



Received: 07 November 2013  
Accepted: 06 May 2014  
Published: 26 June 2014

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Reviewing Editor:  
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## RESEARCH ARTICLE

# Impact of exchange rate depreciation on the balance of payments: Empirical evidence from Nigeria

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**Abstract:** The paper investigates the impact of exchange rate depreciation on the balance of payments (BOP) in Nigeria over the period 1961–2012. The analysis is based on a multivariate vector error correction framework. A long-term equilibrium relationship was found between BOP, exchange rate and other associated variables. The empirical results are in favour of bidirectional causality between BOP and other variables employed. Results of the generalized impulse response functions suggest that one standard deviation innovation on exchange rate reduces positive BOP in the medium and long term, while results of the variance decomposition indicate that a significant variation in Nigeria's BOP is not due to changes in exchange rate movements. The policy implication is that exchange rate depreciation which has been preponderant in Nigeria since the mid-1980s has not been very useful in promoting the country's positive BOP. It is recommended that growth in the real sector should be improved to enhance exports, create employment, curb inflation and reduce poverty, while cutting non-productive imports, attracting foreign private investment and implementing well coordinated macro-economic policies that impact inflation positively and stimulate exchange rate stability.

**Keywords:** balance of payments, cointegration, depreciation, exchange rate, generalized impulse response functions, vector error correction model

**JEL classifications:** C32, E44, E52, E63

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## PUBLIC INTEREST STATEMENT

The objective of the paper was to find out the extent to which exchange rate depreciation has succeeded in promoting a positive balance of payment (BOP) in Nigeria, using data from 1961 to 2012. The empirical results suggest that exchange rate depreciation tends to reduce positive BOP in the medium and long term, implying that a significant variation in Nigeria's BOP is not due to changes in exchange rate movements. Part of the wider policy implication is that, depreciation which has been preponderant in Nigeria since independence and especially intensified in the mid-1980s has not been very useful in promoting the country's positive BOP. It is noteworthy that the results may be linked to other critical issues in the Nigerian economy such as inadequate infrastructure, poor policy framework and implementation, in the midst of which exchange rate depreciation is constrained in achieving set goals.

## 1. Introduction

Exchange rate is the price of one country's currency in relation to another's. In the era of trade liberalization, appropriate policy mix that ensures an effective rate of exchange is imperative because its variation has economic implications. Variation in exchange rate is an important endogenous factor that affects economic performance, due to its impact on macroeconomic variables like outputs, imports, export prices, interest rate and inflation rate. A sound exchange rate policy and an appropriate exchange rate are crucial conditions for improving economic performance (Chang & Tan, 2008). In practice, however, no exchange rate is pure float or completely determined by market forces. Rather, the prevailing system is the managed float type, whereby there is periodic intervention by monetary authorities in the foreign exchange market to attain strategic objectives (Mordi, 2006).

In Nigeria, the management of the exchange rate is the responsibility of the central bank, and this has taken different dimensions over the years. This was especially evident after the introduction of the structural adjustment programme (SAP) which led to several depreciations of the naira with a view to achieving a realistic exchange rate that would facilitate improved macroeconomic performance and diversify the productive base of the economy. Following the adoption of SAP in 1986, the country has moved away from a pegged to a flexible exchange rate regime. Despite the efforts of the Nigerian government to maintain a relatively stable rate of exchange, the naira has continued to depreciate before and after the introduction of the guided deregulation of 1994 when the exchange rate was N21.886 against the US dollar. With the global financial crisis in 2008, the exchange rate of the naira further depreciated to N150.01 at the end of 2009 (Aliyu, 2009). All of this has meant worsening BOP with its attendant effects.

The aim of the paper is to empirically analyse the causal association and long-term relationship between BOP and exchange rate, with other associated variables in the Nigerian economy. The study is motivated by the imperative of incorporating all major sources of BOP determinants within a single framework, using up-to-date data. It is thus different from past studies which have tended to concentrate on some specific variables rather than an integrative approach. A study of the impact of exchange rate movements on Nigeria's BOP is of major interest. Being the largest Black Country in the world, a major economy in Africa, the political and economic powerhouse of West Africa and a major oil producer in the Organization of Petroleum Exporting Countries, a study of its performance has implications for other developing and especially oil-producing countries. This is particularly germane given that with the country's huge potentials in many sectors of the economy, coupled with its natural resource endowments, it has had to struggle with the challenges of poverty, unemployment and underdevelopment. An empirical investigation of its international payments balance will be helpful to planners not only in the country but to other developing and emerging countries in terms of the degree to which exchange rate depreciation can move their production possibility frontier upwards and enhance international competitiveness of their products.

Following the introduction, the rest of the paper is organized as follows. Section 2 deals with literature and theoretical considerations. Data and methods are covered in Section 3. Empirical results and discussions are dealt with in Section 4, while the study is concluded in Section 5.

## 2. Literature Review and Theoretical Considerations

### 2.1. Literature Review

There are numbers of empirical studies on the impact of exchange rates on BOP, albeit with mixed results. While some studies have found a contractionary effect of depreciation of exchange rate on domestic output which consequently impacts the BOP position negatively (e.g. Alejandro, 1963; Kandil, 2004; Pierrer-Richard, 1991), others find expansionary effects of exchange rate depreciation on output (Adewuyi, 2005; Bahmani & Kandil, 2007).

Pentti (1976) investigates the relationship between exchange rate and BOP in the short- and long-run period from the monetary policy approach. His findings show a significant departure from the

traditional analysis by establishing a link between monetary policy and the inflow or outflow of capital through the effect of interest rate and exchange rate on aggregate demand and output and thereby on the current account, which determines the capital account balance.

Alawattage (2002), while examining the effectiveness of exchange rate policy of Sri Lanka in achieving external competitiveness since liberalization of the economy in 1977, shows that the real effective exchange rate does not have a significant impact on improving the trade balance particularly in the short run. Even though the cointegration tests reveal that there is a long-run relationship between trade balance and the real effective exchange rate, it shows very marginal impact in improving trade balance in the long run. Crowe (1999) reveals that maintenance of strict exchange rate control has been central to continued BOP positions on Barbados and a fixed exchange rate is thus recommended in order to maintain macroeconomic balance.

Patricia and Osi (2010) examine the BOP equilibrium in the West African Monetary Zone. Using panel data analysis, the results of within-country effects indicate that interest rate and growth in output play a significant role in achieving a favourable BOP, while the cross-country effects show similar results. They therefore consider a tight rein on domestic credit creation as a necessary condition for maintaining stability in the BOP. Imoisi (2012) examines the trends in Nigeria's BOP. The results indicate a significant relationship between BOP, exchange rate and interest rate; the author therefore recommends an increase in non-oil export through a diversified productive base as a vehicle to correct the deficit in the current account section of the BOP.

It must be asserted that the analysis of the impact of exchange rate depreciation on the BOP must necessarily involve its mechanism on output and trade volume, the stimulation of which can improve a country's net exports. Consequently, De Grauwe's (1988) analysis on the idea of risk transfer from highly volatile investment to less risky ones by risk-averse investors suggest that there exists a negative effect of exchange rate volatility on volume of trade. This view is supported by Barkoulas, Baum, and Caglayan (2002) when they examine the impact of exchange rate fluctuation on the volume and variability of trade flows. They conclude that exchange rate volatility discourages expansion of the volume of trade thereby reducing its benefits. Eichengreen and Leblang (2003) on a study conducted on 12 countries over a period of 120 years find a strong inverse relationship between exchange rate stability and growth, but conclude that the results of such estimations should be interpreted with caution because the outcome strongly depends on the time period and the sample size.

Most of the literatures examining the impact of exchange rates misalignments on economic growth conclude that they can result in output contraction, thereby giving way to economic hardship and unfavourable BOP. Aghion, Bacchetta, Ranciere, and Rogoff (2006) empirically offer evidence that real exchange rate volatility can have a significant impact on long-term rate of productivity growth, depending critically on a country's level of financial development. For countries with relatively low levels of financial development, exchange rate volatility generally reduces growth, whereas for financially advanced countries, there is no significant effect. This is supported by the study conducted by Belke and Setzer (2003) which indicates that the impact of variability of exchange rate is felt more in the developing than in the developed countries. Isard (2007) maintains that there is a reasonably strong evidence that the alignment of exchange rates has a critical influence on the rate of growth of per capita output in low-income countries and consequently BOP difficulties.

Frenkel (2004) examines aggregate employment behaviour in response to real exchange rate movements in Argentina, Brazil, Chile and Mexico between 1980 and 2003. He finds that real exchange rate has an expected negative effect on the change in the national unemployment rates in the period covered with long-run negative impact on current account section of the BOP, the implication of which is that in order to achieve higher rate of employment, growth in output and BOP equilibrium, stable and competitive real exchange rate should be pursued. Jin (2008), in a comparative study finds that appreciation of exchange rate increases GDP in Russia while it

reduces GDP in Japan and China. Razazadehkarsalari, Haghiri, and Behrooznia (2011) find that in Iran during stagnation and low-price period, depreciation of currency has positive and significant effects while depreciation has insignificant effects on real GDP in high-price period. This is consistent with the results from the study conducted by Aliyu (2009), who finds that appreciation of exchange rate exerts positive impact on real economic growth in Nigeria and improves the BOP position.

The policy of exchange rate in developing countries, Nigeria inclusive, is usually sensitive and often controversial, due to certain structural adjustments required, such as reducing imports and increasing non-oil exports, which call for exchange rate depreciation (Osako, Masha, & Adamgbe, 2003). Such adjustments seem to be damaging to the economy due to their short run effects on prices and demand. According to Abiodun and Adeniyi (2012), the variables which determine the regimes adopted by countries can be grouped into four: (1) the optimum currency area variables comprising trade openness, economic size and per capita GNP among others; (2) the capital openness variables comprising capital controls and emerging markets among others; (3) the macroeconomic variables comprising inflation and reserves; and (4) the historical and institutional variables comprising political instability, number of years after independence, among others.

