

EXCHANGE RATE AND TRADE BALANCE IN NIGERIA: TESTING THE J CURVE EFFECT

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Abstract

The study is set out to test the J curve effect of exchange rate depreciation on the balance of trade in the light of the salient characteristics of the merchandise trade in Nigeria, empirically test the role of interaction effects of both macroeconomic variables and the nominal exchange rate on Nigeria's trade balance and to investigate the existence of a threshold exchange rate beyond which exchange rate devaluation policies would boost Nigeria's trade balance performance. Towards addressing these objectives, this study presents theoretical findings that show that the standard Marshall Lerner condition is a necessary but not sufficient condition. In addition, this study avails data pre-testing methods of the Augmented Dickey Fuller test and the Engle Granger test and consequently estimates fully modify ordinary least square (FMOLS) regression method explaining trade balance growth in Nigeria. The results indicate that the presence of a static J-curve and hence a threshold exchange rate as well as the attenuating and accentuating effects of oil and non -oil import and export prices, world income and domestic income on the exchange rate elasticity of the balance of trade.

Keywords: Balance of Trade, Marshall-Lerner Condition, J curve effects, Nigeria & Exchange rate

1.0 Introduction

The Marshall Lerner (ML) condition and the J curve effects have been extensively addressed in the literature on developing countries with Nigeria not being an exception. With the ML condition being based on the assumptions of a small home country status, perfectly elastic home supply of imports and perfectly elastic foreign supply of exports it still does not account for the peculiarities of the trade structure of the oil rich countries like Nigeria. A Quantum of studies investigating the case of the Nigerian economy has subject to empirical evaluation the ML condition without altering the standard theoretical model and *a priori* expectations of the ML condition.

These empirical studies have failed to arrive at a consensus on the relationship between the exchange rate and the trade balance in Nigeria. Udah, (2011), Loto (2011), Igwe and Ogunleye (2014), Oyinlola et al., (2010) and Osundina and

Osundina (2013) all posit that the Marshall-Lerner condition holds for Nigeria and that exchange rate depreciation or devaluation policy will be instrumental in engendering some positive growths in the balance of payments while Ogbonna (2011), Omojimite and Akpokodje (2010), Ogundipe et al. (2013), Iyoboyi et al., (2014), Odili (2014) maintain the contrary in their empirical results. Aside the lack of convergence in these empirical findings, one common characteristic of their results is that their theoretical models which were subjected to empirical analysis did not seek to situate the Marshall Lerner condition in the light of country specific characteristics of the Nigeria merchandise trade. The traditional Marshall-Lerner condition, which was tested repeatedly in the cited works above, was completely silent on the oil exports and non-oil import dependence characterized by the more than 90% average share of oil exports in total exports and more than 80% average share of non-oil imports in the total volume of imports since 1980 (Central Bank of Nigeria [CBN], 2017).

Given this structural defectiveness of the Nigerian merchandise trade, it is expected that the ML condition for Nigeria requires a reflection of the structural characteristics and this paper addresses this theoretical gap by providing the traditional Marshall Lerner condition with this basic structural reality.

The paper equally addressed the interaction effects of macroeconomic variables and the nominal exchange rate on the trade balance, this aspect has been elusive in the empirical literature on Nigeria.

The failure to address the interaction effects could account for the parametric instability and endogeneity problems encountered in previous studies. Lastly, the J-curve which is a dynamic implication of the ML condition, though investigated in some of the literature on Nigeria's exchange rate policy and trade balance, has not been considered in the effects of macroeconomic variables on the exchange rate with respect to the performance of the balance of trade. The implication of this is that while studies may be able to tell the dynamic impact of a discretionary devaluation in the exchange rate they are not able to tell the effects of exchange rate improvement or deterioration in the trade balance, considering the structure of Nigeria production. The rest of this paper is made up of four sections with the next section being the literature review. The third section of this work focuses on the theory and method and this section is followed by the Data Pretesting and Model Estimation section. Afterward, this study concludes with a discussion of the conclusion and recommendations.

