EFFECTS OF REAL EXCHANGE RATE ON TRADE BALANCE: EMPIRICAL EVIDENCE FROM NIGERIA

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ABSTRACT

The paper empirically examines the effects of real exchange rate on trade balance in Nigeria. The econometric diagnostics for presence of unit roots in the series was conducted using the Augmented Dickey-Fuller technique. The results indicate that all the variables are integrated of order one while the major Error Correction terms (ECM_1 and ECM_2) are integrated of order zero, which confirms the existence of long-run equilibrium on the basis of Engel-Granger approach to cointegration. The results of causality test indicate weak evidence of causality between real exchange rate and trade balance. The error-correction model estimates provide evidence in support of restoration of long-run equilibrium after short-run distortion. However, the impulse response function does not establish the existence of J-Curve effect in Nigeria. The implication of the study is that real exchange rate adjustment alone may not ensure favourable balance of trade in Nigeria. Consequently, the study recommends that exchange rate adjustment policies should be accompanied by other policy actions. Overall, this study bridges the dearth of in-depth literature on the effect of real exchange rate on trade balance in Nigeria, as well as adds to existing literature on the subject matter.

Keywords: Real exchange, Trade balance, J-curve, Cointegration, VECM, Nigeria

INTRODUCTION

For some decades now, economists have been preoccupied with several studies to adduce whether exchange rate depreciation improves trade balance, and whether appreciation worsens Bhattarai and Armah, (2005) observed that exchange rate has been used as a tool for regulating flows of trade and capital by many developing economies, which tend to have persistent deficits in the balance of payments position because of a structural gap between the volumes of exports and imports. These

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economies tend to have inelastic demand for both exports and imports. In addition, the rate of growth of imports is often higher than the rate of growth of exports resulting in rising imbalances in trade. If trade balances and real exchange rates do not exhibit a close relationship, then changing the value of the currency will be of little help in closing trade gaps. Understanding what determines the sensitivity of the trade balance to real exchange rates is therefore fundamental to assess whether movements in real exchange rates can affect trade flows significantly and thereby effectively contribute to global rebalancing (Kharroubi, 2011).

Numerous empirical studies have also explored to support or disprove the hypothesis that in the short-run currency depreciation might first worsen the trade balance before subsequently improving it, hence creating the *J-curve* effect; which is due to the low price elasticity of demand for imports and exports in the immediate outcome of an exchange rate change. The empirical evidence on the presence of a longrun relationship, as well as on the empirical validity of the effect of exchange rate variation on trade balance has, however, remained mixed. For instance, while some empirical studies (GylfasonandRisager, 1984;Himarios, 1989) supported the view that devaluation improves the trade balance, others (such as Haynes & Stone, 1982; and Bahmani-Oskooee, 1994) have challenged this view or provided evidence that the negative relationship between exchange rate and trade balance holds only for certain countries or time periods. Rose and Yellen, (1989) and Rose, (1991) have provided evidence that there is no significant relationship whatsoever between the trade balance and the real exchange rate. Findings of empirical studies covering developed countries (e.g. the United States, Canada and Japan), a number of emerging European and Asian economies, as well as few developing African countries, are mixed but still more in favor of the proposition that currency depreciation improves trade balance and that J-curve effect takes place (PetrovicandGligoric, 2009). However, the unresolved issue has been whether this condition holds in various economies across space and time. This is, therefore, an open empirical issue, which this paper attempts to explore for Nigeria.

CONCEPTUAL AND THEORETICAL FRAMEWORK

Real exchange rate refers to the rate at which domestic goods and services can be traded for those produced abroad. Changes in the real exchange rate are needed to achieve balance between net savings and net exports. The real exchange rate is a reflection of a country's competitiveness—the higher its real exchange rate, the more expensive its commodities are to overseas residents. With a high real exchange rate, a country's exports will be low and imports high because foreign goods are cheap. Therefore, the higher the real exchange rates, the lower the level of net exports and the higher the current account deficit (Miles and Scott, 2005; Akpansung, 2011). As explained by Abel *et al. (*2008), since the real exchange rate is the relative price of a country's goods and services, an increase in the real exchange rate induces both foreigners and domestic residents to consume less domestic production and more goods and services produced abroad, which lower net exports.

