Exchange Rate and Trade Balance: The Case for J-curve Effect in Nigeria

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Abstract. The Nigerian currency has since the introduction of the Structural Adjustment Programme (*SAP*) of 1986 has been continually depreciated except for a few years. This study investigated the "J-curve" effect which is the nexus between trade balance (*TB*) and the real effective exchange rate (*REER*) in Nigeria. It adopted Johansen Cointegration following the outcome of the preliminary Augmented Dickey-Fuller (*ADF*) test for stationarity of the data series in the model from 1981 to 2016. The Granger causality and the Impulse Response Function tests were also deployed. The post-estimation diagnostic validation conducted included the normality, heteroskedasticity and autocorrelation tests. Empirical evidence from this study showed that in the short run, the trade balance benefited from the devaluation of the Naira rather than suffer deleterious consequences. There was no long run relationship between the dependent variable, (*TB*) and the explanatory variables, *REER* and *GDP*. In Nigeria, it was the inverted J-curve effect. The evidence from impulse response function corroborated the inconsistent long run relationship beyond the fourth year. There was the absence of Granger-causality directions amongst the variables. In view of the contrarian findings of this study, the Nigerian policy makers are enjoined to allow the financial markets determine exchange rates. Exception can be made for priority areas of the economy with the capacity to benefit the strategic intent of governance. In this investigation of the exchange rate and trade balance nexus, the case for J-curve effect has not been made in Nigeria.

Keywords: Trade Balance, Effective real exchange rate, J-Curve Effect, Johansen Cointegration

JEL: B41, C21, F31

1. Introduction

Arising from economic depression occasioned in part by the fluctuation in world crude oil prices, the Nigerian government undertook a structural adjustment programme (SAP) between 1986 and 1988. The programme was conceived among other things to get rid of inefficient state intervention, liberalize exports, privatise State-owned enterprises, restructure other parastatals to improve efficiency and revalue the exchange rate of the local currency -Naira. One of the key objectives of the programme was to, consistent with economic theory (J-curve effect), improve the trade balance especially in the long run.

Several methods have been deployed by the monetary authority to revalue the Naira. In September 1986, the government initiated a second-tier foreign exchange market (SFEM) for non-controlled foreign trade transactions. The Naira immediately depreciated by 66 percent to N1=US$0.64 (N1.56=US$1), and has declined

further in value except for a few years when the government artificially held the value constant between 1996 and 1999. As at December 2012, the exchange rate stood at 156.81 Naira to 1 US Dollars (Central Bank of Nigeria, 2013). Indeed as of December 2016, the rate dropped to =N=253.5 and further crashed to =N=305.8 and =N= 365.2 on the official and trading windows respectively (Central Bank of Nigeria, 2018).

Sufficient time has elapsed since the advent of the Structural Adjustment Programme in 1986 for a robust evaluation of the programme. Indeed, the stiff devaluation of the Nigerian Naira since the onset of economic depression in first quarter of 2016, calls for an in depth investigation of the efficacy of this macroeconomic policy in Nigeria. The salient question is the applicability of the J-Curve as a depiction of effect of depreciation of a country's exchange rate on the current account or balance of trade. Previous studies have reported disparate findings in empirical literature (Baek, Mulik& Koo, 2006; Danmola, Abba & Oladipo, 2013; Halicioglu, 2008; Umoru & Eboreime, 2013; Ziramba and Chifamba, 2014)

The rest of the paper is designed as follows: The next section covers the review of related literature. In section three, the methodology of the research is presented covering the specification of the model, data sources and the estimation procedure. The findings, analysis and discussions are presented in section four while the fifth section concludes the study.

2. Review of Related Literature

This section covers the appraisal of related literature in previous studies and the theoretical review

2.1 Literature Review

Following from the theoretical discussions in the last section, the review of literature on the applicability of the Marshall-Lerner condition following a J-curve has a long history with mixed and changing views over time. The study by Kulkarni, (2007) provides empirical evidence supportive of the J-Curve proposition in seven countries with significant adjustments in the values of their currencies. Six of the countries with devalued currencies recorded remarkable changes in the rate of exchange manifesting J-Curve shape on the balance of payments. An inverted J-curve was recorded for Japan, a country that revalued its currency in 1985. The summary of findings is that in the absence of market- determined exchange rate values, artificial fixation will result in another exchange modification at a later time.

Using a cointegration statistical model with six different lags, Halicioglu, (2008) tested the statistical causality of currency value fluctuation and trade balance of Turkey and its biggest trading partners. The research finds that in all the 13 countries, the rate of exchange had no effect on bilateral trade balance in the short term. Limited impact in the long run was reported for only USA and the UK. The autoregressive distributed lag (ARDL) model applied by Baek, Mulik and Koo (2006) in estimating bilateral trade data between the U.S. and her three major trading partners (Japan, Canada and Mexico) find little evidence of the J-curve phenomenon with respect to agricultural trade with industrialised countries of Japan and Canada. However, relationship with Mexico, a developing economy did not.

The study of Thailand's forest products trade with the rest of the world conducted by Sulaiman and Abdul-Rahim(2014) using the ARDL and cointegration approach in testing for J-curve existence reports the absence of J-curve effect. This is not in congruence with the study of Ireland which was of interest to Hsing (2011) who a deployed an open-economy macroeconomic model by incorporating the monetary policy reaction function. The findings show an inverted J-shape relationship in compliance with expected raises output during 2001 and 2009 due to real exchange rate appreciation as a result of real appreciation of the Euro against the U.S. dollar with consequential positive effect on real output. The research by Pavle, and Gligorić (2010) shows that using both Johansen's and autoregressive distributed lag approach, the depreciation of exchange rate led to improved trade balance in

the long run. In the short run however, a J-curve effect is manifest in Serbia.