2.0 Literature Review

As stated earlier, the literature on Nigerian trade has tested the ML condition without modifying or augmenting the central assumptions of the Marshall-Lerner condition. These studies such as Ogbonna (2011), Omojimate and Akpokodje (2010), Ogundipe et al. (2013), Iyoboyi et al., (2014), Odili (2014) have found evidence in favor of the application of the Marshall-Lerner condition to Nigeria.

Ogbonna (2011) on availing the multivariate Johansen and Juselius cointegration technique, as well as the vector error correction modeling technique, found that 'the elasticity of the real exchange rate coefficient in the trade balance model is positive and statistically significant at 5 percent level'.

Omojimate and Akpokodje (2010) on the other hand availed the Ordinary Least Squares (OLS) and Generalized Method of Moments (GMM) in estimating both the export and import equations and arrived at the conclusion that 'exchange rate depreciation stimulates non-oil exports'. Odili (2014) with the aid of an Autoregressive Distributed Lag Model (ARDL) bounds testing procedure was able to detect a 0.83% exchange rate elasticity of balance of payment and hence arriving at the conclusion that the exchange rate devaluation policy is instrumental for balance of payment performance – due to balance of trade performance. Ogundipe et al. (2013) on estimating the long run effect of exchange rate devaluation on the trade balance of Nigeria using the Johansen and Juselius cointegration technique and they found an inelastic exchange rate elasticity of the balance of trade though they record a 2.42% impact coefficient of the exchange rate.

On the contrary Loto (2011) applying the ordinary least squares method of estimation, estimated import and export demand equations and found that the Marshall-Lerner condition did not hold as the sum of the elasticities of demand for exports and imports stood at 0.7851 and Udah (2011) lends it voice by applying the Johansen and Juselius multivariate cointegration technique and according to him the ML condition fails to hold in Nigeria. Osundina and Osundina (2013) using a multiple linear regression specification found the ML condition violated significantly with the sum of the elasticities of export demand and import demand being much less than zero. Very much in the same fashion as Loto (2011), Oyinlola et al. (2010) estimate import and export demand equations with the aid of the Autoregressive Distributed Lag Model (ARDL) model specification and they get a sum of the respective elasticities to be -2.0 approximately in both the benchmark and country augmented models thus violating the Marshall-Lerner condition.

These results reveal the lack of consensus mentioned earlier and clearly shows that the literature is yet to address the role of intervening factors which accentuate the effect of exchange rate changes on the balance of trade position. In addition, the literature does not test the existence of nonlinearity in the relationship between exchange rate changes and the balance of trade.

3.0 Theory and Method

In this section, the theoretical propositions that form the basis for the model specification are provided. The characteristics of Nigerian trade are factored into consideration and its small open country status is as provided for.

On assuming a small open economy that imports and exports both oil IM_{ot}, X_{ot} and non-oil IM_{nt}, X_{nt} goods respectively at the respective prices P_{mot}, P_{xot} and P_{mnt}, P_{xnt} then the balance of trade B_t on the definition of Sek and Har (2014), is given as:

$$B_t = \frac{P_{xot}X_{ot} + P_{xnt}X_{nt}}{s_t(P_{mot}IM_{ot} + P_{mnt}IM_{nt})} \dots 3.1$$

But the balance of trade equation can be re-written as:

$$\ln B_t = \ln P_{xot} - \ln P_{mnt} + \ln X_{ot} - \ln IM_{nt} - \ln s_t + \ln \left(1 + \frac{P_{xnt}X_{nt}}{P_{xot}X_{ot}}\right) - \ln \left(1 + \frac{P_{mot}IM_{ot}}{P_{mnt}IM_{nt}}\right) \dots 3.2$$

