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# Econometric Revalidation of Nigeria's Import Demand Behaviour: A Koyck's Dynamic Analysis and the Policy Response

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**Abstract**

This paper estimates import demand functions for Nigeria using yearly data for 2000 to 2017 on basis of dynamics of distributed lag model in line with first-order Koyck lag transformation. GLS estimator was utilized in two ways: Estimation without any restriction imposed on lag coefficients and estimation by restricting Koyck lag weights to satisfy erstwhile assumption of smoothness. Our chosen restriction was such that lag coefficients exponentially decline from initial impact to zero at a lag length of $s$. For estimation without restrictions, probability values of Wald statistic were insignificant. As regards estimation with restrictions, our restrictions on lag coefficients were significant and as such our analysis of results was focussed on estimations with coefficient restrictions. The empirics upholds structural import equation as most well-behaved import function for predicting variation in Nigeria's demand for importation with a mean lag of 1.088 years, median lag of 1.063 years and variance of lag distribution of about 2.271 years. In light of its low variance, it shows that impact of foreign reserves holding and import tariff reduction is spread over 2 years. Thus, consequent upon changes in foreign reserves holding and tariff reduction policy, 52.1 % changes in Nigeria's demand for importation is completed in one year, implying somewhat rapid adjustment. Overall, our empirics denotes that Nigeria's import demand behaviour are significantly responsive to foreign reserves holding, tariff reduction policy and final consumption expenditure. Nevertheless, lag distributions exhibit a sequence of lag coefficients that bounce around positive and negative numerals and so outlying (outliers) in a way not in conformity to economic theory. Hence, the lag distributions are unstable and so diverge as lag length escalates in the long-run. Consequently, with all estimated import functions, the policy response is oscillatory. This implies that response of import demand to government policy on importation is dynamically inconsistent. Such oscillation could be propelled by sensitivity of Nigeria's demand for importation to fluctuating economic circumstances prompted by recent recessionary sequence and its associated economic disorder via reality of Nigerian business cycle given oil price shocks and its socio-economic vulnerability effect on the nation. So, while Nigerian government prudently implement expenditure-reducing policies, there is need to sustain a balance between protection of import substituting industries for the drive to enhancing indigenous production and maintaining a positive payment balance by adequate international reserves through ample acquisition of official remittances to strengthen the country's import funding when the demand to import for national development becomes vital.

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**Keywords:** import demand, Koyck transformation, distributed lag, final consumption, Nigeria.

## 1. Introduction

Nigeria has sought to improve its local production and develop its industry but severe economic policy distortions in economic system persistently impairs progress. Notwithstanding recent reforms, structural changes required to develop a more vivacious local production industry have not emerged, and oil sector still governs national economic activity [37].

The outcome of diminishing oil prices on net oil importers has been to cut taxes and hence lowers costs for consumers and businesses while for net oil exporters such as Nigeria which became leading economy in Africa with GDP of 502 billion US dollars in 2013 [38], foreign investors have had course to flee domestic financial markets and imposes momentous sinking pressure on managed currencies. Hence, Nigeria's import trade has not balance export revenue. This of course contributed to imbalance of payment and external sector had to suffer structural trade deficits in recent time. For example, Nigeria witnessed a 43.1 % decline in import trade value from 2011 to 2012.

The government, identifying this adverse circumstance, embarked on import replacement policy as a source to overcome payment imbalance in Nigeria. The leading challenges to industries in Nigeria comprise protectionist policies and lack of satisfactory chattels rights protection [25]. Regardless of attempts to protect Nigeria's industries by imposing bans on imports to hurt certain consumption and businesses, overall progress in diversifying local production is only negligible.

In line with this background, we seeks to ascertain econometrically the most well-behaved import model for Nigeria by calculating mean lag, median lag, variance of lag distribution and the fraction of adjustment in Nigeria's demand for importation based on Koyck's estimates. For example, contemporary studies conducted for Nigerian namely, Aliyu (2007), Babatunde and Egwaikhide (2010), Omoke (2012) and Ogbonna (2016) only concentrated on estimating elasticity of import demand in relation to its determinants [2; 6; 26; 27].

The paper is further planned into section two which provides synopsis of trends in Nigeria's import, section three which reviews relevant previous literature, section four that specifies import functions, confers data sources, section five which analyzes the econometric results and last section which provides conclusion and policy stance.

## 2. Discussion

Nigeria's import trend analysis

Before SAP, import management of Nigeria's government was controlled mutually by measureable restrictions on import and protectionism of baby industries. According to Ogbona (2016), there exists inconsistency in issuance of import permits, import bills and import tariff in Nigeria and this branded tariff structure by high-priced tariff on final goods while simultaneously lowering tariff on intermediate and manufacturing inputs became hitch block for sustained growth of an efficient industrial strategy in Nigeria [26].

The institution of SAP in 1986 with a policy thrust of ban on food importation, caused some protections that favour importation of specific items [6]. The aftermath of such policy thrust was high production cost and hence failure in withstanding increasing demand. This in turn generated gap in demand besides supply and instantaneously activated illegitimate importation. Nevertheless, in spirit of WTO agreement on trade liberalization, importation bans were lifted.

Nigeria imports are mainly industrial supplies of about 27 % of total imports, capital goods of about 23 %, food and drinks of 17 %, petrol and lubricants of about 14 %, transport equipment and spare parts of about 12 % and consumer goods imports stood at 7 %. Overall, 43 % of imports arrives from Asia; 34 % arrives from Europe; 15% arrives from America and 7 % arrive from Africa (NBS, 2017). According to NBS (2012), in 2004, China supplied 9.4 % of total imports, United States supplied 8.4 %, United Kingdom supplied 7.8 %, Netherlands supplied 5.9 %, France supplied 5.4 %, Germany supplied 4.8 % and Italy supplied 4 %. Principal items imported were manufactured goods, machineries, transport equipment, food products with consumer goods.

In September 2017, Nigeria's import dropped by 13.9 % year-on-year to NGN 697.2 billion as purchases fell for manufactured goods by – 4 %; other crude oil products fell by -37% and also raw material declined by 10 % (CBN, 2017). The essential imports partners were China with 22.3 % imports, US with 8 %, Netherlands with 7.6 %, India with 5 % and the UK with 4.1 % (NBS, 2017).

By 2017, aggregate exports rose by 53.9 % while aggregate imports declined by 4.5 %, shifting the country's trade balance to NGN 1225 billion from NGN 135.9 deficit in 2016.

A foremost basis of external earnings for Nigeria are remittances from overseas. According to IOM, in 2007, Nigeria absorbed increase of remittances from USD 2.3 billion in 2004 to 17.9 billion, signifying 6.7 % of GDP (IOM, 2007). United States explains highest percentage of remittance flows to Nigeria followed by UK, Italy, Canada, Spain, France and South Africa.

**Previous related literature**

There are copious studies on determinants of import demand for both emerging market and developed economies based on panel data, cross-sectional data and most often, time series data. These have generated ample literature with mixed empirical findings. For example, Gumede (2000) reported significant elastic income import demand in South Africa. Mohammed and Tang (2000) found that in Malaysia, investment and consumption expenditures had inelastic impact on import demand with coefficients of 0.78 and 0.72 respectively [12; 23].

To Dutta and Ahmed (2001), import demand is price-inelastic with coefficient of -0.47; and income elastic with a coefficient of 1.48 in Indian. Also, in Malaysia Tang and Nair (2002) evaluated the strength of the Malaysia's import demand and found long-run income and relative price elasticities of 1.5 % and – 1.3 %, respectively. Min, Mohammed and Tang (2002) showed that investment expenditure is insignificant and negatively associated to import in South Korea while relative prices also impacted negatively on import demand [34-36].

Bahmani-Oskooee and Kara (2003) reported inelastic long-run income elasticities [7]. Tang (2003) assessed demand for China's import and found that export expenditures exacted most significant impact on import with a coefficient of 0.51, followed by 0.4 coefficient of investment expenditure [35]. Ho (2004) estimated significantly 0.1396 coefficient of investment expenditure, 1.4810 coefficient of export spending and -0.3041 coefficient of prices for import demand function of Macao [15].

