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Long Run Asymmetric Effects of Exchange Rate Variations on Nigerian Bilateral Trade Balances (Testing for the J-Curve Hypothesis)

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Abstract

This study has examined the long run effects of exchange rate and output of selected regions, on Nigerian trade balance. Trade balance and exchange rate have crucial role to play in today's global economy and are both important in economic growth and stability. Both the symmetric and asymmetric effects are carried out in order to capture the real effect of exchange rate and also to test for the J-curve, a phenomenon refers to the trend of a country's balance of trade following a devaluation or appreciation. Estimation technique is based on the traditional ARDL and NARDL models. Although, a long run co-integrating relationship and convergence to long run equilibrium exist in the models set, but the results show a degree of ambiguity in Nigerian trade balance determinants relative to her trading partners. This may be due to seemingly shambolic Nigerian macro economy. The suggestion offered is that sound macroeconomic framework is essential for Nigeria since the country appears to possess a significant trade advantage over most developing countries. Therefore, prudential macroeconomic policies are required to maintain stable macroeconomic framework.

Keywords: *Nigerian trade balance, asymmetric effect, symmetric effect, exchange rate*

1.0 Introduction

Trade balance and the impact of exchange rate variations pose a great challenge in the international economics. In a developing country like Nigeria, numerous policies have emerged to position exchange rate favourable for businesses and international trade. With respect to these, quite some good suggestions have been made. The critical work of Elbadawi and Helleiner (1998) suggests exchange rate-led growth is better for developing countries to maintain a significant positon in international trade. In a different view, while Collier (1997) observes that high transaction cost may serve as a hindrance to trade, Woods (1997) and Woods and Mayer (1998) reiterate high reliance on abundant natural resources, and not necessarily exchange rate policy, is the factor limiting trade benefits and growth in developing countries. While some of the indigenous authors recommend that currency appreciation and control might help shield

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domestic economy against external shocks (Kwanashie, Garba, & Bogunjoko, 1998; Adewuyi, 2005; Amassoma, 2017), Akinlo and Lawal (2015) suggest an appreciable depreciation of the exchange rate could lead to increase in non-oil exports in Nigeria.

With the foregoing argument for or against exchange rate appreciation/ depreciation and policy management, scanty observations have been made in the literature in Nigeria concerning the asymmetric effect of exchange rate on trade balance. No known work has been carried out on the asymmetric effects of exchange rate on trade balance in Nigeria. It has been notified that trade balance generally improves as currency depreciation boosts export competitiveness in many developing countries (Kandi, 2008). In the series of recent literature on exchange rate effect on trade balance, using the Non-Linear ARDL developed by Shin et al., (2013), Bahmani-Oskooee and Fariditavana (2015), Bahmani-Oskooee (2016), Bahmani-Oskooe, Halicioglu, and Ghodsi (2016), Bahmani-Oskooee and Kanitpong (2017) and Bahmani-Oskooee and Baek, (2017) found that asymmetric effects of exchange rate exist in the trade balance models developed for England, Japan, and Korea. Do these asymmetric effects also hold between Nigeria and each of her trading partners? The focus of this paper is therefore to find the asymmetric effects of exchange rate on Nigeria trade balances with her selected trading partners. These partners are continental Africa, America Asia and Europe. They are selected for being the four Nigeria most significant trading partners.

The rest of this paper is stated as follow: Section 2 contains the models, stated and estimated with either linear or traditional auto-regressive distributed lagged (ARDL) and non-linear auto-regressive distributed lag (NARDL) models. It is explained that the NARDL model is an improvement over the traditional ARDL. In section 3, the study reports the empirical results of asymmetric effects of exchange rate on Nigerian trade balance with each of her selected regional trade partners. Section 4 contains summary and policy recommendations.

