An Econometric Estimation and Prediction of the Effects of Nominal Devaluation on Real Devaluation: Does the Marshal-Lerner (M-L) Assumptions Fits in Nigeria?

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ABSTRACT: Nigeria has been depending on oil as its major export commodity for decades leading to the neglect of other vital economic resources. This situation led to massive unemployment as a result of an undiversified economic system, which in turn created an alarming paucity of external accruals to finance the lingering poverty level of the country. Similar to this, several economic indexes and researchers have been pointing out delusive and inconclusive growth attainment of the country which has not impacted positively on the populace. It is against this backdrop that this study aims to re-investigate whether nominal effective exchange rate could lead to real effective exchange rate and if this can be a synergistic strategy towards spurring competitive trading relationship between Nigeria and the rest of the globe. To ensure this, we use a quarterly time series data from 1971QI-2012QVI, and applied the traditional and structural break unit root tests; the Bayer-Hanck cointegration approach and the VECM-Granger causality test. The findings of the study confirmed that nominal effective exchange rate leads to real effective exchange rate and inflation exerts positive impact on real effective exchange rate in Nigeria. In addition, the study found that real effective exchange rate has positive impact on nominal effective exchange rate, but inflation declines it. The causality analysis, on the other hand, revealed that there is feedback effect between real and nominal effective exchange rates, between nominal effective exchange rate and inflation and between inflation and real effective exchange rate. This finding suggests that there are crystal avalanche of competitive opportunities for the country to jettison all its economic vices and move progressively in international trade with minimal hurdles, thus fitting in with the Marshall-Lerner assumption (M-L).

Keywords: Marshall-Lerner; devaluation; exchange rates; cointegration
JEL Classifications: C2; C5; F1; G0

1. Introduction

The Dutch disease syndrome that characterized the Nigerian economy during the 1970s diminished the role of agriculture and manufacturing sectors making it possible for oil and gas to dominate the national exportable commodity which now account for about 97.4% of the nation's revenue in 2011. The non-oil and gas sector, on the other hand, is left to account for only 2.6% of export revenue to the nation, suggesting that the Nigerian non-oil potentials are not optimally tapped (Yesufu, 1996). In a related development, Ugbede *et al.* (2013) established that the Malaysian oil and non-oil balance of trade impact positively on the country's GDP, which is in contrast to the case of Nigeria where it is only the oil balance of trade that exhibit positive contribution to the country's GDP while the non-oil balance of trade, on the other hand, exhibits an insignificant contribution to the GDP, Oyejide and Adewuyi (2011) affirmed that the Nigerian economy is mainly dependent on its oil sector which supplies the bulk of its foreign exchange earnings and income. The conclusion of Oyejide and

Adewuyi (2011), made Ozurumba and Chigbu (2013) to argue that crude oil is an exhaustible asset which makes it unreliable for sustainable development. In a related development which compounded on the above findings, Rafindadi and Yusof (2014) in their recent study discovered that M3, bank assets, fixed capital formation, trade and private sector contribution in Nigeria have an insignificant contribution to the country's GDP. Following to these developments, the authors argued that it is most likely that the country may face prolonged macroeconomic volatility due to the absence of strong exogenous risk cushioning effects, chaotic and unfavorable investment climate, high rise in unemployment and persistent exchange rate instability. In addition to this, key macroeconomic variables have been pointing an unfavourable direction to the countries' economic growth prospects. For instance inflationary rate was discovered to be at the rate of 16% in 1971 rising to an unprecedented high level up to 72.84% in 1995, down to 13.72%, 10.84% and 12.9% in 2010, 2011 and 2012, respectively. In the international trading perspective, Nigeria's export was reported to be $2,152 billion in 1997 while its import was $14,691.6 billion, thus creating a deficit of $12,539.6 in the same year. Similar trend occurred in 1994 when exports were$5,349 billion, and imports were valued at $120,439.2 leaving a deficit of $115,090 billion in the same year. The situation worsened in 2009 when trade deficit amounted to $366,965 billion, and inflation was 56% in 1988 and 72.8% in 1995 and subsequently dropped to 6.6% in 1999 and 10.3% in 2012. This signifies that import items are rising due to increase in domestic demand. These situations simply lead to the widening of the country's trade deficit. As a consequence, the country's balance of payments deteriorated tremendously in those periods.

Advancing the significance of international trade, McTeer (2008) asserted that a significant rise in international trade volume benefit the general standard of living of a country by curving unemployment, diversification in revenue earnings, exploitation of national resources endowment, exchange rate provision, enhancement of the value of a national currency and help in averting exogenous shock.The author continued to assert that where trade grows significantly, it aids in economic leadership of the country regionally or even at the global level.It is in reference to this that this study aims to investigate the relationship between nominal effective exchange rate and real effective exchange rate in Nigeria. In this study, considering the rising trend of inflation in Nigeria we incorporate inflation as additional variable to the determination of nominal and real effective exchange rates. This is in order to explore more on the assertion made by Bahmani-Oskooee (1998) where the author argued that moderate inflation eats up the unfavorable impacts of nominal devaluation. Following the introduction in section I, section II of the paper will provide an overview of theoretical and empirical review of the literature. Section III will be on the conceptual framework of the study and section IV discusses the data, methodology and model specification. Section V presents the results and discussions, and section VI concludes and makes some recommendations to policy implications.

2. Theoretical and Empirical Review

The ups and downs of currency devaluation that are a result of intentional contrivance or naturally induced due to the deteriorations in the factors of demand and supply can have positive or negative effects on the economy. One of the most substantial impacts arising from currency devaluation is the improvement in thetrade balance. These processes tend to make exportable commodities cheaper and imports comparatively more expensive. This means that the volume of exports can intentionally be increased while that of imports will be reduced. However, a continued exploration of this trend could in the long-run have a contrasting effect on theeconomy particularly if exports are replaced by expensive imports. This situation will further become worst in a country wheretheinflationary trend is spectacular.In essence, a healthy, vibrant and resilient economy is dependent on trade balance i.e. lowering imports and enhancing export by means of full capacity utilisation which in turn piques productivity that curves unemployment and other economic vices. Devaluation can be of two consequences. It can improve the trade balance and thereby, improve the economy or can trigger inflation by raising the domestic costs of imported goods and services. This observation is in line with the expenditure switching mechanism theory, which asserts that the higher the costs of intermediate imports could counteract the beneficial effects of output growth that may arising from an increase in exports. In this situation, devaluation could expand trade deficit and pose a threat to external stability. Moreover, if exports and imports are too inflexible as a result of unfavourable exchange rate conditions, this can greatly limit the advantages of devaluation.

