On the Stability of Nigeria's Import Demand: Do Endogenous Structural Breaks Matter?

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Abstract: In this paper, we reassess the traditional import demand function and an augmented version that includes volatility of external reserves and oil revenue inflows as explanatory variables. In each version, we examine the role of regime shifts on the stability of Nigeria's import demand function which has been ignored in previous studies. Our findings suggest the existence of a long-run relationship between import demand and its determinants. We also present evidence of one-way causality running from changes in relative prices, oil revenue inflows and volatility of international reserves to import demand in Nigeria. However, when structural breaks were introduced, bi-directional causality is observed; indicating the critical role of regime shifts in determining the stability of Nigeria's import demand. The results make a case for diversifying Nigeria's revenue inflows in a bid to dampen the effect of contemporaneous shocks that affect external reserve accumulation thereby weakening its import financing capacity.

Keywords: Import, Structural Breaks, Cointegration, Causality, Nigeria.

1. INTRODUCTION

The stability of import demand and its responsiveness to changing economic conditions induced by internal or external disturbances through the trade and finance channels cannot be downplayed. Such abrupt shocks often distort import demand and this has been unaccounted for in most import demand models estimated for Nigeria. This is in view of the preconceived notion that a causal link running from income and relative prices to import exists. A critical re-assessment of the stability of import demand function that accounts for regime shifts as well as the monoculture nature of the Nigerian economy is crucial for design, formulation and implementation of domestic policies. For instance, it has been argued that imports generally react more swiftly than exports to substantive trade liberalisation, resulting in short-run current account imbalances and need for temporary financing (Faini, Pritchett, and Clavijo, 1988). Therefore, precise forecasts of import flows could help policy makers effectively assess the speed of adjustment of external disequilibrium to trade and other policy changes with a view to curbing the effects of unexpected foreign exchange constraints that may jeopardise import flows and stability.

Figure **1** reveals that Nigeria's imports have over the years exhibited a boom- and bust-like pattern. Similarly, output performance reveals a similar trend except for the last decade when economic growth averaged 6% per annum. This may be partly explained by the sudden trade liberalisation that took place between 2000 and 2011 in addition to other economic reforms. Nevertheless, domestic prices trended upward during the period while dwindling oil revenue, the predominant source of financing Nigeria's import, has remained shrouded by domestic and global uncertainty particularly following the sub-prime mortgage lending crisis in the US that triggered the global economic recession in 2007/2008. Nevertheless the growth of Nigeria's imports has been attributed to the pursuit of broad based economic reforms, favourable global crude oil prices and exchange rate stability. Likewise, inadequate capacity to meet growing domestic demand may have intensified the flow of imports.

Nigeria's import has remained volatile with no clearly defined pattern as a result of the country's exposure and vulnerability to global crude oil market conditions. Nevertheless, trade surpluses have been recorded over the years (between 1970 and 2010) and this may be attributed to increased oil exports and reliance on the imports of finished and capital goods. Nigeria's import basket is primarily made up of manufactured goods (38.45%), machinery and transport equipment (31.81%) and food (10.85%) (Babatunde and Egwaikhide, 2010).

Several studies have examined import demand function by relating the quantity of imports to the country's real income and relative prices: See (Goldstein and Lawrence, 1980) for a group of developed countries; (Faini *et al.* 1988) for a set of developing countries; (Sinha, 1997) for Thailand;

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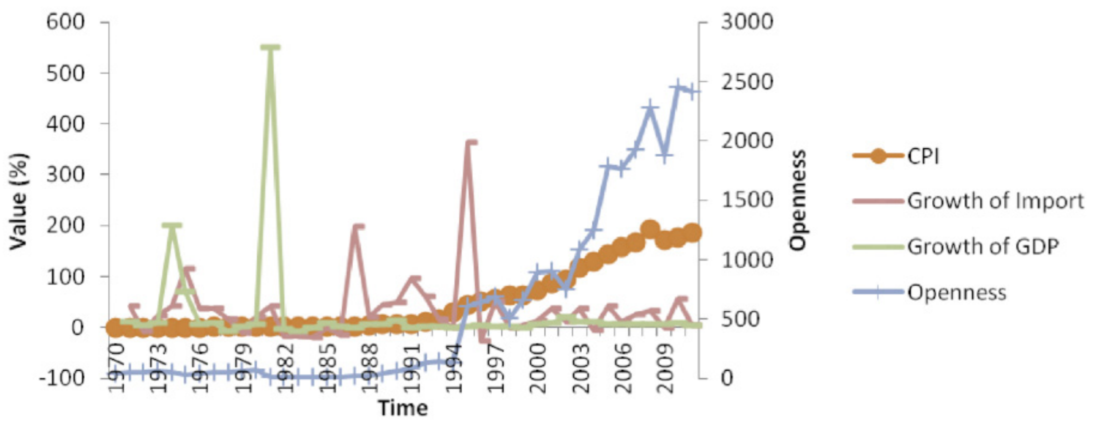

Source: Central Bank of Nigeria (CBN) Statistical Bulletin (2011)

Figure 1: Trend of imports and its determinants.