Figure 2.1 shows this negative relationship between the real exchange rate and net exports. The figure suggests that when countries experience a real depreciation their current account should ultimately improve. Generally, economists usually explain the relationship between trade balance and depreciation of currency using the *J-curve.* They opine that following depreciation of a country's currency (e.g., due to devaluation), initially the trade balance deteriorates but eventually it improves, assuming other things are the same. However, Miles and Scott (2005) stressed that: (i) it is the *real* exchange rate that matters. If the nominal exchange rate falls but is offset by higher domestic inflation so that the real exchange rate is unaltered, then there is no effect on net exports; (ii) the beneficial effect of the depreciation may not be immediately felt. In the short term, the current account may worsen.
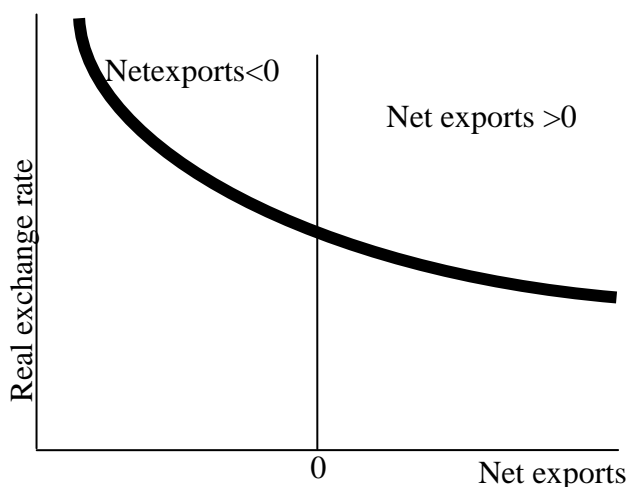
Figure 2.1: Real exchange rate and net exports

Source: Miles and Scott, (2005); p. 519

This of course depends on how quickly importers and exporters can respond to changes in relative prices: the effect of a change in the real exchange rate on net exports may be weak in the short run and may even go the wrong way. The typical *J-curve* response pattern of net exports to real depreciation overtime is depicted in Figure 2.2.In the short run, net exports deteriorates (i.e., become more negative) as the decline in the real exchange rate raises the real cost of imports. Overtime, however, increased exports and reduced quantities of imports more than compensate for the increased costs of imports, and net exports improves (i.e., rise above their initial level).
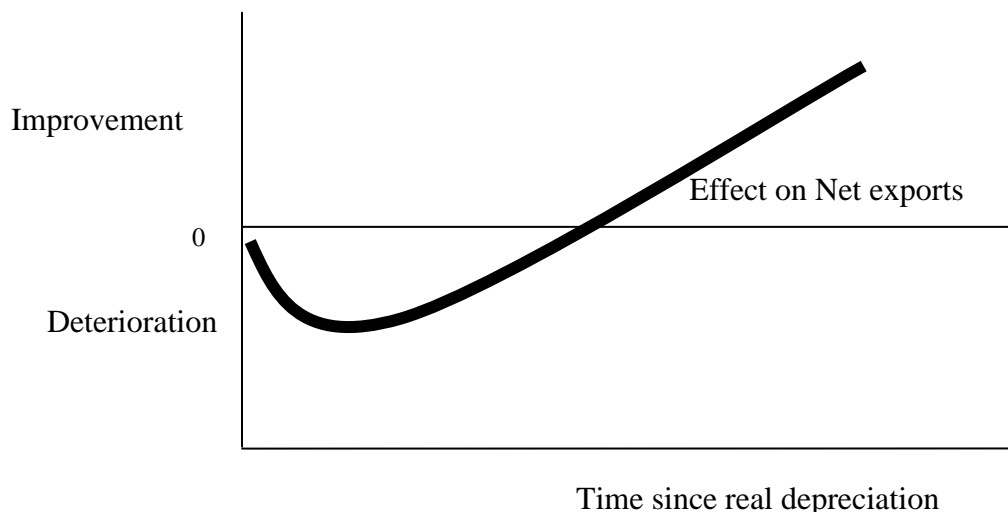
Figure 2.2: J-curve; The current account initially worsens before improving after real depreciation