## 2.2. Theoretical Framework

The argument of the traditional school is that exchange rate depreciation would promote trade balance, alleviate BOP difficulties and consequently expand output and employment, provided the Marshall–Lerner conditions are met. The Marshall–Lerner condition states that depreciation would lead to expansion in output if the sum of price elasticity of demand for export and the price elasticity of demand for imports is greater than unity. The mechanism behind these positive effects is to make export industries more competitive in international markets, stimulate domestic production of tradable goods and induce domestic industries to use more domestic inputs.

The monetarists on the other hand consider exchange rate volatility as having no effect on real variables in the long run. Accordingly, exchange rate devaluation affects real magnitudes mainly through real balance effect in the short run but leaves all real variables unchanged in the long run (Domac, 1977). This view is based on the assumption of the purchasing power parity, which predicts that in the short run, devaluation improves the level of output, but in the long run the monetary consequence of the devaluation ensures that the increase in output and improvement in BOP is neutralized by the rise in prices.

Another strand of thought is the IS-LM model, in which exchange rate is viewed as not having direct effects on output, but indirectly through the import–export and the money supply channels. In the model, the relationship between exchange rate changes and gross domestic product cannot be determined a priori because its effect can be either positive or negative due to the impact of exchange rate depreciation on the domestic economy's interest rate. In this model, depreciation is theoretically expected to have positive effect on export since it makes domestic goods cheaper to foreign consumers. It is expected that depreciation would reduce import as a result of the higher relative price of imported goods, thus increasing net export and income where the Marshall–Lerner condition is satisfied. Where this condition holds, domestic income (output) would increase with depreciation through the goods market. Exchange rate can also affect domestic money supply and through it domestic income. Depreciation is theoretically expected to be accompanied by increase in money supply, leading to a reduction in interest rate and an improvement in investment. Increase in investment would lead to increase in national income and output, given the national income identity. The negative relationship between the exchange rate and GDP can be through interest rate effect of exchange rate changes. With depreciation and the consequent reduction in interest rate due to its expansionary effect on money supply, domestic interest rate becomes lower relative to international interest rate. This is expected to lead to capital flight and consequently reduce domestic income and output (Kandil, 2004).

### 3. Methodology

#### 3.1. Sources of Data and Description of Variables

Annual data for the period 1961–2012 was employed in the study. The choice of annual data was informed by their availability throughout the study period, in addition to the overriding advantage of using annual data which has been proven to be resistant to short-run transitive and seasonal shocks (Beetsma, 2008). The data was obtained from the Statistical Bulletin of the Central Bank of Nigeria. Government Expenditure (GE), Exchange Rate (EXCR), Real Gross Domestic Product (RGDP), Money Supply (M2) and Interest Rate (IR, proxied by the prime lending rate) were first transformed into natural logs before computations, with a view to removing possible heteroskedasticity and capturing non-linear properties. Following standard practice, openness was computed as total trade as a proportion of gross domestic product. The plot of the series and the descriptive statistics of the variables used in the investigation are presented in Figure 1A and Table 1A of the Appendix.

#### 3.2. Model Specification

In the present investigation, a multivariate Vector Error Correction Model (VECM) is adopted. The use of the VECM is advantageous in that model specification error is avoided. This is because no explicit a priori functional form relation of the variables employed is required. In a VECM, and according to the cointegration equation, short-run dynamic adjustment is permitted following an innovation or shock as all variables return to their long-run values.

In Equations 1 through 7, the multivariate VECM specifications of the variables employed in the study are presented in seven endogenous variables:

$$\begin{aligned} \Delta(\text{BOP})_t = & \beta_0 + \beta_{\text{BOP}}\phi_{t-1} + \sum_{i=1}^{q_1} \beta_{1i}\Delta(\text{BOP})_{t-i} + \sum_{i=1}^{r_1} \Psi_{1i}\Delta(\text{GE})_{t-i} + \sum_{i=1}^{s_1} \eta_{1i}\Delta(\text{EXCR})_{t-i} \\ & + \sum_{i=1}^{t_1} \gamma_{1i}\Delta(\text{RGDP})_{t-i} + \sum_{i=1}^{u_1} \Pi_{1i}\Delta(\text{M2})_{t-i} + \sum_{i=1}^{v_1} \delta_{1i}\Delta(\text{IR})_{t-i} + \sum_{i=1}^{v_1} \varphi_{1i}\Delta(\text{OPN})_{t-i} + \varepsilon_{1t} \end{aligned} \quad (1)$$

$$\begin{aligned} \Delta(\text{GE})_t = & \gamma_0 + \gamma_{\text{GE}}\phi_{t-1} + \sum_{i=1}^{q_2} \beta_{2i}\Delta(\text{BOP})_{t-i} + \sum_{i=1}^{r_2} \Psi_{2i}\Delta(\text{GE})_{t-i} + \sum_{i=1}^{s_2} \eta_{2i}\Delta(\text{EXCR})_{t-i} \\ & + \sum_{i=1}^{t_2} \gamma_{2i}\Delta(\text{RGDP})_{t-i} + \sum_{i=1}^{u_2} \Pi_{2i}\Delta(\text{M2})_{t-i} + \sum_{i=1}^{v_2} \delta_{2i}\Delta(\text{IR})_{t-i} + \sum_{i=1}^{v_1} \varphi_{2i}\Delta(\text{OPN})_{t-i} + \varepsilon_{2t} \end{aligned} \quad (2)$$

$$\begin{aligned} \Delta(\text{EXCR})_t = & \Pi_0 + \Pi_{\text{EXCR}}\phi_{t-1} + \sum_{i=1}^{q_3} \beta_{3i}\Delta(\text{BOP})_{t-i} + \sum_{i=1}^{r_3} \Psi_{3i}\Delta(\text{GE})_{t-i} + \sum_{i=1}^{s_3} \eta_{3i}\Delta(\text{EXCR})_{t-i} \\ & + \sum_{i=1}^{t_3} \gamma_{3i}\Delta(\text{RGDP})_{t-i} + \sum_{i=1}^{u_3} \Pi_{3i}\Delta(\text{M2})_{t-i} + \sum_{i=1}^{v_3} \delta_{3i}\Delta(\text{IR})_{t-i} + \sum_{i=1}^{v_1} \varphi_{3i}\Delta(\text{OPN})_{t-i} + \varepsilon_{3t} \end{aligned} \quad (3)$$

$$\begin{aligned} \Delta(\text{RGDP})_t = & \theta_0 + \theta_{\text{RGDP}}\phi_{t-1} + \sum_{i=1}^{q_4} \beta_{4i}\Delta(\text{BOP})_{t-i} + \sum_{i=1}^{r_4} \Psi_{4i}\Delta(\text{GE})_{t-i} + \sum_{i=1}^{s_4} \eta_{4i}\Delta(\text{EXCR})_{t-i} \\ & + \sum_{i=1}^{t_4} \gamma_{4i}\Delta(\text{RGDP})_{t-i} + \sum_{i=1}^{u_4} \Pi_{4i}\Delta(\text{M2})_{t-i} + \sum_{i=1}^{v_4} \delta_{4i}\Delta(\text{IR})_{t-i} + \sum_{i=1}^{v_1} \varphi_{4i}\Delta(\text{OPN})_{t-i} + \varepsilon_{4t} \end{aligned} \quad (4)$$

**Table 1. Lag-Order Selection Criteria**

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-184.5902	NA	6.91e-06	7.982924	8.255808	8.086047
1	132.9070	529.1620*	9.78e-11*	-3.204459	-1.021391*	-2.379474*
2	173.6054	55.96032	1.57e-10	-2.858560	1.234693	-1.311714
3	220.7461	51.06910	2.45e-10	-2.781089	3.222348	-5.12381
4	280.2642	47.11846	3.59e-10	-3.219341*	4.694280	-2.28772

Source: Authors' computations.

\*The lag selected by the criterion.

$$\begin{aligned} \Delta(M2)_t = & \Psi_0 + \Psi_{M2}\phi_{t-1} + \sum_{i=1}^{q_5} \beta_{5i}\Delta(BOP)_{t-i} + \sum_{i=1}^{r_5} \Psi_{5i}\Delta(GE)_{t-i} + \sum_{i=1}^{s_5} \eta_{5i}\Delta(EXCR)_{t-i} \\ & + \sum_{i=1}^{t_5} \gamma_{5i}\Delta(RGDP)_{t-i} + \sum_{i=1}^{u_5} \Pi_{5i}\Delta(M2)_{t-i} + \sum_{i=1}^{v_5} \delta_{5i}\Delta(IR)_{t-i} + \sum_{i=1}^{v_1} \varphi_{5i}\Delta(OPN)_{t-i} + \varepsilon_{5t} \end{aligned} \quad (5)$$

$$\begin{aligned} \Delta(IR)_t = & \eta_0 + \eta_{IR}\phi_{t-1} + \sum_{i=1}^{q_6} \beta_{6i}\Delta(BOP)_{t-i} + \sum_{i=1}^{r_6} \Psi_{6i}\Delta(GE)_{t-i} + \sum_{i=1}^{s_6} \eta_{6i}\Delta(EXCR)_{t-i} \\ & + \sum_{i=1}^{t_6} \gamma_{6i}\Delta(RGDP)_{t-i} + \sum_{i=1}^{u_6} \Pi_{6i}\Delta(M2)_{t-i} + \sum_{i=1}^{v_6} \delta_{6i}\Delta(IR)_{t-i} + \sum_{i=1}^{v_1} \varphi_{6i}\Delta(OPN)_{t-i} + \varepsilon_{6t} \end{aligned} \quad (6)$$

$$\begin{aligned} \Delta(OPN)_t = & \omega_0 + \pi_{OPN}\phi_{t-1} + \sum_{i=1}^{q_7} \beta_{7i}\Delta(BOP)_{t-i} + \sum_{i=1}^{r_7} \Psi_{7i}\Delta(GE)_{t-i} + \sum_{i=1}^{s_7} \eta_{7i}\Delta(EXCR)_{t-i} \\ & + \sum_{i=1}^{t_7} \gamma_{7i}\Delta(RGDP)_{t-i} + \sum_{i=1}^{u_7} \Pi_{7i}\Delta(M2)_{t-i} + \sum_{i=1}^{v_7} \delta_{7i}\Delta(IR)_{t-i} + \sum_{i=1}^{v_1} \varphi_{7i}\Delta(OPN)_{t-i} + \varepsilon_{7t} \end{aligned} \quad (7)$$

where:

- BOP Balance of Payments
- GE Government Expenditure
- EXCR Exchange Rate
- RGDP Real Gross Domestic Product
- M2 Money Supply
- IR Interest Rate
- OPN Openness

In each equation, the left-hand side is expressed in first differences of the variables, while on the right-hand side, an optimum lagged differences of the six variables and the one-period lagged error term of the cointegrating equation are included.  $\beta_0, \dots, \omega_0$  are the intercept terms, while the disturbance terms are denoted by  $\varepsilon_{1t}, \dots, \varepsilon_{7t}$ . Through the VECM framework, there are two sources of causation, the first from the error correction term and the second from the lagged dynamic terms. Consequently, two tests were carried out, i.e. the short-run Granger non-causality test and the long-run causality (otherwise referred to as the weak exogeneity test), both of which were executed through the Wald test.

### 3.3. Model Estimation Procedure

First, the stability properties of the variables used in the investigation are investigated in order to determine their order of integration, which ultimately assists in determining the appropriate econometric framework to be adopted for analysis.

Three unit root tests were used in the present study, i.e. the Augmented Dickey-Fuller (ADF), the Phillips-Perron (PP) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS). The PP unit root test is generally considered to have a greater reliability than the ADF in that it is both robust in the midst of serial correlation and heteroskedasticity; however, in the case of ADF and PP, it has been shown that they suffer from high size distortion (Zivot & Andrews, 1992; Voleslang & Perron, 1998). This study used in addition to the ADF and PP the KPSS unit root tests, in order to avoid these associated problems and to allow for robustness.

The test for unit root for a variable  $X$  is carried out using the following specification:

$$\Delta X_t = \alpha_0 + \alpha_1 t + \alpha_2 X_{t-1} + \sum_{i=0}^p \lambda_i \Delta X_{t-i} + \varepsilon_t \quad (8)$$

where  $\alpha_0, \alpha_1, \alpha_2$  and  $\lambda_1, \dots, \lambda_p$  are parameters to be estimated, and  $\varepsilon_t$  is the disturbance term which is assumed to be normally and identically distributed. The unit root tests are followed by the test of cointegration using the Johansen (1988) framework, after which the examination of short-run dynamics and long-run causality between BOP and exchange rate is carried out through the VECM. Thus, to test for long-run non-causality, the null hypothesis that the coefficient of  $\phi_{t-1}$  is zero is tested

in each equation, in order to determine whether the variables on the right-hand side Granger-cause the variable on the left-hand side. In Equations 1 through 7, this test is carried out by testing the null hypothesis  $\beta_{BOP, \dots}, \eta_{EXCR} = 0$ , against the alternative hypothesis  $\beta_{BOP, \dots}, \eta_{EXCR} \neq 0$ . Moreover, seven short-run Granger causality tests (a Wald *F*-test for short-run non-causality) are performed in Equations 1 through 7, by setting the coefficients of all order-lagged differences of each of the variables on the right-hand side equal to zero. In Equation 1, for example, a test for short-run non-causality from Government Expenditure (GE) to BOP is executed by testing whether the coefficients of the lagged differences of the GE are all equal to zero. The same is done regarding the short-run causality from other variables in the system on BOP. The test of causality is completed by taking an overall causality (strong exogeneity) in each equation. To do this, all the coefficients of each right-hand side variable including the coefficient of the error correction term are jointly set equal to zero. In the present study, after the estimation of the causality tests, the generalized impulse response function and variance decomposition as they relate to the two major variables of interest, i.e. BOP and Exchange Rate (EXCR) are presented and analysed. All estimations were implemented using *EViews7.1*.

#### 4. Results and Discussion

The choice of an appropriate lag is an important issue in autoregressive models. This is because too many lags would deplete the degree of freedom while too few lags may adversely affect the size of the test. A maximum of 1 lag was used in the unit root and cointegration tests, vector autoregression and the VECMs, as suggested by the Schwarz information criterion (SC) and Final Prediction Error (FPE). The results of lag-order selection criteria for the estimated model are presented in Table 1.

The results of the unit root tests are presented in Table 2.

Results in Table 1 suggest that all the variables are non-stationary in levels but in first differences. Thus, the hypothesis of non-stationarity cannot be rejected for the variables in levels. For ADF and PP, the null hypothesis is that the variable has a unit root whereas for KPSS the null hypothesis is that the variable is stationary. All three tests of unit roots lead to the same conclusion and are thus consistent.

**Table 2. Unit Root Test Results**

Variable	ADF		PP		KPSS	
	Constant	Constant and linear trend	Constant	Constant and linear trend	Constant	Constant and linear trend
BOP	-4.512300*	-4.571411*	-6.287622*	-6.415771*	0.128797	.042078
GE	-.688187	-1.870202	-.520579	-2.153067	2.644125*	.119241***
EXCR	.094245	-1.990406	.305602	-1.918104	2.473589*	.462467*
RGDP	-1.255455	-1.428660	-1.182595	-1.377237	2.437516*	.517665*
M2	.546000	-3.266844***	1.363392	-2.899608	2.660627*	.276814*
IR	-1.123196	-1.402920	-1.271370	-1.979201	2.129511*	.304215
OPN	-1.779806	-2.720609	-2.189072	-3.861680*	1.780003*	.105809
ΔBOP	-7.476191	-7.398295	-11.61617	-11.48984	.028064	.024599
ΔGE	-4.523425*	-4.513844*	-7.856513*	-7.804326*	.082981	.073813
ΔEXCR	-3.997712*	-4.037201**	-5.580423*	-5.636693*	.324650	.182290
ΔRGDP	-5.176819*	-5.250273*	-6.500393*	-6.525930*	.155817	.072299
ΔM2	-4.354435*	-4.459394	-4.082940*	-4.159765*	.310744	.086601
ΔIR	-6.281488*	-6.252697*	-10.17808*	-10.10659*	.106325	.091095
ΔOPN	-6.118923*	-6.064025*	-10.60134*	-10.49356	.036788	.036593

Source: Authors' computations.

\*Order of integration at 1%.

\*\*Order of integration at 5%.

\*\*\*Order of integration at 10%.

**Table 3. Johansen Cointegration Test Results**

Hypothesis		Eigen value	$\lambda_{\max}$	5% critical value	$\lambda_{\text{trace}}$	5% critical value
Null	Alternative					
$r=0$	$r \geq 1$	.672223	55.77103*	46.23142	148.7277*	125.6154
$r \leq 1$	$r \geq 2$	.526281	37.35709	40.07757	92.95668	95.75366
$r \leq 2$	$r \geq 3$	.332481	20.20941	33.87687	55.59960	69.81889
$r \leq 3$	$r \geq 4$	.252762	14.56858	27.58434	35.39019	47.85613
$r \leq 4$	$r \geq 4$	.201411	11.24546	21.13162	20.82161	29.79707
$r \leq 5$	$r \geq 6$	.158322	8.617886	14.26460	9.576149	15.49471
$r \leq 6$	$r \geq 7$	.018983	.958262	3.841466	.958262	3.841466

Source: Authors' computations.

Note:  $r$  indicates the number of cointegrating vectors.  $\lambda_{\max}$  denotes maximal eigenvalues and  $\lambda_{\text{trace}}$  trace test statistics.

\*Rejection of the null hypothesis at 5% level of significance.

**Table 4. Long-run Estimates**

Constant	GE	EXCR	RGDP	M2	IR	OPN
-1.851467	.205968** (.09625)	-.282689* (.07409)	-.309001* (.08250)	.138456 (.10716)	.823858* (.18954)	-1.505331* (.37338)

Source: Authors' computations.

Note: Figures in parentheses are standard errors.

\*Significance at 1% level.

\*\*Significance at 5% level.

The results of the cointegration tests are presented in Table 3.

Results in Table 3 suggest that the maximal eigenvalues and trace test statistics indicate that the hypothesis of no cointegration among the variables is rejected at the 5% significance level. From the result, there is one cointegrating vector among the variables of interest based on both the maximal eigenvalues and trace test statistics. The existence of a long-term equilibrium relationship among the variables necessitates the use of the VECM.

The long-run estimates of the cointegrating vector normalized on BOP is presented in Table 4.

The results in Table 4 indicate that GE is positively related to BOP in the long run and is statistically significant at the 5% level. The implication is that government expenditure in Nigeria tends to support a more favourable BOP. That government expenditure impacts the BOP positively is not surprising given that government is an active participant in the economic life of Nigeria.

The result of the relationship between exchange rate and BOP indicates that it is negative and statistically significant at the 1% level. This is consistent with economic theory in that depreciation in exchange rate will improve BOP position due to the increase in net export balance. The result tends to suggest that BOP is likely to be improved using exchange rate devaluation.

Real gross domestic product is negatively related to BOP in the long run and statistically significant at the 1% level. It is expected that as real GDP increases, the BOP position improves. The explanation is that with increase in real output, prices generally fall, a situation that engenders higher demand for domestic products in both the internal as well as the international markets. This result is hardly surprising, giving that real output in the Nigerian economy has had little if any positive impact on the price levels. Inflation has been anything but reduced despite the growth experienced in Nigeria over the years. This is because real output has been helped more by the dynamics of the price of international crude which is externally determined than by local dynamics of production in all its ramifications.