Also employing the Autoregressive Distributed Lag (ARDL) approach, Ardalani and Bahmani-Oskoee (2006), show that in 50% estimated export functions for US industries, the coefficient on exchange rate in line with a priori expectation, is significantly negative. They contend that when aggregated data are applied, some insignificant sectors which may offset the exchange rate of significant ones could lead to the wrong conclusion that no impact on trade flows could be established. The application of ARDL cointegration approach and corresponding ECM by Bahmani-Oskooee and Kutan (2007) find empirical support for the J-curve pattern in Bulgaria, Croatia, Cyprus, Czech Republic, Hungary, Poland, Romania, Russia, Slovakia, Turkey and Ukraine Bulgaria, Croatia and Russia for the short run and exchange decline in long-run improvement.

The J-curve hypothesis tested on four Central American countries and five African countries by Spencer and Kulkarni (2010) using the generalized least squares method confirms the Kulkarni hypothesis that multiple or consistent depreciation of a country's currency would shift the J-curve rightward and continuously weaken the trade balance. Empirical evidence could however not be established by Umoru and Eboreime (2013) in their study of the trade effect of real exchange rate depreciation on the Nigerian oil sector when the Bounds testing approach was applied on time series data spanning 40-year period. The inverted J-Curve shape despite devaluations during the period was ascribed to the fact that Nigerian exports and imports are in its oil sector was denominated in US dollars.

Bahmani-Oskooee and Gelan (2012) were unable to find any support for the J-Curve in nine African countries of Burundi, Egypt, Kenya, Mauritius, Morocco, Nigeria, Sierra Leone, South Africa, and Tanzania using quarterly trade data were available. The finding is also upheld by Arabi and Abdalla (2014) who sought evidence of a J-curve for the Sudanese trade data between 1979 and 2006. The Vector Error Correction method shows that the Marshal-Lerner condition was met for the elasticity of real exchange rate although the condition for elasticity of demand for imports and exports was unachievable. The real exchange rate was found to be influential only in the short-run. Using the same estimation technique, Akpansung and Babalola (2013) in Nigeria reports weak evidence of causality between real exchange rate and trade balance.

The response of trade balance to exchange rate changes in Nigeria was examined by Oyinlola, Omisakin, &Adeniyi (2013) using Engel-Granger Two-Stage, Johansen and the Autoregressive Distributed Lag cointegration approaches on a quarterly data between 1980:Q1 and 2007:Q4. They find that the elasticities of demand for export and import did not sufficiently adjust to lead to improvement of trade balance thereby failing to depict a J-curve. The nexus between exchange rate and trade balance in Nigeria was re-examined by Oyinlola, Omisakin, and Adeniyi (2013). The study, working of quarterly from 1980:Q1 to 2010:Q4 deployed the Gregory-Hansen cointegration technique. The result shows that the depreciation of exchange rate caused the deterioration of trade balance both in the short and long run.

This corroborates the findings by Ogbonna (2010) which highlights limited role of exchange rates in determining the long-run equilibrium behaviour of the republic of Benin's trade balance. The research which employ unit root, cointegration and error correction model (ECM) procedures estimates further show that real exchange rate devaluation improves trade balance which suggests that M-L condition has limited application to Nigeria.

In partial contradiction to the afore mentioned studies on Nigeria, the research by Danmola, Abba and Oladipo (2013) which employs Cointegration, Vector Auto regression Estimate, Granger Causality and Variance Decomposition to analyze the J-Curve hypothesis shows absence of long-run relationships among variables under consideration but find bi-directional short run causality between exchange rate devaluation and trade balance.

A delayed J-Curve effect was ascribed to political economy than economics in the Nigerian case study by Kulkarni and Clarke (2009) who tested the J-Curve hypothesis. The expected decline in trade balance 1999 as a result of exchange devaluation did not happen. Instead it soared 1800 percent and continued its ascent in 2000 by 143 percent growth. In addition, no evidence of the Kulkarni Hypothesis based on the second wave of devaluation between 2002 and 2003 was recorded. In the whole period, the country's balance of trade increase without let or hindrance. The investigation by Loto (2011) on the effect of devaluation of the Nigerian Naira on the country's trade balance for the period 1986 to 2008 adopts the elasticity approach to the Balance of payments adjustment in testing the Marshal- Lerner condition. The study applied Ordinary Least Square (OLS) method and report that devaluation does not improve the trade balance since the sum of demand elasticities for imports and exports was found to be less than Unity. Ziramba and Chifamba (2014) who studied the behavior of South Africa's trade as a result of the crash of real effective exchange rate between 1975 and 2011 confirmed the long run relationship between the two variables.

The summary of literature findings suggests that factors including the level of economic development (Halicioglu, 2008; Baek, Mulik & Koo, 2006), time span (short versus long) (Danmola, Abba & Oladipo, 2013; Ziramba and Chifamba, 2014), currency denomination (US Dollar versus local currency) (Umoru & Eboreime, 2013). It also highlighted the Kulkarni Hypothesis effect based on the second wave of devaluation. In the next section, the methods employed in this research are presented.