Assuming the economy in question records a ratio of non-oil exports to oil exports that is less than the ratio of price of oil exports to the price of non-oil exports and that the ratio oil imports to non-oil imports is less than the ratio of price of non-oil imports to the price of oil imports – signifying the economy to be one marked with relatively high oil exports and non-oil imports then on availing the Taylor's approximation for the terms:

$$\ln \left(1 + \frac{P_{xnt}X_{nt}}{P_{xot}X_{ot}}\right) \cong \frac{P_{xnt}X_{nt}}{P_{xot}X_{ot}} \quad \ln \left(1 + \frac{P_{mot}IM_{ot}}{P_{mnt}IM_{nt}}\right) \cong \frac{P_{mot}IM_{ot}}{P_{mnt}IM_{nt}}$$

and as well as the Taylor's approximation for the terms: $\ln \left(1 + \frac{P_{xnt}X_{nt}}{P_{xot}X_{ot}}\right) \cong \frac{P_{xnt}X_{nt}}{P_{xot}X_{ot}}$ and $\ln \left(1 + \frac{P_{mot}IM_{ot}}{P_{mnt}IM_{nt}}\right) \cong \frac{P_{mot}IM_{ot}}{P_{mnt}IM_{nt}}$ exports of oil and non-oil imports and exports shown below:

$$\ln IM_{ot} = \phi_{mo} + \phi_{moy} \ln y_{ht} + \phi_{mos} \ln s_t \quad \text{where } \phi_{moy} > 0; \phi_{mos} < 0 \dots 3.3$$

$$\ln IM_{nt} = \phi_{mn} + \phi_{mny} \ln y_{ht} + \phi_{mns} \ln s_t \quad \text{where } \phi_{mny} > 0; \phi_{mns} < 0 \dots 3.4$$

$$\ln X_{ot} = \theta_{xo} + \theta_{xoy} \ln y_{ft} + \theta_{xos} \ln s_t \quad \text{where } \theta_{xoy} < 0; \theta_{xos} > 0 \dots 3.5$$

$$\ln X_{nt} = \theta_{xn} + \theta_{xny} \ln y_{ft} + \theta_{xns} \ln s_t \quad \text{where } \theta_{xny} < 0; \theta_{xns} > 0 \dots 3.6$$

$$\begin{aligned} \ln B_t = & \theta_{xo} - \phi_{mn} + \ln P_{xot} - \ln P_{mnt} + \theta_{xoy} \ln y_{ft} - \phi_{mny} \ln y_{ht} + (\theta_{xos} - \phi_{mns} - 1) \ln s_t \\ & + \frac{P_{xnt}}{P_{xot}} \cdot e^{\theta_{xn} - \theta_{xo} + (\theta_{xny} - \theta_{xoy}) \ln y_{ft} + (\theta_{xns} - \theta_{xos}) \ln s_t} \\ & - \frac{P_{mot}}{P_{mnt}} \cdot e^{\phi_{mo} - \phi_{mn} + (\phi_{moy} - \phi_{mny}) \ln y_{ht} + (\phi_{mos} - \phi_{mns}) \ln s_t} \dots 3.7 \end{aligned}$$

On the basis of the equation 3.7 the following second order derivatives which shall form the basis for the theoretical expectations are derived:

$$\frac{\partial \ln B_t}{\partial \ln s_t} = \theta_{xos} - \theta_{mns} - 1 + \frac{P_{xnt}(\theta_{xns} - \theta_{xos})}{P_{xot}} \cdot e^{\theta_{xn} - \theta_{xo}} y_{ft}^{\theta_{xny} - \theta_{xoy}} S_t^{\theta_{xns} - \theta_{xos}} + \frac{P_{mot}(\phi_{mns} - \phi_{mos})}{P_{mnt}} \cdot e^{\phi_{mo} - \phi_{mn}} y_{ht}^{\phi_{moy} - \phi_{mny}} S_t^{\phi_{mos} - \phi_{mns}} \dots 3.8$$

$$\frac{\partial^2 \ln B_t}{\partial \ln P_{xnt} \partial \ln s_t} = \frac{P_{xnt}(\theta_{xns} - \theta_{xos})}{P_{xot}} \cdot e^{\theta_{xn} - \theta_{xo}} y_{ft}^{\theta_{xny} - \theta_{xoy}} S_t^{\theta_{xns} - \theta_{xos}} \dots 3.9$$

$$\frac{\partial^2 \ln B_t}{\partial \ln P_{xot} \partial \ln s_t} = -\frac{P_{xnt}(\theta_{xns} - \theta_{xos})}{P_{xot}} \cdot e^{\theta_{xn} - \theta_{xo}} y_{ft}^{\theta_{xny} - \theta_{xoy}} S_t^{\theta_{xns} - \theta_{xos}} \dots 3.10$$

