

CAUSAL RELATIONSHIP BETWEEN EXCHANGE RATE MISALIGNMENT AND INFLATION IN NIGERIA: EVIDENCE FROM STRUCTURAL VECTOR AUTOREGRESSION (SVAR)

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Abstract

A well-known view in international macroeconomics literature states that a misaligned exchange rate provokes costs to the domestic economy. In other words, an overvalued currency may cause competitiveness loss in international trade, while an undervalued currency may cause inflationary pressures. Based on this, this paper tests the conjecture that exchange rate misalignment is related to inflation using the SVAR framework to compute exchange rate misalignment and subsequently testing the conjecture. The SVAR model is utilized among the competing models in understanding the dynamics of real exchange rate because it has a better empirical fit and allows for greater identification of shocks that make economic sense. Compared to other models, the kind of SVAR model used for this study is based on the Blanchard & Quah, (1989) methodology. Where variables in the model attain their stationarity at first difference, the empirical model should be estimated as a vector auto-regression model in first differences. In other to achieve the objective of the study, this paper uses Toda-Yamamoto Granger noncausality test and the result demonstrate a significant Granger causality from inflation to exchange rate misalignment but the converse is not true which support the view that inflation persistence is responsible for overvaluation of the naira (misalignment) which is inimical to competitiveness and growth, this necessitated the need for appropriate response to bring the real effective exchange rate (REER) on its equilibrium path via embarking on disinflation policies.

Keywords: Exchange Rate Misalignment, Inflation, Oil price, Structural Vector Autoregression

Introduction

In the 1980s, monetary policy was subordinated to the objective of financing large fiscal deficits in most Sub Saharan African countries. This led to high inflation and, in combination with fixed exchange rates, overvalued real exchange rates (Berg, O'Connell, Pattillo, Portillo & Unsal, 2015). From the mid-1980s to the late 1990s countries began reform programs, often with exchange rate unifications and movements toward more market-determined exchange rates, notable reductions in central bank financing of government and financial liberalizations (Nguyen, Dridi, Unsal & Williams, 2017). Between 1960 and 1986, Nigeria practice a fixed exchange rate regime, in which case deficit was recorded most of the time. Furthermore, an examination of exchange rate regime in Nigeria suggest a tendency towards continuous exchange rate depreciation or exchange rate volatility, which may be inimical to monetary stability and beneficial flow of international goods, services and investment especially foreign

direct investment, Jimoh (2004). The movement from fixed to flexible exchange rate regime was itself a desperate move to resolve the problem of persistent balance of payment deficits occasioned by higher inflation. Despite all this effort, inflation persistence has continued to be a recurring policy issue as well as fluctuation in real effective exchange rate which has stimulated studies on the sources of fluctuation of the later.

Following the seminal work of Edwards (1989) that found a significant negative relationship between economic growth and overvaluation, a number of studies have attempt to test the relationship between exchange rate misalignment and economic growth) in Nigeria. For instance, Ali, Ajibola, Omotosho, Adetoba & Adeleke, 2015: Ibrahim 2016) found that misalignment had negative effect on growth. Omotosho (2015) examined the extent to which exchange rate misalignment could serve as an early warning signal for currency crisis. Soludo & Adenikinju (1997) and Ogun (1998) examined the effect of real exchange rate movement (both misalignment and volatility) on non-oil export. Other studies like David & Odjegba (2013) analyzed the relationship between exchange rate misalignment and balance of payment mal-adjustment while Nwokoye, Zubairu & Ayuba (2015) investigated the relationship between exchange rate misalignment and stock market volatility during pre-and-post liberalization era among others. While all these studies looked at various macroeconomic issues, attempt has not been made to examine the nexus between exchange rate misalignment and inflation. Secondly, while other conventional approaches have been used in the literature ranging from purchasing power parity (PPP), behavioural equilibrium exchange rate approach (BEER), permanent equilibrium exchange rate (PEER), attempt has not been made towards identifying various sources of fluctuations shaping the dynamics of real exchange rate. This constitute the entry point for this work. Therefore, the main objective of this work is to examine the nexus between exchange rate misalignment and inflation rate in Nigeria. To achieve the objective, the paper is structured into five sections. Section one deals with the introduction, section two is concern with the literature review. Section three looks at the methodology. In section four, the empirical result is presented and discussed and section five concludes the paper.