Consequently, real GDP aided by external forces cannot be expected to improve production conditions in local sectors such as manufacturing, agriculture and non-oil mining, all of which have been comatose over the years, exacerbated mostly after the introduction of the SAP in the mid-1980s.

In addition, the relationship between money supply and BOP indicates a non-statistically significant positive relationship. It is known that an increase in money supply has the tendency to raise the level of income, and consequently reducing the level of interest rates. A fall in interest rate improves the level of investment and thus local employment and production which can consequently improve a country's net export and thus the BOP position. However, money supply does not tend to support high enough growth in the real sector of the economy and has not tended to induce lower interest rates which are expected to attract firms in sourcing for investment funds in the financial sector. Over the years, the non-oil sector of the Nigerian economy has suffered a variety of constraints ranging from policy summersaults, poor infrastructure, relatively high inflationary trends, inadequate energy, all of which exacerbate production costs, making domestic products less competitive in the international market. The implication of this is that exports are dominated by crude oil, the price of which is set in the international market, and less vulnerable to domestic interest rate shocks.

The interest rate coefficient indicates a positive relationship with BOP which is statistically significant at the 1% level. Although an increase in interest rate is expected to worsen the BOP position, the result is not surprising, giving the nature and trajectory of production in Nigeria, which is dominated by one commodity, i.e. crude oil, and which is largely dictated by external forces. Interest rate has been on the increase in Nigeria over time and while other activities in the real sector of the economy (such as agriculture and manufacturing) have been badly hit due to the trend in interest rate, the oil sector has tended to be resilient, with the consequence that oil production does not appear to have been reflective of the dynamics of rising interest rates.

The coefficient of openness is negatively statistically significant at the 1% level, implying that the openness of the Nigerian to the global economy has been rather harmful to the improvement of the country's BOP. It is evident that the Nigerian economy has been import-dependent over the years and even for non-oil trade, it has recorded chronic deficits. Its import of manufacture such as machines, including raw materials and chemicals needed for domestic production have been on the increase over the years, all of which indicate that it has had to pay more than it received in international non-oil trade, a situation that has been devastating to its net payment balance. The loading factor in the estimated model is negative and statistically significant at the 1% level, and thus follows a priori expectation. This is important in that to have meaningful restrictions, the adjustment coefficient must be statistically significant and its sign should be negative (Wickens, 1996).

#### **4.1. Causality Test Results**

Three causality tests are carried out in the study, i.e. long-run causality, short-run causality and strong exogeneity (overall causality). The results are presented in Table 5.

In Panel A of Table 5, the long-run causality shows evidence of bidirectional causality between BOP and other variables in the system and it is statistically significant at the 1% level. The strong exogeneity (i.e. the overall causality in the system) shows that the null hypothesis that all the variables in the system (i.e. GE, EXCR, RGDP, M2, IR and OPN) do not Granger cause BOP is rejected at 1% level of significance. The short-run causality test results indicate that with the exception of M2, other variables in the system Granger-cause BOP and are statistically significant at 5% level for GE and at 1% level in the case of EXCR, RGDP, IR and OPN.

In Panel B, the null hypothesis that BOP does not Granger-cause other variables in the system is rejected in respect of all the variables and is statistically significant at 1% level, thus confirming the bidirectional causality between BOP and other variables in the system. There is a flow of causality from BOP to GE and OPN at 5 and 10% levels, respectively, in the long run; causality from BOP to other variables in the short run is statistically significant at the 1% level.

**Table 5. Granger Causality Test Results**

Hypothesis	Long run	Short run	Strong exogeneity
<i>Panel A: Causality from other variables to BOP</i>			
GE → BOP	20.16860*	5.516680**	24.47268*
EXCR → BOP		9.814152*	23.63505*
RGDP → BOP		8.408207*	24.25817*
M2 → BOP		1.352111	20.32850*
IR → BOP		9.195615*	24.43600*
OPN → BOP		8.600092*	24.65362*
<i>Panel B: Causality from BOP to other variables</i>			
BOP → GE	4.749900**	20.79744*	28.00091*
BOP → EXCR	.176343		20.82168*
BOP → RGDP	.018635		23.25442*
BOP → M2	1.473864		21.51479*
BOP → IR	.394346		23.16203*
BOP → OPN	3.087366***		31.67185*

Notes: The degree of freedom for the chi-square statistics is 1 for long- and short-run causality, and 2 for the strong exogeneity.

→ denotes “Granger-causes”.

\*Significance at 1% level.

\*\*Significance at 5% level.

\*\*\*Significance at 10% level.

#### 4.2. Estimated VECM

The estimates of the VECM are used to complement the causality tests, and presented in Table 6.

The numbering, i.e. 9–15, are the estimated versions of Equations 1–7. Results in Equation 9 (ignoring the intercept term) shows evidence of long-run causality from one-lagged period BOP, GE, EXCR, RGDP, M2, IR and OPN on BOP. Long-run causality is indicated by the statistically significant ECM coefficient of  $-1.151593$ .

Results in Equations 10 and 15 show evidence of long-run causality from other variables in the system to GE and OPN, respectively. The implication of this is that government expenditure and openness are responsive to variations in BOP, exchange rate, real gross domestic product, money supply and interest rate. Results in Equation 10 are particularly instructive, in that there is statistical evidence that changes in government expenditure are influenced significantly by changes in BOP, exchange rate, money supply and interest rate. The implication of this is that government spending in Nigeria tends to react very little to changes in such variables as past levels of growth and the degree of exposure of the country to the global economy. However, the level of growth encapsulated in RGDP is statistically influenced by changes in government expenditure and the pattern of exchange rate as indicated in the estimated Equation 12.

Results in Equation 11 indicate that other variables in the system are not statistically significant determinants of exchange rate. The implication of this result is that exchange rate movements in Nigeria are not statistically influenced by changes in the identified variables. When it is remembered that the Nigerian economy is far from being productive enough to engender high employment and output for exports, and that the economy is hinged financially on crude oil, it is understandable why exchange rate has tended not to reflect the nature of the Nigerian economy. Given that exchange rate has been on the upward trend (see Figure 1A in the Appendix), this should have ordinarily been reflective of the robustness of the economy. The major emphasis of the SAP introduced in 1986 was

**Table 6. Vector Error Correction Estimates**

Dependent variable →	9	10	11	12	13	14	15
	ΔBOP	ΔGE	ΔEXCR	ΔRGDP	ΔM2	ΔIR	ΔOPN
C	-.167531*** (.09463)	.158546** (.06512)	.101318 (.08129)	.064503 (.08968)	.090500* (.03155)	.023455 (.05257)	.007307 (.02790)
$\phi_{t-1}$	-1.151593* (.22947)	-.506367* (.15791)	-.110435 (.19713)	-.019518 (.21748)	-.094644 (.07650)	-.035944 (.12747)	-.161488** (.06765)
$\sum_{i=1}^{q_1} \Delta BOP_{t-i}$	.016163 (.14776)	.251835** (.10168)	.039053 (.12693)	.052864 (.14004)	.064841 (.04926)	-.066203 (.08208)	.039780 (.04356)
$\sum_{i=1}^{r_1} \Delta GE_{t-i}$	-.181683 (.23438)	-.188842 (.16129)	-.041752 (.20135)	.555231** (.22214)	.087384 (.07814)	-.267122** (.13021)	-.078411 (.06910)
$\sum_{i=1}^{s_1} \Delta EXCR_{t-i}$	.250021 (.20157)	-.257367*** (.13871)	.221709 (.17316)	-.345880*** (.19104)	.015251 (.06720)	.163354 (.11198)	-.008544 (.05942)
$\sum_{i=1}^{t_1} \Delta RGDP_{t-i}$	-.129663 (.16631)	-.077378 (.11445)	-.049641 (.14288)	.040593 (.15763)	.001466 (.05544)	.048760 (.09239)	-.065573 (.04903)
$\sum_{i=1}^{u_1} \Delta M2_{t-i}$	.836697*** (.43114)	.525084*** (.29669)	-.001329 (.37038)	-.154786 (.40862)	.493170* (.14373)	.152879 (.23951)	.108916 (.12710)
$\sum_{i=1}^{v_1} \Delta IR_{t-i}$	.566004*** (.29173)	.601755* (.20075)	.023172 (.25061)	.259941 (.27649)	.107233 (.09725)	-.471415* (.16206)	.182802** (.08600)
$\sum_{i=1}^{v_1} \Delta OPN_{t-i}$	-.561689 (.51380)	-.434248 (.35357)	-.529235 (.44139)	-.007549 (.48696)	-.091744 (.17129)	.089166 (.28543)	-.501451* (.15147)
<i>Diagnostic statistics</i>							
R-squared	.563625	.297382	.087834	.173908	.368840	.242923	.361121
Adj. R-squared	.478479	.160286	-.090150	.012719	.245686	.095201	.236462
Sum sq. resids	4.304843	2.038528	3.176974	3.866832	.478419	1.328490	.374123
S.E. equation	.324031	.222980	.278365	.307104	.108022	.180006	.095525
F-statistic	6.619492	2.169149	.493495	1.078906	2.994966	1.644456	2.896868
Log likelihood	-9.639866	9.047953	-2.044583	-6.957241	45.28537	19.75257	51.43289

Source: Authors' computations.

Note: The figures in parentheses are standard errors.

\*Significance at 1% level.

\*\*Significance at 5% level.

\*\*\*Significance at 10% level.

the deregulation of the economy, which set the tone for the liberalization of exchange rate. It is therefore apposite to say that the exchange rate devaluation which has been preponderant in Nigeria especially since the mid-1980s has not been very useful in promoting the country's international competitiveness and specifically non-oil BOP.