(Constant and Yue, 2010) for Cote d'Voire; (Bathalomew, 2010) for Sierra Leone; (Kotan and Saygili, 1999) for Turkey, (Tang, 2005) for South Korea. For Nigeria studies by (Olayide, 1968; Ajayi, 1975; Egwaikhide, 1999; Aliyu, 2007; Babatunde and Egwaikhide, 2010; and Omoke, 2012) amongst others are worthy of note. These studies were premised on the notion that a one-way causal relationship from income and price to import demand exists. While this preconceived argument has dominated existing literature and remained the backbone of estimated income and price elasticities, this may not hold in the face of uncertainties arising from domestic and global shocks. The stability of estimated parameters may be distorted when regime shifts are considered. A significant contribution of this study is the departure from elasticity based estimations towards a multivariate causality framework that accounts for structural breaks.

The oil dependent nature of the Nigerian economy implies that there are other determinants likely to influence the stability of imports in Nigeria such as oil revenue earnings and this may be linked to availability of foreign exchange for import financing. Volatility of foreign exchange reserves may lead to the use of import controls which in turn inhibits the volume of import due to foreign exchange constraints occasioned by a fall in oil revenue earnings. More so, Harvey and Sedegah (2011) and Sachs (1982) have shown that including a foreign exchange availability/constraint indicator is crucial in an import demand specification.

Estimating import demand equations without adequate attention to endogenously determined structured breaks in the underlying time series has dominated the existing literature. The use of binary dummies in most studies has been predicated on anecdotal evidence. This approach may not be adequate for obtaining robust estimates and drawing meaningful inferences given the potential impact structural changes may have on the stability of import demand. Therefore, unlike other cointegration techniques relied upon in previous studies, we employ the (Gregory and Hansen, 1996) tests for cointegration where the structural break is determined and the cointegrating vectors are allowed to change at an unknown time period. Although cointegration implies that causality exists between/among variables, it does not indicate the direction of causality (Binh, 2011). Thus, we rely on the Granger non-causality test using the Toda-Yamamoto (1995) procedure which is applicable regardless of whether a series is I(0), I(1) or I(2), not cointegrated or cointegrated of any order (Menyah and Wolde-Rufael 2010). This implies that it avoids the potential bias associated with other unit root and cointegration tests (see Rambaldi and Doran 1996).

It is against this background that this study seeks to re-examine the stability of Nigeria's import demand and a modified version of the model in which volatility of foreign exchange reserves and oil revenue earnings are included as explanatory variables.[1] The study departs from elasticity based estimations towards a multivariate causality framework to ascertain the nature of the relationship between the variables used in the

[1]The inclusion of these variables is not only in view of the oil-dependent nature of the Nigerian economy but has been pursued in the literature (See Egwaikhide, 1999; Harvey and Sedegah, 2011; Aziz, 2013 amongst others).

traditional and augmented import demand models. Following this introduction, a brief review of literature is highlighted in Section 2. The analytical framework and methodology is presented in Section 3. Section 4 presents and discusses the results while Section 5 concludes the paper.

2. LITERATURE REVIEW

The international trade literature suggests three major theories that predicate import demand functions and they are; the theory of comparative advantage, Keynesian trade multiplier, and new trade theory (Hong, 1999). These theories explain the role of income and prices as well as other determinants of import. The neoclassical trade theory of comparative advantage, embedded in the Heckscher–Ohlin framework, is focused on how the volume and direction of international trade is affected by changes in relative prices. This is determined by differences in factor endowments between countries engaged in trade. However, the theory explicitly ignores the income-trade linkage because employment is assumed to be fixed and output is given.

While the neo-classical import demand function is based on the assumptions of consumer behaviour and Walrasian general equilibrium theory, the Keynesian import demand function on the other hand is predicated on multiplier analysis. In the Keynesian framework, relative prices are assumed to be rigid and employment is allowed to vary. The model also assumes perfect mobility of capital which, passively adjusts to restore trade balance. The thrust of this framework is on the contemporaneous relationship between income and import demand at the aggregate level.[2]

The new trade theory on the other hand is focused on intra-industry trade and explains the effects of economies of scale, product differentiation, and monopolistic competition on international trade. Hence the new trade theory suggests a new link between trade and income given the role of income (purchasing power) in determining the volume of imports at a more disaggregated level.[3] Three dominant approaches have been used to explain the effect of imperfect by competitive market on international trade: Marshallian, Chamberlainian, and Cournot approaches. The Marshallian approach assumes constant returns to scale at the firms level but increasing returns at the industry level while the Chamberlainian approach assumes that an industry consists of many monopolistic firms and new firm enter the market with differentiated products in order to eliminate industry-level monopoly profit. The Cournot approach postulates a market structure with few imperfectly competitive firms who take each others' output as given.

Various empirical outcomes have been obtained from different methods used to estimate import demand functions for different countries. For instance, Johansen-Juselius (J-J) cointegration tests was relied upon by Abbott and Seddighi (1996) for UK, and they concluded that there is a long-run relationship between the variables in the import demand function and consumption expenditure had the most pronounced impact. Similarly, Ho (2004) observed that a cointegrating relationship exist in the disaggregated model while no long-run linkage was found in the aggregate model of Macao's import demand function. The author opined that the disaggregated model is more appropriate in explaining the import demand of Macao.

Mohammed and Tang (2000) revealed that the disaggregated components of real activity had an inelastic effect on Malaysia's import demand in the long-run with investment and consumption expenditures recording the highest effect with 0.78 and 0.72, respectively while Dutta and Ahmed (2001) found that aggregate import volume in India is price-inelastic with an elasticity of -0.47. Min, Mohammed and Tang (2002) showed that the impact of investment expenditure is statistically insignificant and negatively related to import demand in South Korea while relative price had a negative impact on import demand at 1% significance level. Using cointegration and error correction modelling approach, Omoke (2012) observed that consumption expenditure, exports and investment had a positive relationship with import implying that an increase in expenditure led to a significant import expansion.