Literature Review

Jongwanich, (2009) examined the relationship between real exchange rate misalignment and export for developing Asian Countries between 1995 and 2008 using BEER approach, the result shows that real exchange rate misalignment could have a negative impact on export performance.

Holtemöller & Mallick, (2013) verify the claim that currency board arrangement leads to an overvalued exchange rate and significant worsening of current accounts of Argentina and Estonia using the FEER approach. The result suggests that there were no severe misalignments of the real exchange rates in the currencies of these countries.

Ebaidalla (2014), investigated the behaviour of equilibrium exchange rate and the effect of its misalignment on Sudan economic performance using the PPP approach. The result show that exchange rate exhibited overvaluation within the study period and has deleterious effect on Sudanese export performance. Another study by Razin & Collins, (1997) empirically explored the relationship between real exchange rate and economic growth for 93 countries. Their result shows important nonlinearities between misalignment and growth. Sallenave, (2010) evaluated growth effect of real effective exchange rate misalignment for G20 countries using BEER approach, the result show that the magnitude of misalignment is more pronounced in the case of emerging countries and the speed of convergence is slower for industrialized ones. Misalignment has a negative effect on growth. Similarly, Aflouk & Mazier, (2011) examined the

link between exchange rate misalignment and growth for 25 Emerging Countries and 136 OECD Countries using the fundamental equilibrium exchange rate (FEER) approach. The result shows that the impact of exchange rate misalignment and growth is nonlinear and positive. An overvaluation has negative impact on growth while undervaluation sustain growth until an estimated threshold. Giannellis & Koukouritakis (2013) found evidence that in periods of high depreciation of the home currency the domestic inflation rate was persistent, while in periods of slower depreciation, or relative stability, it was transitory in selected Latin American countries, namely Brazil, Mexico, Uruguay and Venezuela.

Omotosho, (2015) examined the extent to which currency misalignment could serve as an early warning signal for currency crisis using BEER approach for the period 1990: Q1-2011: Q2. The result shows that the likelihood of currency crisis in Nigeria increases when the real exchange rate is misaligned; the exchange rate is volatile; oil price declines; debt/GDP ratio increases; and the current account balance to GDP ratio declines. Another study by Ali, Ajibola, Omotosho, Adetba & Adeleke (2015) investigated the impact of naira real exchange rate misalignment on economic growth, the result shows that the coefficient of real exchange rate misalignment was negative and statistically significant. Implying that a unit increase in misalignment would lead to a reduction in output by about 0.003. Soludo & Adenikinju (1997) examined the effect of real exchange rate movements (defined in terms of misalignment and volatility) on the growth of non-oil export using BEER approach, they found that misalignment series have significant negative impact on manufacturing investment. Similar result was found by Ogun (1998) who examined the effect of real exchange rate movements (defined in terms of misalignment and volatility) on the growth of non-oil export and found that exchange rate misalignment adversely affected the non-oil export growth.

Ibrahim (2016) examined the impact of real exchange rate misalignment on economic growth using BEER approach, the GMM estimate revealed that real exchange rate misalignment has negative but significant impact on economic growth over the period under consideration. Theresa, Okoye, Anyanwu & Okoli (2014) examined the impact of real exchange rate (RER) misalignment and its volatility on the Nigerian agricultural sector using BEER approach, the findings revealed that exchange rate misalignment negatively affect the agricultural sector. Another by David & Odjegba, (2013) examined the relationship between exchange rate misalignment and balance of payments (BOP) mal-adjustment, the result show that exchange rate misalignment exhibited a positive impact on the country's balance of payments position. To investigate the relationship between exchange rate misalignment and stock market volatility during pre-and-post financial liberalization era, Nwokoye, Zubairu & Ayuba (2015) used the BEER approach and found that exchange rate misalignment had a positive but insignificant relationship with stock market volatility before the deregulation of the financial market in Nigeria.

Theoretical Literature

The Purchasing power parity (PPP) is often the measure economists first turn to when asked to think about the issue of equilibrium exchange rates and exchange rate misalignment. But the implications of the so-called PPP puzzle – the combination of high real exchange rate volatility and the slow mean reversion of real exchange rates – implies that PPP on its own is unlikely to be a useful measure of an equilibrium exchange rate. The PPP theory postulates that the exchange rate change between two currencies over any period of time is determined by the change in the two countries' relative price levels (Jongwanich, 2009). When the prices of each

good, in a common currency, are equalized across countries and the same goods enter each country's market with the same weights, the equilibrium RER can be determined as follows:

$$REER^* = \frac{eP^*}{P} \quad (2.1)$$

Where $REER^*$ is the equilibrium real exchange rate, e is the nominal exchange rate (in unit of foreign currency), P^* is the foreign price, and P is the domestic price. Equation (2.1) is referred to as the *absolute* PPP, which relies on the assumption of the law of one price. The law of one price always implies integrated competition markets.