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The ground breaking research of Vaubel (1976) was among the key supporters of currency devaluation. In his empirical arguments, the author established that devaluation provides a significant avenue for international trading competitive advantage, and also help in raising internal efficiencies. From this development, Vaubel (1976) encouraged countries to adopt currency devaluation if they are aiming to achieve full and progressive economy. In the same line of development, Connolly and Taylor (1976, 1979); Bruno, (1978) and Edwards (1988, 1994) find that nominal devaluation results in real devaluation, but only in the short to medium term. For this reason, the authors unanimously, recommend that countries should avoid making devaluation a long term strategy in addressing the problems of balance of payments issues.

With reference to the expenditure switching mechanism theory and the empirical finding of Vaubel, (1976), Nigeria among a group of other countries implemented a system of mixed exchange rate regime which enabled the economy to efficiently distribute resources and remedy the international balance of payments problems until when it was later on abandoned. Bahmani-Oskooee and Mirzai (2000) studied the various probable variations resulting from the implementation of the real effective exchange rate by applying the KPSS test. The study concluded that PPP exists in the majority of developing economies. Subsequently, Bahmani-Oskooee and Miteza (2002) in a further follow up study utilized the error-correction model to examine the importance of the relationship between nominal effective exchange rate and real effective exchange rate in the long run and the short run. The authors used the data set of developing countries, including Pakistan. The findings of the study revealed that nominal devaluation results in real devaluation with minor variations in the values of the variables particularly in the case Pakistan from 1971-1997.

With reference to this finding, devaluation was re-admitted as a mechanism by numerous developing countries to resolve difficulties in balance of payments. To validate this finding and in a further follow up studies, Kent and Naja (1998) found that nominal devaluation results in progressively real devaluation as a nation transfers to a flexible exchange rate system. However, their result with regards to Pakistan was contradictory. Responding to Kent and Naja (1998) Bahmani-Oskooee and Kutan (2008) argued that the results of the previous authors are precarious upon factors such as the level of economic growth, the political climate, the governments' serious commitment and other economic policies.

In another line of theoretical argument from the Keynesian school of thought it was established that devaluation has positive impacts on output. Notwithstanding this, the monetarists, on their own side, maintained the view that the benefits of devaluation can be traced solely in the short-run and that any long-run effects could be negligible. The proponents of this theory continue to maintain their view point that developing continents should not exert persistent pressure on their national currencies; otherwise, the end result may be quite severe. Recently, the comparative value of devaluation in developing countries has been under close scrutiny by the new structuralist economists. They contend that, in the industrialised countries, the position of the exchange rate is market driven. From this perspective, the envisaged benefit of devaluation is obvious. However, in a situation where it is artificially induced it will yield to adverse result.

In addition to the above theoretical suppositions, Copelman and Werner (1996) and Kamin and Rogers (2000)argued that the effects of devaluation include reduction of demand deposits among individuals which will in turn affect domestic savings, thus becoming a systematic avenue that cripples investment thereby, retarding the economic growth prospects of a country. Additionally, Cooper (1971) and Lizondo and Monteil (1989) observe that devaluation compounds foreign debt commitments, which, in turn increases the expense of future borrowing. Similar in the lines of argument are the assertions of Krugman and Taylor (1978), who pointed out that devaluation can lead to a significant increase in trade deficit, thereby, becoming a contractionary measure that reduces collective demand. Edwards (1986) on his own part observed that despite the possible negative effect of devaluation on output growth,however, the short-run and long-term effect could be unbiased.In an expansion of the point put forward by Edwards (1986), Sheeley (1986) added that it is real that devaluation works adversely on the real output growth of the national economy. The findings of Sheeley (1986) were supported in the empirical research of Miteza (2006) where the authors commissioned an investigation into the international trading prospects of the Hungarian, Slovakian, Romanian, Poland and the Czech Republic.In that study, the author found that in the long-run real

devaluation has a contractionary effect and devaluation diminishes supply at a much more rapid rate as aggregate demand rises.

Notwithstanding all the above arguments yet, the recent findings by Ratha (2010) in India showed that, devalued currency is beneficial for economic growth, exports and trade balance. However, Adam, *et al.* (2010) asserted that there is no evidence of any link between devaluation of Taka and export revenue in Bangladesh. Similar line of argument were also maintained in the six main economies of Latin America, as studied by Mejı´a-Reyesab *et al.* (2010) where they concluded that devaluation has a contractionary effect. In another development, Guglielmo *et al.* (2012) while examining the Marshall-Lerner (ML) condition for the Kenyan economy established that a moderate devaluation of the Kenyan shilling created a stabilizing influence on the balance of payment through the current account without the need for high interest rate re-adjustment and this enhanced the international trading competitive abilities of the country. Contrary to findings of Guglielmo, *et al.* (2012), Rafindadi and Yusof (2013) in their empirical research established that the financial development of the Kenyan economy has no significant contribution to the country's economic growth. This surprising facts may be seen that the effects of the moderate devaluation has not yet impacted on the country's economic system and that something concrete need to be done.

It is following to this recent study by Guglielmo *et al.* (2012) and the rising mixed results obtained by authors that this study was motivated to use the latest econometric methodology and re-investigate whether nominal effective exchange rate could lead to real effective exchange rate and to assess the position of the rising inflationary trend in the country Nigeria. The study will equally investigate if this can allow for a synergistic approach towards spurring competitive trading relationship between Nigeria and the rest of the globe?Additionally could the findings of this research fit in with the Marshal-Larner assumptions?

3. Theoretical Framework

The theoretical framework of this study is based on the Marshall-Lerner condition, and the following derivations were obtained from Stern (1973). In that derivation, the author identified trade balance in foreign currency term to follow the outlined definition:

$$B_f \equiv p_{fx}X - p_{fm}M$$ .... (1)

However, when a country devalued its domestic currency (currency depreciation), this leads to:

$$\Delta B_f \equiv (p_{fx}\Delta X + X\Delta p_{fx}) - (p_{fx}\Delta M + M\Delta p_{fx})$$ .... (2)

In line with the above, we continue to accommodate the value of export and import by defining each under the following conditions:

$$V_{fx} \equiv p_{fx}X$$ ....foreign value of exports.......... (3)

$$V_{fx} \equiv p_{fx}M$$ ....foreign value of imports.......... (4)

By rearranging and substituting the above equations into equation (2) we have:

$$\Delta B_f \equiv V_{fx}\left\{\frac{\Delta X}{X} + \frac{\Delta p_{fx}}{p_{fx}}\right\} + V_{fm}\left\{\frac{\Delta M}{M} + \frac{\Delta p_{fm}}{p_{fm}}\right\}$$ .... (5)

