{41}\,\eta_{OP} \end{bmatrix}$$

Historical path generated by supply shocks;

$$\Delta X_t = C(L)\begin{bmatrix} D_{12}\,\eta_S \\ D_{22}\,\eta_S \\ D_{32}\,\eta_S \\ D_{42}\,\eta_S \end{bmatrix}$$

Historical path generated by demand shocks;

$$\Delta X_t = C(L)\begin{bmatrix} D_{13}\,\eta_D \\ D_{23}\,\eta_D \\ D_{33}\,\eta_D \\ D_{43}\,\eta_D \end{bmatrix}$$

Historical path generated by nominal shocks;

$$\Delta X_t = C(L)\begin{bmatrix} D_{14}\,\eta_N \\ D_{24}\,\eta_N \\ D_{34}\,\eta_N \\ D_{44}\,\eta_N \end{bmatrix}$$

4.0 Analysis of Structural VAR

The result from the impulse response function presented in Appendix 1, panel 3 shows that, a positive oil price shock appreciates the real exchange rate up to the 10^{th} horizon after which it started falling until the effect of the shock faded out with time. Also, a positive supply shock appreciates the exchange rate in the long run. A positive oil price shock as well as nominal shock increase relative prices in the long run. However, the long run effect on the real exchange rate is very small and insignificant, and the first two quarters, the real exchange rate actually depreciates, before it gradually appreciates towards its new long run equilibrium level. The most consistent finding is that the response of the real exchange rate to supply shocks is always of opposite sign from what is predicted by the Dornbusch-type model. According to Edward (1989) model, the effect of technological progress on the real exchange rate depends on two things: how technological progress affects different sector and the type of

progress considered, whether product augmenting or factor augmenting. If any productivity shock occurred, it would have a positive income effect, which would in turn generate a positive demand pressures on non tradable, and hence lead to an appreciation in real exchange rate. The channel through which technological progress could lead to depreciation is when the supply effect offset the demand effect

A positive real demand shock like fiscal expansion, appreciate the real exchange rate and increase price gradually and relative GDP increase up to the 8th horizon, thereafter declining gradually to the base-line level. The real exchange rate depreciate, the price level fall and rise gradually but insignificantly and subsequently started declining until it asymptote to zero.

Based on the prediction of Dornbusch overshooting model, a nominal shock depreciates the real exchange rate temporarily, before it appreciates (overshoots) back to long run equilibrium. Prices increase slowly to a new permanent level. Evidence from the impulse response function shows that nominal shock (monetary innovation) appreciate the exchange rate up till the 2^{nd} period horizon, depreciate the exchange rate (though insignificantly) between the 3^{rd} and the 6^{th} period horizon, after which it started appreciating. Output also responded positively, by increasing rapidly up till the 6^{th} horizon and afterwards shows no response. Price level also responded by increasing rapidly as a result of monetary innovation up till the 8^{th} period horizon and afterward shows no response to monetary shock.

Table 2: Estimated Long Run Multiplier Matrix

$$\begin{matrix} & \eta_{OP} & \eta_S\eta_D & \eta_N & \\ \begin{bmatrix} OP \\ Y \\ R \\ P \end{bmatrix} & \begin{bmatrix} 0.7348 & 0.0000 & 0.0000 & 0.0000 \\ 3.2442 & 1.2013 & 0.0000 & 0.0000 \\ -3.5370 & -0.8025 & 0.8846 & 0.0000 \\ -1.9511 & 0.6764 & 0.7534 & 0.2609 \end{bmatrix} \end{matrix}$$

From table 2 above, the estimated long run matrix shows that a positive oil price shock leads to increase in output, depreciation of the exchange rate and a fall in relative prices. A positive supply shock is restricted to have no long run effect on oil price, but is estimated to have positive effect on relative output, depreciation of the real exchange rate and increase in price level. A positive demand shock is restricted to have no long run effect on relative oil price and relative output, but have positive effect on exchange rate and relative output. Nominal shocks are restricted to have only long run effect on relative price, which was estimated to be positive in response to an expansionary monetary shock. All the long run multipliers obtained from the restricted estimation is consistent with the theoretical model of the new open economy macroeconomics.