In Fiji, Narayan and Narayan (2005) obtained import demand elasticities of 0.69 and 0.38 for relative prices respectively. Chang et al (2005) estimated 0.86 and -0.05 short-run elasticities as well as 1.86 and -0.2 long-run elasticities of import demand in relation to income and prices respectively. The study by Chang, Ho and Huang (2005) for South Korea covered 1980-2000 with implication of long-term association between imports, income and prices [8; 24].

For Madagascar, Ivohasina and Hamori (2005) estimated long-run income and prices elasticities of 0.855 and – 0.487 respectively while for Mauritius, Ivohasina and Hamori (2005) also estimated income and relative prices coefficients of 0.671 and -0.644 in the long-run. Frimpong and Oteng-Abayie (2006) found inelastic import demand for all expenditure variables and relative prices in Ghana. The study by Frimpong and Oteng-Abayie (2006) was corroborated four years after by Constant and Yue (2010) when they reported that investment and exports were core factors of import demand in Cote d'Ivoire [11; 18].

On their part, Emran and Shilpi (2010) adopted a structural model and found a long-run price elasticity of -0.78 and a long-run income elasticity of 0.85 for Sri Lankan economy. On stability of Nigeria's import demand, Shuaibu and Fatai (2014) reported long-run association between import demand, instability of reserves and oil revenue inflows with indication of leading role of regime shifts in influencing stability of Nigeria's import demand [7; 30].

**Gaps in Literature Reviewed**

The study by Shuaibu and Fatai (2014) suffers from specification error having included income and oil revenue in the import function simultaneously knowing that oil revenue constitutes greater fraction of GDP in Nigeria. This econometrically invokes multicollinearity problem which makes their estimates unreliable. Such specification error is avoided by the present study. Besides, no studies reviewed estimated variance of lag distribution needed to ascertain the fraction of adjustment in demand for importation taking into knowledge behaviour of its acclaimed predictors. This development, present study attempts to accomplish in addition to estimating short-run and long-run coefficients of import demand in the spirit of Koyck equation [30].

Another significance is in our modelling pattern whereby we consider not only how much effect on import our predictors would impact but when such predictors have the impact. We also ascertains if such impact is instantaneous or not, if the impact emerges slowly or rapidly and if there is an initial impact that dies off in next few years. These we achieved by estimating lag

distribution associating Nigeria's import behaviour to its predictors. Also, for drive of revalidation of Nigeria's import demand behaviour, ECMs were also estimated.

**Economic theory and specification of import demand functions**

Economic theory propelling our study is Keynesian import demand theory as adopted in theoretical framework of Ho (2004) where import function is either aggregated or disaggregated on income basis. The nitty-gritty of the Keynesian theory is on contemporaneous relationship between aggregated income and import which permits rigidity of relative prices with perfect mobility of capital and slow adjustment towards restoration of trade balance.

To realistically model Nigeria's importation circumstance having recognized Nigeria as net oil exporter, we afterwards tracked the works of Arize and Osang (2007) to specify a structural import function with variables like oil revenue, trade liberalization policy, exchange rate and foreign reserves holding to explain Nigerian situation. In what follows, we considers distributed lag model in line with Koyck's dynamic specification as follows [3]:

$$M_t = a + \eta Z_t + \eta\partial Z_{t-1} + \eta\partial^2 Z_{t-2} + \ldots + \eta\partial^s Z_{t-s} + \ldots + u_t \quad where\ -1 < \partial < 1 \tag{1}$$

Whatever is true about association between current year import volume and the previous values of real income holds also for previous year observation on import demand. Hence, we have:

$$M_{t-1} = a + \eta Z_{t-1} + \eta\partial Z_{t-2} + \eta\partial^2 Z_{t-3} + \ldots + \eta\partial^s Z_{t-(s+1)} + \ldots + u_{t-1} \tag{2}$$

Multiply relation (2) by $\partial$,

$$\partial M_{t-1} = \partial a + \eta\partial Z_{t-1} + \eta\partial^2 Z_{t-2} + \eta\partial^3 Z_{t-3} + \ldots + \eta\partial^{s+1} Z_{t-(s+1)} + \ldots + \partial u_{t-1} \tag{3}$$

Now subtract relation (3) from relation (1) and reorganize terms to obtain our final equation for Koyck's transformation as:

$$M_t = a(1-\partial) + \eta Z_t + \partial M_{t-1} + u_t - \partial u_{t-1} \tag{4}$$

$$\Rightarrow M_t = \beta_0 + \beta_1 Z_t + \beta_2 M_{t-1} + e_t$$

$$where\ \beta_0 = a(1-\partial),\ \beta_1 = \eta,\ \beta_2 = \partial,\ e_t = u_t - \partial u_{t-1}$$

The instantaneous impact of a one period income changes for example is "$\eta$". After one year, import demand increases by "$\eta\partial$" compared to initial demand. After two years, import demand exceeds its previous demand by "$\eta\partial^2$" such that with passage of time, percentage impact on import of income changes dies out. Table 1 shows this impact. If income change is stable then the annual impacts must be summed to find total change in the demand for import as provided in closing column.

**Table 1.** Koyck's Transformation Parameters

| Years | Yearly impact | Total impact |
|---|---|---|
| 1 | $\eta$ | $\eta$ |
| 2 | $\eta\partial$ | $\eta[1+\partial]$ |
| 3 | $\eta\partial^2$ | $\eta[1+\partial+\partial^2]$ |
| . | . | . |
| . | . | . |
| . | . | . |

| | | |
|---|---|---|
| t | $\eta\partial^t$ | $\eta[1+\partial+...+\partial^t]$ |

Source: author's derivation

Final column is a convergent infinite series provided $-1<\partial<1$ such has the cumulative effect $[\eta/(1-\partial)]$. Given that in the log-run, $M_t = M_{t-1} = M$,

$$M = a(1-\partial)+\eta Z+\partial M$$
$$\Rightarrow M = a+[\eta/(1-\partial)]Z \quad (5)$$

So, long run impact on import of income changes becomes the slope coefficient in import function (5). Analytically, mean lag becomes $\partial/(1-\partial)$, median lag which is duration of time required for 50 % adjustment in importation to be completed given a change in level of income is $\ln(0.5)/\ln(\partial)$ and variance becomes $\partial/(1-\partial)^2$. Percentage of changes in demand for importation in current time *(t)* period subsequent to variations in import determinants is $(1-\partial^t)$. Thus, our distributed lag specification of the import functions are:

$$M_t = \wp_0+\wp_1 Y_t+\wp_2 P_t + \wp_3 M(t-1)+u_{1t}, \quad [0<\wp_3<0] \quad (6)$$

$$M_t = \Im_0+\Im_1 C_t+\Im_2 I_t+\Im_3 X_t + \Im_4 P_t+\Im_5 M(t-1)+u_{2t} \quad [0<\Im_5<0] \quad (7)$$

$$M_t = \omega_0+\omega_1 R_t+\omega_2 T_t+\omega_3 N_t + \omega_4 O_t+\omega_5 M(t-1)+u_{3t}, \quad [0<\omega_5<0] \quad (8)$$