The ARDL bounds test approach has also been used to investigate the determinants of import demand. For example, Tang and Nair (2002) evaluated the stability of the Malaysia's import demand and found long-run income and relative price elasticities of 1.5% and -1.3%, respectively. Similarly, Tang (2003) estimated China's import demand for the period between 1970 and 1999 and concluded that relative

[2]The relationship can be defined by a few ratios such as the average and marginal propensity to import and the income elasticity of imports.
[3]Bathalomew (2010) and Babatunde and Egwaikhide (2010) provide an excellent theoretical review of literature on import demand functions.

price had a negative effect on the demand for imports. Narayan and Narayan (2005) also applied the same approach to examine the long-run disaggregated import demand model for Fiji. Their results revealed the existence of a long-run cointegrating relationship among the variables with import demand elasticities of 0.69 for both export and consumption expenditures and 0.38 for relative price.

Chang, Ho and Huang (2005) examined the relationship between demand for imports and it's determinants for South Korea for the period 1980-2000 and found that the volume of imports, income, and relative prices are cointegrated and carried the expected signs. Constant and Yue (2010) examined a disaggregated import demand model for Cote d'Ivoire using annual data for the period 1970-2007 and found the existence of a long-run relationship between the variables. The study also showed that there was an inelastic import demand for all the expenditure components and relative price. They concluded that investment and exports were the main determinants of import in Cote d'Ivoire in the long-run while expenditure components were the most significant in the parsimonious model.

Arize (1987) examined Nigeria's import demand function from 1960 to 1977 using two-stage least square approach and finds high income elasticity, as expected in an oil exporting country like Nigeria. Structural stability test (Brown-Durbin-Evans and Chow test) of the estimated function identified 1971 as a significant break point which, coincided with the import substitution policy implemented at the time. Egwaikhide (1999) assessed the determinants of aggregate imports in Nigeria between 1953 and 1989 using Engle-Granger two-step procedure. Although he did not account for structural breaks endogenously, the empirical results revealed that the variables considered were cointegrated and the estimated coefficients suggest foreign exchange earnings, relative prices and real income significantly explain the behaviour of import demand in Nigeria. Likewise, Arize (1987) considered the role of structured breaks in Nigeria's import demand function but excludes foreign exchange earnings as an explanatory variable in the model. Gumede (2000) in an aggregated and disaggregated analysis of import demand in South Africa using the Engle–Granger two step procedure, showed that the coefficient of income elasticity was significant and relatively larger compared to the coefficients of price in both models.

Evidently, the existing literature on import demand suggests that relative price and domestic income are significant determinants of import for both developed and developing economies. However other significant determinants particularly within the context of a resource dependent economy like Nigeria, such as international reserves and oil revenue inflows have not received adequate attention. Aziz (2013) augments the import demand model of Bangladesh with the latter based on the fact that sufficient foreign exchange earnings may be a significant determinant of import demand. This is because exporters to low- and middle-income countries are assured of payment if countries have adequate stock of external reserves. Other studies such as Arize and Osang (2007) and Emran and Shilpi (2001) have emphasized the need to include foreign exchange reserve as a determinant of import demand and this further justifies our inclusion of external reserves in the augmented import demand model adopted. This is further buttressed by Egwaikhide (1999) who forcefully argued that international reserves are held not only to pay for imports but finance the difference between payments and receipts.

Egwaikhide's (1999) finding of oil export earning as a significant determinant of import demand in Nigeria lends support to our inclusion of oil revenue inflows as an additional independent variable. Furthermore, Nigeria's imports are primarily financed with foreign exchange earnings and distorting its flow is likely to affect the country's import demand. As regards the methodological literature, only Arize (1987) and Egwaikhide (1999) for Nigeria accounted for structural breaks, exogenously, while more recent endogenous breakpoint identification techniques have been employed by Aziz (2013) for Bangladesh. Our study departs from the aforementioned in that we identify the break dates endogenously as against the use of anecdotal evidence and move a step further to account for the identified structural break point in a multivariate causality framework.

The use of real GDP, real GNP or industrial production index in import demand models has generated extensive discussion and debate in the literature. Xu (2002) noted the drawbacks of using GDP or GDP minus exports as a proxy for domestic real activity and advocates the use of a 'national cash flow' variable computed as GDP-I-G-EX (where I is investment, G is government spending, and EX is exports). Senhadji (1998) also makes a case for the use of GDP minus exports as a more appropriate measure of real activity. Harb (2005) carried out a comparative analysis on aggregate import demand function for 40 countries considering real GDP, expenditure and GDP minus exports. The study concluded that real GDP was the most appropriate measure. This further lends support to our use of real GDP.

Other relevant indicators used to augment the import demand specification in the literature include, among other things, the following proxies for foreign exchange constraints: Import duties, debt, export receipts; international reserves; and parallel market premia (Sachs, 1982). Hemphill (1974) argued that import demand functions are related to foreign exchange constraints. This makes international reserves and foreign exchange receipts potential drivers of import demand particularly in a resource dependent economy like Nigeria. This also accounts for the possibility that demand for foreign exchange may exceed supply at the prevailing exchange rate due to inadequate stock of foreign exchange reserves (*ibid.*). For instance, if export earnings fall and/or capital inflows are reduced, government may tighten import restrictions in the short-run and may conversely ease restrictions if capital inflows and/or exports were to rise (Harvey and Sedegah, 2011).