Table 3: Forecast Error Variance Decomposition

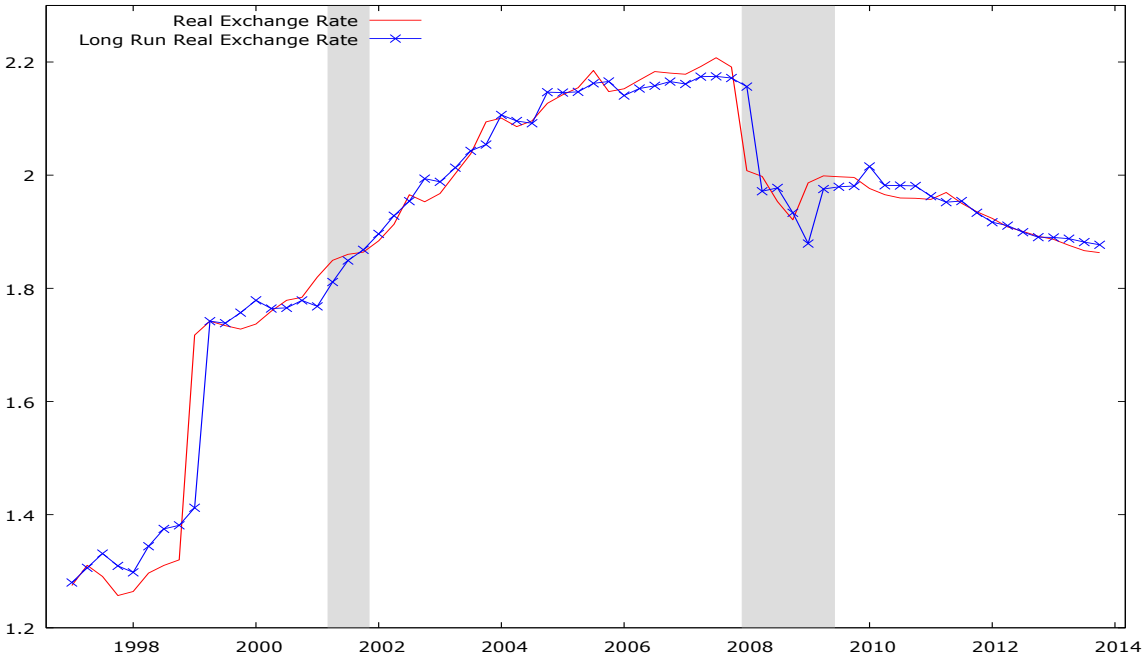
% of Variance In RGDP due to: $\eta_{op}\eta_s\eta_d\eta_n$	% of Variance In REER Due to: $\eta_{op}\eta_s\eta_d\eta_n$	% of Variance In Oil price Due to: $\eta_{op}\eta_s\eta_d\eta_n$	% of Variance In Relative CPI Due to: $\eta_{op}\eta_s\eta_d\eta_n$
1 0.76 0.16 0.04 0.04	1 0.03 0.01 0.85 0.11	1 0.04 0.38 0.18 0.40	1 0.19 0.78 0.04 0.00
2 0.74 0.17 0.03 0.06	2 0.03 0.01 0.88 0.08	2 0.03 0.46 0.17 0.34	2 0.16 0.79 0.04 0.01
3 0.73 0.19 0.02 0.06	3 0.03 0.01 0.90 0.06	3 0.03 0.54 0.15 0.29	3 0.13 0.82 0.03 0.01
4 0.72 0.20 0.02 0.07	4 0.03 0.01 0.91 0.05	4 0.02 0.60 0.13 0.25	4 0.10 0.85 0.03 0.02
5 0.72 0.20 0.01 0.07	5 0.03 0.01 0.91 0.04	5 0.02 0.64 0.11 0.22	5 0.08 0.88 0.02 0.02
6 0.72 0.20 0.01 0.07	6 0.04 0.03 0.90 0.04	6 0.02 0.66 0.11 0.21	6 0.06 0.89 0.02 0.03
7 0.72 0.21 0.01 0.07	7 0.04 0.04 0.89 0.03	7 0.02 0.64 0.14 0.20	7 0.05 0.90 0.02 0.04
8 0.72 0.21 0.01 0.07	8 0.04 0.06 0.87 0.03	8 0.02 0.61 0.17 0.20	8 0.04 0.90 0.01 0.04
9 0.72 0.21 0.01 0.07 10 0.72 0.21 0.01 0.06	9 0.04 0.08 0.85 0.03	9 0.03 0.58 0.20 0.19	9 0.04 0.90 0.02 0.05
11 0.72 0.21 0.01 0.06	10 0.04 0.09 0.84 0.03	10 0.03 0.56 0.22 0.19	10 0.03 0.90 0.02 0.05
12 0.72 0.21 0.02 0.06	11 0.04 0.10 0.83 0.03	11 0.04 0.55 0.23 0.18	11 0.03 0.90 0.02 0.06
----------	12 0.04 0.11 0.82 0.03	12 0.05 0.55 0.23 0.17	12 0.03 0.89 0.02 0.06
20 0.700.22 0.04 0.05	----------	----------	----------
	20 0.04 0.11 0.82 0.02	20 0.08 0.53 0.23 0.16	20 0.02 0.86 0.07 0.05