Generally, the theoretical linkage between the real exchange rate and balance of trade can be examined using the following functional equation:

$$BOT = F(Y_d, Y_f, XR_r) \tag{1}$$

This model expresses the balance of trade as a function of the levels of domestic and foreign income and the real exchange rate. Based on economic a priori restrictions, it is expected that:

$$\frac{\partial BOT}{\partial Y_d} < 0; \frac{\partial BOT}{\partial Y_f} > 0; \text{and} \frac{\partial BOT}{\partial XR_r} < 0$$

This equation says that the trade balance is negatively related to domestic incomes (due to the impact of such incomes on import expenditures), positively related to foreign incomes (for the same reason), and negatively related to the real exchange rate. The last variable is an index of the home country's cost and price competitiveness in world markets. When it is high, the home country's currency is overvalued and its products are overpriced, resulting in depressed exports and a larger volume of imports, and vice versa (Munn and Mutti, 2004).

LITERATURE REVIEW

Following the pioneering study by Magee (1973), a large number of empirical studies have explored both long-run impact of exchange rate on trade balance, and whether J-curve phenomenon exists. For instance, Bahmani-Oskooee (1994) found cointegration for only a limited number of countries, while Rose and Yellen, (1989) rejectedcointegration altogether, thus casting doubt on the

long run effect of devaluation on the trade balance. These negative results, according to Shirvani and Wilbratte (1997), are, however, weakened by their use of the less powerful Engle-Granger cointegration approach. In contrast, however, Rose (1991) found that the Marshall-Lerner condition does not exist in five major OECD countries (United Kingdom, Canada, Germany, Japan, and the United States). Her results also showed insignificant relationship between trade balance and exchange rate, thus implying that devaluation could not improve trade balance in the long-run. Shirvani and Wilbratte, (1997) examined the relationship between trade balance and real exchange rate in United States and the G7 countries (Canada, France, Germany, Italy, Japan, United Kingdom and United States).

$$\log(\mathcal{T}\beta_t) = \alpha_0 + \alpha_1 \log(Q_t) + \alpha_2 \log(Y_t) + \alpha_3 \log(Y_t^*) + t^i \qquad (2)$$

This model expresses the balance of trade as a function of the real exchange rate (Q_t) and the levels of domestic (Y_t) and foreign (Y_t^*) incomes. They found that currency devaluation can improve balance of trade in the long-run.

Wilson and Kua, (2001) in their study, found no correlation between exchange rate and trade balance whileStucka, (2003) found the existence of the J-curve in Croatia. In their study of China's bilateral trade with the G-7 countries, Ahmad and Yang, (2004) found no evidence of J-curve effect. Bhattarai and Armah, (2005) in their study confirmed a stable long-run relationship between both exports and imports and the real exchange rate. Thorbecke, (2006) empirical study demonstrated that exchange rate appreciation in Indonesia, Malaysia, and Thailand would decline export.An extensive study for emerging Europe (Bulgaria, Croatia, Cyprus, Czech Republic, Hungary, Poland, Romania, Russia, Slovakia, Turkey and Ukraine) by Bahmani-Oskooee and Kutan, (2007) found empiricalsupport for the J-curve pattern in three countries: Bulgaria, Croatia and Russia; indicating that short run deterioration combined with long-run improvement.Yuen-Ling *et al.(2008)* adopted equation which expresses the balance of trade as a function of the levels of domestic and foreign income and the real exchange rate, thus:

$$\ln(T\beta_t) = \beta_0 + \beta_1 \ln(Y_t) + \beta_2 \ln(Y_t^*) + \beta_3 \ln(RER_t) + u_t \qquad (3)$$