2.0 Model Specification and Estimation Technique

The models developed in this paper follow those developed in the literature by Rose and Yellen (1989), Shin et al. (2013), Bahmani-Oskooee and Fariditavana (2015), and Bahmani-Oskooee et al. (2016). It is assumed that the trade balance between Nigeria and trading partner i is a function of the level of economic output in both countries and the real bilateral exchange rate. In other words, the bilateral model of trade balance can be stated below:

$$\log TB_{i,t} = \varphi + \varphi_1 \log OUT_{NG,t} + \varphi_2 \log fOUT_{i,t} + \varphi_3 \log REX_{i,t} + \varepsilon_t \quad (2.1)$$

Where TB_i is a measure of the trade balance between Nigeria and trading partner *i* and is defined as the ratio of Nigeria imports from trading partner *i* over her exports to trading partner *i*. The assumption is that this measure of the trade balance is a positive function of the Nigerian output ($OUT_{NG,\,t}$) and a negative function of the trading partner's output ($fOUT_{i,\,t}$). It is theorized that as the Nigerian economy grows, we expect her to import more and as the economy of trading partner *i* grows, it is anticipated Nigeria export increases. A rise in the real exchange rate represents depreciation in the real value of Nigerian domestic currency, that is, the naira. While a fall represents exchange rate appreciation. If naira depreciation reduces Nigeria's imports from partner *i* but increases her exports, the coefficient estimates of φ_3 is expected to be positive for long run adjustments. The variables are expressed in their natural log and ε_t, the error term in year *t*.

In equation (2.1), the long run model is stated via which the long run coefficient estimates of the effects of the independent variables on dependent variables are examined. However, the short run dynamic adjustment process is carried out to find the short run effects of exogenous variables. To achieve this, the Pesaran and Shin (1997), Pesaran and Shin (1999) and Pesaran, Shin, and Smith (2001) linear auto-regressive distributed lag (ARDL) model of the bounds test approach to co-integration is adopted. This allows us to capture both the long run and short run effects in a single equation. The bounds testing approach is stated in equation (2.2) below:

$$\Delta \log TB_{i,i} = \delta_0 x + \sum_{i=1}^{r} \delta_1 \Delta \log TB_{t-i} + \sum_{i=0}^{r} \delta_2 \Delta \log OUT_{NGt,i} + \sum_{i=0}^{r} \delta_3 \Delta \log OUT_{k\,t-i} + \sum_{i=0}^{r} \delta_4 \Delta \log REX_{t-i} + \varphi_1 \log TB_{i,t-1} + \varphi_2 \log OUT_{NG,t-1} + \varphi_3 \log OUT_{i,t-1} + \varphi_4 \log REX_{i,t-1} + \mu_t \tag{2.2}$$

$$\Delta \log TB_{i,i} = \delta_0 x + \sum_{i=1}^{r} \delta_1 \Delta \log TB_{t-i} + \sum_{i=0}^{r} \delta_2 \Delta \log OUT_{NGt,i} + \sum_{i=0}^{r} \delta_3 \Delta \log OUT_{k\,t-i} + \sum_{i=0}^{r} \delta_4 \Delta \log REX_{t-i} + ECM_t \tag{2.2b}$$

$$\log TB_{i,i} = \psi_0 x \psi_1 \log TB_{i,t-1} + \psi_2 \log OUT_{NG,t-1} + \psi_3 \log OUT_{k,t-1} + \psi_4 \log REX + \mu_t \tag{2.2c}$$

From equation (2.2), the short run effects are obtained from estimation of coefficient of first differenced variables (δ_1 to δ_4). To examine the long run effects, co-integration must be established and the effects are derived by the estimates of ϕ_2 to ϕ_4, normalized onϕ_1. The co-integration is achieved by applying the Pesaran et al. (2001) bound test approach. This requires the Pesaran *F*-test with new tabulated critical values. Unit-root test may be unnecessary in as much as these new critical values account for integrating properties of all variables. However, the integrating properties of the variables should require variables in a combination of I(0) and I(1), which are properties associated with nearly all macro variables (Bahmani-Oskooee et al., 2016).