From the above equation, we can then continue to invoke the elasticity's of demand and supply of import and export. In this equation we apply the negative demand elasticity's to allow us to have a positive equation as follows:

$$e_x \equiv \frac{\frac{\Delta X}{X}}{\frac{\Delta p_{fx}}{p_{fx}}} = \text{home export supply elasticity} \ldots\ldots (6)$$

$$\eta_x \equiv -\frac{\dfrac{\Delta X}{X}}{\dfrac{\Delta p_{fx}}{p_{fx}}} = \text{foreign export demand elasticity} \ldots \text{(7)}$$

$$e_m \equiv \frac{\dfrac{\Delta M}{M}}{\dfrac{\Delta p_{fm}}{p_{fm}}} = \text{foreign import supply elasticity} \ldots \text{(8)}$$

$$\eta_m \equiv \frac{\dfrac{\Delta M}{M}}{\dfrac{\Delta p_{fm}}{p_{fm}}} = \text{home import demand elasticity} \ldots \text{(9)}$$

In the light of the above, it is expected that foreign currency and home currency should relate as a result of the ensuing exchange rate r,and this will us to have:

$$p_{fm} \equiv p_{km} r \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(10)}$$

Next to the above, we assume home currency to be devaluated by a proportion of k, and this will make the home currency to be worth r(1-k) unit of foreign currency, as a result of this development, the level of price changes can be seen as follows:

$$p_{fm} + \Delta p_{km} = (p_{km} + \Delta p_{km})r(1-k) \ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(11)}$$

$$\Delta p_{fm} = (p_{km} + \Delta p_{km})r(1-k) - p_{km}r \ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(12)}$$

$$\Delta p_{km} = p_{km}r - p_{km}rk + \Delta p_{km}rk - p_{km}r \ldots\ldots\ldots\ldots\ldots\ldots \text{(13)}$$

$$\Delta p_{km} = -p_{km}r + \Delta p_{km}r - \Delta p_{km}rk \ldots\ldots\ldots\ldots\ldots\ldots \text{(14)}$$

$$\frac{\Delta p_{fm}}{p_{fm}} = -k + \frac{\Delta p_{km}}{p_{km}}(1-k) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(15)}$$

$$\frac{\Delta p_{fx}}{p_{fx}} = -k + \frac{\Delta p_{kx}}{p_{kx}}(1-k) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(16)}$$

From our definition of elasticity and substituting equation (6)-(9) into equation (15)-(16) will allow us to have the following:

$$\frac{\Delta X}{X} = e_x \frac{\dfrac{\Delta p_{kx}}{\Delta p_{kx}}}{p_{kx}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(17)}$$

$$\frac{\Delta X}{X} = e_x \left\{ \frac{\dfrac{\Delta p_{km}}{p_{km}}}{1-k} + k \right\} \ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(18)}$$

$$\frac{\Delta X}{X} = e_x \left(-\frac{\dfrac{\Delta X}{X}}{(1-k)\eta_x} \right) + e_x \frac{k}{1-k} \ldots\ldots\ldots\ldots \text{(19)}$$

$$\frac{\Delta X}{X} = e_x \frac{\dfrac{k}{(1-K)}}{\dfrac{e_x}{(1-k)\eta_x}} \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(20)}$$

$$\frac{\Delta X}{X} = \frac{ke_x\eta_x}{e_x + (1-k)\eta_x} \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(21)}$$

$$\frac{\Delta p_{fx}}{p_{fx}} = -\frac{ke_x}{e_x + (1-k)\eta_x} \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(22)}$$

$$\frac{\Delta M}{M} = \frac{ke_m\eta_m}{\eta_m + e_x(1-k)} \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(23)}$$

$$\frac{\Delta p_{fm}}{p_{fm}} = \frac{k\eta_m}{\eta_m + e_m(1-k)} \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(24)}$$

To determine the respective changes in the foreign currency value of continental trade balance on the basis of its respective demand and supply elasticity's we substitute between equation (21) to equation (24) into equation (5), and that will provide us with the following result:

$$\Delta B_f = k\left[V_{fx}\frac{e_x(\eta_x - 1)}{e_x + \eta_x(1-k)} + V_{fm}\frac{\eta_m(e_m + 1)}{\eta_m + e_m(1-k)}\right] \dots\dots \text{(25)}$$

In the above analysis, we further assume that the magnitude of the devaluation in K is meager then we can re-write the equation as follows:

$$\Delta B_f = V_{fx}\frac{\eta_x - 1}{1 + (\eta_x / e_x)} + V_{fm}\frac{\eta_m\left[1 + (1/e_m)\right]}{(\eta_x / e_x) + 1} \dots\dots\dots\dots \text{(26)}$$

The last equation above provide an explanation on what happen in a situation where prices of goods and services are fixed in sellers currency; the equation, therefore, inform us that the supply elasticity will be infinite elastics. This is commonly known as the Bikerdike-Robinson-Metzler condition (BRM). This is as expressed below:

$$e_x = e_m = \infty \dots\dots\dots\dots \text{(27)}$$

From this situation, we will have

$$\Delta B_f = V_{fx}(\eta_x - 1) + V_{fm}(\eta_m) \dots\dots \text{(28)}$$

In the above situation when balanced trade and foreign currency value of exports are equal to the foreign currency value of import then this translate into the following equation:

$$V_{fx} / V_{fm} = 1 \dots\dots\dots\dots\dots \text{(29)}$$

This condition will undoubtedly increase the international trade balance thus leading to:

$$\Delta B_f \geq 0 \dots\dots\dots\dots\dots \text{(30)}$$

Following to the above, what if the sum of the import and export demand elasticity's is greater than or equal to 1.

$$\eta_x + \eta_m \geqslant 1 \dots\dots\dots\dots \text{(31)}$$

The above situation is known as the Marshall-Lerner condition, commonly referred to as (M-L). The Marshall-Lerner condition assumes a surplus balance of trade such as in:

$$V_{fx} / V_{fm} > 1 \ldots\ldots\ldots\ldots (32)$$

This condition will undoubtedly increase the foreign currency value such as in:

$$\Delta B_f > 0 \ldots\ldots\ldots\ldots\ldots (33)$$

In this respect if the total of export demand elasticity and the weighted import demand elasticity are more than 1, in this respect, consider where the weight is the foreign currency value of the total import then divide by foreign currency value of exports thus:

$$\eta_x + \frac{V_{fm}}{V_{fx}}\eta_x > 1 \ldots\ldots\ldots (34)$$

From the above situation if we invoke our Marshall-Lerner assumption of trade balance being in surplus, this situation yield an insufficient condition. As a result going back to our initial assumptions of trade deficit becomes essential that is where we have:

$$V_{fx} / V_{fm} < 1 \ldots\ldots\ldots\ldots (35)$$

Then the following will happen:

$$\Delta B_f > 0 \ldots\ldots\ldots\ldots (36)$$

Particularly if:

$$\eta_x + \frac{V_{fm}}{V_{fx}}\eta_m > 1 \ldots\ldots\ldots (37)$$

In the above equation, the M-L assumption will become the final condition considering the weighted import demand elasticity which can be significantly large or small.