$$\frac{\partial^2 \ln B_t}{\partial \ln P_{mot} \partial \ln s_t} = \frac{P_{mot}(\phi_{mns} - \phi_{mos})}{P_{mnt}} \cdot e^{\phi_{mo} - \phi_{mn}} y_{ht}^{\phi_{moy} - \phi_{mny}} S_t^{\phi_{mos} - \phi_{mns}} \dots 3.11$$

$$\frac{\partial^2 \ln B_t}{\partial \ln P_{mnt} \partial \ln s_t} = -\frac{P_{mot}(\phi_{mns} - \phi_{mos})}{P_{mnt}} \cdot e^{\phi_{mo} - \phi_{mn}} y_{ht}^{\phi_{moy} - \phi_{mny}} S_t^{\phi_{mos} - \phi_{mns}} \dots 3.12$$

$$\frac{\partial^2 \ln B_t}{\partial \ln y_{ft} \partial \ln s_t} = \frac{P_{xnt}(\theta_{xns} - \theta_{xos})(\theta_{xny} - \theta_{xoy}) \ln y_{ft}}{P_{xot}} \cdot e^{\theta_{xn} - \theta_{xo}} y_{ft}^{1 + \theta_{xny} - \theta_{xoy}} S_t^{\theta_{xns} - \theta_{xos}} \dots 3.13$$

$$\frac{\partial^2 \ln B_t}{\partial \ln y_{ht} \partial \ln s_t} = \frac{P_{mot}(\phi_{mns} - \phi_{mos})(\phi_{moy} - \phi_{mny}) \ln y_{ht}}{P_{mnt}} \cdot e^{\phi_{mo} - \phi_{mn}} y_{ht}^{1 + \phi_{moy} - \phi_{mny}} S_t^{\phi_{mos} - \phi_{mns}} \dots 3.14a$$

$$\frac{\partial^2 \ln B_t}{\partial (\ln s_t)^2} = \frac{P_{xnt}(\theta_{xns} - \theta_{xos})^2}{P_{xot}} \cdot e^{\theta_{xn} - \theta_{xo}} y_{ft}^{\theta_{xny} - \theta_{xoy}} S_t^{\theta_{xns} - \theta_{xos}} + \frac{P_{mot}(\phi_{mns} - \phi_{mos})^2}{P_{mnt}} \cdot e^{\phi_{mo} - \phi_{mn}} y_{ht}^{\phi_{moy} - \phi_{mny}} S_t^{\phi_{mos} - \phi_{mns}} \dots 3.15$$

The equations 3.8 provides the needed modification of the ML condition and the J curve effects in the light of the structure of the Nigerian merchandise trade, while the equations 3.9-3.12 form the basis for capturing the interaction effect between macroeconomic variables and the nominal exchange rate on the performance of the merchandise trade balance. In conclusion, the combination of the equations 3.8 and 3.13 form the basis for measuring the threshold exchange rate beyond or below which exchange rate devaluation policy could be beneficial or detrimental to trade balance performance. The econometric specification that adequately captures, and enables the empirical testing, of the model is given by 3.14b as specified earlier but now in functional form as:

$$\ln B_t = \psi_0 + \psi_1 \ln s_t + \psi_2 (\ln s_t)^2 + \psi_3 \ln s_t \cdot \ln y_{ht} + \psi_4 \ln s_t \cdot \ln y_{ft} + \psi_5 \ln s_t \cdot \ln P_{ht} + \psi_6 \ln s_t \cdot \ln P_{ft} + \psi_7 \ln s_t \cdot \ln P_{ct} + \psi_8 \ln s_t \cdot \ln P_{ot} \dots 3.14b$$

Where B_t the balance of trade, s_t the nominal exchange rate of the naira to the dollar (which is a reserve currency), y_{ht} is the Nigerian gross domestic product, y_{ft} is the foreign income proxied by the aggregation of the reported gross domestic product of countries except Nigeria, P_{ht} is consumer price index proxying the price of non-oil exports, P_{ct} is the price of crude oil exports proxying oil export price, P_{ot} is the average price of crude oil derivatives proxying the oil import prices and P_{ft} is the world consumer price index proxying the foreign price.