There is evidence that interest rate reacts to changes in the level of government expenditure and past interest rates in the economy (Equation 14). The results are hardly surprising, given that government in Nigeria is a dominant force in economic affairs and a major participant in financial markets. Interest rates have been on the increase in Nigeria over the years and government's deficit financing has tended to crowd out private investment, so that the reaction of interest rate to its past levels is consistent with theory. In addition, the degree of the country's exposure to the global economy is statistically influenced by the past levels of interest rate movements.

Diagnostic tests for serial correlation, normality and heteroskedasticity for the estimated model are presented in the Appendix. Both the residual portmanteau tests for autocorrelations (Table 1B), and the residual serial correlation LM tests (Table 1C) indicate that there is no serial correlation in the residuals. The model also passes the heteroskedasticity tests (Table 1D). The estimated model satisfies the stability condition, as indicated by the result of the roots of characteristic polynomial (Table 1E).

#### 4.2. Generalized Impulse Response Function and Variance Decomposition

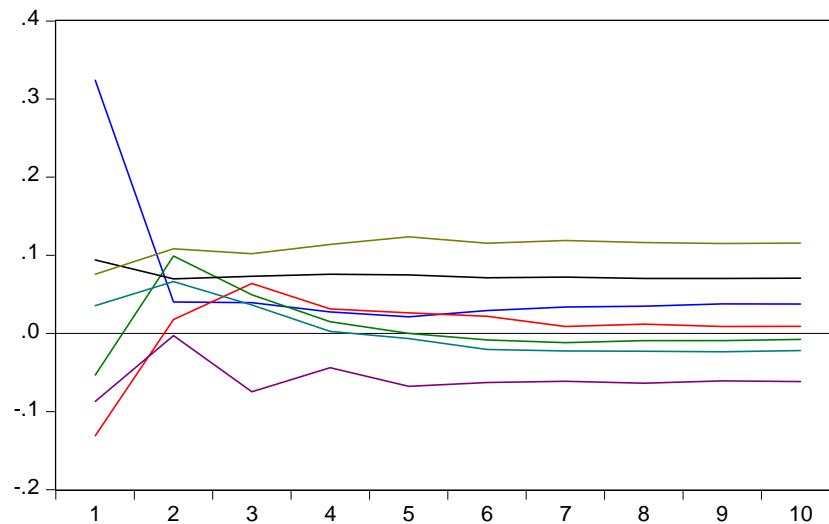
The generalized impulse response functions of the BOP and exchange rates in Figure 1. To conserve space, emphasis is on the two variables over the sample period. The complete figures are however available on request.

From Panel 1 in Figure 1, it can be observed that one generalized standard deviation innovation on EXCR does not improve BOP in the 10-year forecast horizon. Consequently, the long-run effect of exchange rate depreciation on Nigeria's BOP tends to be initially positive up to the 4th period and thereafter becomes negative. From the figure, there is no indication that BOP has been positively improved in the medium and long term. What can be concluded is that exchange rate which has

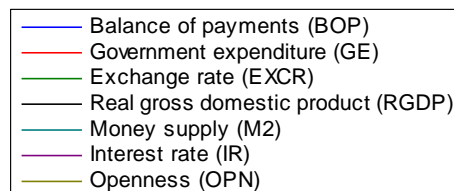
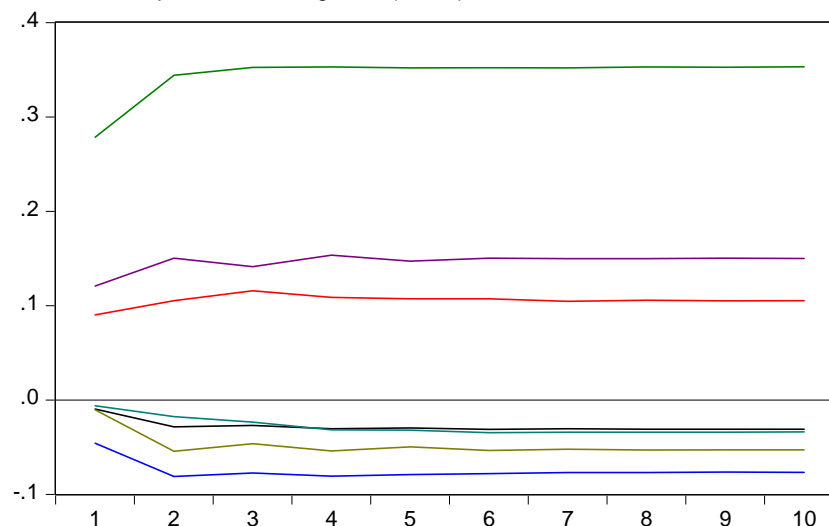
**Figure 1. Generalized impulse response functions.**

Source: Authors' computations.

Panel 1: Response of balance of payments (BOP) to Generalized One S.D. Innovations



Panel 2: Response of exchange rate (EXCR) to Generalized One S.D. Innovations



**Table 7. Results of Variance Decomposition**

Period	S.E.	BOP	GE	EXCR	RGDP	M2	IR	OPN
<i>Panel 1. Variance Decomposition of balance of payments (BOP)</i>								
1	.324031	55.23092	16.30756	2.723919	7.619960	7.524027	6.288129	4.305486
2	.373384	42.35830	12.50967	12.73700	8.350538	8.619087	4.885313	10.54008
3	.410328	35.15496	12.78060	14.36226	10.97135	7.256243	6.737774	12.73681
4	.436326	31.41400	11.81744	13.33318	13.50009	6.463254	7.006611	16.46542
5	.467815	28.24121	10.59737	12.05419	15.32330	5.761217	8.440362	19.58236
6	.493742	25.62371	9.709701	10.98614	16.83879	5.551910	9.596836	21.69292
7	.518826	23.51532	8.823122	10.10958	18.03176	5.314369	10.47581	23.73005
8	.542442	21.73135	8.119792	9.438304	18.98240	5.150860	11.32498	25.25231
9	.564317	20.23568	7.527192	8.896101	19.80746	5.013541	11.95061	26.56942
10	.585582	18.95504	7.015303	8.453792	20.49783	4.872110	12.49608	27.70985
<i>Panel 2. Variance Decomposition of exchange rate (EXCR)</i>								
1	.278365	.000000	10.48310	67.19762	.367282	2.240915	19.71108	.000000
2	.445082	.149159	9.696193	66.63287	.817494	2.685520	19.25629	.762481
3	.569411	.138241	10.05123	67.19163	.814997	3.160749	17.84975	.793399
4	.671741	.126712	9.832146	66.84403	.872591	3.563174	17.86783	.893519
5	.759821	.133061	9.677621	67.05163	.886975	3.789242	17.55923	.902243
6	.839022	.121414	9.565241	67.01478	.909722	3.990263	17.45657	.942009
7	.911142	.115990	9.425552	67.09330	.923342	4.105662	17.38112	.955040
8	.978355	.110043	9.342772	67.13544	.935460	4.194228	17.31022	.971830
9	1.041203	.104831	9.265547	67.17268	.944806	4.257468	17.27078	.983887
10	1.100578	.101200	9.207956	67.20809	.952148	4.304327	17.23328	.993002

Source: Authors' computations.

consistently risen (i.e. depreciated) over the years has not led to the desired improvement in the country's payments balance in the medium and long term. In Panel 2, it can be observed that exchange rate reacts positively to interest rate, government expenditure and real gross domestic product throughout the forecast horizon. Thus, real output has not be helped by interest rate levels and this might have had its negative impact on payment balance. These results are consistent with those from the generalized impulse response functions at the VAR level (see Figure 1B in the Appendix).

The variance decompositions (at VEC level) of the major variables of interest, i.e. BOP and exchange rates at the end of 10years horizon are presented in Table 7 (the results of other variables are not reported here to conserve space, but are provided in Table 1G in the Appendix).

The results in Panel 1 of Table 7 suggest that 19% of the variation in BOP is explained by its own shocks, with only 8% due to exchange rate. Thus, a significant variation in Nigeria's BOP is not due to changes in exchange rate movements. The shocks due to openness are particularly instructive. This is because it is more than the combined shocks originating from government expenditure, interest rate and money supply. In essence, the result suggests that the degree of openness might have been responsible for the overall negative BOP experienced by the country over the years. This is plausible given the country's propensity to import and the domestic inhibitions of the real sector of the economy such as inadequate power, poor infrastructure, high interest rate, policy inconsistencies, poor governance structures and institutional weaknesses.

A similar result can be observed for the variance decomposition of exchange rate in Panel 2 of Table 7. Whereas 67% of variation in EXCR is explained by its own shocks, those of BOP, GE, RGDP, M2, IR and OPN are .10, 9.2, .95, 4.30, 17.23 and .99%, respectively. The implication of the result is that exchange rates over the years for the Nigerian economy have not been highly influenced by the country's real

output and money supply but rather appeared to be dictated by interest rate movements. The results in Panels 1 and 2 of Table 7 are thus consistent with those obtained in the vector error correction estimates. The results are also consistent with those obtained from the variance decomposition at the VAR level (see Table 1F in the Appendix). In both cases, the influence of openness is evident.

## 5. Conclusion

The paper empirically investigates the impact of exchange rate on Nigeria's BOP using time series data from 1961 to 2011 generated from secondary sources. The study was undertaken within a multivariate vector error correction framework. A long-run equilibrium relationship was found between Nigeria's BOP and the macroeconomic variables employed in the study. Results of impulse response functions suggest that one standard deviation innovation on exchange rate reduces BOP in the medium and long terms, while results of the variance decomposition indicates that a significant variation in Nigeria's BOP is not due to changes in exchange rate movements. The results of the estimated VECM, generalized impulse response and variance decomposition are consistent.