The dynamic marginal impact of corresponding to equation (6), (7) and (8) are thus derived as outlined:

$$\frac{\partial M_{t+s}}{\partial Y_t} = \wp_1\Phi^S$$

$$where\ \Phi = \wp_3$$

$$\frac{\partial M_{t+s}}{\partial P_t} = \wp_2\Phi^S$$

$$where\ \Phi = \wp_3$$

$$\frac{\partial M_{t+s}}{\partial C_t} = \Im_1\Gamma^S$$

$$where\ \Gamma = \Im_5$$

$$\frac{\partial M_{t+s}}{\partial I_t} = \Im_2\Gamma^S$$

$$where\ \Gamma = \Im_5$$

$$\frac{\partial M_{t+s}}{\partial X_t} = \Im_3 \Gamma^S$$

$$where \ \Gamma = \Im_5$$

$$\frac{\partial M_{t+s}}{\partial P_t} = \Im_4 \Gamma^S$$

$$where \ \Gamma = \Im_5$$

$$\frac{\partial M_{t+s}}{\partial R_t} = \omega_1 \vartheta^S$$

$$where \ \vartheta = \omega_5$$

$$\frac{\partial M_{t+s}}{\partial T_t} = \omega_2 \vartheta^S$$

$$where \ \vartheta = \omega_5$$

$$\frac{\partial M_{t+s}}{\partial N_t} = \omega_3 \vartheta^S$$

$$where \ \vartheta = \omega_5$$

$$\frac{\partial M_{t+s}}{\partial O_t} = \omega_4 \vartheta^S$$

$$where \ \vartheta = \omega_5$$

The dynamic marginal impacts of all predictors decline exponentially at same rate $\Phi$, $\Gamma$ and $\vartheta$ for equations (6), (7) and (8) individually. This goes to show that with Koyck lag, policy response is dynamic and symmetric. Our error correction specification of the import functions become:

$$D(M) = D(\delta_0) + \delta_{1i} \sum_{i=0}^{k} D(Y_{t-i}) + \delta_{2i} \sum_{i=0}^{k} D(P_{t-i}) + \delta_3 [M_{t-1} - \delta_0 - Y_{t-1} - P_{t-1}] + e_{1t}$$

$$D(M) = D(\delta_0) + \delta_{1i} \sum_{i=0}^{k} D(Y_{t-i}) + \delta_{2i} \sum_{i=0}^{k} D(P_{t-i}) + \delta_3 ecm(t-1) + e_{1t} \quad (9)$$

$$where, \ ecm(t-1) = M_{t-1} - \delta_0 - Y_{t-1} - P_{t-1}$$

$$D(M) = D(\phi_0) + \phi_{1i}\sum_{i=0}^{k} D(C_{t-i}) + \phi_{2i}\sum_{i=0}^{k} D(I_{t-i}) + \phi_{3i}\sum_{i=0}^{k} D(X_{t-i}) + \phi_{4i}\sum_{i=0}^{k} D(P_{t-i}) + \phi_5[M_{t-1} - \phi_0 - C_{t-1} - I_{t-1} - X_{t-1} - P_{t-1}] + e_{2t}$$

$$D(M) = D(\phi_0) + \phi_{1i}\sum_{i=0}^{k} D(C_{t-i}) + \phi_{2i}\sum_{i=0}^{k} D(I_{t-i}) + \phi_{3i}\sum_{i=0}^{k} D(X_{t-i}) + \phi_{4i}\sum_{i=0}^{k} D(P_{t-i}) + \phi_5 ecm(t-1) + e_{2t} \quad (10)$$

$$where,\ ecm(t-1) = M_{t-1} - \phi_0 - C_{t-1} - I_{t-1} - X_{t-1} - P_{t-1}$$

$$D(M) = D(\Theta_0) + \Theta_{1i}\sum_{i=0}^{k} D(R_{t-i}) + \Theta_{2i}\sum_{i=0}^{k} D(T_{t-i}) + \Theta_{3i}\sum_{i=0}^{k} D(N_{t-i}) + \Theta_{4i}\sum_{i=0}^{k} D(O_{t-i}) + \Theta_5[M_{t-1} - \Theta_0 - R_{t-1} - T_{t-1} - N_{t-1} - O_{t-1}] + e_{3t}$$

$$D(M) = D(\Theta_0) + \Theta_{1i}\sum_{i=0}^{k} D(R_{t-i}) + \Theta_{2i}\sum_{i=0}^{k} D(T_{t-i}) + \Theta_{3i}\sum_{i=0}^{k} D(N_{t-i}) + \Theta_{4i}\sum_{i=0}^{k} D(O_{t-i}) + \Theta_5 ecm(t-1) + e_{3t} \quad (11)$$

$$where,\ ecm(t-1) = M_{t-1} - \Theta_0 - R_{t-1} - T_{t-1} - N_{t-1} - O_{t-1}$$

Where, $D$ is first difference operator, *M* is volume of import demand, *O* is oil revenue, *Y* is real income proxied by GDP of Nigeria, *P* is relative price of import, *R* is foreign exchange reserves, *N* is nominal exchange rate.

**Data Sources and Variable Description:** Final consumption outlay was calculated as sum of private household consumption and government consumption expenditures, investment expenditure was calculated as expenditure on investment goods, real income was proxied by constant Nigeria's GDP at local currency, export overheads was calculated as total overheads on exports of goods and services and relative prices was calculated as ratio of import price to domestic price indices, volume of import demand was calculated as a ratio of value of imports at local currency prices to import price index, foreign reserves holding was calculated as official remittance inflows from abroad.

Our measure of trade liberalization policy is import tariff reduction. This measurement is a policy-driven measurement with reference to transnational trade negotiations. Data were accessible and calculated from periodicals of NBS of Nigeria, CBN and WDI. Data on import tariff reduction were accessed and calculated from the country's tariff data, specifically, from Nigeria's Customs data base augmented with data from WTO when indispensable.

**Econometric Methodology:** We cured our data from unit root problem and making same stationary having conducted the relevant preliminary ADF test. In a likewise scenario, we conducted Johansen's co-integration test for each multivariable import demand function. We transformed our data as follows, M = log (import), P = log (relative prices), Y = log (real GDP), C = log (final consumption), I = log (investment expenditures), R = log (foreign reserves), X = log (export overheads), O = log (oil revenues), N = log (nominal effective exchange rate) and T = log (import tariff reduction).

Given that some of our predictors are strictly exogenous while $M_{t-1}$ is by definition weakly exogenous since Koyck error term is white noise, we estimated Koyck equations with the GLS in two ways: Estimation without any restriction imposed on lag coefficients and estimation by restricting Koyck lag weights to satisfy erstwhile assumption of smoothness. Our chosen restriction

was such that lag coefficients exponentially decline from initial impact to zero at a lag length of $s$. Our interest in use of distributed-lag technique based on Koyck transformation derives from scientific uniqueness of its theoretical and empirical application.

## 3. Results

**Results of Lag Effects of Koyck Import Equations:** Table 1 shows the lag effects of Koyck import functions, evidently, the results reported mean lag of 4.714 years, 3.603 years median lag and variance of the lag distribution of 26.939 years for import equation (6). Considering the high variance, it shows the influence or impact of real income and relative prices is spread over 26 years. Thus, resulting from changes in real income and relative prices, 17.5 % is the fraction of adjustment in Nigeria's demand for importation over a period of one year. In effect, aggregated income import equation explains only 17.5 % changes in import demand by Nigeria in one year, implying slow adjustment.

**Table 2.** Lag Effects of Koyck Import Equations

| Statistics | Aggregated Import Equation (6) | Disaggregated Import Equation (7) | Structural Import Equation (8) |
|---|---|---|---|
| Mean lag | 4.714 | 1.320 | 1.088 |
| Median lag | 3.603 | 1.229 | 1.063 |
| Variance of lag | 26.939 | 3.063 | 2.271 |
| Fraction of adjustment | 17.5 % | 43.1 % | 52.10 % |

Source: authors

For import equation (7), mean lag is 1.320 years, median lag is 1.229 years and variance of the lag distribution is 3.063 years. With low variance, it shows that impact of final consumption, investment spending, export overheads and relative prices is spread over 3 years. Thus, ensuing from changes in these predictors, 43.1 % changes in Nigeria's demand for importation is completed in one year. The inference is that adjustment in disaggregated income import equation is moderately rapid

Similarly, structural import equation (8) reported a mean lag of 1.088 years, median lag of 1.063 years and variance of the lag distribution of just 2.271 years. This shows that impact of foreign reserves holding, import, tariff reduction policy, nominal exchange rate and oil revenue is spread over 2 years. In particular, fraction of adjustment in import demand in one year by Nigeria is 52.1 % consequent upon changes in foreign reserves holding, tariff reduction, nominal exchange rate and oil revenue. So, adjustment in this structural import equation is somewhat rapid and also given consideration to its low variance, we observed that the appropriate model for forecasting variation in Nigeria's demand for importation is the structural import equation.