The objective this study is to find if asymmetric effects exist between Nigerian trade balances with her trading partners. This may entail the *J*-curve phenomenon involving effects of exchange rate depreciation and appreciation. Exchange rate effect may be asymmetric, that is depreciations may have significant effect whereas appreciations may not. Testing asymmetric effect is therefore important to allow capturing effects of domestic currency valuation and devaluation on international trade transaction. In the recent literature, there have been quite evidences of asymmetric effects of exchange rate given support to the *J*-curve illustration (Bahmani-Oskooee & Fariditavana, 2015; Bahmani-Oskooee et al., 2016). This study therefore follows the recent literature and decomposes the $LogREX$ in equation (2) into its positive and negative deviations employing the concept of partial sums as in equation (2.3) below:

$$^{+}tvx_t = \sum_{k=1}^{t} \Delta \log REX_i^{+} = \sum_{i=j}^{t} MAX(\Delta \log REX_i, 0), \tag{2.3}$$

$$^{-}tvx_t = \sum_{i=1}^{t} \Delta \log REX_i^{-} = \sum_{i=j}^{t} MIN(\Delta \log REX_i, 0), \tag{2.4}$$

Where $^{+}tvx_t$ and $^{-}tvx_t$ are partial sum of positive and negative changes; and currency appreciation and depreciation respectively. Following Shin et al. (2013), the logREX in equation (2.2) can be replaced with $^{+}tvx_t$ and $^{-}tvx_t$ to form the asymmetric long run and short run equations (2.5) and (2.6) below:

$$\Delta \log TB_{i,i} = \alpha_0 x + \sum_{i=1}^{r} \alpha_1 \Delta \log TB_{t-i} + \sum_{i=0}^{r} \alpha_2 \Delta \log OUT_{NGt,i} + \sum_{i=0}^{r} \alpha_3 \Delta \log OUT_{k,t-i} + \sum_{i=0}^{r} \alpha_4 \Delta \log {}^{+}tvx_t + \sum_{i=0}^{r} \alpha_4 \Delta \log {}^{-}tvx_t + ECM_t \tag{2.5}$$

$$\log TB_{i,i} = \psi_0 x \psi_1 \log TB_{i,t-1} + \psi_2 \log OUT_{NG,t-1} + \psi_3 \log OUT_{k,t-1} + \psi_4 \log {}^{+}tvx_{t-1} + \psi_4 \log {}^{-}tvx_{t-1} + \mu_t \tag{2.6}$$

The new variables in equation (2.5) and (2.6) permit the test of asymmetric or symmetric effect of exchange rate on Nigerian trade balance with her trading partner *i*. Bahmani-Oskooee and Fariditavana (2015), emphasized that the error-correction model (2.4) is said to be a non-linear ARDL model and non-linearity is introduced through partial sum or cumulative sum concept included in generating the new variables $^{+}tvx_t$ and $^{-}tvx_t$. The Pesaran et al. (2001) bounds testing approach to co-integration is suggested by Shin et al. (2013) as the best estimation technique. It should be noted that expected sign of **normalized** coefficient estimates of positive and negative variables in model (2.5) and (2.6) are the same as that of REX in model (2.2). Consequently, if the effects of exchange rate variations are to be symmetric and favourable on the

trade balance, it is expected both the positive and negative effects of new variables in (2.5) and (2.6) will carry significantly normalized favourable effects as in equation (2.2) and (2.2c) above (Bahmani-Oskooee and Fariditavana, 2015), otherwise it is asymmetric if they carry effects other than equation (22.) and (2.2c) above. In addition, the error-correction models (2.2b) and (2.5) are also estimated to obtain the speed of convergence to equilibrium.

3.0 Presentation of Results

This session deals with estimation of short-run error correction model (2.2b) and long run model (2.2c) and more elaborated in model (2.5) and (2.6) using bilateral data between Nigeria and each of her continental trading partner. The list of continents includes Africa, America, Asia and Europe. Data ranging from 1987 – 2016 are obtained from the National Bureau of Statistics (NBS), Nigeria for estimation process.