The relative contributions of real oil price shocks, nominal shock, relative demand shock and supply shock can be gauged through the forecast error variance decompositions. Table 3 reports the variance decompositions for the real effective exchange rate, real oil price, relative GDP and relative prices in logarithmic first differences at selected horizons.

The initial contribution of oil price shocks to relative GDP movements is almost 76%. It then accounts for 73% of the variance in the 3rd quarter, which decreases to around 72% in the 20th horizon. The real oil price shock explains the majority of the forecast error variance of relative GDP, demand and nominal shock appears to be unimportant for variation in relative GDP at all horizons. However, the contribution of supply shock to variation in relative GDP in the 1st quarter is 16% and later increase to 22% in the 20th. This result is not surprising, since Nigeria is a small open economy, were the oil sector play the dominant role in variation of GDP. This finding is broadly in line with other studies utilizing Blanchard and Quah's (1989) methodology.

For an oil dependent country like Nigeria, stochastic shock to the goods market (shock to IS curve) may precipitate excessive exchange rate volatility. As evidence from the FEVD, this view is supported by the data as demand shock constitute 85% of variation in exchange rate in the 1st quarter and rose to 90% in the 3rd quarter. At the end of the 20th horizon demand shock explain 82% of variation in exchange rate, while other three shocks all together accounted for 17%. This could be the result of high fiscal spending that mostly characterized period of positive oil price shock.

Figure 3: Real Exchange Rate



3 suggest that the trend (accumulated demand, nominal, oil price and supply shock) follow the real exchange rate closely in many period. In 1997Q1, the exchange rate was undervalued (-0.41%) this was closely followed by overvaluation in 1997:Q2. However, long period of undervaluation was recorded between 1997:Q3-1998:Q3 with an average undervaluation of (-3.71), high level of disequilibrium (overvaluation) was recorded between 1999Q1-1999Q2 with an average of (10.80%). There was undervaluation between 1999:Q3-2000:Q2, this period was followed by overvaluation of the exchange rate with an average of (1.34%). From 2002:Q4 – 2003:Q3 exchange rate was undervalued with an average of (-0.97%), a long period of overvaluation was experienced between 2006:Q1-2007:Q4, the average of undervaluation in 2011 is (-1.05%) while in 2012:Q3-Q4 it is overvalued with an average of (0.07%) which was followed by undervaluation of (-0.59%).