The specified model shall have its series subjected to the Augmented Dickey Fuller test for both the intercept only and intercept and trend specifications with the aim of discovering the order of integration of the series. Furthermore, the presence of cointegration is established by the Engle –Granger test and upon establishing the presence of cointegration among the series in the model 3.14 the single equation error correction model shall be estimated with the corresponding long run and short run equations reported.

Appropriate summary and diagnostic tests shall be reported as well. This study avails data from the Organization of Petroleum Exporting Countries (OPEC) statistical database for 2015, the World Development Indicators (WDI) database for 2015, the Central Bank of Nigeria (CBN) statistical database for the years 2014, 2015 and the US Energy Information Agency (EIA) database for 2015. The dataset from these sources all spans 34 years from 1981 to 2014. The variable codes, variable definitions, and sources are shown in table 4.1

Table 4.1 Variable Definitions, Proxy and Data Sources

Variable codes	Proxy definitions	Variables	Data sources
B	Balance of trade; measured as a ratio of merchandise exports to merchandise imports	Balance of trade	WDI (2015)
S	Nominal exchange rate; measured as the average annual nominal exchange rate of the naira to the dollar	Exchange rate	OPEC (2015)
Yh	Real gross domestic product; measured as the ratio of the GDP at market prices to the consumer price index	Domestic income	CBN (2015, 2014)
Yf	World income; measured as the gross domestic product of the world less the income of Nigeria	Foreign income	WDI (2015)
Ph	Consumer price index	Price of non-oil exports	WDI (2015)
Pf	Average world consumer price index	Price of non-oil imports	WDI (2015)
Pc	Annual crude oil price	Price of oil exports	EIA (2015)
Po	Average crude oil derivative price index; measured as the average of the price indices of: premium motor spirit (PMS), automotive diesel oil (AGO), Kerosene and Liquefied natural gas	Price of oil imports	OPEC (2015)

4.0 Model Estimation and Interpretation

Data pretesting conducted in the table 4.2 reveals that all the series in the model specification are stationary at first difference at the 1% level of significance for both the intercept only and intercept and trend test specifications. This signifies the presence of cointegration but nevertheless, the single equation test for cointegration based on the Engle Granger z-test shall be availed to provide further evidence of the presence of cointegration among the series in the estimated model

Table 4.2 Augmented Dickey Fuller Unit Root Testing

Specification	Intercept only		Intercept and trend		Order of integration
Null hypotheses	ADF at level	ADF at first difference	ADF at level	ADF at first difference	
LOG(B)	0.3913	0.0006**	0.9935	0.0010**	I(1)
LOG(S)	0.2812	0.0004**	0.9504	0.0007**	I(1)
(LOG(S))^2	0.8296	0.0001**	0.6470	0.0006**	I(1)
(LOG(S))*(LOG(YF))	0.2979	0.0004**	0.9492	0.0007**	I(1)
(LOG(S))*(LOG(YH))	0.3239	0.0004**	0.9474	0.0007**	I(1)
(LOG(S))*(LOG(PC))	0.6291	0.0002**	0.5103	0.0008**	I(1)
(LOG(S))*(LOG(PF))	0.5942	0.0001**	0.8911	0.0005**	I(1)
(LOG(S))*(LOG(PH))	0.9044	0.0001**	0.7964	0.0005**	I(1)
(LOG(S))*(LOG(PO))	0.6572	0.0001**	0.8389	0.0003**	I(1)

Computed by the author; **indicates statistical significance at the 1% level

The estimation of the model, which contains information on the Engle-Granger test, is conducted in table 4.3. Given that the series is stationary to the order of one I(1), Fully modified ordinary least square (FMOLS) is suitable for estimation. The Fully modified ordinary least square (FMOLS) is credited to Phillips and Hansen (1990) who provide optimal estimates of cointegrating regressions. The FMOLS modifies least squares to elucidate the serial correlation effects and for endogeneity in the regressors that arise from the existence of a cointegrating relationship.