With reference to the literature (Bahmani-Oskooee & Fariditavana, 2015) suggest a maximum lag of eight, but this study imposes a maximum lag of two on each first differenced variable and use Akaike's Information Criterion (AIC) to select the optimum lags. However, since the analysis contains finite data, a maximum lag of one period was adopted in most cases. For simplicity, results from each long run model and the error correction terms are reported in Tables 1 and 2. Table 1 contains the long run relationship between Nigeria and her trading partners using the traditional ARDL model while Table 2 contains the same using NARDL model.

Table 1 Empirical result of the long run relationship between Nigeria and her trading partners (The ARDL Model)

Regressors	Dependent variable: TB relative to Africa	Dependent variable: TB relative to America	Dependent variable: TB relative to Asia	Dependent variable: TB relative to Europe
TB(−1)	0.1366 [0.4612]	−0.1252 [−0.5692]	−0.0639 [−0.2958]	0.1511 [0.7479]
OUT_{NG}	3.4653 [0.8746]	1.1967 [0.6769]	0.7459 [0.3891]	−0.5627 [−0.3208]
$OUT_{NG}(-1)$	−3.0962 [−0.7385]	0.8053 [0.4978]	0.0111 [0.0046]	0.6577 [0.3616]
fOUT	−11.6853 [−0.9939]	−0.1556 [−0.3801]	−.0.7268 [−0.3724]	−0.0270 [−0.0855]
fOUT(−1)	9.9961 [0.7983]	−9.4293 [−2.1659]**	1.8431 [1.0749]	−0.0518 [−0.1482]
REX	1.6378 [1.3482]	2.5333 [2.1639**]	−0.7333 [0.74405]	2.9997 [2.2846]**
REX(−1)	−1.0102 [−0.9741]	−1.2829 [−0.0661]	−0.6444 [−0.6714]	−2.6102 [−2.1695]**
R^2	39%	63%	73%	55%
Adjusted R^2	17%	51%	65%	40%
F-statistics	1.9 (0.11)	5.27 (0.00)	8.44 (0.00)	3.68 (0.00)
LM	0.22 (0.79	5.80 (0.01)	1.89 (0.17)	3.71 (0.04)
$\chi 2$	0.47 (0.84)	3.52 (0.01)	3.66 (0.00)	2.56 (0.04)

Short Run Error Correction Terms

ECT	−1.6442 [−0.9107]	−1.1782 [−4.9061]***	−3.0719 [−2.9028] **	−0.3598 [−1.4815]

***, **, * = Significant at 1%, 5% and 10% level; [ ] = *T*-statistics; ( ) Probability value

Table 2 Empirical result of the long run relationship between Nigeria and her trading partners (The NARDL Model)

Regressors	**Dependent variable: TB relative to Africa**	**Dependent variable: TB relative to America**	**Dependent variable: TB relative to Asia**	**Dependent variable: TB relative to Europe**
TB(−1)	0.2098 [0.4679]	−0.1983 [−1.0220]	0.2598 [1.2441]	−0.0245 [−0.1097]
OUT_{NG}	0.6231 [0.1893]	0.4172 [0.2528]	1.4801 [0.3511]	0.3701 [0.4344]
OUT_{NG}(−1)	−1.9761 [−0.5926]	2.1248 [1.3443]	0.4143 [0.2209]	−0.4769 [−0.5874]
fOUT	1.4164 [0.1334]	−0.2211 [−0.5946]	−2.4487 [−1.5815]	0.8606 [7.0658]***
fOUT(−1)	1.2495 [0.1238]	−11.1109 [−3.0732]***	1.9858 [1.5093]	0.1088 [0.5119]
REX_P	−0.1627 [−0.2103]	1.4961 [1.3570]	−1.1425 [−1.9512*]	0.7601 [2.2354]**
REX_P(-1)	−0.3047 [−0.6110]	−0.2402 [−0.2238]	0.5700 [1.0000]	−0.6613 [−2.1856]**
REX_N	−0.0565 [−0.4986]	–	0.0647 [4.4226]***	0.0002 [0.0944]
REX_N(−1)	−0.1335 [−0.9828]	–	−0.0493 [−2.8565]**	0.0011 [0.3767]
R^2	46%	71%	87%	85%
Adjusted R^2	19%	61%	81%	78%
F-statistics	1.72 (0.15)	7.22 (0.00)	13.98 (0.00)	12.06 (0.00)
LM	1.53 (0.24)	5.38 (0.01)	0.41 (0.66)	5.67 (0.01)
$\chi 2$	1.05 (0.43)	0.72 (0.65)	1.18 (0.36)	3.03 (0.02)