2.2 The Nigerian Experience

A cursory look at the trend analysis of the domestic balance of trade and Naira exchange devaluation depicted in Figure 1 do not show a discernible relationship between the two variables in the long run. A closer look however reveals noticeable associations between the two variables.
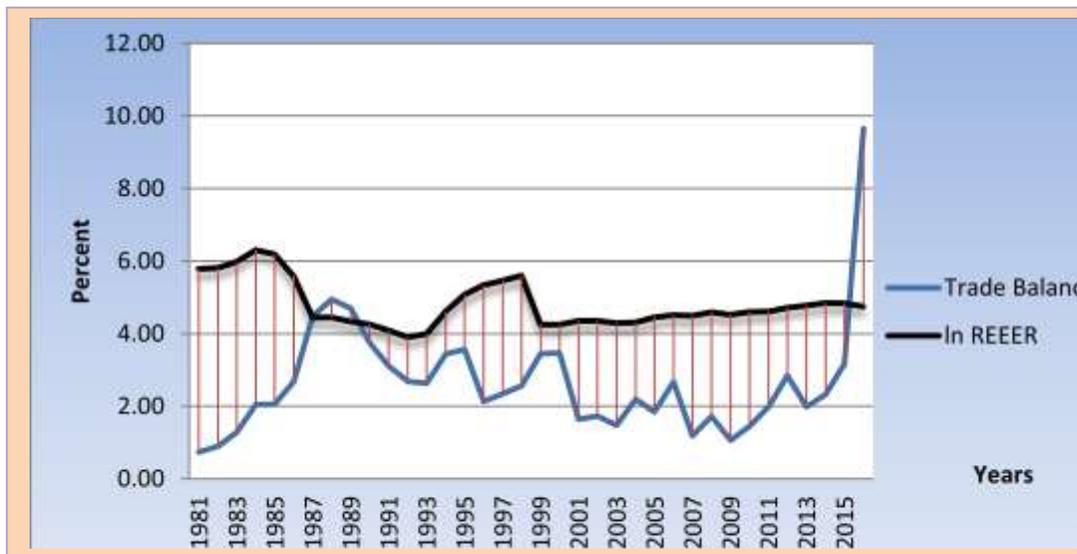

Fig 1: Trend of Trade Balances and Reel Exchange Rates (1981 -2016)
Source: Author's compilation from the Central Bank of Nigeria Statistical Bulletin (2017)

The devaluation of the Naira by about 126% and 99%, 13% and 63% in 1986, 1987, 1988 and 1989 respectively consequent upon the Structural Adjustment Programme of the country led to a sharp plummet of the exchange rates. This boosted the competitiveness of Nigerian exporters in the following two years up to 1989 because although imports were more expensive as a result of the decline in the rate

of exchange, the volumes remained steady. The low elasticity of exports in during the period also caused its response to the more competitive value of Naira to be slow.

The balance of trade actually deteriorated subsequently for the next decade not withstanding further devaluation during the period. The sharp rise in the balance of trade in year 2000 could not be ascribed to the artificial pegging of the Naira value by the then General Abacha military Junta between 1996 and 1999. The devaluation exercise in year 2000 actually led to an inverted J-curve in the same year when the trade balance also crashed. Between 2001 and 2006, the impact of the depreciation in the Nigeria started to manifest in increased export volumes and slower growth of imported goods and services with net improvement in the balance of trade in goods.

The Nigerian trade balance posted a surplus of 2.2 trillion Naira, compared with a 253.3 billion Naira deficit in 2016. Between 1981 and 2017 the Balance of Trade averaged 198.4billion Naira. It attained a peak record of 2.2 trillion Naira in October 2011. A low of -592 billion Naira was recorded in March, 2011. Nigeria's trade surplus widened to NGN 837.1 billion in March of 2018 from NGN 114.1 billion in the same month a year earlier. The investigation methodology of possible J-curve evidence is presented in the next section.

2.3 Theoretical Framework

The volume of imports and exports may remain largely unaffected immediately following the devaluation of the currency, due partly to pre-existing trade contracts that have to be honoured. Also in the short run, the demand for imports and exports stay price inelastic due to time lags in the consumer's search for cheaper alternatives. Given an unchanged import level, the value of the currency falls. When the devaluation takes place at *t,* the net export falls from *A* to *B* (Figure 2).

Over time, the net export will gradually increase since consumers consumes less imported goods and other countries purchases more goods from the country, induced by the lower real price. The net export breakeven is achieved at point **C** where the Marshall – Lerner condition is met. In the long term, the exchange rate depreciation can have the most wanted impact of improving the current account balance. Based on the assumption that equivalent domestic alternatives exist, domestic consumers may switch from expensive imported goods and services.
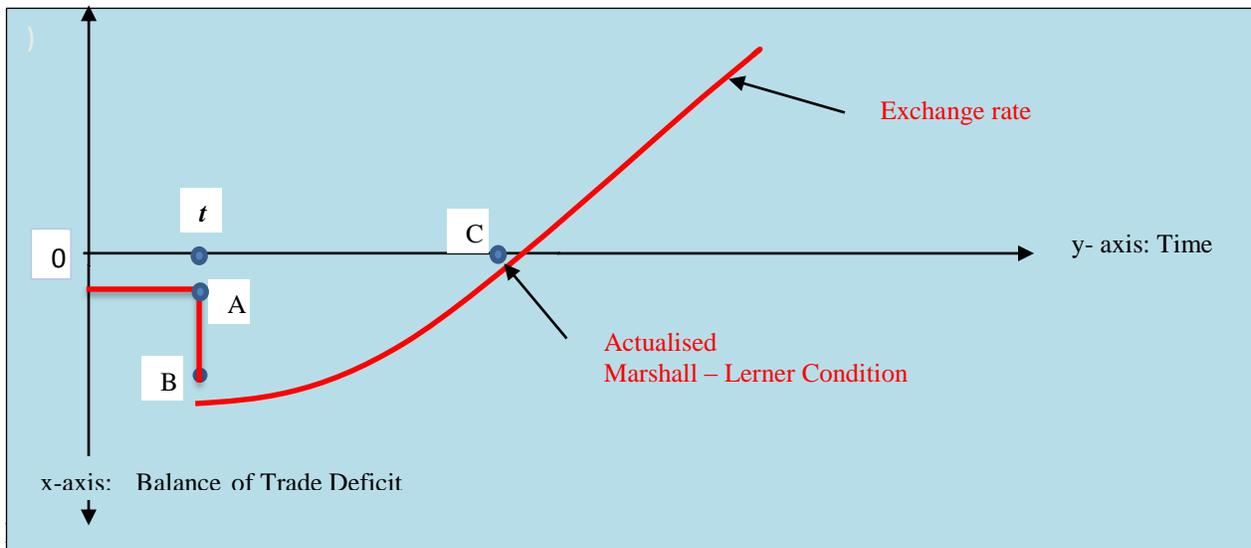
Source: Adapted from Kulkarni and Clarke (2009)

The consumers the foreign trading countries may also switch from expensive imports to their own domestically produced goods and services which are now cheaper. With time the net export will find equilibrium. Ultimately, due to a lessened exchange rate and reduction in the demand for more expensive imports, the value of the domestic country's currency appreciates resulting in improvement in the trade balance.