Their results support the empirical validity of the Marshall-Lerner conditionindicating that depreciation improves the trade balance. The use of impulse response analyses indicated no J-curve effect. In their study of Serbian economy,Petrovic and Gligoric (2010) found that real exchange rate depreciation improves trade balance in the long run. They also found the existence of J-curve effect.In a recent study, Kharroubi (2011) built his econometric model on Goldstein and Khan's (1985) reduced form model of the trade balance, in which the trade balance depends negatively on domestic income, positively on foreign income, and negatively on the real exchange rate (an

increase in the real exchange rate being equivalent to an appreciation). Their findings confirmed that real exchange rate adjustment should be accompanied by other policy actions.

In their study on Pakistan's trade balance using the ARDL bounds testing approach to cointegration, Shahbaz *et al.*(2011) found a long-run relationship between exchange rate, income and money supply. In their recent study, Shahbaz *et al.*(2012) explored the relationship between changes in real exchange rate and trade balance in Pakistan using the Autoregressive Distributed Lag (ARDL) approach to cointegration. Their study found a long-run relationship between the series and nonexistence of J-curve relation. Their finding, however, suggested that currency depreciation led to the deterioration of Pakistan's trade balance.

METHODOLOGY AND DATA DESCRIPTION

Empirical Model Specification

The econometric model used in this study is rooted in similar studies (e.g., Goldstein & Khan, 1985; Shirvani andWilbratte, 1997; Yuen-Ling *et al. 2008;* Kharroubi, 2011), in which trade balance was posited to depend on domestic income, foreign income, and real exchange rate. Thus, using log transformation we specify that:

$$lnBOT_t = \alpha_0 + \alpha_1 lnREER_t + \alpha_2 lnRGDP_t + \alpha_3 lnWGDP_t + \varepsilon_t \qquad (4)$$

Where:

$lnBOT_t$ = Natural log of balance of trade

$lnREER_t$ = Natural log of real exchange rate of Nigerian naira to US dollar

$lnRGDP_t$ =Natural log of Real Gross Domestic Product

$lnWGDP_t$ = Natural log of world Gross Domestic Product, proxied by U.S real GDP

$\quad \varepsilon_t$ = White noise error term, with the usual stochastic assumptions.

A priori Expectation: $\alpha_0 > 0$, $\alpha_1 < 0$, $\alpha_2 < 0$, $\alpha_3 > 0$

Principally, $\alpha_1 < 0$ implies that the Marshall-Lerner condition holds, meaning that a real devaluation of the Nigerian currency improves the trade balance.

Data

The data used in this study are basically time series of balance of trade (BOT), real exchange rate (REER), real gross domestic product (RGDP) and world gross domestic product (WGDP) covering the period 1970 – 2010. The data are sourced from Central Bank of Nigeria (CBN) statistical bulletin and various issues of its Statement of account and annual reports.

DIAGNOSTICS

Unit root test

The test for unit root is by standard the first step to take before conducting the cointegration analysis. This is necessary to verify the order of integration of the variables. In this study, we adopt the Augmented Dickey-Fuller (ADF) test. The study relies on the Akaike Information Criterion (AIC) for lag length selection.

Cointegrationtest

Cointegration test is conducted with a view to avoiding spurious regression estimates. The study adopts the Engel and Granger, (1987) method in which variables are said to be cointegrated if they produce a residual that is stationary.

Granger causality test

Generally, variable x is said to Granger cause y if lagged values of x predict y conditional on lagged values of y. According to Granger if x fails to Granger-cause y then, the correlations between the two variables can be taken to represent the causal influence of y on x.