**Results of Lag Distribution:** The lag distributions are displayed in figures 1, 2 and 3 respectively. The parameters of the first-order Koyck lag namely, $\Phi$, $\Gamma$ and $\vartheta$ determine the shape of the lag distribution. In all figures, lag distributions tend to exhibit similar behaviour such that sequence of lag coefficients bounce around positive and negative values and between large and small numerals in a way not in conformity to economic theory. Hence, the lag distributions are unstable and hence diverges as lag length increases in long-run. Consequently, with all estimated import functions, the policy response is oscillatory. By implication, response of import demand to government policy on importation is oscillatory. In fact, the oscillation in Nigeria's demand for importation could be sensitive to fluctuating economic circumstances impelled by current recessionary sequence and its accompanying economic disorder through the Nigerian business cycle given socio-economic weakness of Nigeria to oil price shocks.

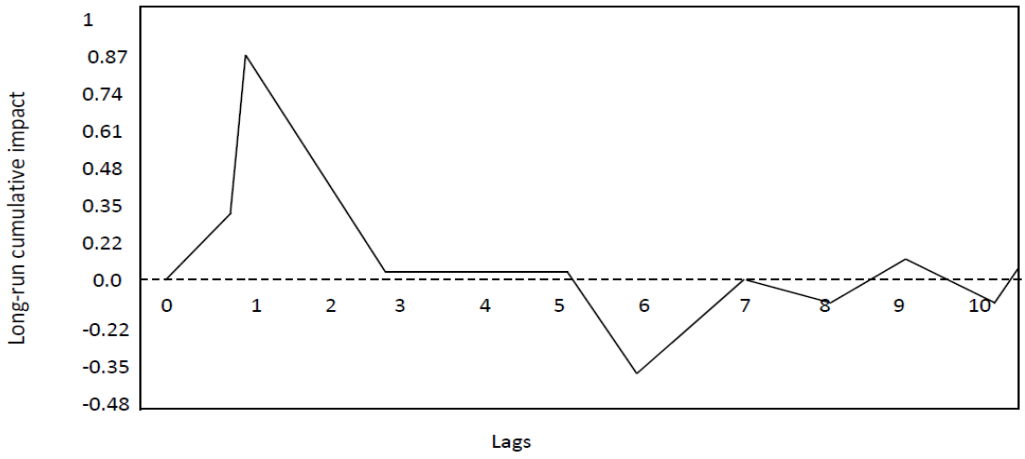


Figure: 1: Lag distribution of import demand equation (6)



Source: authors

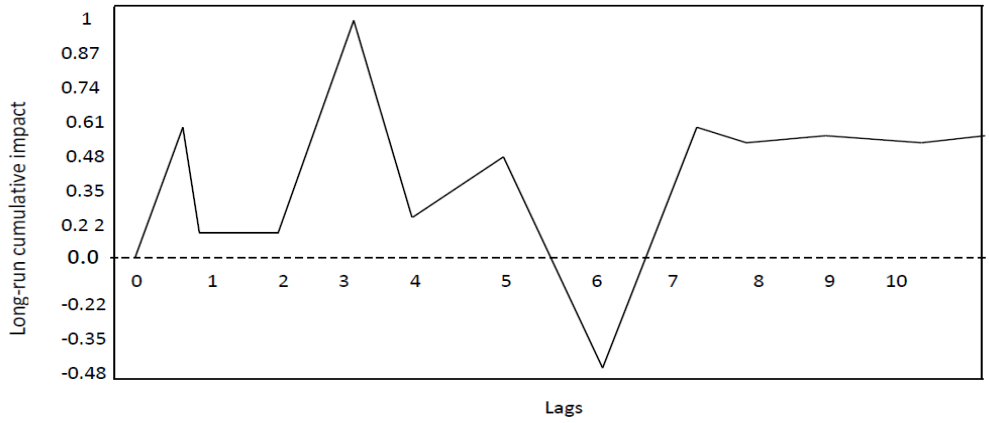


Figure: 2: Lag distribution of import demand equation (7)



Source: authors

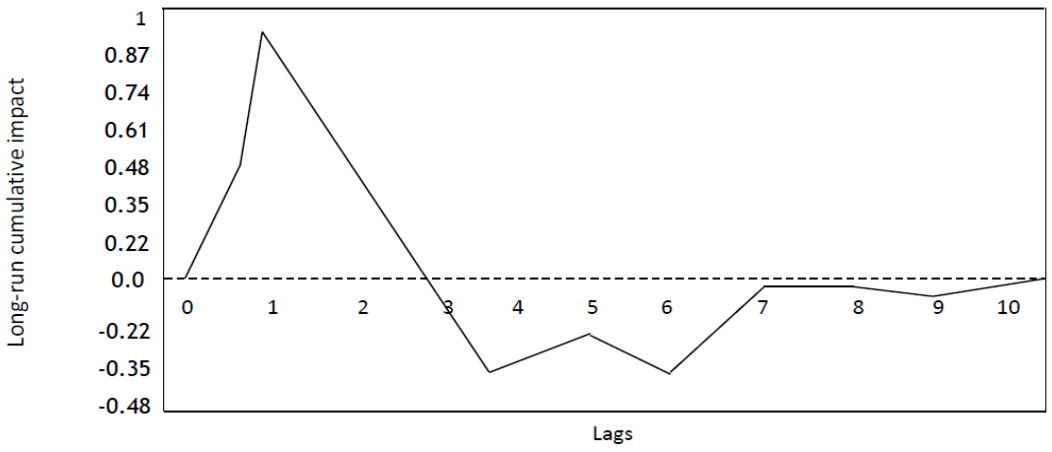


Figure: 3: Lag distribution of import demand equation (8)



Source: authors

**Collinearity Results:** We estimated collinearity statistics for distributed lag import functions based on tolerance (T) and VIF. The VIF, by quantifying degree of multicollinearity in regression of Koyck equation, provides a measure of how much variance of an estimated coefficient of the import function was amplified due to mulcollinearity. In Table 3, we observe approximately VIF $\leq$ 10 which implies low collinearity between the predictors. With VIF of 10.021 for real income, this means that standard error for coefficient of real income is 3.166 (√10.021) times as

outsized as it would be if real income was uncorrelated with other predictors namely, relative prices and one-period lag imports. The tolerance indices are extremely low signifying the low variance for each coefficient estimate.

**Table 3.** Collinearity statistics for import demand equation (6)

| Statistics | Tolerance (T) | VIF |
|---|---|---|
| $Y$ | 0.010 | 10.021 |
| $P$ | 0.100 | 9.990 |
| $M$ (-1) | 0.010 | 10.009 |

Source: authors

Table 4 clearly indicates a VIF of 13.937 for relative prices and this implies variance of coefficient of relative prices is excessive because of collinearity. As it were, standard error for the coefficient of relative prices is 3.737 (√13.964) times as large as it would be if relative price was uncorrelated with other predictors in the disaggregated import function. This could be one reason why variable of relative price practically failed test of significance in all estimations. All other predictors had VIF below or equal to 10 and hence low tolerance indices which denotes low collinearity between the predictors. This is empirically acceptable.

**Table 4.** Collinearity statistics for import demand equation (7)

| Statistics | Tolerance (T) | VIF |
|---|---|---|
| $C$ | 0.125 | 8.025 |
| $I$ | 0.173 | 5.793 |
| $X$ | 0.095 | 10.542 |
| $P$ | 0.072 | 13.964 |
| $M$ (-1) | 0.010 | 10.063 |

Source: authors

**Table 5.** Collinearity statistics for import demand equation (8)

| Statistics | Tolerance (T) | VIF |
|---|---|---|
| $R$ | 0.001 | 10.957 |
| $T$ | 0.001 | 10.043 |
| $N$ | 0.003 | 10.793 |
| $O$ | 0.056 | 10.542 |
| $M$ (-1) | 0.099 | 10.112 |

Source: authors

In Table 5, the results shows noticeably that all predictors had VIF around 10 and this denotes that standard error of estimated coefficients of all predictors are less than excessive to

induce multicollinearity in estimation. This is further portrayed by low tolerance indices for each coefficient. In effect, relative prices, expenditures on export and aggregate income are insignificant predictors of import demand in Nigeria.