The linkage involving a country's price elasticities of demand for exports and imports is examined by Marshall-Lerner Condition (M-L). Foreigners' demand for exports from a country is relatively elastic, and then a slightly weaker local currency should lead to greater rise in foreign demand for its output, resulting in considerable rise in export income. On the other hand, if the country's demand for importsis highly price elastic, then a slightly weaker local currency to relatively greater rise in local demand for imports, and reduction in expenditures on imports. The M-L condition provides that if the combined price elasticities of demand for imports and exports are greater than unity (i.e. the coefficient is greater than 1) in the long term, then the depreciation of a country's currency will cause the shift its current account towards surplus (Kulkarni, 2007; Kulkarni & Clarke, 2009). This is stated in equation 1.

$$PED_x + PED_m > 1 \tag{1}$$

Where:

PED_x = price elasticities of demand for exports

PED_m = price elasticities of demand for imports

In a situation, where the elasticities of demand for exports and imports are highly inelastic, any attempt at devaluing the currency would reduce a trade surplus or worsen a trade deficit since the import expenditures will rise while export income from abroad will decline.

It can be inferred from the Marshall-Lerner (M-L) condition proposition that the condition for achieving improvement in the Balance of Payment is also time dependent. The changes in elasticity in the short run are small thereby making the attainment of the M-L Condition less likely. With time, the elasticities become larger, ultimately crossing the M-L threshold. The other major determinant of the degree of elasticity is the number of substitutes for the commodity or service. The availability of a large number of substitutes engenders high elasticity and vice versa. Where the M-L condition is not met before devaluations is done, there will be a shift in the J-Curveto the right as the elasticities import and export are realigned. Yet another cause, is the floating exchange rates mechanism of the free market which evaluates currency value using relationships like purchasing power parity (PPP). This has allows increased money supply by governments through *seigniorage*. The consequential currency crises and hyperinflation however leads to shifts in the trade balance as predicted by the J-Curve theory which this study investigates in the subsequent sections.

3. Methodology

This study attempts to explore empirically, the relationship between foreign exchange revaluation and the trade balance impact on the economy the trade balance is expected to depend on the real exchange rate and a measure of domestic and foreign income respectively, i.e. on the main determinants of import and export.

3.1 Model Specification and Estimation Procedure

The objective is to understand the effect of the real exchange rate (*REER*) on trade balance (*TB*) and confirm whether the relationship between the real exchange rate and trade balance of Nigeria follows the prescribed "J-curve" pattern. The long run relationship between the real effective exchange rate and trade balance of Nigeria is therefore modeled as equation (2):

$$TB = \alpha + \beta GDP_d + \delta REER + e \tag{2}$$

Where:

TB = Trade balance

REER = Real effective exchange rate

The domestic balance of trade of country i trading with country j (TB_{ij}) can be expressed as a ratio of exports to imports(X_1/M_1) (Onafowora, 2003). As posited by Hacker and Hatemi (2004), the trade ratio (exports divided by imports) is a better measure than the trade balance (exports minus imports). This derives from the fact that the trade ratio is capable of being logged regardless of whether a trade surplus or trade deficit exists. Ho (2012) defines the effective exchange rate as a ratio of the normalized exchange value of Currency i against the US dollar to the normalized exchange value of the benchmark currency basket against the US dollar. The US dollar is used as numeraire for convenience. To calculate the real effective exchange rate (REER), the nominal effective exchange rate (*NEER*) is adjusted by appropriate foreign price level and the home country price level.

REER as defined by the World Bank (2014) is the nominal effective exchange rate which is a measure of the value of a currency against a weighted average of several foreign currencies) divided by a price deflator or index of costs. Some of the identified methodologies for calculating the REER in the literature include the elasticity approach (Robinson, 1937); absorption approach (Greene, 2003); monetary approach (Kreinin, 1978), and portfolio management (Dornbusch, 1980). The trade weighting method for example favoured by Fung, Lau, and Xiong (2006) can be quite misleading in a world of production fragmentation where trade volumes are assumed to correlate with value added. The trade value addition in general, is not proportional to gross volumes as discovered by Fung et al (2006). Their research into trade which focused only on the value added of the trading countries understated the bilateral trade balance between the China and USA by about 25%. In addition, the trade weighting approach is also limited by the need to tailor-make (country-specific) for it to be useful since different countries have different trading partners. The GDP-weighted benchmark currency basket recommended by Ho (2009) for the effective exchange rate index is predicated on the fact that a country big in GDP is also ultimately a large importer. However, the argument falls flat if a big country is in aurtarky and does not directly trade with other countries.

The procedure recommended by Erlat, and Arslaner (1997) for measuring *REER* has been adopted by this study. This involves the utilization of either the end-of-year or the average of the nominal exchange rate during the period; choice of price indexes; decision on the number of trading partners in calculating the weights and the taking decision on the formula to use in aggregation. This approach has stood the test of time in spite of new approached being canvassed in the literature. The adopted approach which concentrates on the effect of relative price on the trade balances as postulated by Husted and Michael, (1995), submits that the impact of deliberate currency depreciation on the trade deficit depends on both the demand elasticity of imports and the supply elasticityof foreign goods.

The other key question is whether the depreciation of currency will improve trade balance in the long run real. In the case of foreign exchange appreciation, the a priori expectation is that the trade balance will be deleteriously impacted upon. In order for relationship to hold, the coefficient on real exchange rate should be positive in which case $\delta > 0$. In order to estimate the effect of exchange rate on trade balance, the domestic income is controlled for by including the gross domestic product (GDP_d) in equation (2). The inclusion of lagged values of the explanatory variable variables (GDP and exchange rate) is required to eliminate estimation bias which is likely associated with simultaneity and serial correlation. Also, the lag length is chosen using various criteria including the Akaike Information Criteria (AIC) as well as Sims (1980) and Blanchard (1990) procedures.