Vector error correction models

After testing for unit roots and cointegration, the short-run dynamics is established by specifying the following error correction models:

$$\Delta BOT_t = \beta_0 + \sum_{i=1}^{p_1}\beta_{1,i}\Delta BOT_{t-i} + \sum_{i=0}^{p_2}\beta_{2,i}\Delta REER_{t-i} + \sum_{i=0}^{p_3}\beta_{3,i}\Delta RGDP_{t-i} + \sum_{i=0}^{p_4}\beta_{4,i}\Delta WGDP_{t-i}$$
$$+ \vartheta_1 ECM_{1t-1} + \varepsilon_t \qquad (5)$$

$$\Delta REER_t = \gamma_0 + \sum_{i=1}^{q_1}\gamma_{1,i}\Delta BOT_{t-i} + \sum_{i=0}^{q_2}\gamma_{2,i}\Delta REER_{t-i} + \sum_{i=0}^{q_3}\gamma_{3,i}\Delta RGDP_{t-i} + \sum_{i=0}^{q_4}\gamma_{4,i}\Delta WGDP_{t-i}$$
$$+ \vartheta_2 ECM_{2t-1} + \mu_t \qquad (6)$$

$$\Delta RGDP_t = \delta_0 + \sum_{i=1}^{r_1}\delta_{1,i}\Delta BOT_{t-i} + \sum_{i=0}^{r_2}\delta_{2,i}\Delta REER_{t-i} + \sum_{i=0}^{r_3}\delta_{3,i}\Delta RGDP_{t-i} + \sum_{i=0}^{r_4}\delta_{4,i}\Delta WGDP_{t-i}$$
$$+ \vartheta_3 ECM_{3t-1} + \pi_t \qquad (7)$$

$$\Delta WRGDP_t = \varphi_0 + \sum_{i=1}^{s_1} \varphi_{1,i}\Delta BOT_{t-i} + \sum_{i=0}^{s_2} \varphi_{2,i}\Delta REER_{t-i} + \sum_{i=0}^{s_3} \varphi_{3,i}\Delta RGDP_{t-i} \sum_{i=0}^{s_4} \varphi_{4,i}\Delta WGDP_{t-i}$$

$$+ \vartheta_4 ECM_{4t-1} + \rho_t \quad (8)$$

where, Δ = difference operator, $\vartheta_1, \vartheta_2, \vartheta_3 \ and \ \vartheta_4$ = measures of speed of adjustment back to long-run equilibrium after short-run disturbance, $ECM_{1t-1}, ECM_{2t-1}, ECM_{3t-1} \ and \ ECM_{4t-1}$ = lagged stationary residuals from the cointegrating equation.

Impulse response function

Cholesky's impulse response function will be estimated to track the impact of shock from real exchange rate on balance of trade with a view to establishing the presence or otherwise J- curve effect.

EMPIRICAL RESULTS AND DISCUSSION

The results of unit root property of the series in this study are summarized in Table-1.The results indicate that all the variables with the exception of two error correction residuals (ECM_1 and ECM_2) are stationary in first or second differences (d (1)). The attainment of stationarity by the error terms (ECM_1 and ECM_2) in levels signals the existence of cointegrating relationship among the variables on the basis of Engle-Granger cointegration test approach. This further implies that the variables have long-run relationship.

Table 1: Results of unit root test using ADF

With Trend						Without Trend			
Variable	Level	1st Difference	2nd Difference	Lag Length	Order of Integration	Level	1st Difference	Lag Length	Order of Integration
BOT	-2.8702 (0.1864)	-3.6227 (0.0481)**	-	1	I(1)	-0.9434 (0.7589)	-3.7189 (0.0101)**	1	I(1)
REER	-2.8285 (0.1962)	-3.9816 (0.0179)**	-	1	I(1)	-2.8864 (0.0561)***	-3.9783 (0.0039)	1	I(1)
RGDP	-1.5973 (0.7758)	-4.8662 (0.0018)*	-	1	I(1)	-1.3114 (0.6147)	-4.7010 (0.0005)*	1	I(1)
WGDP	-2.9214 (0.1672)	-4.7149 (0.0028)*	-	1	I(1)	-1.2329 (0.6504)	-4.6400 (0.0006)*	1	I(1)
ECM_1	-3.1461 (0.1157)	-3.9812 (0.0232)**	-	1	I(1)	-3.2039 (0.0304)**	-	1	I(0)
ECM_2	-3.0449 (0.1386)	-3.2973 (0.0873)***	-6.7779 (0.0001)*	1	I(2)	-3.0853 (0.0393)**	-	1	I(0)
ECM_3	-1.4239 (0.8342)	-6.2913 (0.0001)*	-	1	I(1)	-1.4503 (0.5454)	-6.4314 (0.0000)*	1	I(1)
ECM_4	-2.9462 (0.1624)	-5.0245 (0.0019)*	-	1	I(1)	-2.9143 (0.0548)***	-5.1252 (0.0003)*	1	I(1)