A major finding is that exchange rate movements in Nigeria are not statistically influenced by changes in the identified variables. This is underscored on the fact that the Nigerian economy has not been very productive especially from the 1980s and particularly in the real non-oil sector of the economy, which are expected to generate high employment and output for exports, with the consequence that exchange rate depreciation has tended not to reflect the dynamics of local realities. Noteworthy is the fact that the SAP introduced in 1986 and which led to the deregulation of the economy and set the tone for the liberalization of exchange rate did not engender improvement in local production. Although net export was positive for some years, the fact that the country has had to contend with the myriad of macroeconomic distortions of debt service and repayment, high poverty and inflation, high interest rates, poor infrastructure and general institutional weaknesses, meant a gradual deterioration of net output and a comatose real sector of the economy. The policy implication of this is that exchange rate depreciation which has been preponderant in Nigeria especially since the mid-1980s has not been very useful in promoting the country's positive BOP due largely to internal forces. It is important to stress that the results of the study are based on the proxies employed and that the findings may be country-specific.

For Nigeria to have a sustainable and improved BOP, there is need to engender growth in the real sector of the economy, as a way of improving exports and creating employment, curbing inflation and reducing poverty. Management of demand in all its ramifications is called for; for example, drastic cuts in non-productive imports are palliative. Attracting foreign private investment through the institution of macroeconomic policies that impact inflation positively and stimulate exchange rate stability can assist in improving BOP position. Macroeconomic stability can be ensured through monetary and fiscal coordination in order to ensure proper management of macroeconomic dynamics of interest and exchange rates, inflation and output. In particular, a realistic exchange rate is imperative which takes account of prevailing local circumstances rather than the dynamics of international undertones. However, to maintain and have a sustainable BOP and avoid growing external debt stock, it is important to have a moderate exchange rate and in particular one that is not over-valued, both of which are capable of being achieved in an environment of fiscal and monetary discipline. Above all, domestic fundamentals must be got right in terms of adequate power supply, infrastructure, governance and the like, all of which can reduce unemployment and inflation and consequently attract higher exports, while discouraging frivolous imports.

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### Article Information

Cite this article as: Impact of exchange rate depreciation on the balance of payments: Empirical evidence from Nigeria, M. Iyoboyi & O. Muftau, *Cogent Economics & Finance* (2014), 2: 923323.

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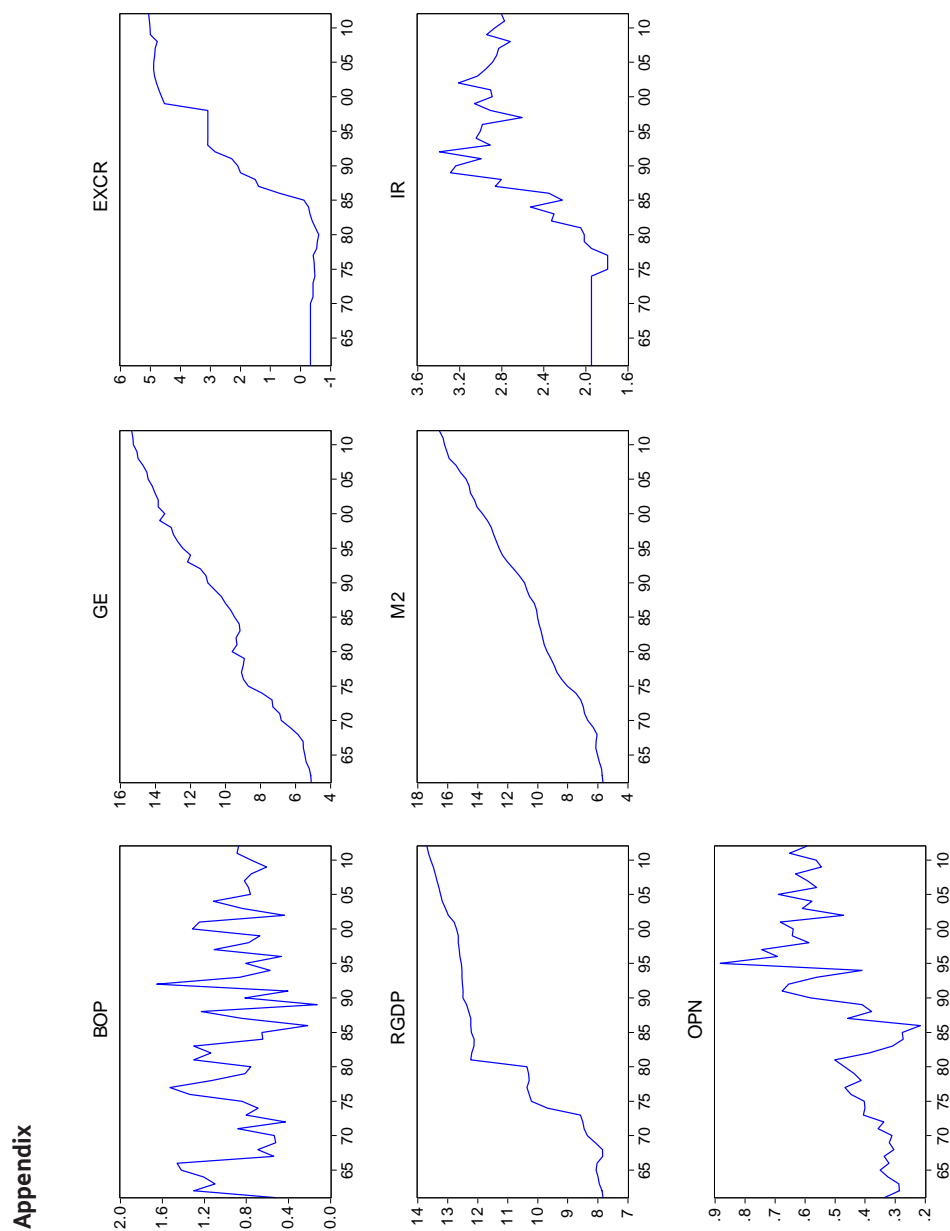


Figure 1A. Plot of series, 1961–2012.



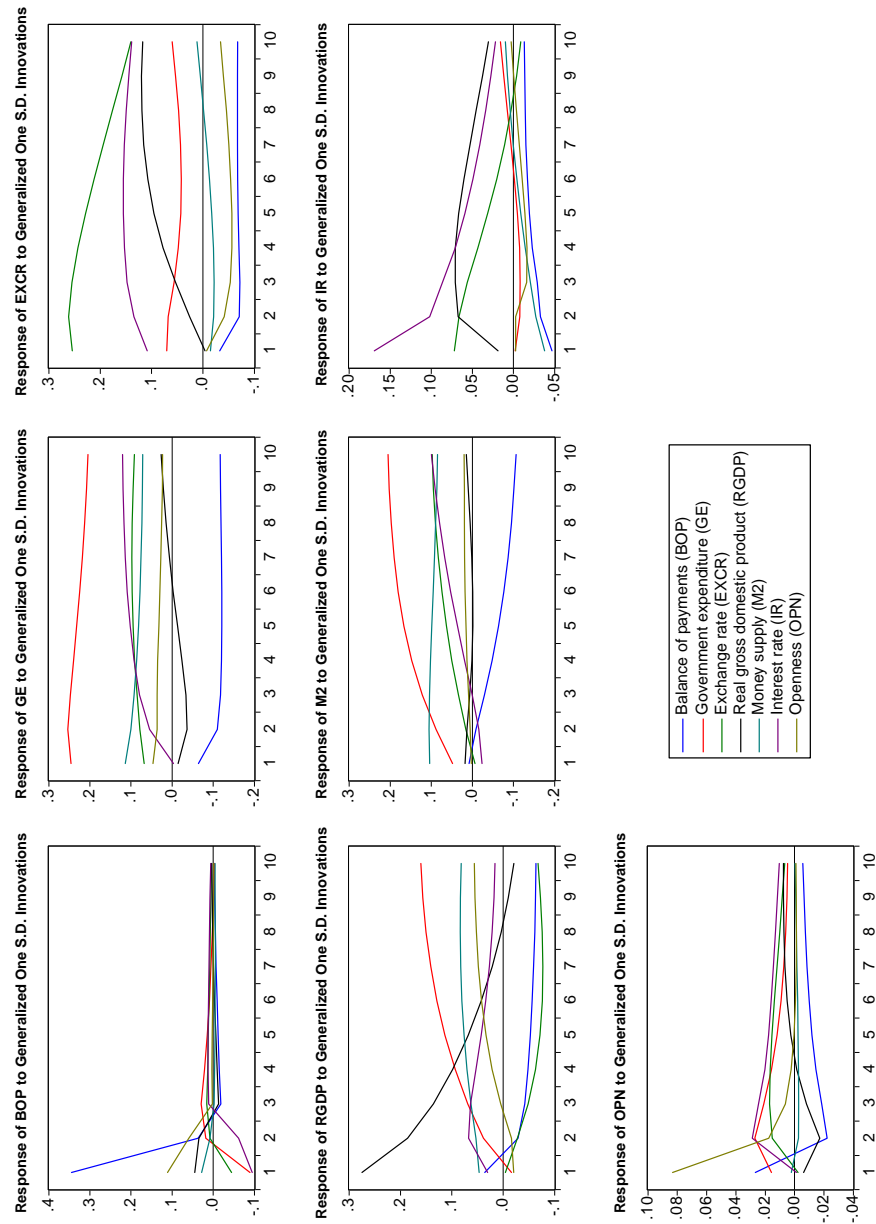
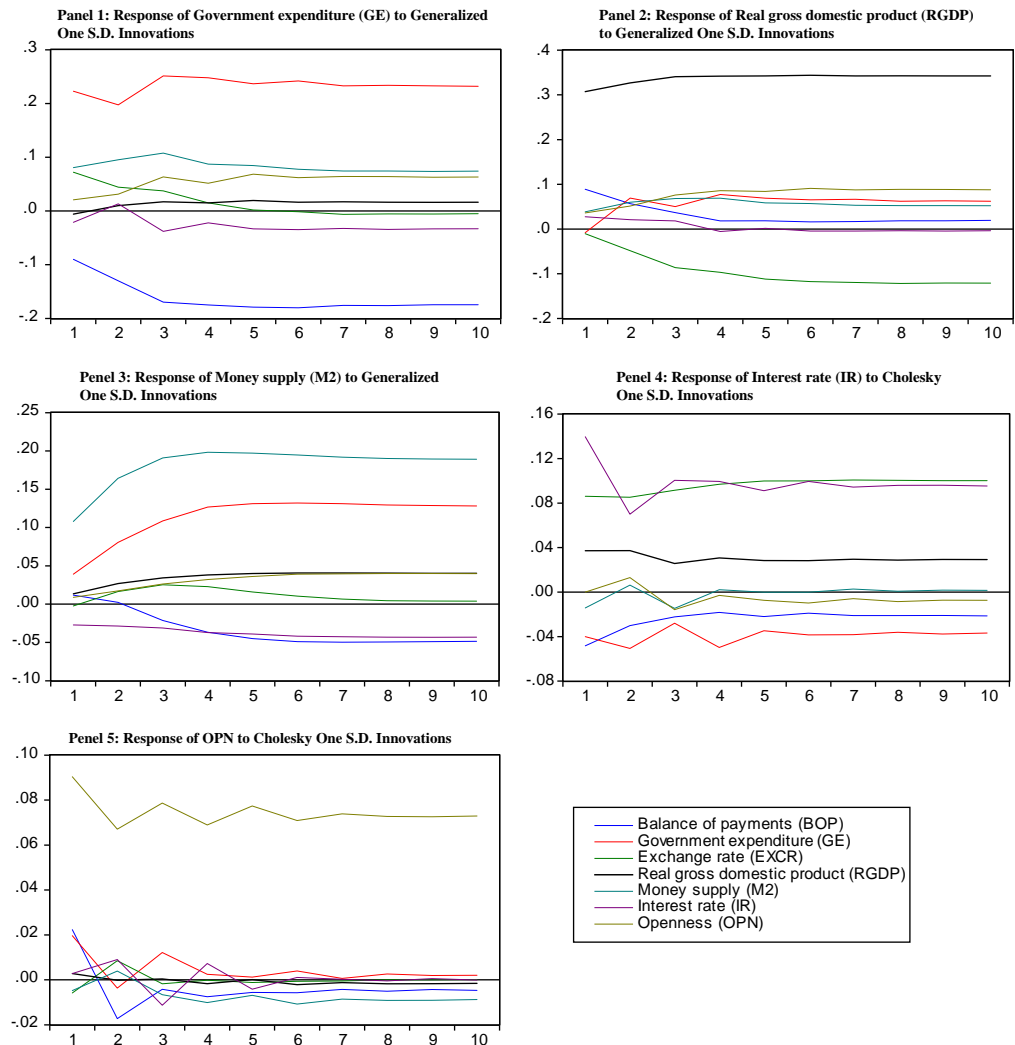