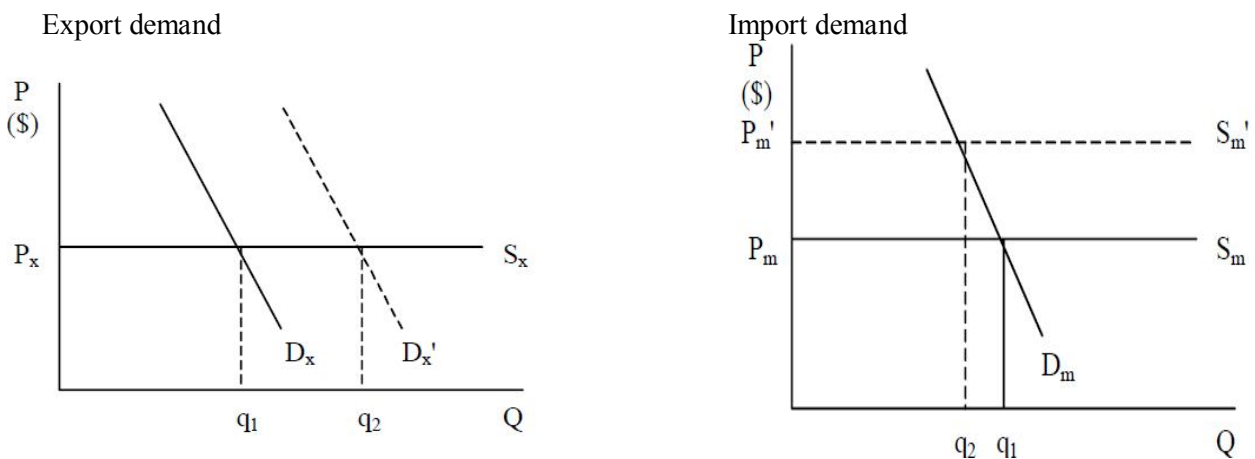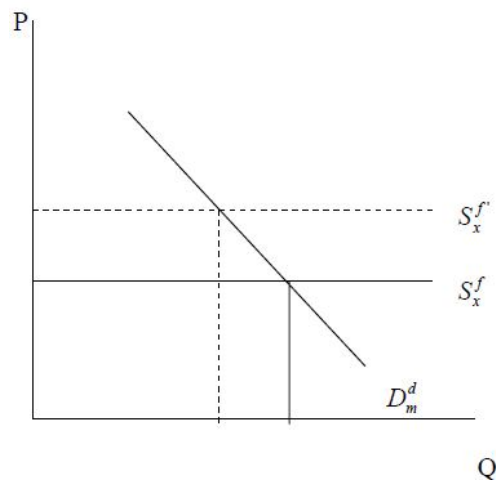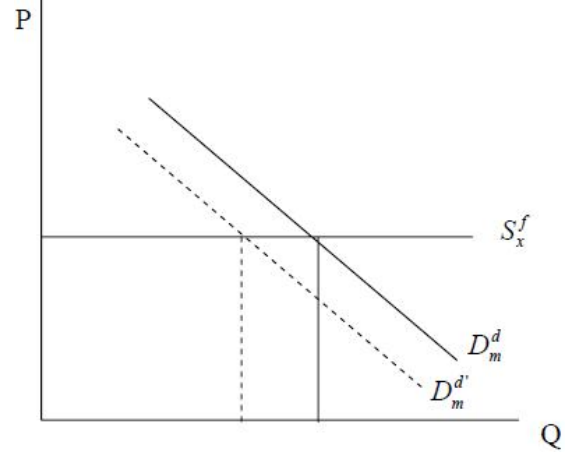**Figure 1. graphical representation of Marshall-Lerner conditions for domestic currency**

Figure 2. graphical representation of Marshall-Lerner conditions for domestic currency and foreign currency.
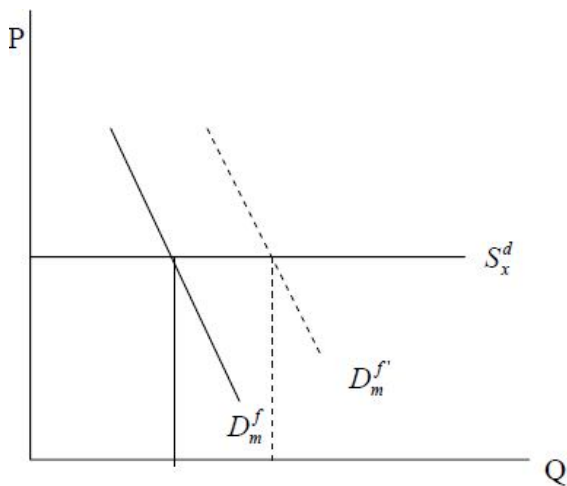
Showing domestic demand for imports