Table 4.3: Engle-Granger Co-integration Test

	Value	Probability
Tau-Statistic	-5.176140	0.2541
Z-Statistic	-462.4238	0.0000

Table 4.4 FMOLS and DOLS Estimation Result Dependent Variable: $\log(B)$

FMOLS	
Variable	Coefficient
LOG(S)	38.27047 (0.0022)**
(LOG(S))^2	0.216244 (0.0002)**
(LOG(S))*(LOG(YF))	-1.119189 (0.0060)**
(LOG(S))*(LOG(YH))	-0.138948 (0.0426)*
(LOG(S))*(LOG(PC))	0.139399 (0.0005)**
(LOG(S))*(LOG(PF))	-0.453845 (0.0188)*
(LOG(S))*(LOG(PH))	-0.815523 (0.0000)**
(LOG(S))*(LOG(PO))	0.888739 (0.0000)**
C	-0.444668 (0.0180)*
@TREND	0.188195 (0.0017)**
Diagnostics and Summary Results	
R-squared	0.781449
Adjusted R-squared	0.695929
Long-run variance	0.010434

Computed by the author; **indicates statistical significance at the 1% level and * indicates statistical significance at 5% level

Table 4.4 reveals that all the variables are statistically significant and the price of oil exports and price of oil imports all have the effect of boosting exchange rate elasticity and domestic income by 0.139% and 0.89% respectively. Also, foreign income, domestic income and prices of non-oil imports and exports all retard the exchange rate elasticity by 0.14%, 1.12%, 0.45% and 0.82% respectively.

The implication of this finding is that oil is a major factor boosting exchange rate elasticity in the case of Nigeria. This is an indication that Nigeria is a factor driven

economy which is subject to any form of fluctuations arising as a result of either or both price or quantity shocks in the global oil market. The equation possess suitable fit as determined by the R-square and the adjusted R-square with the respective values 78.14% and 69.59%, however, a high R-square or adjusted R-square is not enough to conclude that the model possesses a good fit, but is necessary but not sufficient condition for such conclusion and the z-statistic 462.42 test for overall significance has a p-value of 0 which rejects the null hypothesis that the overall regression output is not statistically significant at the 5% level. The Engle-Granger z-test buttresses the conclusions reached on the basis of the Augmented Dickey Fuller test as it rejects the null hypothesis that the series in the equation are not cointegrated at the 1% level of significance.

5.0 Conclusion and Recommendations

The study was set out to test for the existence of a nonlinear impact of exchange rate on the balance of trade vis-à-vis the J curve effects and the existence of intervening macroeconomic factors that influence the effect of the exchange rate on the balance of trade. The results support the existence of the U-shaped relationship between the balance of trade and the exchange rate. Non-oil import price, oil import price, and the world income are all negative catalysts to the exchange rate elasticity of the balance of trade while the oil export price, non-oil export price and domestic income are equally inimical to the exchange rate elasticity of the balance of trade. Hence depending on the location of the country; the non-oil import price, oil import price and the world income increases will have adverse effects on the country's balance of trade while the oil export price, non-oil export price, and domestic income increases would be beneficial to the Nigerian economy.

Succinctly, and based on the empirical findings, this study recommends that:

- (i) Exchange rate depreciation (increase in naira value to the convertible currency such as US Dollar) promotes a healthy balance of trade has the tendency to reduce excessive imports, however, the level of preference for imported consumer goods in Nigeria is too high for such policy to be effective. The government needs to promote made in Nigeria products and ensure that manufactured goods originating from Nigeria meet international product standard to create the trade in the domestic tradeable sector of the economy.
- (ii) Exchange rate depreciation can also encourage real sector performance and pursue export led industrialization since non-oil and oil export prices provided evidence of slowing down the adverse effect of exchange rate changes in this period. This may improve the country's terms of trade as export price improves relative to import price in the domestic economy.

- (iii) It is needful for Nigeria to pursue Gross Domestic Product (GDP) growth targeting in addition to a well-managed exchange rate policy.

Improvement in the home income will support fiscal spending that can promote non-oil sector of the economy and improve overall trade balance in Nigeria.

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