The other pertinent question to be answered is the true nature of the impact of the effect of the exchange rate (*REER*) on trade balance (*TB*). A rise in domestic output which may although, increase imports could also enhance exports. The net effect could be to either to improve or worsen the trade balance. Also, a supply-driven output growth could lead to an enhancement of

the trade balance. The import of this is that the expected sign of coefficient (β) is imprecise.

In view of the afore mentioned issues and based on an observed non-stationary nature of the Nigerian time-series data, the linear form of equation (2) suggests itself to log-linear function modification in which all the variables except the Trade balance are expressed as logarithms as in equation (3). The TB is not logged is due to the fact that is a generated rate. From the above discussions, equation (3) therefore lends itself for estimation by this study.

$$TB = \alpha + Ln\beta GDP_d + lnEXP + lnIMP + Ln\delta REER + e \qquad (3)$$

In order to estimate the long run relationship among variables in the model, three competing techniques were considered. These are the Ordinary Least Squares (OLS), Johansen cointegration technique and the Autoregressive Distributed Lag (ARDL) Bounds Test. The choice of the appropriate techniques depended on the outcome of the preliminary test for the stationarity property of the variables in the model using the Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) unit root tests.

If all the variables are integrated at level, the OLS method will be utilized. On the other hand, the ARDL Bound test approach will be appropriate if the variables in the model are a mixture of stationarity I(0) and non-stationary I(1) variables. The Johansen cointegration test will be selected if all the variables in the model are both non-stationary and integrated of the same order (Johansen 1996). Prior to the use of this method, the optimal lag length is determined using lag selection criteria such as Schwarz Information Criteria (SIC) and Akaike Information Criteria (AIC). The lag combination that minimizes the criteria lag is selected for the model.

Since the short-run effects of exchange rate changes could be different from its long-run impact, the study also considered the Vector Error Correction Model Test. Although the results obtained from the cointegration test reveal the causality between the variables, the direction of causality may not be directly manifest. The Granger causality fills this gap.

The use of Granger causality may not reveal the full interactions between the variables of a system. It is important to know the response of one variable to an impulse in another variable in a system that involves a number of other variables. The Impulse Response Function is applied for this test. This functions, also known as the forecast error impulse response is modeled in the context of a Vector Autoregression to illustrate the reaction economy over time to exogenous impulses, endogenous macroeconomic variables and time (Hamilton, 1994 & Lütkepohl, 2008). In order to test the validity and robustness of the model the research conducted the Breusch- Godfrey serial correlation LM test, Durbin Watson statistics test and Breusch-Pagan-Heteroscedasticity tests.

3.2 Data Description and Sources

The data from 1981 to 2016 across various business cycles and foreign exchange variations, import, export and GDP are obtained from the Central Bank of Nigeria Statistical Bulletin (CBN 2012). The National Bureau of Statistics (NBS, 2014) provided the rationale for the GDP rebasing exercise of Central Bank of Nigeria (2014). In the submission of Goldsbrough, Adovor and Elberger (2007), the challenge of data have is manifestly bedeviled developing countries including Nigeria due to fundamental limitations in national data tracking systems. The need has therefore arisen for data sourcing from other areas. The World Bank (2014) database has proven to be a veritable source of data for the real effective exchange rate (*REER*).

The choice of the period of study is informed by the rapid devaluation of the Nigerian Naira consequent upon the Structural Adjustment Programme (SAP) embarked upon by the then administration in 1986. Except for some period between 1996 and 1999, the local currency had consistently fallen in value. Some data transformation was considered necessary. As the GDP values are in billions the logarithm are taken. Also, since *REER* and *TB* are in units, rate or ratio, appropriate scaling tools are utilized in

order to arrive at data sets with relatively close range.

4. Empirical Findings and Discussions

4.1.1 Descriptive Statistics

This statistic states the attributes of each variable are presented in Table 1.

Table 1: Descriptive Statistics

STATISTICS	LNEXP	LNGDP	LNIMP	LNREER	TB
Mean	29.53	30.98	28.74	4.80	2.42
Median	29.35	30.74	28.67	4.60	2.26
Maximum	30.50	31.88	29.90	6.30	4.95
Minimum	28.90	30.36	27.46	3.91	0.74
Std. Dev.	0.51	0.51	0.73	0.64	1.07
Skewness	0.69	0.59	0.079	0.93	0.57
Kurtosis	2.10	1.76	1.76	2.75	2.75
Jarque-Bera	4.05	4.41	2.35	5.23	2.02
Probability	0.13	0.11	0.31	0.07	0.36
Sum	1,062.97	1,115.40	1,034.76	172.80	87.25
Sum Sq. Dev.	9.02	9.02	18.59	14.39	40.08
Observations	36	36	36	36	36

Source: *Author's computation using E-views 8.0 (2018)*

A large difference exists between the minimum and maximum values over the 36 year period of consideration. In addition, all the variables are platykurtic in nature amongst with skewness value less than 3. The Kurtosis values of the series are also less than 2. The combined implications of these two characteristics indicate non normality of the variables. This is corroborated by the estimation of the Jacque-Bera statistics. In spite of these non-normalities, the stability of the variables has to be confirmed using the stationarity test. This is discussed in the next section.

4.1.2 Stationarity Test Results

The results of the Augmented Dickey Fuller (ADF) test and the Phillip Perron test are presented in Table 2.

4.1 Preliminary Analyses

The preliminary analyses of the nature of the variables are in two parts. These are descriptive statistics and stationarity test.