showing domestic demand for exports

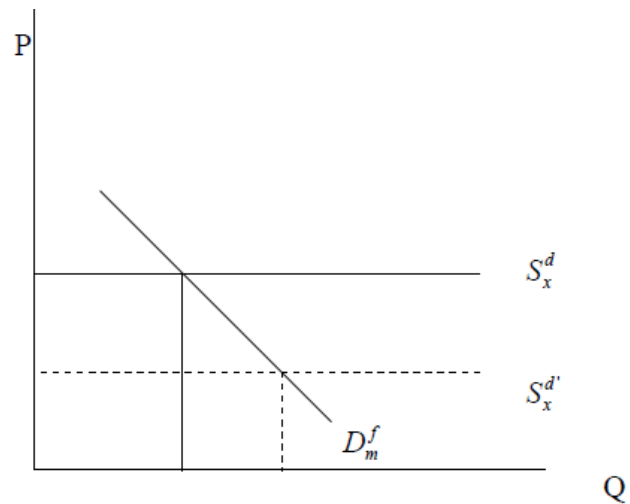Showing demand for domestic exports
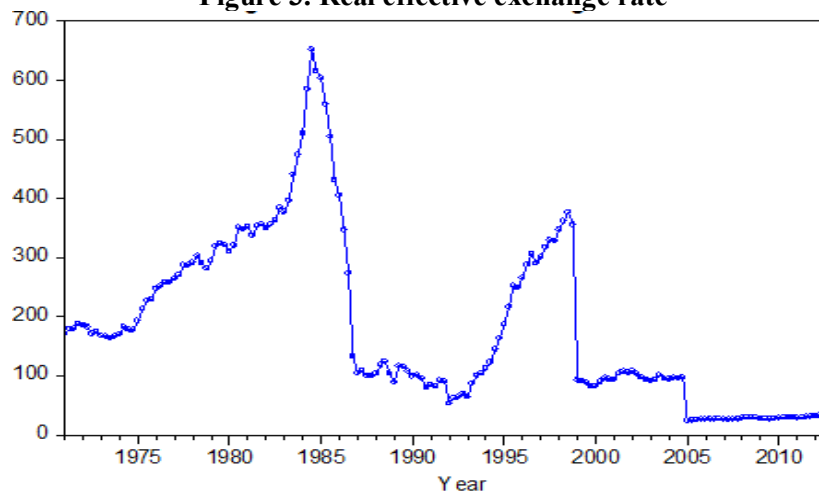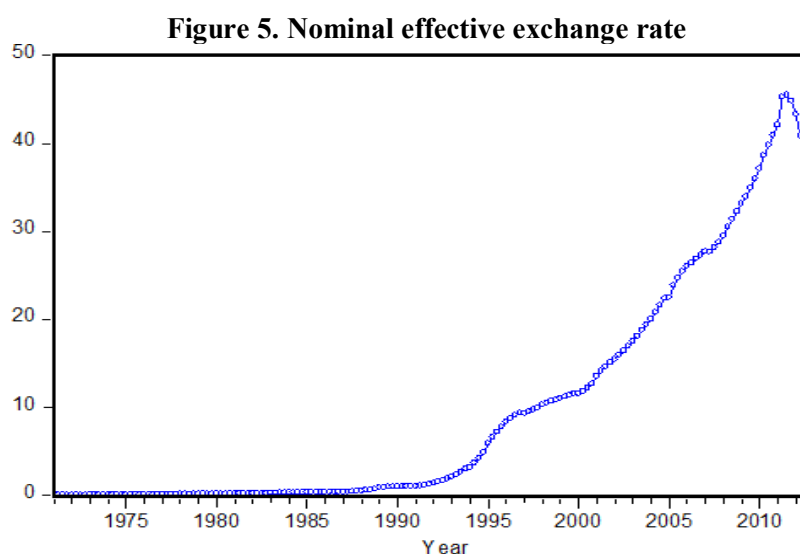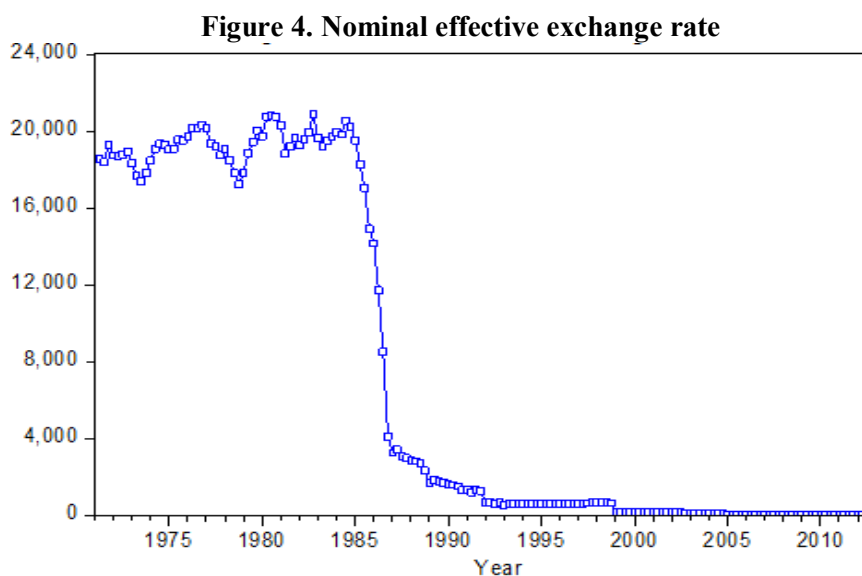
Showing foreign demand for imports

Figure 3. Real effective exchange rate

Figure 4. Nominal effective exchange rate

Figure 5. Nominal effective exchange rate

4. Model Construction and Data Collection

The prime objective of the present study is to reinvestigate whether nominal effective exchange rate leads to real effective exchange rate in the case of Nigeria. In doing so, and considering the high rates of inflation in the country we have incorporated inflation (consumer price index) as additional determinant of both real and nominal effective exchange rates in order to assess its position in enhancing the favourability or otherwise of the real effective exchange rate in Nigeria. The empirical equations of both models are given as follows:

$$\ln RER_t = \alpha_1 + \alpha_2 \ln NER_t + \alpha_2 \ln INF_t + \mu_i \quad \ldots\ldots\ldots\ldots (38)$$

$$\ln RER_t = \beta_1 + \beta_2 \ln NER_t + \beta_2 \ln INF_t + \mu_1 \quad \ldots\ldots\ldots\ldots (39)$$

Where, RER_t is the real effective exchange rate, NER_t is the nominal effective exchange rate, INF is the inflation rate proxied by the consumer price index and μ_i is the error term which is assumed to be normally distributed. The data of the study covers the period of 1971QI-2012QIV, and these were obtained from the Central Bank of Nigeria (CBN). In addition to this, the data on Nigeria's inflationary rate was also obtained from the Central Bank of Nigeria.

4.1. Bayer-Hanck Cointegration Approach

There are many cointegration approaches available in existing econometrics literature all having different theoretical backgrounds and assumptions. For instance Pesavento (2004) pointed out that the power of ranking cointegration methods is sensitive to the value of the nuisance estimators.

Following to this, conflicting results will be common. In this circumstance, it is difficult to obtain consistent results because one cointegration test rejects the null hypothesis but another accepts it. To reduce the effects of this situation Bayer and Hanck (2012) developed a new cointegration technique which combines all non-cointegrating tests to obtain consistent and reliable cointegration results. This cointegration test provides efficient estimates by ignoring the nature of multiple testing procedures. This suggests that the application of non-combining cointegration tests provides robust and efficient results compared to individual t-test or system based test. In his econometric modeling, Bayer and Hanck (2012) followed Fisher (1932) by combining the statistical significance level i.e. p-values of single cointegration analysis as follows:

$$EG-JOH=-2[\ln(P_{EG})+\ln(P_{JOH})]$$ ………………………….. (40)

$$EG-JOH-BO-BDM=-2[\ln(P_{EG})+\ln(P_{JOH})+\ln(P_{BO})+\ln(P_{BDM})]$$ …… (41)

The probability values of different individual cointegration tests such as Engle-Granger, (1987); Johansen, (1995); Boswijik, (1994) and Banerjee, Dolado and Mestre (1998) are shown by P_{EG}, P_{JOH}, P_{BO} and P_{BDM} respectively. To take decision whether cointegration exists or not between the variables, we follow Fisher statistic. We may conclude in favor of cointegration by rejecting the null hypothesis of no cointegration once critical values generated by Bayer and Hanck are less than calculated Fisher statistics and vice versa.