The second approach in the theoretical literature is the behavioural equilibrium exchange rate (BEER). The starting point of the BEER approach is the proposition that real factors are a key explanation for the slow mean reversion to PPP observed in the data and as such offers a way of exploiting a theoretical (real) exchange rate model in order to obtain a measure of the equilibrium exchange rate and therefore, by implication, exchange rate misalignment. The BEER has the potential to capture all of the systematic and fundamental movements of exchange rates and can be subject to rigorous statistical testing, in terms of various metrics, such as the speed of mean reversion (Clark & MacDonald, 1999).

The third approach is the Permanent Equilibrium Exchange Rate, the PEER is closely related to the BEER approach. It underscores that the total RER misalignment at any given moment (the difference between the fitted and actual value of the RER) depends on transitory (short-term) factors and on the departure of fundamentals from their long-term value; usually, the decomposition into permanent and transitory components is obtained by using the Gonzalo-Granger method (Gonzalo & Granger, 1995).

The fourth and the most widely used concepts in determining equilibrium RER is FEER (Williamson, 1994). The FEER is defined as the RER that simultaneously attains internal and external balances. Internal balance is reached when the economy is at full employment output and operating in a low inflation environment. External balance is characterized as a sustainable balance of payments position over the medium term, ensuring desired net flows of resources and external debt sustainability (Jongwanich, 2009). The FEER tends to abstract from the short-run cyclical and speculative forces in the foreign exchange market. To determine FEER, the current account position (CA) is first set as a function of equilibrium real exchange rate ($REER^*$), full employment output of the local (Y^{d*}), and foreign (Y^{f*}) economies. The CA is then equated to the level of equilibrium capital account over the medium term (CAP^*). This equation can be written as in equation (2.2).

$$CA = f(REER^*, Y^{d*}, Y^{f*}) = CAP^* \quad (2.2)$$

However, the fundamental equilibrium exchange rate (FEER) is a normative measure of equilibrium RER as it involves some notion of "ideal" economic circumstances of internal and external balances. In particular, defining external balances, i.e., sustainable CA balance, tends to be controversial. In addition, to determine FEER, trade elasticity needs to be calculated to determine the response of exports and imports to relative price changes. Different forms of CA equations could lead to different values of the trade elasticity. Relying too much on trade elasticity may generate an inaccurate estimate of the FEER trajectory. Note that empirical studies that apply the FEER approach often rely on a full-blown multicountry macroeconomic model to capture the linkages of key macroeconomic variables. The sustainable value of the CA balance is set exogenously (Williamson, 1994). The SVAR model is utilized among the competing

models in understanding the dynamics of real exchange rate because it has a better empirical fit and allows for greater identification of shocks that make economic sense.

Methodology

Data and Property

All data are quarterly spanning 1998: Q1 to 2014: Q4, data on consumer price index (CPI) is obtained from Central Bank of Nigeria statistical bulletin, the real effective exchange rate and oil price is obtained from WDI database of World Bank while relative output and relative prices are computed from the same source.

The ADF test and the PP tests were undertaken under the assumption of the existence of a unit root (H_0) and a stationary variable in the alternative hypothesis (H_a).

The SVAR model is utilized among the competing models in understanding the dynamics of real exchange rate because it has a better empirical fit and allows for greater identification of shocks that make economic sense. Compared to other models, the kind of SVAR model used for this study is based on the Blanchard & Quah, (1989) methodology. Where variables in the model attain their stationarity at first difference, the empirical model should be estimated as a vector auto-regression model in first differences. Hence, defining $\Delta X_t = (\Delta op, \Delta y, \Delta r, \Delta p)$ 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

$$L: B(L) = B_0 + B_1L + B_2L^2 + \dots + B_NL^N \quad (3.1)$$

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

$$B(L)\Delta X_t = \varepsilon_t \quad (3.2)$$

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

$$\Delta X_t = D(L)\eta \quad (3.3)$$

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.3.3 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. The long run expression of eqn. (3.3) can simply be written as