**Koyck's Dynamic Results:** In the analysis of our Koyck estimates, note that aaa(aa) indicate significance of coefficient @1 %( 5%) respectively. The Wald statistic which measures insignificance of coefficient restrictions under null hypothesis was estimated for each of Koyck equation. Table 6 reports Koyck transformation results for equation 6. Having estimated our distributed-lag regression based on Koyck transformation, we then extracted regression residuals and engages Breusch-Godfrey BG-LM test to test null hypothesis that residuals are white noise. With the statistical significance of moving average representation and low probability values of BG-LM statistics, our estimates are indicative of absence of autocorrelation and implies our Koyck estimates both restricted and unrestricted are efficient and hence reliable with low standard errors. Therefore, BG-LM test shows robust evidence of acceptance of white-noise.

For estimation without restrictions, the probability values of Wald statistic are insignificant. This suggests non-smoothness of unrestricted lag weights could possibly be induced by multicollinearity. This indeed is corroborated by insignificant one-year lagged coefficients of import in the unrestricted estimations. Regarding estimation with restrictions, significance of probability values of Wald statistics denotes that the restrictions on lag coefficients are significant and hence our data shows strong evidence that our lag distribution does follow smoothed Koyck import model and as such the smoothness restriction is valid.

Hence, our analysis of results and policy response was propelled on estimations with coefficient restrictions. In effect, use of distributed lags is highly justified for restricted coefficients as made evident by significance of lagged coefficients, namely 0.825, 0.521 and 0.569 with t-ratios of 9.326, 2.536 and 2.179 in the three specifications at 1 % respectively. Table 2 reveals that the short-run impact of real income and relative prices are 0.012 and -0.051 respectively while long-run impact are 0.067 and 0.291 respectively. Nevertheless, none of these is significant. Only the one-year lag value of import passes test of significance even at 1 % level. The F-statistic (148.071) is exceedingly significant and Wald statistic indicates validity of coefficient restriction. *LM* statistic and the *MA* coefficient show suitable correction for autocorrelation in the GLS estimation.

**Table 6.** Koyck results for import demand equation (6)

| Variables | Unrestricted Coefficients | Restricted Coefficients |
|---|---|---|
| $\wp_0$ | 1.164$^{aaa}$<br>(9.410) | 1.094$^{aaa}$<br>(5.632) |
| $\wp_1$ | 0.013<br>(0.037) | 0.012<br>(1.135) |
| $\wp_2$ | 0.050<br>(1.791) | 0.051<br>(1.042) |
| $\wp_3$ | 0.123<br>(1.051) | 0.025$^{aaa}$<br>(9.326) |
| $MA(1)$ | 0.561$^{aaa}$<br>(7.198) | 0.673$^{aaa}$<br>(7.248) |
| $Adjust\ R^2$ | 0.792 | 0.647 |
| $F\ stat$ | 159.073(0.000) | 148.071(0.000) |
| $Wald\ stat$ | 4.239(0.000) | 0.019(0.056) |
| $B-G\ LM\ test$ | 1.526(0.529) | 3.925(0.000) |

Source: authors

Table 7 reports Koyck transformation estimates for import function (7) and according to the results, short-run impact of final consumption is 0.015 and this impact is significant with a t-ratio of 3.524. Similarly, the short-run impact of total overheads on export of goods and services passes

the significance test at 1 % with a t-ratio of 6.973. The short-run coefficient of relative prices is as usual positive and also failed significance test. The long-run impact of final consumption, investment expenditure, export overheads and relative prices are 0.015, 0.018, 0.027 and 0.106 respectively.

The F-statistic (125.043) passes significance test and points to an overall significance of the disaggregated import function. Also, the insignificance of Wald statistic (0.152) with high probability value of 0.956 indicates validity of coefficient restriction. *LM* statistic of 5.642 and the *MA* coefficient indicates success in the correction for autocorrelation in the GLS estimation.

**Table 7.** Koyck results for import demand equation (7)

| Variables | Unrestricted coefficients | Restricted coefficients |
|---|---|---|
| $\Im_0$ | 0.142$^{aaa}$ (56.002) | 0.042$^{aaa}$ (11.132) |
| $\Im_1$ | 0.012$^{aa}$ (1.954) | 0.015$^{aaa}$ (3.524) |
| $\Im_2$ | 1.013$^{aa}$ (2.179) | 0.017$^{aaa}$ (6.973) |
| $\Im_3$ | 0.016$^{aaa}$ (4.321) | 0.026 (1.724) |
| $\Im_4$ | 0.023 (1.055) | 0.103 (0.058) |
| $\Im_5$ | 0.029 (1.756) | 0.569$^{aa}$ (2.536) |
| *MA*(1) | 0.023$^{aa}$ (2.991) | 0.023$^{aaa}$ (3.981) |
| *Adjust* $R^2$ | 0.855 | 0.765 |
| *F stat* | 143.026 (0.000) | 125.043 (0.000) |
| *Wald stat* | 3.721(0.000) | 0.052(0.956) |
| *B – G LM test* | 1.984(1.568) | 5.642(0.000) |

Source: authors

Table 8 shows Koyck's estimates for import function (8) and the results reveal that changes in importation in relation to changes in foreign reserves holding, tariff reduction policy, exchange rate and oil revenue gives short-run impact of 0.062, 0.014, 0.051 and 0.023 respectively. Only impact of reserves holding, tariff reduction policy ad one-year lagged import demand are significant at 1 %, 5 % and 5 % level respectively.

As noted earlier the short-run impact of relative prices is certainly not significant and above all, the coefficient is positive in the Koyck's transformation estimations. The long-run impact of

foreign reserves holding, tariff reduction, exchange rate and oil revenue are 0.144, 0.032, 0.118 and 0.053 respectively. Nominal exchange rate predictor which serves as a channel for transmission of domestic productivity to benefit in foreign competitiveness fails significance test.

Significance of structural import function as measured by F-statistic of 192.067 with zero probability is highly indicative, implying a substantial fit of Nigerian data by Koyck's transformation regression. Besides, Wald statistic (0.009) with significant probability of 0.539 indicates validity of coefficient restriction. *LM* statistic of 4.092 and the significant *MA* coefficient of 0.017 indicates exultant correction for autocorrelation in the Koyck estimation. In this circumstance of significance of *MA* coefficients in all estimations, it provides an indication that "noise" from random disturbance and its associated imprecision of GLS regression estimates has been thoroughly filtered out.

**Table 8.** Koyck results for import demand equation (8)

| Variables | Unrestricted Coefficients | Restricted Coefficients |
|---|---|---|
| $\omega_0$ | 0.062$^{aaa}$ (5.371) | 0.032$^{aaa}$ (5.039) |
| $\omega_1$ | 0.004$^{aaa}$ (2.760) | 0.062$^{aaa}$ (6.124) |
| $\omega_2$ | 0.014 (1.368) | 0.014$^{aa}$ (2.824) |
| $\omega_3$ | 0.050 (1.000) | 0.051 (1.100) |
| $\omega_4$ | 0.023$^{aa}$ (2.991) | 0.023 (1.458) |
| $\omega_5$ | 0.569 (0.128) | 0.479$^{aa}$ (2.179) |
| $MA(1)$ | 0.010$^{aaa}$ (13.561) | 0.017$^{aaa}$ (13.486) |
| $Adjust\ R^2$ | 0.754 | 0.721 |
| $F\ stat$ | 152.000(0.000) | 192.067(0.000) |
| $Wald\ stat$ | 1.386(1.629) | 0.009(0.539) |
| $B-G\ LM\ test$ | 0.052(1.238) | 4.092(0.000) |

Source: authors

The inverse roots of the characteristic equation associated with the restricted *MA (1)* process that we used to correct imprecision of Koyck estimates for aggregated income import equation (6) is dynamically unstable since not all inverted roots are strictly inside unit circle as shown in figure 4.