4.2 The VECM Granger Causality Approach

We apply the vector error correction model (VECM) Granger-causality test to examine the direction of the causal relationship between the variables. This method is followed by the two steps of Engle and Granger (1987) and employed to investigate the long-run and short-run dynamic causal relationships. The first step estimates the long-run parameters in equations (1-2) this was done in order to obtain the residuals corresponding to the deviation from equilibrium. The second step estimates the parameters related to the short-run adjustment. The resulting equations are used in conjunction with Granger causality testing:

$$(1-L)\begin{bmatrix} \ln RER_t \\ \ln NER_t \\ \ln INF_t \end{bmatrix} = \begin{bmatrix} a_1 \\ a_2 \\ a_3 \end{bmatrix} + \sum_{i=1}^{p}(1-L)\begin{bmatrix} b_{11i} & b_{12i} & b_{13i} \\ b_{21i} & b_{22i} & b_{23i} \\ b_{31i} & b_{32i} & b_{33i} \end{bmatrix} \times \begin{bmatrix} \ln RER_{t-1} \\ \ln NER_{t-1} \\ \ln INF_{t-1} \end{bmatrix}$$
$$+ \begin{bmatrix} \alpha \\ \beta \\ \delta \end{bmatrix} ECT_{t-1} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix} \quad (42)$$

Where, ϕ_j (j=1,2,3) represents the time-invariant constant; c ($c = 1,...,d$) is the optimal lag length determined by the minimization of AIC criterion; $(1-L)$ is the lag operator; ECT_{t-1} is the lagged residual; λ_j (j=1,2,3) is the adjustment coefficient; and $\xi_{j,t}$ (j=1,2,3) is the disturbance term assumed to be uncorrelated with zero means. The statistical significance of the coefficient of lagged error term i.e. ECT_{t-1} shows the long run causal relationship between the variables. The short run causality is shown by statistical significance of F-statistics using Wald-test by incorporating differences and lagged differences of independent variables in the model. Moreover, the joint significance of the lagged error term with differences and lagged differences of independent variables provides joint long-and-short runs causality. For example, Granger causality running from nominal effective exchange rate to real effective exchange rate if $b_{12,i} \neq 0 \forall_i$ and from the opposite side it is $b_{21,i} \neq 0 \forall_i$.

In order to test for stationarity of the selected variables, this study observe that the unit root tests by Dickey and Fuller (1979), the Philip Peron (1988) unit root test, the KPSS by Kwiatkowski *et al* (1992) test, DF-GLS by Elliot *et al.* (1996) and Ng-Perron by Ng-Perron (2001)are inappropriate as they lack information for the assessment of structural breaks stemming in the series, particularly those arising as a result of financial crisis, business and other economic cycles etc. Consequently the, econometric result produced by these tests are mostly biased and unreliable. It is in reference to this that we invoke the application of the Zivot-Andrews (1992) unit root test which provides an empirical

econometric mechanism that eliminate the observed bias in other tests and to equally allow for the accommodation of a single structural break point at level form. The Zivot-Andrew (1992) test with structural breaks as used in this study can be tested using the following econometric models:

$$ax_{t-1} + bt + cDU_t + \sum_{j=1}^{k} d_j \Delta x_{t-j} + \mu_t \dots\dots\dots\dots\dots(43)$$

$$\Delta x_t = b + bx_{t-1} + ct + bDT_t + \sum_{j=1}^{k} d_j \Delta x_{t-j} + \mu_t \dots\dots\dots\dots(44)$$

$$\Delta x_t = c + cx_{t-1} + ct + dDU_t + dDT_t + \sum_{j=1}^{k} d_j \Delta x_{t-j} + \mu_t \dots\dots\dots(45)$$

Where DU_t denotes the dummy variable, and it provides the shifting possibilities of the mean in each point while DT_t is a shift in the trending variable.

$$DU_t = \begin{cases} 1...if-t \ge TB \\ 0...if-t \le TB \end{cases} \; and DU_t = \begin{cases} t-TB...if.t \ge TB \\ 0...if.t \le TB \end{cases} \dots\dots\dots(46)$$

The null hypothesis of unit root break date is $c = 0$ which indicates that series is not stationary with a drift not having information about structural break stemming in the series while $c < 0$ hypothesis implies that the variable is found to be trend-stationary with one unknown time break. Zivot-Andrews unit root test fixes all points as potential for possible time break and does estimation through regression for all possible structural breaks successively. Then, this unit root test selects that time break that decreases one-sided t-statistic to test $c\hat{}(= c - 1) = 1$. Zivot- Andrews intimate that in the presence of end points, asymptotic distribution of the statistics is diverged to infinity point. It is necessary to choose a region where end points of sample period are excluded. Further, Zivot-Andrews suggested the trimming regions i.e. (0.15T, 0.85T) are followed.

5. Presentation and Interpretation of Results

Primarily, we have to test for the unit root properties of the variables, in doing so, we choose the combining non-cointegration test to examine whether cointegration between the variables exist. In addition to this, it requires that all the series should be stationary at I(1). If none of the variables are stationary, under or beyond the order of integration then computation process for cointegration becomes useless. To solve this problem, we apply ADF and PP unit root tests to test the integrating properties of the variables. The results of ADF and PP unit root tests are reported in Table-1. The results reveal that all the variables have unit root problem (with intercept and trend). However, at first difference, we found all the variables to be stationary. This shows that all the series are integrated at I(1). The same inference is drawn from PP unit root test.

Table 1. Unit Root Testing

Variables	ADF Unit Root Test		PP Unit Root Test	
	T-statistics	Prob.-values	T-statistics	Prob.-values
$\ln NER_t$	-2.1875 (4)	0.4930	-2.3197 (3)	0.4206
$\ln RER_t$	-2.6496 (4)	0.2592	-2.3398 (3)	0.4098
$\ln CPI_t$	-0.6574 (2)	0.9739	-0.7395 (9)	0.9679
$\Delta \ln NER_t$	-5.2291 (4)*	0.0001	-11.7370 (6)*	0.0000
$\Delta \ln RER_t$	-4.8782 (4)*	0.0004	-11.6040 (3)*	0.0000
$\Delta \ln CPI_t$	-3.4964 (2) **	0.0430	-3.4134 (3) **	0.0530
Note: * and ** show significant at 1% and 5% levels respectively. () indicates lags and bandwidth for ADF and PP unit root tests respectively.				