$$\begin{bmatrix} \Delta_{OP} \\ \Delta_Y \\ \Delta_R \\ \Delta_P \end{bmatrix} = \begin{bmatrix} D_{11}(I) & D_{12}(I) & D_{13}(I) & D_{14}(I) \\ D_{21}(I) & D_{22}(I) & D_{23}(I) & D_{24}(I) \\ D_{31}(I) & D_{32}(I) & D_{33}(I) & D_{34}(I) \\ D_{41}(I) & D_{42}(I) & D_{43}(I) & D_{44}(I) \end{bmatrix} \begin{bmatrix} \eta_{OP} \\ \eta_S \\ \eta_D \\ \eta_N \end{bmatrix} \quad (3.4)$$

As Blanchard & 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 $C(I)\Omega C(I)'$:

$$HH' = C(I)\Omega C(I)' \quad (3.5)$$

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

First, 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, for long run PPP (see Clarida & 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:

$$D_{34}(1) = 0 \quad (3.6)$$

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 & Quah, 1989). However, in the short run, due to nominal and real rigidities, all four disturbances can influence production. Hence:

$$D_{23}(1)=D_{24}(1)=0 \quad (3.7)$$

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:

$$D_{12}(1)=D_{13}(1)=D_{14}(1)=0 \quad (3.8)$$

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 .

Results

Augmented Dickey Fuller (ADF) and Phillips Peron (PP) Unit Root Tests

The standard Augmented Dickey-Fuller (ADF) and Philip-Perron unit root test was exercised to check the order of integration of these variables. The results obtained are reported in Table 4.1.

Table 4.1 Augmented Dickey Fuller (ADF) and Phillips Peron (PP) Unit Root Tests

Augmented Dickey Fuller Test					Philips Peron Test				
Variables	Levels		First Difference		Levels		First Difference		OOI
	With C	With C & T	With C	With C & T	With C	With C & T	With C	With C & T	
REER	-2.3841	-1.9800	-3.6817	-3.8461	-2.0844	-1.7381	-4.8310	-4.8636	I(1)
RGDP	-2.4861	-2.6124	-2.6659	-3.0504	-1.8773	-1.6055	-4.7374	-5.1077	I(1)
ROILP	-2.4454	-0.9762	-8.0695	-8.5349	-2.6560	-0.7822	-7.9776	-8.1450	I(1)
RP	-2.6529	-0.9388	-2.3774	-3.3210	-2.7221	-1.8277	-4.9477	-5.4137	I(1)
CPI	-1.7929	-2.4568	-3.4577	-3.4539	-1.8547	-2.2401	-5.3583	-5.3312	I(1)
MISAL	-7.2332	-7.1849	-	-	-12.3764	-12.3232	-	-	I(0)

Note: T = trend, C = constant and OOI = order of integration. ADF test: 1 per cent = -3.654, 5 Per cent = -2.957: Philip Perron, 1 per cent = 3.646, 5 per cent = -2.954

The unit root test implies that the empirical model should be estimated as a vector auto-regression model in first differences. Hence, defining $\Delta X_t = (\Delta op, \Delta y, \Delta r, \Delta p)$ 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}). The four columns from left to right and the corresponding rows show the response of real oil price, relative output, real effective exchange rate and relative price to oil price shock, supply shock, demand shock and nominal shock.

Matrix 4.1: Estimated Long Run Multiplier Matrix

$$\begin{matrix} & \eta_{OP} & \eta_S & \eta_D & \eta_N \\ \begin{bmatrix} OP \\ Y \\ R \\ RP \end{bmatrix} & \begin{bmatrix} 0.0796 & 0.0000 & 0.0000 & 0.0000 \\ 0.0003 & 0.0047 & 0.0000 & 0.0000 \\ -0.0197 & 0.0262 & 0.0952 & 0.0000 \\ -0.0043 & 0.0022 & -0.0023 & 0.0102 \end{bmatrix} \end{matrix}$$

From Matrix 4.1, the estimated long run matrix shows that a positive oil price shock leads to increase in relative 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, appreciation of the real exchange rate and increase in relative price. 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 a fall in relative price. 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. 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 4.2 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, demand shock, and nominal shocks to relative GDP movements are 1st to the 20th horizon. Supply shock explains the majority of the forecast error variance of relative GDP constituting 97% of variation in relative GDP at all horizons. This finding is broadly in line with other studies utilizing Blanchard & 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 83% of variation in exchange rate in the 1st quarter and rose to 86% in the 2nd quarter and remain so up till the 20th horizon. This could be the result of high fiscal spending that mostly characterized period of positive oil price shock.