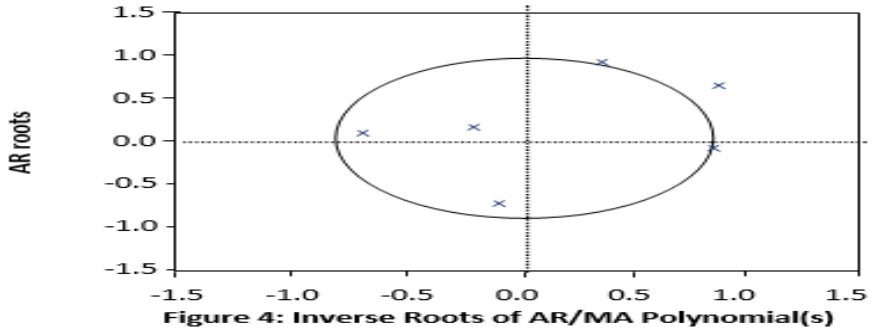

Figure 4: Inverse Roots of AR/MA Polynomial(s)

Source: authors

The inverse AR roots of characteristic relation that links the restricted *MA (1)* process that we utilized in correction of imprecision of Koyck estimates for disaggregated income import equation (7) is dynamically unstable. All inverted roots are not stringently inside unit circle as in figure 5.

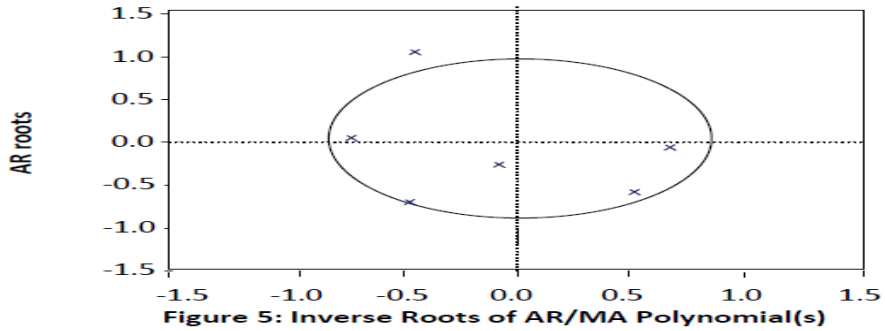

Figure 5: Inverse Roots of AR/MA Polynomial(s)

Source: authors

The inverted roots are all firmly within unit circle as presented in figure 6. Thus, the inverse roots of the characteristic equation that corresponds to the restricted *MA (1)* process that we applied in correcting imprecision of Koyck estimates for structural import equation (8) is dynamically stable. Hence, the equation is fit for forecasting.

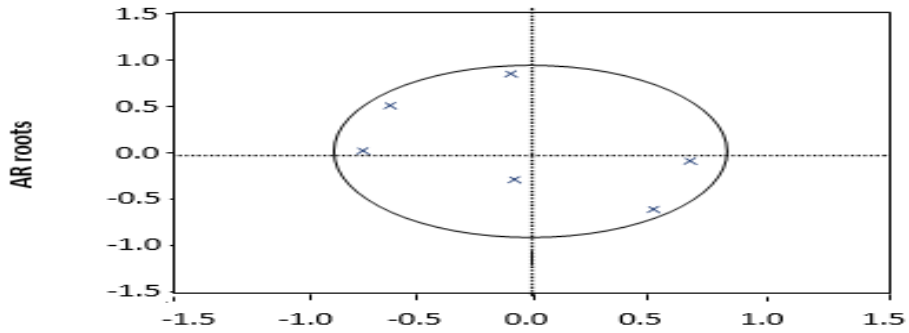

Figure 6: Inverse Roots of AR/MA Polynomial(s)

Source: authors

## 4. Conclusion

We have so far embarked on a theory based econometric analysis of import functions for Nigeria using three distributed lag functions namely, aggregated import, disaggregated import function and structural import functions based on Koyck dynamic specification. The study found structural import demand equation as the most well-behaved import function for Nigerian economy as it is dynamically stable with mean lag of 1.088 years, median lag of 1.063 years and a low variance of lag distribution of just 2.271 years. In spirit of low variance, it shows that impact of foreign reserves holding and import tariff reduction policy was spread over 2 years.

Consequent upon changes in foreign reserves holding and tariff reduction policy, 52.1 % changes in Nigeria's demand for importation is completed within a year, implying somewhat rapid adjustment for the structural import equation. Overall, our empirics denotes that Nigeria's importation is significantly responsive to foreign reserves holding, final consumption and tariff reduction policy. In effect, our results uphold three policy variables of foreign reserves holding, final consumption expenditures and tariff reduction as significant determinants for predicting variation in Nigeria's demand for importation.

However, the lag distributions exhibit a sequence of lag coefficients that rebound around positive and negative values displaying outlier behaviour in a way that do not conform to economic theory. Hence, the lag distributions are unstable and hence diverge as lag length rises in long-run. Consequently, with all estimated import functions, the policy response is oscillatory. This implies that response of import demand to government policy on importation is oscillatory. The oscillation in Nigeria's demand for importation could be sensitive to inconsistent economic circumstances provoked by current recessionary sequence and its accompanying economic disorder through the Nigerian business cycle that cannot be unnoticed given socio-economic susceptibility of Nigeria to oil price shocks. This corroborates findings of Shuaibu and Fatai (2014) that Nigeria's import has stayed volatile with no distinct pattern owing to the country's exposure to external crude oil market conditions [30].

So, our recommendation is a straight one, while Nigerian government guardedly implement expenditure-reducing policies as measures to curtail excessive importation, there is need to establish balance between protection of import substituting industries for resolve of enhancing indigenous production and maintaining a surplus payment balance by earning abundant foreign reserves through sufficient accumulation of official remittance inflows needed to strengthen country's import funding when the demand to import for national development becomes vital. Protective measures will scarcely stimulate capacity of indigenous industries in the face of feeble institutions. Moreover, import of capital goods plays vivacious role in inducing economic advancement of nations.

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## References

1. Alias, M. H. and Tang, T. C. (2000). Aggregate imports and expenditure components in Malaysia: A Co-integration and Error Correction Analysis, ASEAN Economic Bulletin, vol. 17(3): 257-269.

2. Aliyu, S. U. R., (2007). "Imports-exports demand functions and balance of payment stability in Nigeria: a co-integration and error correction modelling." MPRA Paper No. 10396.

3. Arize, A. C. and Osang T. (2007), Foreign exchange reserves and import demand: evidence from Latin America, The World Economy, vol. 30(9): 1477-1489.

4. Aziz, N. (2012), Does a real devaluation improve the balance of trade? empirics from Bangladesh economy, The Journal of Developing Areas, vol. 46(2): 19-41.

5. Aziz, M. N. (2013). "Modelling of import demand function for a developing country: an empirical approach." Asian-African Journal of Economics and Econometrics. 13(1), 1-15.

6. Babatunde, M. A. and Egwaikhide, F.O. (2010). "Explaining Nigeria's import demand behaviour: a bound testing approach." International Journal of Development Issues 9(2):167-187.

7. Emran, M. Shahe and Shilpi, F. (2001), Foreign trade regimes and import demand function: evidence from Sri Lanka, Working Paper, International Trade, EconWPA.

8. Egwaikhide F. O. (2000). Determinants of imports in Nigeria: A dynamic specification; publication and dissemination, African Economic Research Consortium.

9. Bathalomew, D. (2010). 'An econometric estimation of the aggregate import demand function for Sierra Leone.' Journal of Monetary and Economic Integration 10(4).

7. Bahmani-Oskooee, M., & O. Kara. (2003). Relative responsiveness of trade flows to a change in price and exchange rate. International Review of Applied Economics, Vol (17), 3, 293-308.

8. Chang, T., Ho, Y. and Huang, C., 2005. "A re-examination of South Korea's aggregate import demand function: a bounds test analysis." Journal of Economic Development 30: 119-128. Chang, T., Y.