3. ANALYTICAL FRAMEWORK AND METHODOLOGY

3.1. Model Specification

This paper adopts and adapts the standard import demand specification following Bowen, Hollander and Viaene (1998) and Egwaikhide (1999) as the basis for our model specification. The authors provide a lucid theoretical exposition where they assume, in line with the consumer theory of demand, that real income is a positive function of import demand while relative price is an inverse function of import demand. The model is specified as follows:

$$M_t^d = \beta_0 + \beta_1 Y_t + \beta_2 RP_t + e_t \quad (1)$$

Where M_t^d represents import demand, Y_t represents real income and RP_t denotes relative price while e_t is the error term assumed to be normally distributed with zero mean and constant variance. Apriori, we expect β_1>0 and β_2<0. While an examination of the stability of the estimated demand function (equation 1) is the focus of our study, an additional contribution of the paper is the extension of Equation 1 in the spirit of Faini *et al*. (1988), Babatunde and Egwaikhide (2010) and Aziz (2013) by including a foreign exchange availability indicator (external reserve holding) and oil revenue earning as additional independent variables:

$$M_t^d = \beta_0 + \beta_1 Y_t + \beta_2 RP_t + \beta_3 VIR_t + \beta_4 OR_t + e_t \quad (2)$$

In equation 2, VIR represents variability of international reserves and OR denotes oil revenue inflows. For a resource dependent economy like Nigeria, where oil accounts for over 90% of its foreign exchange earnings and foreign exchange reserve accumulation, the inclusion of this variables are crucial determinants of the country's import demand. Furthermore, the fact that imports is financed by foreign exchange, *a priori*, we expect VIR and OR to be positive functions of import demand. This specification is rooted in the argument that international reserves are held to finance the gap between imports and receipts (See Aziz, 2013). In other words, external reserves are accumulated to intervene in the foreign exchange market as well as guarantee a country's ability to finance its imports (See Egwaikhide, 1999 and Emran and Shilpi, 1996).

3.2. Estimation Techniques

Zivot-Andrew (Z-A) Unit Root Test[4]

Several studies have found that conventional unit root tests fail to reject the unit root hypothesis for time series that are actually trend stationary with a structural break (Binh, 2011).[5] Therefore, the unit root test developed by Zivot and Andrew (1992) will be utilised for this study. The authors basically modified the Perron unit root tests that consider a breakpoint as endogenously determined. Thus, to test for unit root against the alternative of trend stationarity process with a structural break both in slope and intercept, the following regressions are applied:

$$Y_t = \mu + \phi_2 DU_t(\tau_b) + \beta T + \alpha Y_{t-1} + \sum_{i=1}^{p} \varphi_i \Delta Y_{t-i} + e_t \quad (2)$$

[4]For comparison, the Philip-Perron (P-P) test is conducted and the result is presented in the appendix A.

[5]For example, the (Dickey and Fuller, 1979) type test for unit root is not consistent if the alternative is that of a stationary noise component with a break in the slope of the deterministic trend while the Perron (1989) test has been generally criticised for treating the time of break as exogenous or the time of break is known *a priori* (Altinay and Karagol, 2004).

$$Y_t = \mu + \lambda DT_t(\tau_b) + \beta T + \alpha Y_{t-1} + \sum_{i=1}^{p} \varphi_i \Delta Y_{t-i} + e_t \qquad (3)$$

$$Y_t = \mu + \phi DU_t(\tau_b) + \beta T + \lambda DT_t(\tau_b) + \alpha Y_{t-1} + \sum_{i=1}^{p} \varphi_i \Delta Y_{t-i} + e_t \qquad (4)$$

Where DU*t* and DT*t* are dummy variables for a mean shift and a trend shift respectively; DU*t*(τb) = 1 if t > τ_b and 0 otherwise, and DT*t*(τ_b) = t- τ_b if t >τb and 0 otherwise. In other words, DU*t* is a dummy variable that captures a shift in the intercept, and DT*t* represents a shift in the trend occurring at time τ_b.[6]

Gregory-Hansen (G-H) Cointegration Test[7]

We employ the Gregory and Hansen (1996) tests for cointegration where the structural break is endogenously determined and the cointegrating vectors are allowed to change at an unknown time period. This is because ignoring structural breaks can produce misleading results leading to incorrect inference.[8] The test equations are:

$$y_{1t} = \mu_1 + \mu_2 \varphi_{t\tau} + \alpha^T y_{2t} + e_t \qquad (5)$$

$$y_{1t} = \mu_1 + \mu_2 \varphi_{t\tau} + \beta t + \alpha^T y_{2t} + e_t \qquad (6)$$

$$y_{1t} = \mu_1 + \mu_2 \varphi_{t\tau} + \alpha^T y_{2t} + \alpha^T y_{2t} \varphi_{t\tau} + e_t \qquad (7)$$

Where y is the observed data while μ_1 and μ_2 represent the intercept before the shift and change in the intercept at the time of the shift; φ is a dummy variable that captures structural change;[9] *β* is the trend slope before the shift; *α* is the slope coefficients and are assumed to be constant. Y_{1t} represents the regressand while Y_{2t} denotes the independent variable(s). Equation 5 is the level shift model while the level shift and trend as well as the regime shift models are represented by Equations 6 and 7. The standard methods to test the null hypothesis of no cointegration are residual-based and are obtained when Equations 5, 6 and 7 are estimated using ordinary least square and ADF unit root test is applied to the regression residual (Gregory and Hansen, 1996).