Table 4.2: Variance Decomposition of RGDP, REER, Oil price and Relative price

% of Variance In RGDP due to: Due to:	% of Variance In REER Due to:	% of Variance In Oil price Due to:	% of Variance In Relative Price
1 0.00 0.97 0.01 0.01	1 0.09 0.08 0.83 0.00	1 0.92 0.01 0.04 0.03	1 0.19 0.19 0.01 0.61
2 0.01 0.97 0.01 0.01	2 0.07 0.07 0.85 0.00	2 0.92 0.01 0.04 0.03	2 0.17 0.15 0.01 0.67
3 0.01 0.97 0.01 0.01	3 0.07 0.07 0.86 0.00	3 0.92 0.01 0.04 0.03	3 0.16 0.13 0.01 0.69
4 0.01 0.97 0.01 0.01	4 0.07 0.07 0.86 0.00	4 0.91 0.01 0.04 0.03	4 0.15 0.12 0.02 0.71
5 0.01 0.97 0.01 0.01	5 0.06 0.07 0.86 0.00	5 0.91 0.01 0.04 0.03	5 0.15 0.12 0.02 0.71
6 0.01 0.97 0.01 0.01	6 0.06 0.07 0.86 0.00	6 0.91 0.01 0.04 0.03	6 0.15 0.11 0.02 0.72
7 0.01 0.97 0.01 0.01	7 0.06 0.07 0.86 0.00	7 0.91 0.01 0.04 0.03	7 0.15 0.11 0.02 0.72
8 0.01 0.97 0.01 0.01	8 0.06 0.07 0.86 0.00	8 0.91 0.01 0.04 0.03	8 0.15 0.11 0.02 0.72
9 0.01 0.97 0.01 0.01	9 0.06 0.07 0.86 0.00	9 0.91 0.01 0.04 0.03	9 0.15 0.11 0.02 0.72
10 0.01 0.97 0.01 0.01	10 0.06 0.07 0.86 0.00	10 0.91 0.01 0.04 0.03	10 0.15 0.11 0.02 0.72
11 0.01 0.97 0.01 0.01	11 0.06 0.07 0.86 0.00	11 0.91 0.01 0.04 0.03	11 0.15 0.11 0.02 0.72
12 0.01 0.97 0.01 0.01	12 0.06 0.07 0.86 0.00	12 0.91 0.01 0.04 0.03	12 0.15 0.11 0.02 0.72
20 0.01 0.97 0.01 0.01	20 0.06 0.07 0.86 0.00	20 0.91 0.01 0.04 0.03	20 0.15 0.11 0.02 0.72