9. Constant, N.B.Z.S and Yue, Y. (2010) 'An econometric estimation of import demand function for Cote D'Ivoire', International Journal of Business and Management, vol. 5, No 2, pp. 77-84.

10. Dutta, D. and Ahmed, N. (2001) 'An aggregate import demand function for India: a Co-integration analysis', (Available online: http://eprints.anu.edu.au/archive/00001731/).

11. Frimpong, J. M. and Oteng-Abayie, E. F. (2006) 'Aggregate import demand and expenditure components in Ghana: an econometric analysis', MPRA Paper, No. 599

12. Gumede, V. (2000) 'Import demand elasticities for South Africa: a co-integration analysis', Journal for Studies in Economics and Econometrics, vol. 24, pp. 21-37.

13. Harvey, S. and Sedegah, K. (2011). "Import demand in Ghana: Structure, behaviour and stability" AERC Research Paper 233.

14. Ho, and Huang, C. (2005) 'A re-examination of South Korea's aggregate import demand function: a bounds test analysis', Journal of Economic Development, vol. 30, pp. 119-128.

15. Ho, W. S. (2004) 'Estimating Macao's import demand functions', Monetary Authority of Macao, 18.

16. Islam, M. A. (2003), Exchange rate policy of Bangladesh: not floating does not mean sinking, occasional paper series, Centre for Policy Dialogue (CPD), Bangladesh.

17. Islam, M. A. and Hassan, M. K. (2004), An econometric estimation of the aggregate import demand function for Bangladesh: some further results, Applied Economics Letters, vol. 11: 575-580.

18. Ivohasina F. R., and Hamori, S. (2005). Import demand function: some evidence from Madagascar and Mauritius', Journal of African Economies vol. 14 No. 3, pp. 411-434.

19. Johansen, S. (1988), Statistical analysis of co-integration vectors, Journal of Economic Dynamics and Control, vol. 12: 231-254.

20. Koyck, L. M. (1954). *Distributed Lags and Investment Analysis*. Amsterdam: North-Holland

21. Min, B. S., Mohammad H. A., and Tang, T. C. (2002) 'An analysis of South Korea's import demand', Journal of Asia-Pacific Affairs, vol. 4, No. 1, pp. 1-17.

22. Mohamed, H. A., and Othman, J. (2001) 'Aggregate import demand and expenditure components in five ASEAN countries: an empirical study', Jurnal Ekonomi Malaysia, vol. 35, pp. 37-60.

23. Mohammed, H. A. and Tang, T.C. (2000). Aggregate imports and expenditure components in Malaysia: a co-integration and error correction analysis', ASEAN Economic Bulletin, vol. 17, pp. 257-69.

24. Narayan, P. K. and Narayan, S. (2005). An empirical analysis of Fiji's import demand function', Journal of Economic Studies, vol. 32, No. 2, pp. 158-168.

25. Ogundele, F. (2012), trade liberalization and import demand for rice in Nigeria: a dynamic modelling. Nigeria Institute for Social and Economic Research (NISER), Ibadan, Oyo State, Nigeria.

26. Ogbonna B. C. (2016). Estimating aggregate import-demand function for Nigeria revisited, IOSR Journal of Business and Management (IOSR-JBM). Volume 18, Issue 3.Ver. I (Mar. 2016), pp. 64-72.

27. Omoke, P. O. (2012). "Aggregate import demand and expenditure components in Nigeria". Economica 8(1).

28. Xu, X. (2002) 'The dynamic-optimizing approach to import demand: a structural model', Economics Letters, Vol. 74, pp. 265–270.

29. Santos-Paulino, A. U. (2002). The effects of trade liberalization on imports in selected developing countries. World Development, 30, 959–974.

30. Shuaibu, M. I. and Fatai, B. O (2014), On the stability of Nigeria's import demand: do endogenous structural breaks matter? Journal of Reviews on Global Economics, 3, 228-240.

31. Sinha, D. (2001), A note on trade elasticities in Asian countries, International Trade Journal, vol. 15(2): 221–237.

32. Shrestha, M. B. and Chowdhury K. (2005) 'ARDL modelling approach to testing the financial liberalization hypothesis', Economics Working Paper, Series 2005, University of Wollongong.

33. Rijal, A., R. K. Koshal., & C. Jung. (2000). Determinants of Nepalese imports. Journal of Asian Economics, 11, 347-54.

34. Tang, T. C. (2005), Revisiting South Korea's import demand behaviour: a co-integration analysis, Asian Economic Journal, vol. 19(1): 29-50.

35. Tang, T. C. (2003) 'An empirical analysis of China's aggregate import demand function', China Economic Review, vol. 12, No. 2, pp. 142-63.

36. Tang T. C. and Nair, M. (2002) "A co-integration analysis of Malaysian import demand function: reassessment from the bounds test", Applied Economic Letters, vol. 9, No. 5, pp. 293-296.

37. Umoru D. and G. Akhabue (2017), Estimation of Effects and the Threshold of Fiscal Deficit Financing for the Nigerian Economy: An Econometric Re-evaluation of Recent Trends International Journal of Social Sciences & Educational Studies, Iraq. Vol. 4, No. 3, 68–86. December.

38. Umoru D. and G. Nwokoye (2018), FAVAR Analysis of Foreign Investment with Capital Market Predictors: Evidence on Nigerian and Selected African Stock Exchanges. Academic Journal of Economic Studies, Romania. Vol. 4, No. 1, 12-20.

## Appendix

A1: Unit Root Results

| Variables | ADF | | PP | |
|---|---|---|---|---|
| | Level | Difference | Level | Difference |
| $M$ | -0.359 | -6.431 | -1.254 | -12.432 |
| $Y$ | -1.267 | -9.362 | -2.167 | -9.362 |
| $P$ | -1.953 | -7.351 | -2.953 | -14.356 |
| $C$ | -0.672 | -3.589 | -1.872 | -12.137 |
| $I$ | -1.335 | -4.260 | -1.965 | -19.260 |
| $X$ | -2.749 | -5.791 | -2.749 | -8.791 |
| $R$ | -1.358 | -9.723 | -1.258 | -15.623 |
| $T$ | -0.491 | -6.491 | -2.136 | -9.279 |
| $N$ | -0.627 | -4.872 | -1.145 | -13.146 |
| $O$ | -1.253 | -9.134 | -1.279 | -20.925 |

Source: authors

A2: Co-Integration Results for ECM (9)

| Hypothesis | | Statistics | | | |
|---|---|---|---|---|---|
| $H_0$ | $H_1$ | Trace | CV@5% | Max eigen | CV@5% |
| $r=0$ | $r=1$ | 36.438 | 28.473 | 25.372 | 15.792 |
| $r=1$ | $r=2$ | 29.367 | 21.591 | 19.725 | 13.654 |
| $r=2$ | $r=3$ | 10.571 | 14.239 | 6.389 | 10.531 |

Source: authors

A3: Co-Integration Results for ECM (10)

| Hypothesis | | Statistics | | | |
|---|---|---|---|---|---|
| $H_0$ | $H_1$ | Trace | CV@5% | Max eigen | CV@5% |
| $r=0$ | $r=1$ | 41.032 | 32.173 | 24.192 | 21.951 |
| $r=1$ | $r=2$ | 35.112 | 26.523 | 18.364 | 14.357 |
| $r=2$ | $r=3$ | 24.073 | 10.592 | 5.427 | 2.0596 |

Source: authors

A4: Co-Integration Results for ECM (11)

| Hypothesis | | Statistics | | | |
|---|---|---|---|---|---|
| $H_0$ | $H_1$ | Trace | CV@5% | Max eigen | CV@5% |
| $r=0$ | $r=1$ | 26.341 | 12.725 | 15.471 | 12.921 |
| $r=1$ | $r=2$ | 17.592 | 9.941 | 11.233 | 8.569 |
| $r=2$ | $r=3$ | 3.456 | 3.726 | 2.495 | 2.351 |

Source: authors

**Unit Root Test:** Unit root test results shown in Appendix 1 indicate that at 5 % level of significance all variables were non-stationary at level as values at level do not exceed critical values of ADF and PP tests namely -3.27 and -5.39 for intercept and trend option at 1 % level respectively. Nevertheless, all variables became stationary at first difference which implies that our variables are all [I (1)] variables.