Toda-Yamamoto (T-Y) Granger Causality Test

This study modifies the T-Y Granger non-causality technique by accounting for the break dates obtained from the G-H cointegration test.[10] The T-Y approach fits a standard VAR model with the variables at level and accounts for the long-run information often ignored in systems that require first differencing and pre-whitening (Clarke and Mirza, 2006). The approach employs a modified Wald test for restrictions on the parameters of the VAR with lag length k. The basic principle of the T-Y approach is to augment the correct order, k, by the maximal order of integration, say dmax. Subsequently, a (k+dmax)[th] order VAR is estimated and the coefficients of the last lagged dmax vectors are ignored (Caporale and Pittis, 1999).

To undertake this test, we considered the following equation:

$$\left[\ln \Psi_t\right] = A_0 + A_1\left[\Psi_{t-1}\right] + A_2\left[\Psi_{t-2}\right] + A_3\left[\Psi_{t-3}\right] + A_4\left[\Psi_{t-4}\right] + A_5\left[\Psi_{t-5}\right] + \varepsilon_{\ln \Psi_t} \qquad (8)$$

In Eq. (8), $A_1 \ldots A_5$ are five n×n matrices of coefficients with A_0 being the n×1 identity matrix while the ε_s are the error terms assumed to satisfy the white noise condition. From Eq. (8) we can test the hypothesis that relative price, income, volatility of international reserves and oil revenue earnings do not Granger cause import demand, with the following hypothesis: $H_0 = a_{14}^1 = a_{14}^2 = a_{14}^3 = a_{14}^4 = a_{14}^5 = 0$ and an opposite of non-causality from import demand to relative price, income, volatility of international reserves and oil revenue earnings with the following hypothesis: $H_0 = a_{41}^1 = a_{41}^2 = a_{41}^3 = a_{41}^4 = a_{41}^5 = 0$.

Data Issues

Annual data covering the period 1970–2011 is utilised for this study and the variables of interest are

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[6]The breakpoint τ_b is obtained using the Quandt-Andrews breakpoint test while the optimal lag length *p* is determined by using the general to specific approach in order to obtain the minimum AIC or SIC. The (Zivot and Andrews 1992) unit root test suggests that we reject the null hypothesis of a unit root if computed *t* is less than the left-tail critical *t* value.

[7]The Engle and Granger cointegration test is also used for comparative purpose and can be found in appendix A

[8]Cointegration frameworks such as Engle and Granger and Johansen have limitations especially when dealing with time series data characterised by structural breaks (Esso, 2010). Thus, we tend to reject the hypothesis of cointegration, albeit one with stable cointegrating parameters because the residuals from cointegrating regressions capture unaccounted breaks and typically exhibit non-stationary behaviour (*ibid.*).

[9] $\varphi_t = \begin{bmatrix} 0 \; if \; t \le (n\tau) \\ 1 \; if \; t > (n\tau) \end{bmatrix}$ where the unknown parameter $\tau \in (0,1)$ implies the timing of the break point, and ($n\tau$) denotes integer part.

[10]As pointed out by Clarke and Mirza (2006) unit root and cointegration might suffer from sample size variations, which often imply the use of inaccurate models for the non-causality test. To obviate this problem, based on augmented VAR modelling, T-Y introduced a Wald test statistic that asymptotically has a chi square (χ2) distribution irrespective of the order of integration or cointegration property of the variables.

import demand (MD), income is measured by GDP (Y), relative price (RP) is the ratio of foreign and domestic price, volatility of international reserves (IR) and oil revenue inflows (OR). Data was sourced online from the World Bank World Development Indicators (WDI) and the Central Bank of Nigeria (CBN) statistical bulletin.

4. PRESENTATION AND DISCUSSION OF RESULTS

4.1. Unit Root Test Results

The null hypothesis of the Zivot-Andrew unit root test is that α = 1, i.e. the series has a unit root with structural break in constant, trend or constant and trend stationary process. Table **1** presents sufficient evidence for rejecting the alternate hypothesis as the null hypothesis could not be rejected based on the critical values provided by Zivot and Andrews. Augmented Dickey Fuller (ADF) and Philips-Perron (PP) unit root tests are also carried out and presented in the Appendix to aid comparison with the Z-A test results (See Appendix). The PP and ADF unit root test results showed in the appendix reveal that all the variables are non-stationary at levels but became stationary after their first difference is taken. This result may in fact be misleading as structural breaks were not taken into consideration.

4.2. Cointegration Test Results

For the long-run analysis, we considered the level shift, level shift with trend and regime shift models. The test is carried out with a maximum of 8 lags and the Schwarz Information Criteria (SIC) is used to determine the optimal lag length, The G-H cointegration test result is presented in Tables **2a** and **2b**. The Engle and Granger cointegration test conducted and presented in the appendix also validates the Gregory-Hansen cointegration test result which shows the existence of a long-run relationship amongst the variables (See Appendix A3).

The result of the G-H cointegration test presented in Tables **2a** and **2b** reveal the existence of a long-run relationship between import demand and the variables considered in both specifications. The implication of this finding is that the identified structural breaks are not sturdy enough to cause any divergence from the long-run equilibrium relationship obtained. Nevertheless, there is no indication regarding the direction of causality. We therefore proceed to conduct the Toda-Yamamoto MWALD-based causality test.