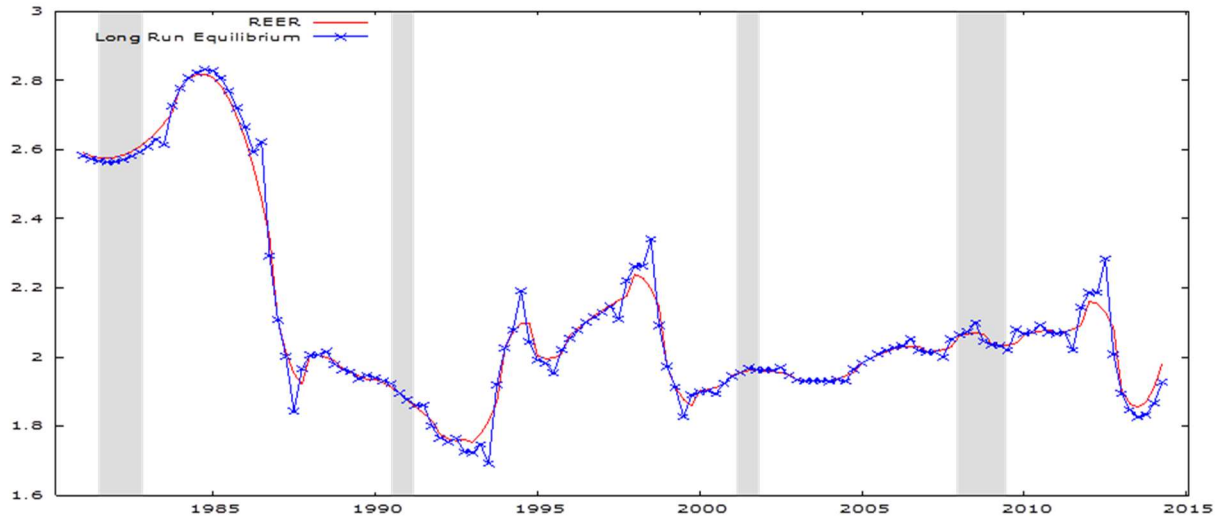


Figure 4.1: Real Effective Exchange Rate and Long Run Equilibrium Exchange Rate

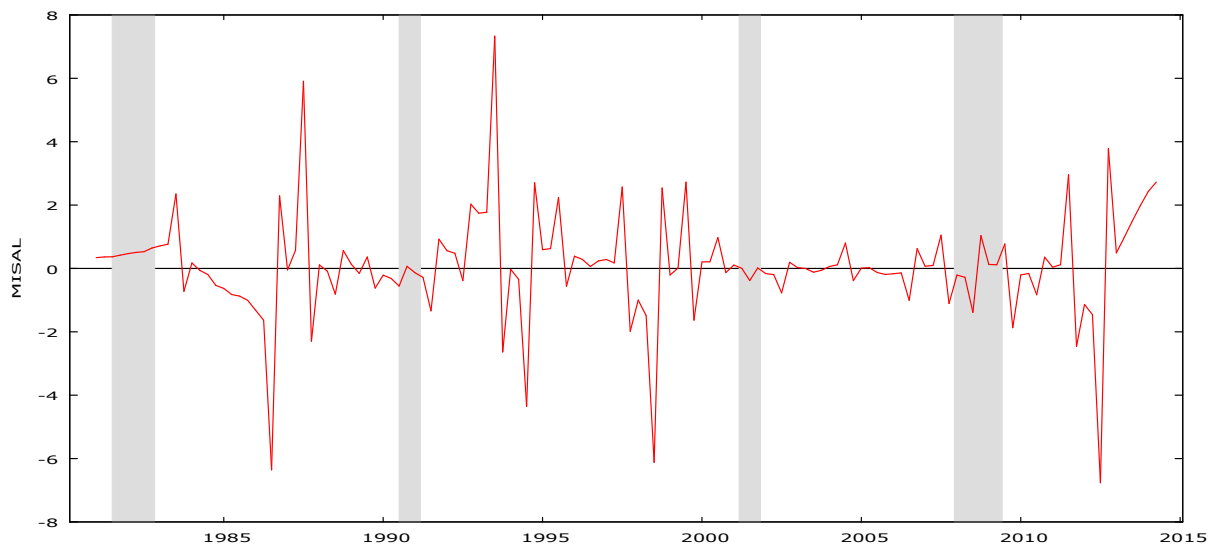


Figure 4.2. Exchange Rate Misalignment Series Generated by the SVAR Methodology

The result of exchange rate misalignment generated from the SVAR approach as presented in Table 4.3 shows that the episodes of misalignment have shorter horizon in terms of frequency of occurrence. The longest period of exchange rate misalignment occurred between 1981: Q1-1983: Q3 with an average and maximum overvaluation of 2.35%. This was followed closely by an average and maximum undervaluation of -6.36% and a minimum of -0.06 between 1984: Q2-1986: Q3. In terms of magnitude, the highest incidence of misalignment was recorded between 1992: Q4-1993: Q3 with an average and maximum of 7.33% and a minimum of 1.74. However, the actual real effective exchange rate was closest to its equilibrium value between 2001: Q1-2001: Q2. This is further shown in the relationship between equilibrium exchange rate and actual real effective exchange rate as evident in Figure 4.1. Also, the trend of the misalignment

series shows an explosive dynamic with periods of overvaluation alternating periods of undervaluation as evident in Figure 4.2.