5.0 Conclusion and Policy Recommendation

This paper clarifies the concept of macroeconomic shocks affecting real exchange rate. Four structural shocks are identified; nominal, relative demand, supply and oil price shocks. The short run and long run impact of these shocks on relative output, relative price, real exchange rate fluctuations are broadly consistent with the implications of the Mundel - Fleming - Dornbusch type model that provide the necessary backdrop for the identification restrictions used in this work. The identified shocks suggest that long term movement in real exchange rate has been primarily driven by relative demand shock that has played significant role in explaining episodes of appreciation/depreciation of real exchange rate and how it led to significant changes in the implied equilibrium exchange rate. However, while monetary shocks do not affect the long run real exchange rate, in the short-run they seem to have had an expansionary effect that led to appreciating pressure on the exchange rate. The finding that real shocks are predominant in driving real exchange rate movements implies that policy

makers need to focus more on the factors that drive the real side of the economy in order to stabilize the foreign exchange market.

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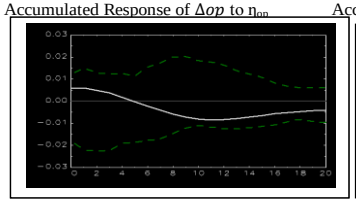
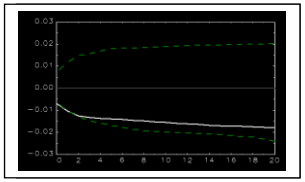
Appendix 1

Accumulated Response of Δop to η_{op}



Accumulated Response of Δop to η_s



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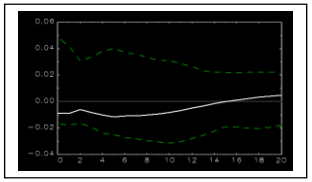
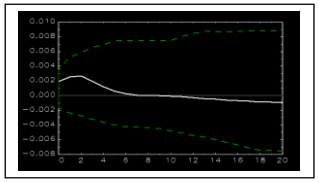
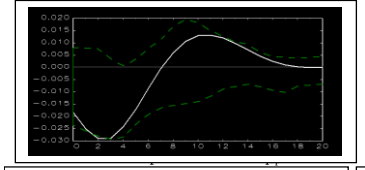


Accumulated Response of Δop to η_N



Accumulated Response of ΔY to η_{op}



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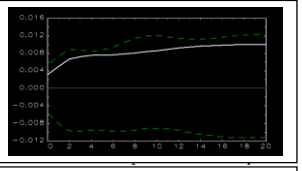

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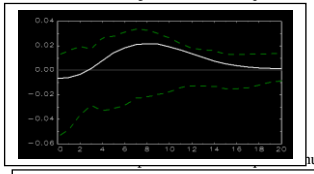

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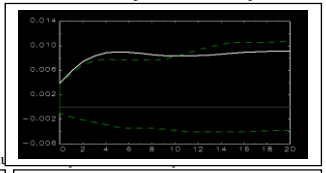
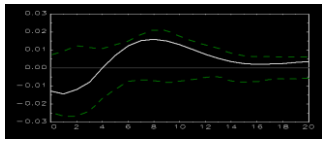
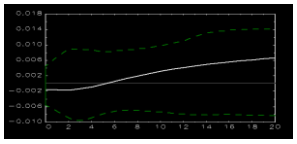
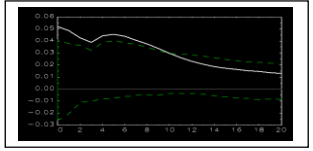
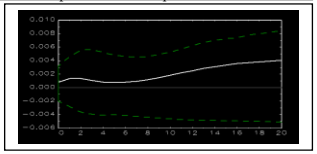


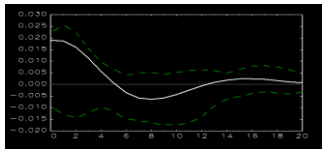




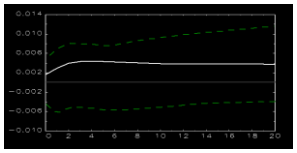




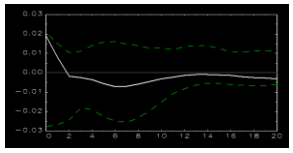
Accumulated Response of ΔP to η_{op}



Accumulated Response of ΔP to η_s



Accumulated Response of ΔP to η_D



Accumulated Response of $\Delta P$to η_N