4.3. Granger Non-Causality Test Results

The Toda-Yamamoto causality test result is shown in Tables **3a** and **3b**. Table **3a** shows that there is a causal link running from relative price to import demand in Nigeria and vice versa in the absence of structured breaks. Similarly, Table **3b** revealed that when a structural break was introduced, we still fail to reject the null hypothesis of no causality from relative price (RP) to import demand (MD) in Nigeria. This implies that our findings give credence to elasticity-based estimations carried out for Nigeria by amongst others, Egwaikhide (1999) and Babatunde and Egwaikhide (2010) for Nigeria, Harvey and Sedegah (2011) for Ghana and Aziz (2013) for Bangladesh. It is pertinent to note that the estimated income and price elasticities presented in these studies conformed to theoretical expectations and the parameters of the model were found to be stable.

In Table **3b**, we present the traditional import demand model in which a structural break was included using a binary dummy. Unlike the version without breaks, a unidirectional causality running from relative

Table 1: Zivot-Andrews Unit Root Test Results

Variable	Z-A (1992)								
	Model A			Model B			Model C		
	t	Breakpoint	Lag	t	Breakpoint	Lag	t	Breakpoint	Lag
MD	-3.33	1991	0	-2.36	1985	0	-3.25	1980Q2	0
Y	-4.60	1981	0	-4.88	1983	0	-7.07	1981	0
RP	-0.86	1982	2	-3.37	1992	2	-2.94	1990	2
VIR	-3.58	1981	0	-3.34	1983	0	-3.88	1986	0
OR	-3.30	1989	0	-2.83	1983	0	-3.59	1988	0

Note: The break locations i.e. intercept, trend and both, are denoted by Models A, B and C. All the variables were significant at the 1% based on percentage points of the asymptotic distribution critical values as provided by Zivot and Andrew (1992) Table **2** page 30.
Source: Computed by the Authors using Eviews 7.

Table 2a: Gregory-Hansen Cointegration Test Results (Equation 1: $M_d = f(Y, RP)$)

	Level Shift Model	Level Shift with Trend Model	Regime Shift Model
ADF Procedure			
t-stat	-4.78	-4.20	-3.69
Lag	3	0	0
Break	1990	1983	1993
Phillips Procedure			
Za-stat	-21.73	-25.74	-21.28
Za-break	1989	1983	1993
Zt-stat	-3.78	-4.26	-3.77
Zt-break	1989	1983	1993

Source: Computed by the Authors using Eviews 7.

Table 2b: Gregory-Hansen Cointegration Test Results (Equation 2: $M_d = f(Y, RP, VIR, R)$)

	Level Shift Model	Level Shift with Trend Model	Regime Shift Model
ADF Procedure			
t-stat	-4.61	-5.77	-5.82
Lag	0	8	8
Break	2002	1986	1999
Phillips Procedure			
Za-stat	-28.95	-27.07	-35.10
Za-break	2002	1982	1983
Zt-stat	-4.67	-4.45	-5.41
Zt-break	2002	1982	1983

Source: Computed by the Authors using Eviews 7.

price to import demand was observed. This suggests that regime shifts may have dampened the responsiveness of import demand to relative price changes.

In view of Nigeria's over-reliance and vulnerability to the global crude oil market conditions, we re-assess the import demand model by including foreign exchange reserves and oil revenue earnings as additional independent variables. Two scenarios are considered- case 1 includes structural breaks while case 2 does not. In other words, the augmented version of the model is presented in Tables **4a** (no break) and **4b** (break inclusive). Table **4a** revealed the existence of a bi-causal relationship running from relative price, variability of external reserves and oil revenue inflows to Nigeria's import demand. Real income has no causal link to import demand and this suggests that domestic output expansion does not necessarily induce an increase in per capita expenditure on imported goods due to the availability relatively cheaper domestic substitutes.

Table 3a: Augmented Granger Causality Test Results without Structural Breaks (Equation 1: MD = f (Y, RP))

Null Hypothesis	MWALD (Prob.)
Y causes MD	3.34 (0.64)
RP causes MD	41.34 (0.00)
MD causes Y	1.35 (0.93)
MD causes RP	19.66 (0.00)

Note: Sample (1970-2011), 40 observations were included.
Source: Computed using Eviews 7.

Table 3b: Augmented Granger Causality Test Results with Structural Breaks (Equation 1: M_d = f (Y, RP, DUM_t))

Null Hypothesis	MWALD (Prob.)
Y causes MD	0.48 (0.49)
RP causes MD	2.74 (0.04)
MD causes Y	0.37 (0.54)
MD causes RP	0.57 (0.46)

Note: Sample (1970-2011), 40 observations were included.
Source: Computed using Eviews 7.

In Table **4b** we observe a similar finding but in this case, bidirectional causality running from variability of external reserves and oil revenue inflows is recorded. This suggests that a positive global crude oil price shock may amongst other factors affect oil revenue inflows and foreign exchange reserve accumulation in Nigeria. Moreover, the rule of thumb that countries should have adequate stock of reserves that can finance at least three months of import further highlights the crucial role of foreign exchange constraints to the stability of Nigeria's import demand. Instructively, a uni-causal linkage running from real income to import demand is recorded. This implies that a positive external shock that induces aggregate output expansion and increased per capita income will spur demand for imported commodities. Notably, the role of real income and relative price are neutral in the case where structural breaks were considered in the augmented version of the model.

Table 4a: Augmented Granger Causality Test Results without Structural Breaks (Equation 2: MD = f (Y, RP, IR, OR))

Null Hypothesis	MWALD (Prob.)
Y causes MD	4.93 (0.55)
RP causes MD	140.18 (0.00)
OR causes MD	42.37 (0.00)
VIR causes MD	28.50 (0.00)
MD causes Y	4.79 (0.57)
MD causes RP	19.60 (0.00)
MD causes OR	120.91 (0.00)
MD causes VIR	6.93 (0.03)

Note: Sample (1970-2011), 40 observations were included.
Source: Computed using Eviews 7.