Note: Probability values in parentheses below ADF statistics. *, ** and *** indicate significant at 1%, 5% and 10% respectively

Table 2 contains the results of Granger causality tests. The results indicate that RGDP Granger causes BOT, while WGDP is found to Granger cause BOT. There is also evidence of causation running from REER to RGDP. However, there is no sufficient evidence of either unilateral or bilateral flow of causation between BOT and REER. This further implies that we cannot over-stress the impact of real exchange rate on balance of trade in Nigeria.

Table 2: Results of granger causality tests

| Sample: 1970 – 2010			
Lags: 1			
Null Hypothesis:	Obs	F-Statistic	Probability
REER does not Granger Cause BOT	32	0.13364	0.71734
BOT does not Granger Cause REER		2.42851	0.12999
RGDP does not Granger Cause BOT	32	4.05375***	0.05344
BOT does not Granger Cause RGDP		0.08402	0.77398
WGDP does not Granger Cause BOT	32	12.1571*	0.00158
BOT does not Granger Cause WGDP		2.50510	0.12432
RGDP does not Granger Cause REER	40	0.00830	0.92789
REER does not Granger Cause RGDP		4.63747**	0.03787
WGDP does not Granger Cause REER	40	0.00652	0.93607
REER does not Granger Cause WGDP		0.61321	0.43857
WGDP does not Granger Cause RGDP	40	1.45642	0.23516
RGDP does not Granger Cause WGDP		0.59991	0.44353

Note: *, ** and *** indicate significant at 1%, 5% and 10% respectively.

Table 3: Results of vector error correction models

Variable	Model (2)	Model (3)	Model (4)	Model (5)
C	-0.001025	-0.048054	0.160913	0.021174
	(0.9966)	(0.5114)	(0.1748)	(0.0037)*
ΔBOT_{t-i}	0.209594	-0.017429	0.063245	-0.010710
	(0.4270)	(0.0398)**	(0.4798)	(0.0749)***
$\Delta REER_{t-i}$	-1.270903	0.424159	0.283587	0.011662
	(0.0655)	(0.7424)	(0.3583)	(0.5025)
$\Delta RGDP_{t-i}$	0.722873	0.126267	-0.034564	-0.009123
	(0.1392)	(0.3787)	(0.8762)	(0.4751)
$\Delta WGDP_{t-i}$	2.124735	-0.097458	-1.061237	0.414881
	(0.8027)	(0.9608)	(0.7445)	(0.0423)**
ECM_{1t-1}	-0.735007	-	-	-
	(0.0110)**			
ECM_{2t-1}	-	-0.202612	-	-
		(0.0484)**		
ECM_{3t-1}	-	-	-0.169313	-
			(0.1007)	
ECM_{4t-1}	-	-	-	-0.070461
				(0.3213)

Note: Probability values in parentheses below parameter estimates. *, ** and *** indicates significant at 1%, 5% and 10%, respectively.