Table 2: Unit Root Test Results: Augmented Dickey Fuller and Phillip PerronTest

Series	5% Critical Value	ADF Test at First Difference (Prob.)	Phillip Perron Test At First Difference (Prob)	Equation Specification	Order of integration
LNEXP	-2.95	-6.96 (0.00)	-7.08 (0.00)	Intercept	I(1)
LNGDP	-2.95	-4.34 (0.00)	-4.32 (0.00)	Intercept	I(1)
LNIMP	-2.95	-5.31(0.00)	-5.28 (0.00)	Intercept	I(1)
LNREER	-2.95	-4.40 (0.00)	-4.30 (0.00)	Intercept	I(1)
TB	-2.95	-5.67 (0.00)	-5.62 (0.00)	Intercept	I(1)

Source: *Authors computation using E-Views 8.0 (2018)*

The Augmented Dickey Fuller and Phillip Perron test result in Table 2 showed that all the variables were stationary at first difference since their respective absolute test statistic values were greater than the critical values at 5% significance level. This suggested that the Ordinary Least Square (OLS) method was not the appropriate estimation technique. The Johansen cointegration test lent itself for determination of

the long run relationship amongst the variables (Johansen, 1996; and Johansen & Juselius, 1990). This was deployed in the next section after determining the optimal lag length.

4.2 Estimation Results

4.2.1 Optimal Lag Length Selection

This determination of the lag length to be selected assesses the impact on the current year as a result of changes in the previous year.

Table 3: Optimal Lag Length Selection Criteria

Lag	Log L	LR	FPE	AIC	SC	HQ
0	35.75	NA*	1.07e-07*	-1.86*	-1.64*	-1.79*
1	50.83	24.68	1.99e-07	-1.26	0.10	-0.81
2	63.77	17.25	4.62e-07	-0.53	1.96	0.31

Source: *Authors computation using E-views 8.0 (2018)*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: -Hannan- Quinn information criterion

The lag order length of (0) was selected by all the criteria was adopted. After establishing the lag order length, the Co-integration test was estimated and explained in the next section.

4.2.2 Cointegration Test Result

Two types of tests were considered under the Johansen method. These are the Eigenvalue and Trace statistic tests.

$$\lambda\text{trace} = -T \sum_{i=r+1}^{n} \ln(1 - \lambda_i^2) \tag{4}$$
$$\lambda\text{max} = -T \ln(1 - \lambda_{r+1}) \tag{5}$$

Where, λ_i is the estimated values of the ordered Eigenvalues obtained from the estimated matrix and T is the number of the observations after the lag adjustment. The trace statistics test the null hypothesis that the number of distinct cointegrating vectors (*r*) is less than or equal to *r* against a general alternative. The maximal eigenvalue tests the null that the number of cointegrating vectors is *r* against the alternative of *r+1* cointegrating vectors.

The result of the Johansen Co-integration for both the Trace Statistic and Maximum Eigen Value is reported in Table 4. With the hypothesized level of acceptance is 5 percent,

Table 4: Result of Johansen Co-integration test based on Trace Statistic and Max Eigenvalue

		Trace Statistic			Max. Eigen Value		
No. of CE	Eigenvalue	Trace Statistic	Critical Value 0.05	Prob.	Max-Eigen Value	Critical Value	Prob.**
None *	0.68	100.38	69.82	0.00	36.06	33.88	0.03
At most 1 *	0.59	64.32	47.86	0.00	28.69	27.58	0.04
At most 2*	0.42	35.63	29.80	0.01	17.13	21.13	0.16
At most 3*	0.30	18.50	15.50	0.02	11.20	14.27	0.15
At most 4*	0.20	7.29	3.84	0.01	7.29	3.84	0.01

Source: *Authors computation using E-views 8.0 (2018)*

Notes:
Trace test indicates 5 cointegrating eqn(s) at the 0.05 level
Max-eigenvalue test indicates 2 cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
        **MacKinnon-Haug-Michelis (1999) p-values

The Trace Statistics and the Max-Eigen Value are optimized at most 1. The co-integration computation postulates at most 4 variables possess a long run relationship with the dependent variable. Thus, there exists a long-run relationship between trade balance on the one hand and each of import, export, GDP and real effective exchange rate, on the other.

The assessed vector error correction model results are presented below in Table 5.

Table 5: Result of Vector Error Correction Model Test

Variable	Co-Efficient (After Normalization)	Standard Error	T-Statistic	(df31 = 2.042)
TB	1.00			
LNEXP	1.42	0.79	1.79	
LNGDP	2.01	1.03	1.96	
LNIMP	-3.13	0.25	12.43	
LNREER	0.61	0.14	4.39	

Source: Authors Computation using E-Views 8.0(2018)

The estimated long run model is recast equation 6 as:
        $TB = 1.42\ lnEXP + 2.0\ lnGDP - 3.13\ lnIMP + 0.61\ lnREER$ (6)
R-squared: 0.17 Adjusted R-squared: -0.27   F: 119.56

The equation (6) reveals the existence of positive relationship between trade balances on the one hand and export, GDP and each of real effective exchange rate on the other in the long run. However, export and GDP are not statistically significant at 5% because the calculated t-statistic of both independent variables (1.79 and 1.96 respectively) is less than the tabulated t-statistic (2.042 at df_{28}).

One hundred percent increase in real effective exchange rate raises the trade balance by 61 percent. However, the negative but significant nexus between import and trade balance in the long run means that one hundred increase imports will cause about three-fold reduction in trade balance. Having established the long run relationships and estimates, the next phase is to determine the short-run dynamics.

4.2.3 Vector Error Correction Model Short –Run Result

This test is carried out after the application of the Vector Auto-Regressive (VAR) model which is done to integrate the multi-variate time series. It is employed in order to determine the existence or otherwise of a short-run relationship amongst the variables and the dynamics which helps to maintain the long-run equilibrium. The short run estimation result is reported in Table 6.

Table 6: Vector Error Correction Model (VECM) Result.