Table 4.3: Misalignment Series Generated by the SVAR method

Range	Min	Max	Average	Range	Min	Max	Average
1981:Q1-1983:Q3	0.34	2.35	2.35	1983Q4		2.54	2.54
1984Q1		-0.72	-0.72	1999Q1		-0.21	-0.21
1984:Q2-1986:Q3	-0.06	-6.36	-6.36	1999:Q2-1999:Q3	0.01	2.72	2.72
1986Q4		2.29	2.29	1999Q4		-1.63	-1.63
1987Q1		-0.05	-0.05	2000:Q1-2000:Q3	0.20	0.97	0.97
1987:Q2- 1987:Q3	0.57	5.91	5.91	2000Q4		-0.13	-0.13
1987:Q4		-2.30	-2.30	2001:Q1-2001:Q2	0.00	0.11	0.00
1988Q1		0.11	0.11	2001Q3		-0.38	-0.38
1988:Q2-1988Q3		-0.81	-0.81	2001Q4		0.02	0.02
1988:Q4-1989:Q1	0.13	0.57	0.13	2002:Q1-2002:Q3	-0.16	-0.77	-0.77
1989Q2		-0.16	-0.16	2002:Q4-2003:Q1	0.03	0.19	0.03
1989Q3		0.36	0.36	2003:Q2-2003:Q4	0.00	-0.12	-0.06
1989:Q4-1990:Q3	-0.21	-0.62	-0.56	2004:Q1-2004:Q3	0.06	0.80	0.80
1990Q4		0.07	0.07	2004Q4		-0.38	-0.38
1991:Q1-1991:Q3	-0.14	-1.34	-1.34	2005:Q1-2005:Q2	0.01	0.02	0.02
1991:Q4-1992:Q2	0.48	0.92	0.48	2005:Q3-2006:Q3	-0.13	-1.01	-1.01
1992Q3		-0.38	-0.38	2006:Q4-2007:Q3	0.07	1.05	1.05
1992:Q4-1993:Q3	1.74	7.33	7.33	2007:Q4-2008:Q3	-0.21	-1.39	-1.39
1993:Q4-1994:Q3	-0.03	-4.35	-4.35	2008:Q4-2009:Q3	0.12	1.04	0.77
1994:Q4-1995:Q3	0.59	2.71	2.24	2009:Q4-2010:Q3	-0.16	-1.87	-0.83
1995Q4		-0.56	-0.56	2010:Q4-2011:Q3	0.04	2.96	2.96
1996:Q1-1997:Q3	0.06	2.57	2.57	2011:Q4-2012:Q3	-1.14	-6.76	-6.76
1997:Q4-1998:Q3	-1.00	-6.12	-6.12	2012:Q4-2014:Q2	0.49	3.78	2.72

Source: Computed by the authors

Exchange Rate Misalignment and Inflation

The statistical approach taken in this study involves two steps. First, the existence of long-run equilibrium relationships is tested using the bound testing approach to cointegration. The use of the bounds technique is based on three validations. First, Pesaran, Shin & Smith (2001)

advocated the use of the ARDL model for the estimation of level relationships because the model suggests that once the order of the ARDL has been recognised, the relationship can be estimated by OLS. Second, the bounds test allows a mixture of I (1) and I (0) variables as regressors, that is, the order of integration of appropriate variables may not necessarily be the same. Therefore, the ARDL technique has the advantage of not requiring a specific identification of the order of the underlying data. Third, this technique is suitable for small or finite sample size (Pesaran, Shin & Smith, 2001). The result of the bound testing approach is presented in Table 4.4 below.

Table 4.4: Bound Testing Approach to Cointegration

ARDL Bounds Test

Sample: 1981:Q1 2014:Q4

Null Hypothesis: No long-run relationships exist

Test Statistic	Value	K
F-statistic	6.7756	1

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	3.02	3.51
5%	3.62	4.16
2.5%	4.18	4.79
1%	4.94	5.58

Source: Eviews 9 Output

Having established the existence of long run relationship, the next step is to run causality test. The most common way to test the causal relationship between two variables is the Granger-Causality proposed by Granger (1969). Other tests include Sims (1972) and Gwekes, Meese, & Dent, (1983). All these tests are based on null hypothesis formulated as zero restriction on the coefficients of the lags of a subset of the variables, as such, the test are grounded in asymptotic theory. In addition to its reliance on asymptotic theory which is only valid for stationary variables, I(0). The standard causality test is invalid if a series of variables is deducted to be non-stationary, 1(1). According to Toda & Yamamoto (1995) and Dash (2009), other alternatives for the testing of non-stationary between economic time series of variables like the error correction model (ECM) and the vector auto regression error-correction model (VECM) are based on the possibility that incorrect inferences could be made about a causality case simply due to the sensitivity of stationary or cointegration tests (Elian & Adil, 2015). The Toda-Yamamoto causality (1995) allows causal inference to be made in level VARs regardless of whether the series of

variables are integrated, cointegrated or not. As such, the test outwits the pre-tests biases that confront other modelling strategy.