**Co-integration Test Results:** The trace statistic and the mag eigenvalue test rejects null hypothesis of $r=0$ against $r=1$ at 5 % level of significance for ECM (9) as shown in Appendix 2. Results shows two co-integrating relations. Also, for ECM (10), trace statistic and maximum eigenvalue statistic for ECM (10) shows three co-integrating vectors at 5% level. The trace statistic for ECM (11) shows two co-integrating vectors while maximum eigenvalue statistic validates three co-integration relations at 5 % level.

**Error Correction Estimates:** In analysis of the error correction results, note that $^{bbb(bb)}$ indicate significance of estimated coefficient $@^{1\%(5\%)}$ respectively. Theoretically, *ECC* is expected to be$[-1<ECC<0]$, and in reality all estimated error correction coefficients (*ECC*) for ECM (9), ECM (10) and ECM (11) are individually negative and statistically significant. These estimated *ECC* coefficients conformed to economic theory, with implication that the process of adjustment towards equilibrium whenever there is a perturbation to Nigeria's demand for importation as driven by changes in real income, relative prices, final consumption demand, investment expenditures, export overheads, foreign reserves holding, trade liberalization policy, nominal exchange rate and oil revenue converges in the long run. This also validated absence of autocorrelation in the ECMs.

The F-statistics (571.0) with probability 0.000, (224.56) with probability 0.000 and (389.5) with probability 0.000 indicate that the overall ECM estimation for ECM (9), ECM (10) and ECM (11) are significant at 1 % level and have strong explanatory power. For example, ECM (9) explains 79.4%, ECM (10) explains 65.2 % and ECM (11) explains 87.9 % individually. The LM (Ramsey reset) tests reported these statistics 0.062 (0.690) for ECM 9, 0.043 (0.092) for ECM 10 and 0.09 (0.064) for ECM 11 respectively. The high probability values associated with the LM statistics show estimations are devoid of problem of serial correlation.

A5 reports EC estimation results of aggregated import function (6) and as shown, the results substantiate results of Koyck transformation. Income coefficient is 0.378 with an insignificant t-ratio of 1.023 even though Nigeria's import demand is income inelastic. This could be pointing to slow growth rate of the Nigerian economy in recent time which perhaps have prevented her from significant purchase of capital goods in the world market. The coefficient of relative prices is positive and insignificant with a t-ratio of 1.178. This is an indication that Nigeria's imports demand are not responsive to relative price changes. The positive sign is not in conformity with economic theory. This could be due to export promotion policy of Nigeria.

A5: Results of ECM (9)

| Variables | Coefficients | t-statistics |
|---|---|---|
| $D(Y_t)$ | 0.378 | 1.023 |
| $D(P_t)$ | 0.012 | 1.178 |
| $D(\delta_0)$ | -1.242bbb | -11.160 |
| $ecm(t-1)$ | -0.794bb | -2.759 |
| $Adjust\ R^2$ | 0.794 | |
| *Serial C.* | 0.062 (0.794) | |
| *F stat* | 571.0 (0.000) | |
| *Ramsey R.* | 0.690 (0.593) | |

Source: authors

A6 shows EC estimates of disaggregated import function where real income is disaggregated into final consumption spending, investment spending and exports overheads. The results show 0.019, 0.143 and 0.017 changes in import demand in relation to percentage change final consumption, investment expenditure and export overhead respectively. The results predominantly imply that import demand is significantly responsive to changes in final consumption expenditure and exports. Specifically, a 10 % increase in final consumption and total overheads on export of goods and services are accompanied by 0.19 % and 0.17 % increase in Nigeria's importation respectively.

A6: Results of ECM (10)

| Variables | Coefficients | t-statistics |
|---|---|---|
| $D(C_t)$ | 0.019bbb | 5.789 |
| $D(I_t)$ | 0.143 | 1.421 |
| $D(X_{t-1})$ | 0.017bb | 2.510 |
| $D(P_t)$ | 0.019 | 1.583 |
| $D(\phi_0)$ | 1.827bbb | 3.592 |
| $ecm(t-1)$ | -0.792bbb | -4.162 |
| $Adjust\ R^2$ | 0.652 | |

| | |
|---|---|
| *Serial C.* | 0.043 (0.082) |
| *F stat* | 224.5(0.000) |
| *Ramsey R.* | 0.092(0.675) |

Source: authors

A7 shows EC estimates of the structural import demand function. The results unambiguously reveals significance of one-period lag of reserves holding coefficient of 1.053 with a t-ratio of 5.942. This positive result is vast. In effect, our empirics uphold a case for accumulation of official remittances needed to strengthen the country's import funding.

Trade liberalization policy is significantly positive with a coefficient of 0.027 and a t-ratio of 2.756. So, a 10 % import tariff reduction stimulates elasticity of importation by 0.27 %. This denotes fruitful effect of the Nigerian trade liberalization policy on imports as against import restriction and protection policy which negates allocative and technical efficiencies and international competition due to imperfect agency relationship within the local industry but rather promotes monopoly control that induces high prices and hence superfluous profits as scarcity of local supplies cannot satisfy demand. This in turn attract rent-seeking behaviour of existing firms which leads to depletion of resources and as an effect repudiates attainment of market led economy.

As obtained in estimation of Koyck's transformation, coefficient of nominal exchange rate is 0.037 denoting that 10 % devaluation is complemented by a 0.37 % rise in Nigeria's importation. However, the coefficient is statistically insignificant with t-statistic of 0.051. While coefficient of oil revenue at current year fails significance test, coefficient of previous year oil revenue passes significance test with t-ratio of 2.095.

A7: Results of ECM (11)

| Variables | Coefficients | t-statistics |
|---|---|---|
| $D(R(-1))$ | $1.053^{bbb}$ | 5.942 |
| $D(T)$ | $0.027^{bb}$ | 2.756 |
| $D(N)$ | 0.037 | 0.051 |
| $D(O_t)$ | 0.014 | 0.283 |
| $D(O(-1))$ | 0.016 | 2.095 |
| $D(\Theta_0)$ | $1.950^{bbb}$ | 3.629 |
| $ecm(t-1)$ | $-0.879^{bbb}$ | -4.792 |
| *Adjust* $R^2$ | 0.793 | |
| *Serial C.* | 0.09 (0.794) | |
| *F stat* | 389.5(0.000) | |
| *Ramsey R.* | 0.064(0.593) | |

Source: authors

The coefficients of relative prices was consistently positive and insignificant while the coefficient of aggregated real income was also insignificant. In final analysis, both error correction and Koyck's results show Nigeria's imports are significantly responsive to foreign reserves holding, final consumption and import tariff reduction, a proxy for trade liberalization policy.

УДК 33

## Эконометрическая переоценка поведения Нигерии в отношении спроса на импорт: динамический анализ Koyck и ответные политические меры

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**Аннотация.** В настоящей работе на основе динамики распределенной модели лагов в соответствии с преобразованием лагов Koyck первого порядка оценены функции спроса на импорт для Нигерии с использованием годовых данных за 2000-2017 гг. Оценка GLS проводилась двумя способами: оценка без каких-либо ограничений, наложенных на коэффициенты лага, и оценка путем ограничения весов лага Koyck для удовлетворения прежнего предположения о гладкости.

В целом, авторами демонстрируется, что поведение Нигерии в отношении спроса на импорт в значительной степени зависит от наличия иностранных резервов, политики снижения тарифов и расходов на конечное потребление. Реакция импортного спроса на государственную политику по импорту является динамично противоречивой. Такое колебание может быть вызвано чувствительностью спроса Нигерии на импорт в связи с изменяющимся экономическими обстоятельствами, вызванным недавними ценовыми потрясениями на нефть и социально-экономической уязвимостью страны.

**Ключевые слова:** импортный спрос, Koyck трансформация, распределенный лаг, конечное потребление, Нигерия.

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