Figure 1B. Generalized Impulse Response Function (VAR).

Figure 1C. Generalized Impulse Response Function (VEC).



**Table 1A. Descriptive Statistics**

	<b>BOP</b>	<b>GE</b>	<b>EXCR</b>	<b>RGDP</b>	<b>M2</b>	<b>IR</b>	<b>OPN</b>
Mean	.870914	10.35983	1.720744	11.24736	10.61752	2.483315	.476179
Median	.814064	9.846938	1.047077	12.23367	10.15116	2.565781	.452352
Maximum	1.652718	15.34272	5.059422	13.69773	16.55531	3.394508	.882360
Minimum	.127220	5.099256	-.612674	7.824526	5.660875	1.791759	.215544
Std. Dev.	.343486	3.294240	2.271935	2.064000	3.438166	.505925	.151848
Skewness	.238671	-.062960	.355357	-.623613	.130261	.040058	.393484
Kurtosis	2.503365	1.766313	1.415629	1.778351	1.786593	1.418690	2.328716
Jarque-Bera	1.028088	3.331987	6.533249	6.603995	3.337163	5.431749	2.318206
Probability	.598072	.189003	.038135	.036810	.188514	.066147	.313768
Sum	45.28751	538.7111	89.47871	584.8625	552.1109	129.1324	24.76132
Sum Sq. Dev.	6.017125	553.4528	263.2461	217.2649	602.8703	13.05398	1.175950
Observations	52	52	52	52	52	52	52

*Correlation matrix*

BOP	1.0000	-.1165	-.1220	-.0918	-.1108	-.1915	.0738
GE	-.1165	1.0000	.9252	.9337	.9929	.8093	.7845
EXCR	-.1220	.9252	1.0000	.7972	.9358	.8432	.7648
RGDP	-.0918	.9337	.7972	1.0000	.9294	.8308	.6781
M2	-.1108	.9929	.9358	.9294	1.0000	.8075	.7537
IR	-.1915	.8093	.8432	.8308	.8075	1.0000	.6845
OPN	.0738	.7845	.7648	.6781	.7537	.6845	1.0000

**Table 1B. VEC Residual Portmanteau Tests for Autocorrelations**

<b>Lags</b>	<b>Q-Stat.</b>	<b>Prob.</b>	<b>Adj Q-Stat.</b>	<b>Prob.</b>	<b>df</b>
1	11.55459	NA*	11.79039	NA*	NA*
2	47.25110	1.0000	48.97427	.9999	91
3	106.8362	.9832	112.3626	.9586	140
4	152.4984	.9761	161.9955	.9231	189
5	198.5987	.9703	213.2180	.8743	238
6	261.7079	.8555	284.9330	.5234	287
7	319.8256	.7285	352.5117	.2571	336
8	377.8486	.5930	421.5868	.0963	385
9	434.6140	.4827	49.8128	.0306	434
10	477.8747	.5573	544.8887	.0266	483
11	531.3644	.4996	613.4653	.0082	532
12	599.4594	.2893	703.0640	.0004	581

Note: df is degrees of freedom for (approximate) chi-square distribution.

\*The test is valid only for lags larger than the VAR lag order.

**Table 1C. VEC Residual Serial Correlation LM Tests**

Lags	LM-Stat.	Prob.
1	45.10295	.6318
2	42.26097	.7410
3	57.37735	.1925
4	48.97075	.4743
5	52.39364	.3438

Note: Probs from chi-square with 49 df.

**Table 1D. VEC Residual Heteroskedasticity Tests (Joint Test): No Cross Terms**

	Chi-sq	df	Prob.
No cross terms	457.7924	448	.3643
Includes cross terms	1277.472	1232	.1792

**Table 1E. Roots of Characteristic Polynomial**

Lag specification: 1 1	
Root	Modulus
.986271	.986271
.886389 - .114681i	.893777
.886389 + .114681i	.893777
.862795	.862795
.412640	.412640
-.103022	.103022
.078537	.078537

Notes: No root lies outside the unit circle.

VAR satisfies the stability condition.

**Table 1F. Variance Decomposition (VAR Level)**

Period	S.E.	BOP	GE	EXCR	RGDP	M2	IR	OPN
<i>Panel 1: Variance decomposition of BOP</i>								
1	.344560	64.19778	6.733580	.920613	1.185066	5.176413	5.319231	16.46732
2	.361188	58.47810	6.383936	1.708448	2.913009	4.711299	7.985985	17.81922
3	.363036	57.89155	6.974698	1.692331	2.941222	4.901687	7.939882	17.65863
4	.364160	57.54123	7.266339	1.682411	2.960560	5.042927	7.954043	17.55249
5	.364843	57.33187	7.397782	1.677571	2.964586	5.145165	7.995534	17.48749
6	.365254	57.20750	7.445753	1.676930	2.960910	5.216083	8.044280	17.44854
7	.365507	57.13179	7.455262	1.679223	2.956818	5.263100	8.089048	17.42476
8	.365673	57.08232	7.451342	1.682841	2.956249	5.292760	8.125203	17.40929
9	.365793	57.04664	7.446636	1.686401	2.960063	5.310344	8.151694	17.39822
10	.365886	57.01837	7.446512	1.689062	2.967342	5.319891	8.169290	17.38953
<i>Panel 2: Variance decomposition of GE</i>								
1	.246088	.000000	100.0000	.000000	.000000	.000000	.000000	.000000
2	.360969	.313847	95.98398	.316102	.603152	.291030	2.321576	.170311
3	.447754	.491170	92.97378	.460661	.787959	.508004	4.573323	.205101

(Continued)

**Table 1F. (Continued)**

Period	S.E.	BOP	GE	EXCR	RGDP	M2	IR	OPN
4	.518456	.628773	90.72460	.493934	.740311	.667836	6.531322	.213219
5	.578823	.742542	88.85244	.485395	.629028	.788304	8.280251	.222037
6	.631957	.839385	87.20050	.465937	.528301	.877969	9.854401	.233505
7	.679762	.923101	85.70201	.448679	.466887	.942724	11.27030	.246300
8	.723480	.995978	84.33093	.439471	.450679	.987238	12.53678	.258924
9	.763958	1.059530	83.07849	.441690	.474628	1.015427	13.65997	.270256
10	.801796	1.114860	81.94191	.458089	.529192	1.030637	14.64571	.279598

*Panel 3: Variance decomposition of EXCR*

1	.254476	.000000	7.607344	72.74974	.039454	4.401961	15.20150	.000000
2	.369180	.466466	6.958749	68.08208	.395766	4.619999	18.65720	.819737
3	.456539	.622338	6.063454	64.64557	1.318635	4.422234	21.52258	1.405192
4	.528023	.723613	5.348367	61.67084	2.694391	4.129570	23.71545	1.717767
5	.588290	.805054	4.848479	58.75952	4.264045	3.837679	25.57840	1.906830
6	.639623	.876621	4.534646	55.90060	5.874246	3.571385	27.21680	2.025701
7	.683480	.942323	4.380730	53.13352	7.430801	3.336794	28.67592	2.099915
8	.720997	1.003927	4.372334	50.49428	8.874538	3.133478	29.97787	2.143568
9	.753160	1.062135	4.505271	48.00840	10.16829	2.958495	31.13236	2.165051
10	.780880	1.117061	4.782035	45.69220	11.28957	2.808007	32.14147	2.169654