Short Run Error Correction Terms

ECT	−2.4748 [−3.9902]***	−0.9906 [−4.1693]***	−0.6014 [−2.1755]**	−1.4274 [−3.0915**]

***, **, * = Significant at 1%, 5% and 10% level; [ ] = *T*-statistics; ( ) Probability value

The Wald statistics tests for equation (2.2) show there is a long run relationship between Nigerian trade balance and her trading partners. This leads us to examine the effects of dependent variables on the trade balance and also the existence of the *J*-curve. From Tables 1 and 2, evidence of *J*-curve hypothesis exists between Nigeria and Asia. The coefficients of NARDL model are significant for the real exchange rate unlike the traditional ARDL model. Nevertheless, it appears the relationship between Nigerian trade balance with her trading partners is ambiguous. For instance, for the trade balance between Nigeria and Africa, exchange rate has no significant long run effect. This means there might be no support for *J*-curve hypothesis. In the long run, real exchange rate is significant in the trade balance with Asia and Europe. However, whether exchange rate appreciation or depreciation would be better is not clearly expressed from the results. Apart from foreign incomes lag value which is significant relative to Nigerian trade balance, many other explanatory variables (Nigerian income or output, real exchange rate and foreign income) are not significant. This ambiguity reflects the common cause of policy reversal in developing or underdeveloped countries. This points to the fact that exogenous factors should be considered in

formulating feasible macroeconomics policy for the Nigerian economy with her high tendency to currency depreciation, relatively high level of economic openness and macroeconomic instability.

For the traditional ARDL method, the error correction terms indicate significant convergence to long run equilibrium in trade balance between Nigeria and Asia as well as America. There is no long run asymmetric result for American real exchange rate relative to Nigeria trade balance owing to the fact that negative decomposition amounts to zero. In the NARDL method, however, there is evidence of significant convergence to long run equilibrium with all the trade partners. This is given by the negative value of the error correction terms (ECT). In other words, any disequilibrium in the short run can be corrected as far as trade flows between Nigeria and her trading partners. The *R*-squared and adjusted *R*-squared are significantly low for Nigeria and Africa trade balance. This explains the weak trade relations between Nigeria and the African countries. The volume of Nigerian trade with non-African countries is significant and this suggests the direction of trade Nigeria should follow.

Coefficient Diagnostic Tests

A few other diagnostic statistics indicates that the Lagrangian multiplier (LM) statistic is reported to make sure residuals is free from autocorrelation since the statistic value is not significant at 10% implying no existence of serial correlation. We also report Ramsey's RESET statistic shows that the model is correctly specified since the RESET statistic is insignificant. Both the ARDL and NARDL models seem homoscedastic going by the insignificant statistic values. The cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) of the residuals tests clearly show that all coefficient estimates are stable. However, elements of instabilities are displayed in Europe short run CUSUM test for traditional ARDL model and Asia CUSUM test for NARDL model.

4.0 Summary and Recommendations

The study has examined the effects of exchange rate and output of selected continents or regions, as Nigeria's trading partners, on Nigerian trade balance. Apart from Asia, evidence of *J*-curve is not found between Nigeria and her trade partners. The relationship between Nigeria and her trade partners is found to be ambiguous suggesting the unstable and volatile nature of the Nigerian macroeconomic framework. In spite of this, a long run relationship exist between Nigeria and her trading partners. However, adjustment to long run equilibrium is also established. Nigeria may have favourable balance of trade if her macroeconomic framework is redirected to the right path. With

abundant human and natural resources, Nigeria has potential trade advantage over most developing countries of the world. Therefore, prudential macroeconomic policies are required to maintain stable macroeconomic framework.

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