To apply the Toda & Yamamoto (1995) version of the Granger non-causality test, we summarize the *CPI–MISAL* model in the following VAR system:

$$misal_t = \phi_0 + \sum_{i=1}^k \phi_{1i} misal_{t-i} + \sum_{j=k+1}^{d_{max}} \phi_{2j} misal_{t-j} + \sum_{i=1}^k \theta_{1i} cpi_{t-i} + \sum_{j=k+1}^{d_{max}} \theta_{2j} cpi_{t-j} + \varepsilon_t \quad 4.1$$

$$cpi_t = \alpha_0 + \sum_{i=1}^k \alpha_{1i} cpi_{t-i} + \sum_{j=k+1}^{d_{max}} \alpha_{2j} cpi_{t-j} + \sum_{i=1}^k \beta_{1i} misal_{t-i} + \sum_{j=k+1}^{d_{max}} \beta_{2j} misal_{t-j} + \varepsilon_t \quad 4.2$$

From equation 4.1. Granger-causality from cpi_t to $misal_t$ implies $\theta_{1i} \neq 0 \forall i$; similarly, in equation 4.2 $misal_t$ Granger-causes cpi_t if $\beta_{1i} \neq 0 \forall i$. The Toda & Yamamoto (1995) test involves estimation of a vector autoregressive (VAR) model in levels, in order to minimize the risks associated with incorrect identification of the order of integration of the respective time series and cointegration among the variables. The VAR is estimated not with its true lag order k but with lag order $(k+d)$, where d is the maximal potential order of integration of variables (d_{max}). After which Granger-causality is formulated by carrying out hypothesis tests in the VAR ignoring the supplementary $k+1, k+2, k+3, \dots, k+d$ (Elian & Adil, 2015).

The result of the Granger-causality test as presented in Table 4.5 involves 2 steps. The first step is the determination of the true lag length of k and the maximum order of integration (d_{max}) of the variables in the system and an $(k + d_{max})^{th}$ order VAR is then estimated. The second step is to apply standard Wald tests to the first k^{th} VAR in order to conduct inference on Granger non-causality using modified Wald (MWALD) to test for restriction. The result from Table 4.5 shows that at the 1 per cent level of significance the null hypotheses that *CPI* does not Granger-cause *MISAL* can be rejected, suggesting that higher domestic price level (*CPI*) could lead to disequilibrium in the real exchange rate leading to misalignment. Our finding is in line with Giannellis & Koukouritakis (2013) who found evidence that in periods of high depreciation of the home currency the domestic inflation rate was persistent, while in periods of slower depreciation, or relative stability, it was transitory selected Latin American countries, namely Brazil, Mexico, Uruguay and Venezuela.

Table 4.5. Result of Toda-Yamamoto Causality Test

Dependent Variable	Independent Variable	
	<i>MISAL</i>	<i>CPI</i>
<i>MISAL</i>	-	1.4575 (0.0030)
<i>CPI</i>	6.6316 (0.3563)	-

Source: Compiled by the authors

Conclusion and Recommendation

This paper empirically explores the relationship between real exchange rate misalignment and inflation in Nigeria over the period 1981: Q1 to 2014: Q4. Since real exchange rate misalignment is an unobservable concept, equilibrium exchange rate is estimated using structural vector auto

regression (SVAR). The SVAR model is utilized among the competing models in understanding the dynamics of real exchange rate because it has a better empirical fit and allows for greater identification of shocks that make economic sense. Compared to other models, the kind of SVAR model used for this study is based on the Blanchard & Quah, (1989) methodology. Estimate from the first part of the paper shows that the real effective exchange rate is in disequilibrium with episodes of overvaluation and undervaluation. The result from the Toda-Yamamoto Granger non causality test and the result demonstrate a significant Granger causality from inflation to exchange rate misalignment but the converse is not true which support the view that inflation persistence is responsible for overvaluation of the naira (misalignment) which is inimical to competitiveness and growth, this necessitated the need for appropriate policy response to bring the REER on its equilibrium path via embarking on disinflation policies to avoid overvaluation of the naira real exchange rate.

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