Table 4b: Augmented Granger Causality Test Results With Structural Breaks (Equation 2: M_d = f (Y, RP, VIR, R, DUM_t))

Null Hypothesis	MWALD (Prob.)
Y causes MD	5.98 (0.01)
RP causes MD	2.09 (0.15)
OR causes MD	78.71 (0.00)
VIR causes MD	49.59 (0.00)
MD causes Y	0.05 (0.83)
MD causes RP	2.25 (0.13)
MD causes OR	10.50 (0.00)
MD causes VIR	10.54 (0.00)

Note: Sample (1970-2011), 40 observations were included.
Source: Computed using Eviews 7.

It is pertinent to note that the stability of import demand is based on the ability of the system to return to its original equilibrium after a shock (For example, a sudden price change or revenue shortfall). Therefore, an examination of the residuals based on the LM test for serial correlation that signifies the absence of autocorrelation in Equations 1 and 2 is imperative. The estimated T-Y model is dynamically stable as indicated by the inverse root of the AR characteristic polynomial as the roots lie within bounds of the unit circle. Thus the augmented Granger non-causality test for Equations 1 and 2 satisfy the stationarity condition.

5. CONCLUSION AND POLICY IMPLICATIONS

This study re-examined Nigeria's import demand with a view to establish its stability with and without structural breaks. The following tests were employed: (i) Zivot-Andrews unit root test which, accounts for structural break and its robustness was reaffirmed by the ADF and PP unit root tests; (ii) Gregory-Hansen cointegration test was also reinforced by Engle and Granger two-step cointegration procedure and; (iii) Toda-Yamamoto MWALD-based causality test. The results revealed the existence of a long-run relationship between import demand and the variables considered in the traditional and augmented versions of our import demand model. The result of the Toda-Yamamoto causality test showed there is no causality running from changes in income to import demand in Nigeria while a bi-directional causality was observed between import demand and relative price. However, introduction of a structural break in the traditional import demand model revealed a one-way causal link running from relative price to import demand. Findings from the augmented version of the model without structural breaks show that we cannot reject the null hypothesis of no bi-causality from relative price, volatility of reserves and

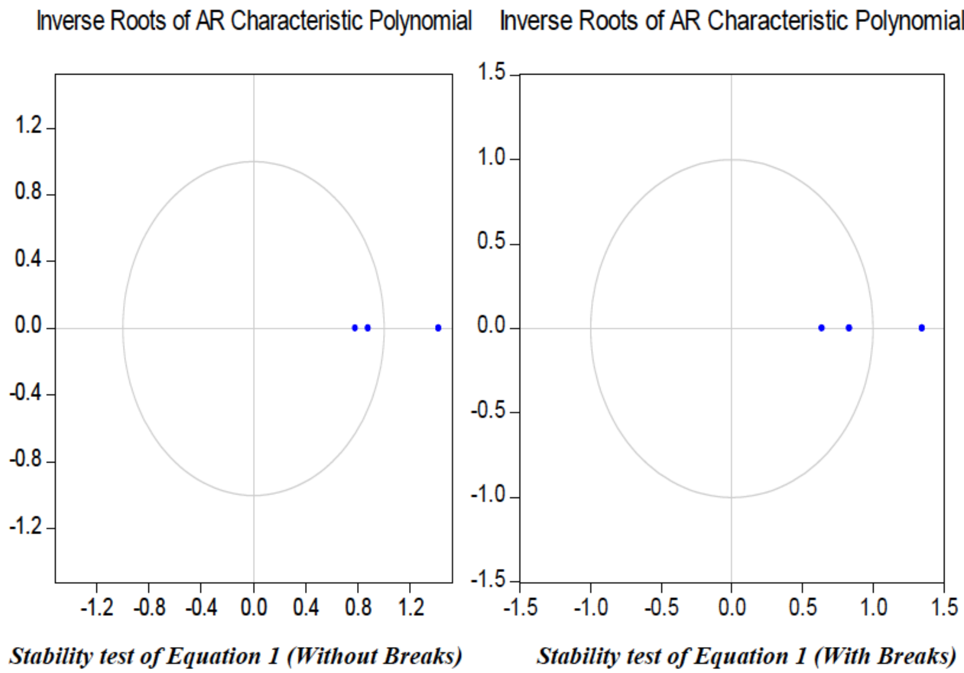

Figure 2: Stability Test for the Traditional Import Demand Model (Equation 1).