The problem with traditional unit root tests such as ADF and PP is that these tests do not accommodate information about structural break stemming in the series. These structural breaks may be a source of unit root problem and make the series non-stationary. The ADF and PP unit root tests over reject the null hypothesis once it is true and vice versa particularly in the presence of structural breaks. To manage the situation of structural breaks, we applied the Zivot-Andrews unit root test that accommodates the information about single unknown structural break in the series. The results are shown in Table-2. We find that the nominal real effective exchange rate ($\ln NER_t$), the real effective exchange rate ($\ln RER_t$) and the consumer price index ($\ln CPI_t$) are non-stationary in the presence of structural breaks. The structural breaks such as 1986Q2, 2005Q1 and 1991Q2 are found in the nominal real effective exchange rate, the real effective exchange rate) and the consumer price index, respectively. At first difference, the nominal real effective exchange rate ($\ln NER_t$), the real effective exchange rate ($\ln RER_t$) and the consumer price index are found to be stationary. This shows that variables have a unique order of integration. This leads us to apply the Bayer and Hanck, (2012) cointegration approach to examine the long-run relationship between the variables.

Table 2. Zivot-Andrews Unit Root Test

	T-statistic	Time Break
$\ln NER_t$	-3.625 (2)	1986Q2
$\ln RER_t$	-3.134 (0)	2005Q1
$\ln CPI_t$	-3.372 (2)	1991Q2
$\Delta \ln NER_t$	-12.258(3)*	1985Q2
$\Delta \ln RER_t$	-11.970 (1)*	1998Q4
$\Delta \ln CPI_t$	-4.888 (3)***	1987Q2

Note: * and *** indicate significance at 1% and 10% levels respectively. () indicates the lag length of the variables.

Table 3. Lag Length Selection

VAR Lag Order Selection Criteria						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-472.9615	NA	0.076988	5.949519	6.007179	5.972933
1	600.2211	2092.706	1.29e-07	-7.352764	-7.122126	-7.259110
2	691.9719	175.4735*	4.57e-08*	-8.387149*	-7.983533*	-8.223254*
3	697.2476	9.891803	4.79e-08	-8.340595	-7.763999	-8.106459
4	699.7698	4.634551	5.20e-08	-8.259622	-7.510048	-7.955246
5	703.3138	6.379185	5.57e-08	-8.191422	-7.268870	-7.816805
6	708.2398	8.682064	5.87e-08	-8.140497	-7.044966	-7.695640
7	713.2899	8.711498	6.18e-08	-8.091124	-6.822614	-7.576026
8	714.9262	2.761289	6.79e-08	-7.999078	-6.557590	-7.413739

* 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

Before going to the Bayer and Hanck (2012) cointegration approach, we selected the most appropriate lag length of the variables. In doing so, we prefer to select lag length based on the Akaike information criterion. The AIC provides consistent and efficient results regarding lag length selection. Our results are reported in Table 3. We found that we cannot take lag more than 2 in such sample size. After selecting appropriate lag length, the next step is to examine the cointegration between the variables by applying Bayer and Hanck (2012) cointegration test. The results are reported in Table 4. We find that the Fisher statistics for EG-JOH and EG-JOH-BO-BDM tests exceed the critical values at

5 percent level of significance once we used the real effective exchange rate and the nominal effective exchange rate as the dependent variables. It rejects the null hypothesis of no cointegration between the variables. This confirms the presence of two cointegrating vectors. This validates that there is a long run relationship between the variables over the period of 1971Q1-2012Q4 in the case of Nigeria.

Table 4. The Results of Bayer and Hanck Cointegration Analysis

Estimated Models	EG-JOH	EG-JOH-BO-BDM	Cointegration
$RER_t = f(NER_t, CPI_t)$	17.888	33.169	Yes
$NER_t = f(RER_t, CPI_t)$	23.313	52.066	Yes
$CPI_t = f(RER_t, NER_t)$	2.653	6.462	No
Note: ** represents significant at 5 per cent level. Critical values at 1% level are 16.679 (EG-JOH) and 32.077 (EG-JOH-BO-BDM) respectively.			

The long run results are reported in Table 5. We find that the nominal effective exchange rate affects the real effective exchange rate positively, and it is statistically significant at 1 percent level of significance. An increase of 1 percent in the nominal effective exchange rate is linked with 1.02 percent increase in the real effective exchange rate; all else is the same. The relationship of inflation (consumer price index) is positive and statistically significant at 1 percent. An increase of 0.773 percent in the prices of commodities in Nigeria will lead to increases the real effective exchange rate by 1 percent with other things constant. Simultaneously, the real effective exchange rate affects the nominal real effective exchange rate positively and is statistically significant at 1 percent level of significance. Meaning that, 1 percent increase in the real effective exchange rate will lead the nominal effective exchange rate to rise by 1 percent. The impact of inflation on the nominal exchange rate is negative and is statistically significant at 1 percent level of significance. We find that the nominal effective exchange rate leads the real effective exchange rate and vice versa in the case of Nigeria.

Table 5. Long Run and Short Run Analysis

Variables	Dependent Variable $= \ln RER_t$		Dependent Variable $= \ln NER_t$	
Long Run Analysis				
	Coefficient	T-statistics	Coefficient	T-statistics
Constant	-2.7680*	-13.8395	3.1917*	27.9172
$\ln NER_t$	1.0207*	38.9321	….	….
$\ln RER_t$	….	….	0.8834*	38.9321
$\ln CPI_t$	0.7728*	27.8784	-0.7832*	-87.4805
R^2	0.9483		0.9938	
Adj. R^2	0.9477		0.9937	
Short Run Analysis				
Constant	-0.0030	0.5646	0.0002	0.0438
$\ln NER_t$	1.0435*	46.263	….	….
$\ln NER_{t-1}$	-0.3664*	-4.7909	0.3211*	4.2660
$\ln RER_t$	….	….	0.8900*	14.930
$\ln RER_{t-1}$	0.3073*	4.4156	-0.2610*	-4.1108
$\ln CPI_t$	0.5435*	5.5911	-0.4884*	-4.3104
ECM_{t-1}	-0.0413**	-2.3294	-0.0426*	-3.0509
R^2	0.9344		0.9319	
Adj. R^2	0.9324		0.9298	
Note: * shows significance at 1% level.				