Error Correction	D(*lnEXP*)	D(*lnGDP*)	D(*lnIMP*)	D(*lnREER*)
CointEq1	0.08	0.09	0.00	0.56
	(0.12)	(0.03)	(0.17)	(0.16)
T-stat (Cal)	[0.67]	[2.91]	[0.01]	[3.49]

Source: Authors computation using E-views 8.0 (2018)

Given that the tabulated T-stats value (2.042) is greater than the calculated *lnEXP* (0.67) and LNIMP (0.01), the null hypotheses is accepted which states the absence of a short run relationship. This does not apply to *lnGDP* (2.91) and *lnREER* (3.49) which means that in the short run, trade balances react to the

real effective exchange rate and GDP. The effective real rate of exchange of the immediate prior year is positive and significantly, at 5 percent, related to the trade balance. A percentage increase in the real effective exchange rate will lead to 0.09 percent increase in trade balance. In the same vein, a percentage increase in previous period's GDP will cause 0.56 percent rise trade balance. The implication of this is that supply side factors are important in driving the growth of output Nigeria with consequential enhancement of the trade balance.

4.2.3 Granger Causality Test

Although the results obtained from the cointegration test reveal the causality between the variables, the direction of causality may not be directly manifest. The Granger causality fills this gap. The result is presented in Table 7.

Table 7: Result of Granger Causality Test

Dependent variable: D(AGD)			
Excluded	Chi-sq	df	Prob.
D(EXP)	0.38	2	0.83
D(GDP)	0.37	2	0.83
D(IMP)	0.65	2	0.72
D(REER)	0.83	2	0.66
All	3.88	8	0.87

Source: Authors Computation using E-views 8.0 (2018)

The result stipulates the absence of causal directions amongst the variables.

4.2.4 Impulse Response Function Test

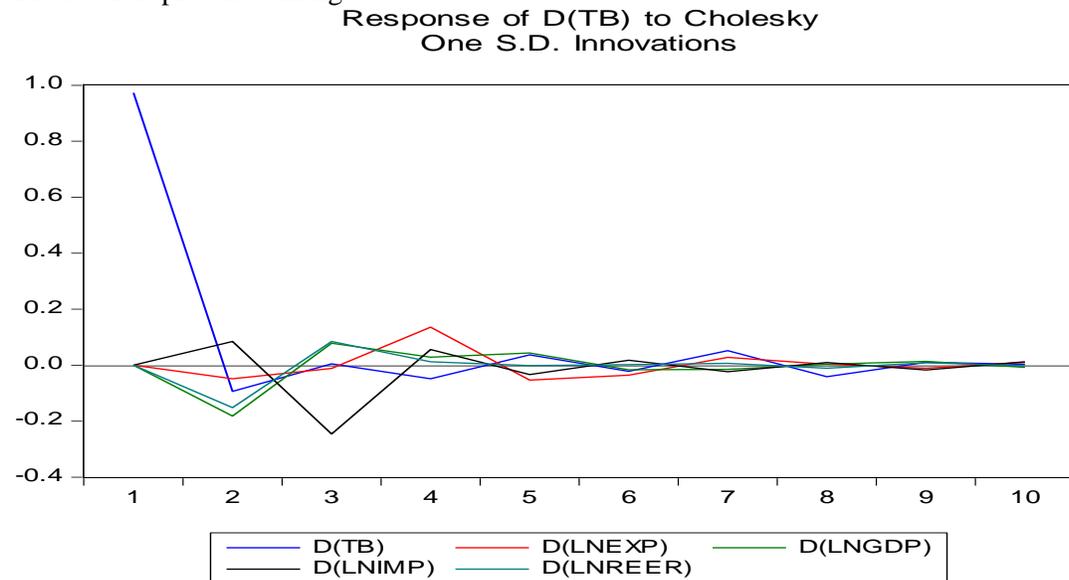The result is presented in figure 3.

Figure 3 Response of Trade Balance to Cholesky One Standard Deviation
Source: Authors Computation using E-views 8.0 (2018)

One standard deviation of export led trade balance to rise steadily across the years till it rose above the trend line in the third year, peaks in year four and fell drastically the next year soar above the line in the seventh year. Also, GDP fell immediately until the second year, reached its peak at the third year and fell till the fifth year while moving along the line in subsequent years. The import rose steadily from the first to the second year and experienced a nose dive below the trend line in the third year and soared above the

line in the fourth year. With respect to the real effective exchange rate, one standard deviation led trade balance to rise up to the second year and thereafter fluctuates along the line till the tenth year. This corroborates the absence of J-curve findings of the cointegration technique that real effective exchange rate depreciation indeed improved trade balance in the short run, ranging from the initial period of depreciation up to the second year.

4.3 Post-Estimation Tests

This section deals with the validity and robustness of the model. To achieve this, the study conducted the Breusch-Godfrey serial correlation LM test, Durbin Watson statistics Tests test and Breusch-Pagan-Heteroscedasticity Tests. The results are presented in the next sub-sections

4.3.1 Breusch-Godfrey Serial Correlation Lm Test

The Breusch-Godfrey Serial Correlation Lm Test is a proof for the existence of a serial relationship between the variables and the test results are presented in Table 8.

Table 8: Result of Breusch-Godfrey Serial Correlation LM Test

F-statistic	11.28	Prob. F(2,29)	0.00
Obs*R-squared	15.75	Prob. Chi-Square(2)	0.00

: Authors computation using E-views 8.0 (2018)

The result shows the presence of serial correlation probability value of 0.00as it is less than the 5% level of significance.

4.3.2 Durbin Watson statistics Tests

This test establishes the level of auto-correlation between the variables and the test result is presented in Table 9.

Table 9: Durbin Watson Autocorrelation Test Results

DW value (d)	D-UPPER ($d_{U,a,}$)	D-LOWER ($d_{L,a,}$)	DECISION CRITERIA
0.71	1.51	0.96	No positive auto-correlation

Source: Authors computation using E-views 8.0 (2018)

The test results depict a no positive auto-correlation in the variables as $0 < d < d_L$ exists.

4.3.3 Breusch-Pagan-Heteroscedasticity Tests

This was used to test for the fitness of the model based on the level of heteroscedasticity. This result is presented in Table 10.