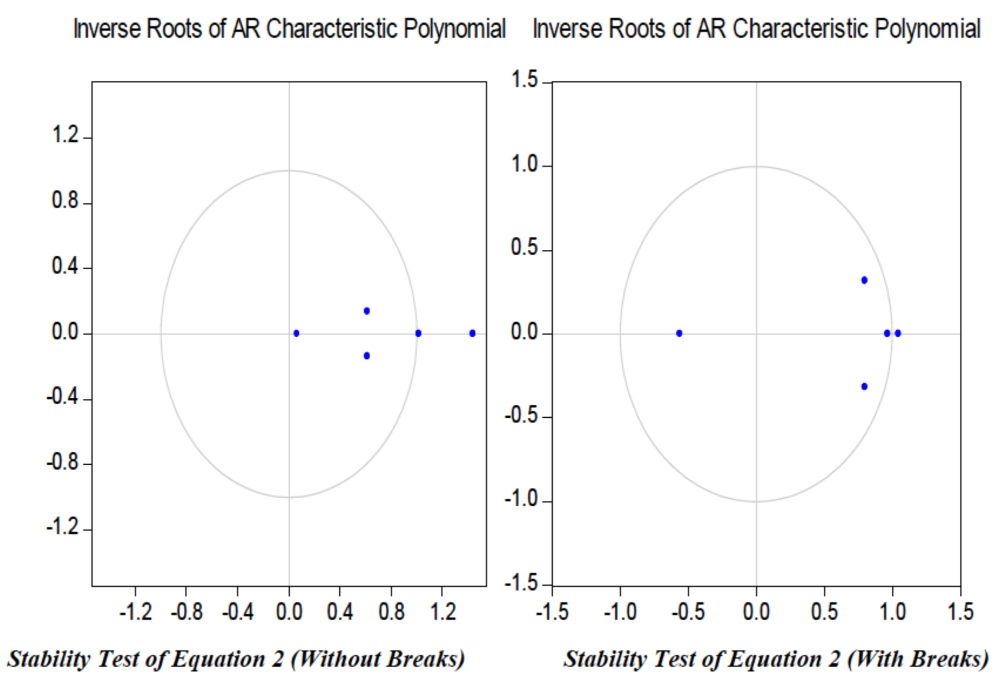

Figure 3: Stability Test for the Augmented Import Demand Model (Equation 2).

oil revenue inflow to import demand. The inclusion of a structural break in the augmented version however revealed the existence of bi-directional causality running from import demand, volatility of international reserves and oil revenue earnings while a unidirectional linkage running from income to import demand is recorded. The inverse roots of AR characteristic polynomial reveal the stability of our models. Our findings underscore the need to account for structural breaks in Nigeria's import demand function given the need to understand how imports react to changing domestic and global economic conditions. Instructively, policy makers may consider gearing efforts towards minimising volatility of external reserves and oil revenue inflows in a bid to absorb the effects of abrupt shocks that may distort the stability of import demand.

APPENDIX

A1: Unit Root Test Result (At level)

		ADF		PP
CPI		2.67*(1.00)*		6.33*(1.00)*
LNVIR		-0.88*(0.78)*		-0.86*(0.79)*
LNMD		-0.48*(0.89)*		-0.48*(0.89)*
LNRP		-1.32*(0.61)*		-1.38*(0.58)*
LNY		-2.37*(0.16)*		-5.54*(0.00)*

Source: Authors' Computation using Eviews 7.
Note: ADF and PP represents Augmented Dickey-Fuller Test and Phillips-Perron Test respectively. P values are in italics and brackets.

A2: Unit Root Test Result (At first Difference)

		ADF		PP
CPI		-5.10*(0.00)*		-3.30*(0.08)*
LNIR		-6.19*(0.00)*		-6.26*(0.00)*
LNMD		-7.25*(0.00)*		-7.20*(0.00)*
LNR		-7.12*(0.00)*		-7.14*(0.00)*
LNY		-6.21*(0.00)*		-6.85*(0.00)*

Source: Authors' Computation.
Note: ADF and PP represents Augmented Dickey-Fuller Test and Phillips-Perron Tests respectively. P values are in italics and brackets.

A3: Engle-Granger Co-integration Results

Coefficient	P-Value	Order of Integration	Decision
-3.74	0.03	I(0)	Cointegrated

Source: Authors' Computation using Eviews 7.

A4: Gregory-Hansen Cointegrating Equation (Equation 1: M_d=f(Y, RP))

	Level Shift Model		Level Shift with Trend Model		Regime Shift Model	
Variables	**Coefficient**	**Prob**	**Coefficient**	**Prob**	**Coefficient**	**Prob**
C	-0.136	0.905	9.023	0.000	0.296	0.780
@TREND			0.255	0.000		
@TREND>36-2					-27.036	0.830
CPI	5.344	0.000	0.755	0.334	5.873	0.000
LNY	0.832	0.000	-0.256	0.152	0.786	0.000
@TREND>36-2	-2.152	0.001	-0.827	0.062		
(@TREND>36-2)*CPI					-5.909	0.388
(@TREND>36-2)*LNY					2.356	0.813
R-squared	0.94		0.97		0.30	
Prob(F-statistic)	0.00		0.00		0.26	

A5: Gregory-Hansen Cointegrating Equations (Equation 2: M_d=f(Y, RP, VIR, R))

	Level Shift Model		Level Shift with Trend Model		Regime Shift Model	
Variables	**Coefficient**	**Prob**	**Coefficient**	**Prob**	**Coefficient**	**Prob**
C	0.074	0.916	3.096	0.161	0.066	0.930
@TREND			0.087	0.150		
@TREND>36-2	-0.986	0.011	-0.823	0.036	-54.000	0.754
CPI	2.122	0.000	1.408	0.051	2.128	0.004
LNIR	-0.063	0.502	-0.081	0.388	-0.075	0.457
LNR	0.781	0.000	0.618	0.001	0.797	0.000
LNY	0.200	0.048	-0.012	0.944	0.195	0.086
(@TREND>36-2)*CPI					-3.630	0.740
(@TREND>36-2)*LNIR					-0.324	0.895
(@TREND>36-2)*LNR					-0.558	0.570
(@TREND>36-2)*LNY					5.293	0.752
R-squared	0.98		0.98		0.98	
Prob(F-statistic)	0.00		0.00		0.00	

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