The short-run results are also reported in Table 5 (lower segment). In this table, we find that the nominal effective exchange rate leads the real effective exchange rate at 1 percent level of significance. The impact of lagged difference term of the nominal exchange rate exerts a negative impact on the real exchange rate but becomes positive in the future period. The impact of inflation on the nominal effective exchange rate is positive and significant at 1 percent. The dependent variable is also positively affected by its own lag at 1 percent. It reveals that 1 percent increase in the real effective exchange rate in the previous period leads the real effective exchange rate in the current period by 0.30 percent. Table 5 shows the estimate of the lagged error term i.e. ECM_{t-1} which is statistically significant at 1 percent with a negative sign. This indicates the speed of adjustment from the short run towards the long-run equilibrium path. Bannerjee *et al.* (1998) suggests that the"significance of lagged error term further validates the established long-run relationship between the variables". We find that the coefficient of ECM_{t-1} is 0.0413 (0.0426), and it is significant at 1% level of significance. This means that the real effective exchange rate has corrected 4.13% (4.26) previous period disequilibrium. In other words, it will take almost 6 years (5 years and 8 months) to reach long-run equilibrium path of real effective exchange rate (nominal effective exchange rate) function in Nigeria.

Table 6. The VECM Granger Causality Analysis

Dependent Variable	Direction of Causality						
	Short Run			Long Run			
	$\Delta \ln RER_{t-1}$	$\Delta \ln NER_{t-1}$	$\Delta \ln CPI_{t-1}$	ECT_{t-1}	$\Delta \ln RER_{t-1}, ECT_{t-1}$	$\Delta \ln NER_{t-1}, ECT_{t-1}$	$\Delta \ln CPI_{t-1}, ECT_{t-}$
Lag 1							
$\Delta \ln RER_t$	....	10.8677* [0.0000]	16.3467* [0.0000]	-0.0396** [-2.2270]	....	7.3003* [0.0000]	12.6919* [0.0000]
$\Delta \ln NER_t$	11.0864* [0.0000]	....	9.0649* [0.0002]	-0.0406* [-2.8184]	7.9539* [0.0000]	....	8.8448* [0.0000]
$\Delta \ln CPI_t$	4.2845** [0.0154]	3.6817** [0.0273]	....	-0.0150*** [-1.9137]	3.1657 [0.0261]	3.5390** [0.0161]	....
Lag 2							
$\Delta \ln RER_t$	....	7.1511* [0.000]	11.2662* [0.0000]	-0.0362 [-1.9843]	....	5.4070* [0.0076]	9.7121* [0.0000]
$\Delta \ln NER_t$	7.3468* [0.0000]	....	6.2855* [0.0005]	-0.0393** [-2.5201]	5.9651* [0.0010]	....	6.5741* [0.0001]
$\Delta \ln CPI_t$	2.7993** [0.0420]	3.2446** [0.0236]	....	-0.0162** [-2.0299]	3.0178** [0.0197]	2.7093** [0.0322]	....
Note: * and ** show significance at 1 and 5 percent levels respectively. [ ] shows probability values.							

Once the variables are integrated to the order of I(1) then, we can apply the VECM Granger causality test to examine the direction of the causal relationship between the variables. It is argued by Granger, (1969) that, in the presence of cointegration between the variables, there must be causality at least from one direction. In doing so, we have applied the VECM Granger causality, and the results are reported in Table-6. The results show that, in the long run, the feedback effect was found to exist between the nominal and the real effective exchange rates. This suggests that the nominal effective exchange rate leads to the real effective exchange rate and in resulting circumstances; the real effective exchange rate leads to the nominal effective exchange rate in the case of Nigeria, thus affirming the existence of Marshal-Larner hypothesis. Similarly, the relationship between the nominal effective exchange rate and inflation (consumer price index) is bidirectional. Inflation (consumer price index) Granger causes real effective exchange rate and converse is the result. In the short run, the study found that the nominal effective exchange rate leads the real effective exchange rate and the same is true from the opposite side. In addition to this, we further discovered that the bidirectional causality exists between the real effective exchange rate and inflation, and the same is true for inflation and the nominal effective exchange rate. Our findings do not change with the change of the lag order.

6. Conclusion, Policy Implications and Recommendations

Nigeria is a country that has been depending on oil as its key export commodity for decades and this situation has led to the neglect of many vital economic resources, thereby breeding a cancerous mono economic dependence situation in the country for decades. This situation in turn creates massive unemployment and an alarming paucity of external accruals to finance the lingering poverty of the country (all things being equal). Similarly, several economic indexes and researchers have been pointing out delusive and inconclusive growth attainment of the country which has not impacted positively on the populace. It is along the line of this development that this study reinvestigated the relationship between the nominal effective exchange rate and the real effective exchange rate. In a bid to make a unique contribution in this study, we further incorporate inflation as an additional determinant of nominal and real effective exchange rates and utilized time series data from the periods of 1971QI to 2012QVI. The main objective is to assess if there are possible competitive opportunities for the country to move progressively in international trade in terms of tradable goods with minimal hurdles, thus exploring the fitness of the Marshall-Lerner assumption (M-L) to the case of Nigeria. In doing so, we applied traditional and structural break unit root tests to the series, while the presence of cointegration between the variables was explored using the Bayer-Hanck cointegration approach. In addition to this, the direction of the causal relationship between the nominal and the real effective exchange rates is investigated by applying the VECM Granger causality test.

Interestingly, the findings of the study suggest the presence of cointegration between the variables, meaning that nominal effective exchange rate leads to the real effective exchange rate. While the most impressive and surprising discovery is that moderate inflation eats up the unfavorable impacts of nominal devaluation in the case of Nigeria. The results from the causality analysis, on the other hand, confirmed the existence of effective feedback between the real and the nominal effective exchange rates, and between the nominal effective exchange rate and inflation and between inflation and the real effective exchange rate.

Overall the findings of this study suggest that a moderate depreciation of the Nigerian local currency may, in fact, have stabilizing influence on the balance of payments through the current account, without the need for imposing high-interest rates. As a result of this, we hold the opinion that a less contractionary monetary policy by the Central Bank of Nigeria could, in fact, be combined with an appropriate exchange rate policy to achieve more effectively the objectives of devaluation in Nigeria. This would be a better option than the current high-interest rate policy being pursued by the Central Bank, which in the long run ends up in stifling economic growth. Finally, we believe that the findings of this study will help in formulating comprehensive trade policy in Nigeria including the use of efficient and effective devaluationary strategies for enhancing international trade. In our concluding remark, we argue that, in order to achieve the benefits of the Marshall-Larner assumptions in Nigeria, we propose considerable need for massive infrastructural provision (particularly electricity) in the country. This should in turn encourage manufacturers to engage in production quality; product differentiation, innovation and product specialization. Additionally, the domestic industries should be liberalized and strategized towards international competitive operation by enhancing their capacity to expand commensurate with the new demand. The proposed findings to our believe will help in reducing the J-curve effect as found in the case of Kenya by Guglielmo *et al*. (2012)

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