Table 10: Result of Breusch-Pagan-Godfrey Heteroscedasticity Test

F-statistic	1.38	Prob. F (4,31)	0.26
Obs*R-squared	5.44	Prob. Chi-Square (4)	0.25
Scaled explained SS	4.36	Prob. Chi Square (4)	0.36

Source: Authors computation using E-views 8.0 (2018)

This result shows the absence of heteroskedasticity based on Prob. Value (0.26) greater than the 5% level of significance.

5. Discussion of Findings

The primary objective of this paper is to examine the "J-curve" effect for Nigeria. The short run estimation result was presented in Table 6. This result is against the proposition of the "J-curve" effect which suggests that exchange rate depreciation will worsen the trade balance of the depreciating country in the short run. This is against the a priori expectation which is that of deterioration of the trade balance in the short-run consequent upon the devaluation of the local currency.

The absence of causal directions between trade balance and real effective exchange rate can be ascribed to the nature of exported and imported goods and services. The most prominent trading partners of Nigeria are oil consumers which will demand for oil for smooth running of their economies irrespective of what happens to exchange rate between the two countries. By implication, this may not have impact on export even at the instant of *REER* depreciation.

This is upheld by the impulse response function with respect to the real effective exchange rate, where one standard deviation led trade balance to rise up to the second year and thereafter fluctuates along the line till the tenth year. This corroborates the absence of J-curve findings of the cointegration technique that real effective exchange rate depreciation indeed improved trade balance in the short run, ranging from the initial period of depreciation up to the second year.

The rationale is that if Nigeria's exports were invoiced in Naira - the local currency units and the invoicing of imports are in foreign currency units (say US Dollars, the immediate impact of Naira devaluation will be the rise in the prices of imported goods while prices of export goods would not change. The explanation for this contrarian finding is found in the violation condition precedent to a J-curve situation which is predicated on the combined effect of inelastic domestic demand for imports and foreign-currency-denominated imports. In the Nigerian case, the oil sector which provides about 95 percent of foreign exchange earnings is denominated in US Dollars.

On the other hand, Nigeria imports capital goods as well as luxurious consumer goods from her trading partners and may demand for more or less imports, depending on past level of imports demand and expectation about future capital formation but irrespective of variation in *REER*. Thus, imports may have not been affected by exchange rate depreciation. Consequently, the trade balances may not be influenced by real exchange rate.

Similar contrarian findings have been reported in studies by Bahmani-Oskooee and Goswami (2003), and Akbostanci (2004). They did not find the existence of J-curve. The implication of this is that supply side factors are important in driving the growth of output Nigeria with consequential enhancement of the trade balance.

In comparison with some similar works on the three largest economies in Africa: Nigeria, South Africa and Eqypt in the order of size Ziramba and Chifamba (2014) for the period 1975 to 2011 found a cointegration relationship between the trade balance and REER and domestic and foreign income. It could not support the J-curve occurrence in South Africa, just like in Nigeria.

The study by Abd-El-Kader (2013) investigated the J-curve hypothesis between Egypt and her twenty major trading companions between 1989 and 2010. The research ascribed a significant portion of the trade balance change in Egypt to the variationsin real exchange rate. Indeed, depreciation deteriorates the trade balancein the short-run, but it improves in the long-run. The author's results provide support for the J-curve effect.

Beyond the size of the economy, similar study by Adeniyi, Omisakin, and Oyinlola (2011) sought to find the existence of J-curve in the West African Monetary Zone consisting of Nigeria, Ghana, Sierra Leone and The Gambia. The research which covered the first quarter in 1980 through the fourth quarter of 2007 deployed the Bounds test and ARDL method similar to the primary estimation method of this

paper. It reports the existence lack of J-curve in Nigeria, inverted J-curve in Sierra Leone and lack of J-curve in Ghana and The Gambia. In the latter cases, the initial improvement in the trade balances was followed by deteriorating balances in the subsequent period.

The contradictory findings amongst the nations and even with respect to Nigeria is indicative of the fact that other exogenous factors including inter-temporal variables are at play in the determination of the efficacy of currency devaluation as a veritable tool of trade balance determination.

6. Conclusion

This study assesses "J-curve" effect for Nigeria, to know whether devaluation of a currency improves the trade balance in the short-run or / and the long-run. If real currency depreciation would worsens the trade balance in the short-run or long-run, the policy makers may apply fiscal or monetary policy in order to stabilize the value of the currency as recommended by Hsing (2009). If on the other hand, real depreciation would improve the trade balance in the short-run or long-run, the devaluation of the currency may be required to stimulate net exports in support movement of the economy on sustainable growth path especially in the long-run.

This study specifically examined the short and the long run relationship between trade balance (TB) and the real effective exchange rate (*REER*). In addition, the study adopts Johansen cointegration method following the outcome of the preliminary test for stationarity of the series in the model. Empirical evidence from this study shows that in the short run the trade balance appeared to have benefited from the devaluation of the Naira rather than suffer deleterious consequences. However in the long run there seems to be impetus for the trade balance consequent upon the consistent reduction of the exchange rate.

The evidence from impulse response function from the impulse response function the results obtained for Nigeria also negates the experience found in other countries that currency devaluation enhances trade balance in long run, and does so with the J-curve effect. Rather, in Nigeria, the experience is the inverted J-curve effect. This contrarian finding can due to the relative non-responsiveness of Nigeria exports and imports to real effective exchange rate depreciation especially arising from the oil and gas sector which forms the bulk of the country's export. A shift from crude oil dependency to a more diversified economy is therefore recommended so that vacillations in export earnings from one source can be toned down by stability in others.

In view of the contrarian findings of this study, the Nigerian policy makers are enjoined to allow the financial markets determine exchange rates, instead of guided manipulation of the exchange rates. This study further recommends selective application of managed flexible exchange regime to priority areas of the economy with the capacity to benefit the strategic intent of governance. In this investigation of the real effective exchange rate and trade balance nexus, the case for J-curve effect has not been made in Nigeria

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