Table 3 contains the vector error correction regression estimates. The results indicate that expectedly, the error correction term coefficients are negative and statistically significant at 5 percent level for models 2 and 3 as indicated by their probability values 0.0110 and 0.0484 respectively. This further implies that these models are capable of adjusting back to long-equilibrium after short-run distortion. However, the coefficients of error-correction terms for models 4 and 5 are negative, but no evidence of their statistical significance.However, the graph of impulse response function below shows that the study could not establish the existence of J-Curve effect in Nigeria. The response of BOT to REER is only positive with a marginal value of 0.04 at the 6th period and declines throughout the remaining study periods.
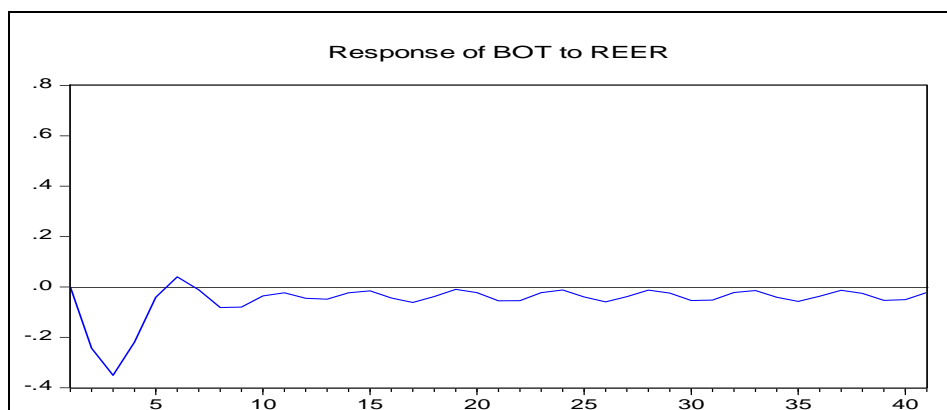
Figure 3: Response of BOT to cholesky's One S.D. innovations from REER

Having established the long-run equilibrium, short-run dynamics and the impulse response function, we therefore present the summary of estimates for model 1 as follows:

$$lnBOT = -78.4610 - 0.0885lnREER - 0.3790lnRGDP + 10.3880lnWGDP$$

Prob: (0.0000)   (0.7389)   (0.0413)   (0.0000)

$$R^2 = 0.9514; \bar{R}^2 = 0.9469$$

$$F - statistic = 208.91$$

(0.0000)

The results indicate that all the coefficients except that of real exchange rate are statistically significant as indicated by their probability values in parentheses. Theoretically, coefficients of REER, RGDP and WGDP agree with the theory, which says that trade balance is negatively related to the real exchange rate and domestic incomes, and positively related to foreign incomes (Munn and Mutti, 2004; Miles and Scot, 2005; Abel *et al.* 2008). The insignificant relationship between trade balance and real exchange rate in our study agrees with those of Rose, (1991) on five major OECD countries, and Wilson and Kua, (2001) on Singapore and United States, respectively. Overall, all the parameters are jointly significant as indicated by the probability value 0.0000 of F-statistic. The result of coefficient of multiple determination also shows that 95.14 percent of total

variation in trade balance is explained by the regression equation, while the value slightly fell to 94.69 percent after adjusting for the degree of freedom.Finally, these results are in agreement with similar studies by Yuen-Ling *et al.* (2008) on Malaysia, Mohammad and Hussain (2010), and Shahbaz *et al.*(2012) on Pakistan, Shirvani and Wilbratte(1997) on United States and the G7 countries and Kharroubi (2011) on twenty OECD countries respectively.

CONCLUDING REMARKS AND POLICY IMPLICATIONS

The paper examines the effect of real exchange rate on balance of trade in Nigeria. The econometric diagnostic tests reveal that all the variables are integrated of order 1 and cointegrated. The short-run dynamics indicate that the trade balance model is capable of adjusting back to its long-run equilibrium path after short-run distortion. There is no sufficient evidence of significant improvement in Nigeria's trade balance following the devaluation of her currency.Moreover, the impulse response function could not establish the existence of J-curve effect in Nigeria. The study further reveals that despite evidence of long-run relationship between the trade balance and real exchange rate, the result should be taken with caution because of weak evidence of causality between the two variables. The implication of the study is that real exchange rate adjustment alone may not ensure favourable balance of trade in Nigeria. Consequently, the study recommends that exchange rate adjustment policies should be accompanied by other policy actions. Overall, this study bridges the deficiency of exhaustive literature on the effect of real exchange rate on trade balance in Nigeria, as well as complements the existing literature on the subject matter.

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