*Panel 4: Variance decomposition of RGDP*

1	.275053	.000000	.340033	.000000	91.76596	4.995502	2.898507	.000000
2	.346962	.295956	1.443096	3.800850	82.58497	4.466212	7.153396	.255517
3	.398155	.441351	4.113834	9.529063	72.53188	4.137725	9.009373	.236775
4	.442684	.517189	7.778584	15.49673	62.83352	3.825847	9.356593	.191539
5	.484848	.547809	11.93047	20.85218	54.03337	3.498310	8.967305	.170554
6	.525935	.551185	16.14727	25.20923	46.47818	3.168215	8.275114	.170800
7	.566050	.540065	20.15422	28.50269	40.25133	2.853564	7.514905	.183224
8	.604849	.522618	23.81147	30.83982	35.25886	2.567178	6.799515	.200545
9	.641879	.503650	27.07341	32.39340	31.32288	2.315405	6.173100	.218151
10	.676738	.485759	29.94871	33.34109	28.24615	2.099641	5.645119	.233542

*Panel 5: Variance decomposition of M2*

1	.103966	.000000	21.48516	.000000	.000000	78.51484	.000000	.000000
2	.155077	.000172	42.21742	.165496	.008506	57.41769	.045928	.144787
3	.205450	.038864	59.14844	.206244	.011318	39.69769	.604552	.292887
4	.258021	.131520	70.10584	.183211	.036729	27.34628	1.808699	.387720
5	.312067	.252055	76.39144	.150296	.052377	19.31170	3.404943	.437187
6	.366420	.379980	79.68293	.121812	.048951	14.14169	5.161929	.462707
7	.420152	.504487	81.17738	.099086	.037703	10.76737	6.936978	.476990
8	.472657	.620795	81.61595	.080869	.034106	8.511002	8.651349	.485934
9	.523584	.727130	81.44265	.066298	.049630	6.959539	10.26282	.491931
10	.572754	.823121	80.92504	.055607	.089762	5.861497	11.74917	.495798

*Panel 6: Variance decomposition of IR*

1	.169285	.000000	.015413	.000000	.000000	6.066731	93.91786	.000000
2	.209616	1.132297	.147103	2.060253	7.729459	5.550807	83.30131	.078771
3	.237611	1.391984	.229460	2.863254	13.02828	4.961327	77.35224	.173455
4	.257522	1.476145	.278077	3.027592	17.25544	4.455681	73.23355	.273522

(Continued)

**Table 1F. (Continued)**

Period	S.E.	BOP	GE	EXCR	RGDP	M2	IR	OPN
5	.271801	1.513667	.281215	2.876917	20.44419	4.077400	70.46667	.339937
6	.282065	1.535674	.262843	2.675202	22.77081	3.805935	68.57494	.374594
7	.289527	1.550507	.260480	2.591605	24.39628	3.614317	67.19968	.387131
8	.295114	1.559956	.314068	2.717984	25.44788	3.479223	66.09432	.386563
9	.299521	1.563992	.458561	3.087915	26.03142	3.381979	65.09653	.379604
10	.303251	1.562341	.718636	3.691713	26.24161	3.308191	64.10673	.370781

*Panel 7: Variance decomposition of OPN*

1	.083265	.000000	3.596291	.960064	.195972	.469552	.098216	94.67990
2	.095757	.867481	10.80347	1.316050	3.230748	3.600346	7.284784	72.89712
3	.101923	1.077648	13.74630	1.162945	3.449405	5.064998	11.12816	64.37054
4	.105490	1.189641	15.04931	1.186553	3.232077	5.832326	13.41727	60.09282
5	.107990	1.262498	15.59231	1.315661	3.144055	6.248246	15.07699	57.36024
6	.109908	1.314309	15.76792	1.453276	3.233642	6.460314	16.36866	55.40188
7	.111442	1.352938	15.77620	1.552985	3.455421	6.551218	17.39664	53.91460
8	.112689	1.382507	15.72052	1.604237	3.752998	6.571649	18.21632	52.75178
9	.113709	1.405505	15.65327	1.615393	4.078467	6.553354	18.86505	51.82897
10	.114546	1.423556	15.59995	1.602670	4.396387	6.515909	19.37197	51.08956

**Table 1G. Variance Decompositions (VEC Level)**

Period	S.E.	BOP	GE	EXCR	RGDP	M2	IR	OPN
--------	------	-----	----	------	------	----	----	-----

*Panel 1: Variance decomposition of GE*

1	.222980	16.30751	83.69249	.000000	.000000	.000000	.000000	.000000
2	.310681	25.92921	69.14799	.556202	1.150460	1.568110	.737398	.910635
3	.419437	30.57312	60.62912	1.700927	1.946969	1.453123	.896783	2.799956
4	.504159	33.21619	56.72166	3.221835	2.255944	1.038578	.621033	2.924755
5	.577853	34.86592	52.86893	4.512198	2.621849	.829970	.544628	3.756513
6	.644257	35.85990	50.77026	5.496540	2.743142	.667739	.480887	3.981527
7	.701742	36.50064	49.13690	6.279705	2.857409	.562831	.427004	4.235518
8	.755062	36.97703	47.97665	6.823869	2.925876	.486149	.397876	4.412547
9	.804161	37.30887	47.15588	7.243724	2.971631	.428732	.369186	4.521971
10	.850249	37.57879	46.49511	7.560957	3.010979	.383514	.348085	4.622556

*Panel 2: Variance decomposition of RGDP*

1	.307104	.000000	.072038	.000000	96.29954	2.083712	1.544710	.000000
2	.461502	.030275	2.273805	2.706304	92.05440	1.583496	1.343072	.008644
3	.589127	.453607	2.122704	5.190567	88.97508	1.807044	1.215241	.235753
4	.701017	.930079	2.715656	6.700492	86.70619	1.669834	.890588	.387157
5	.799486	1.113593	2.828772	8.265216	85.11450	1.486589	.731513	.459814
6	.888652	1.359843	2.832536	9.268558	84.00724	1.365190	.605333	.561300
7	.969396	1.466818	2.850318	10.06041	83.24789	1.251472	.518273	.604827
8	1.043916	1.548014	2.811221	10.65460	82.70971	1.172526	.456127	.647797
9	1.113256	1.608117	2.790817	11.08807	82.31656	1.111322	.407846	.677271
10	1.178403	1.646131	2.768945	11.43397	82.01772	1.063429	.370924	.698872

(Continued)

**Table 1G. (Continued)**

Period	S.E.	BOP	GE	EXCR	RGDP	M2	IR	OPN
<i>Panel 3: Variance decomposition of M2</i>								
1	.108022	.000000	13.13615	.000000	.000000	86.86385	.000000	.000000
2	.198774	.130366	20.26795	.158081	.106504	78.85915	.458714	.019233
3	.281689	1.364152	24.98030	.176070	.224466	72.53490	.628683	.091429
4	.353297	2.553699	28.75734	.113721	.357915	67.50922	.548512	.159592
5	.414074	3.565250	30.94884	.118228	.474862	64.17990	.476632	.236292
6	.467023	4.398041	32.31041	.175541	.572123	61.82814	.402968	.312776
7	.513699	4.976833	33.21419	.257567	.645437	60.18841	.348002	.369563
8	.555882	5.404996	33.78482	.334044	.701060	59.05133	.306853	.416894
9	.594742	5.715939	34.19898	.395806	.742439	58.21952	.275316	.451998
10	.631016	5.947178	34.50295	.444310	.773995	57.60145	.251153	.478967
<i>Panel 4: Variance decomposition of IR</i>								
1	.180006	.000000	.902724	.000000	.000000	5.486917	93.61036	.000000
2	.222832	1.218564	2.940374	2.311963	.119099	4.314545	89.00832	.087132
3	.265549	1.224022	2.458394	2.714748	.087852	4.805041	88.44542	.264528
4	.305861	.932309	3.406002	3.211395	.070842	4.123935	88.05020	.205317
5	.338160	.779579	3.243018	4.002636	.060435	3.859306	87.85125	.203772
6	.370085	.712931	3.261557	4.302476	.051375	3.616764	87.84128	.213617
7	.398561	.623949	3.254043	4.670167	.046290	3.399801	87.80490	.200855
8	.425193	.571042	3.191288	4.906013	.041829	3.270102	87.81484	.204884
9	.450376	.522933	3.178868	5.079475	.038721	3.150763	87.82878	.200461
10	.474029	.483606	3.149052	5.231507	.036207	3.062843	87.83822	.198565
<i>Panel 5: Variance decomposition of OPN</i>								
1	.095525	.000000	.870238	.033190	1.564814	.271373	.745925	96.51446
2	.118749	6.091679	.657373	.024641	1.398143	.229309	2.395709	89.20315
3	.143616	6.754356	1.245028	.064497	.998671	.310514	2.231889	88.39504
4	.159981	6.675339	1.112264	.155568	.828902	.752956	1.916919	88.55805
5	.177997	7.292730	.934399	.126796	.669845	.795793	1.589609	88.59083
6	.192035	7.191980	.898786	.125439	.581408	1.026888	1.366487	88.80901
7	.205980	7.228500	.793492	.117143	.507098	1.090912	1.188499	89.07436
8	.218703	7.246667	.744998	.106374	.452879	1.167429	1.056804	89.22485
9	.230662	7.214805	.693196	.099718	.409766	1.222727	.950441	89.40935
10	.242138	7.225543	.653002	.092423	.374172	1.259346	.863264	89.53225



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