Imports-Exports Demand Functions and Balance of Payments Stability in Nigeria: A Co-integration and Error Correction Modeling

Shehu Usman Rano, Aliyu
Bayero University Kano, Nigeria

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Shehu Usman Rano Aliyu
Department of Economics,
Bayero University Kano

Abstract

This paper assesses the determinants of import and export demand functions. The object is to empirically measure the relative strengths and weaknesses of the determinants import and export, and to examine, using the Marshall-Lerner hypothesis, the condition under which balance of payments adjustment works in the Nigerian economy. The analytical framework employed is an econometric methodology, which encompasses wide a range of tests for stationarity, cointegration and specification of an error correction model. Using data obtained from the Nigerian economy covering the period of 1970 to 2004, result of over-parameterized error correction model show significant causational relationships in the two models. Specifically, from the values of the coefficient of the current and past (lag) level of exchange rate in the two models, the paper knots balance of payments adjustment to regime of exchange rate stability in Nigeria. The paper, therefore, recommends exchange rate adjustment as potent instrument of achieving balance of payments stability in Nigeria.

Keywords: Imports, exports, stationarity, cointegration, Balance of Payments

1.0 Introduction

Predicaments in the foreign trade sector have been shown to have destabilizing effects not only on the external sector, but, also on the domestic economy at large. Put in other words, disequilibrium in Nigeria's balance trade can influence the way resources are allocated internally just as disequilibrium in the domestic economy translated in the form of unemployment or inflation, affects the external economy. The use of expenditure-switching and expenditure-changing fiscal and monetary policies to affect prices, interest rate and exchange rate can be relied upon to bring the economy back on tract.

Available evidence, generally, suggests that most developing countries, including Nigeria have witnessed persistent decline in their foreign exchange earnings in the early 1980's. This largely follows the collapse in their exports prices and since most of them specialize in limited line(s)

of Exports. Reinhart and Wickham (1994) confirm the long term decline in the primary product prices since 1970's. This triggered series of developments within domestic economy.

In the early 1980s petroleum Exports in Nigeria accounted for between 20 and 25 percent of the country's total GDP, 90 per cent of foreign exchange earnings and up to 70 per cent of budgetary revenue (Iyoha 1996). Consequent upon this, Aliyu (2001) discovers that the share of non-oil exports in total exports declined drastically from 97.3 per cent in 1960 to 17 per cent in 1992 and to 3.1 per cent in 1981. The share stood at 2.6 per cent in 1994. Besides, the Nigerian economy is highly import dependant; capital goods, intermediate goods, raw materials and even consumer (food) items. The process of deregulation coupled with an appreciable degree of openness during the Structural Adjustment Programme (SAP) era made the economy vulnerable to international trade shocks and the widening of the size of disequilibrium in balance of payments (BOP). Egwaikhide (1999) shows that between 1953 and 1989, imports as proportion of GDP did not fall below 10 per cent except for 1974 and 1986. On the degree of openness, Aliyu (2001) discovers that the measure of openness was 40 per cent in 1989, 64.8 per cent in 1992, 86.9 per cent in 1995 and then fell to 73.6 per cent in 1997. The study further shows that for ten years, that is, from 1989-1998, except for 1993, 1995 and 1998 the BOP balance was consistently in deficit. Thus the size of the openness of the economy and the pattern of disequilibrium in BOP explain how this disequilibrium is transmitted promptly and widely to the rest of the economy.

A number of empirical studies on the nature of exports supply and imports demand functions by Khan (1974), Ali (1987), Reinikka (1994), Ajayi (1975), Yekini (1999), Egwaikhide (1999), Aliyu (2005), have presented different and yet interesting findings on the nature and influence of different variables determining the level of Exports and Imports demand functions.

1.1 Research Problem

The structure of Nigeria's foreign trade basically remains the same although it is now almost two decades since the implementation of the structural adjustment programme (SAP). During

the regime of controls, the economy's external sector was plunged into serious crises. External reserves fell sharply in the 1980's consequent to the fall in the price of crude oil, the economy's main life-wire. Even among the cycles of policy makers, the demerits of controls were quite evident, namely misallocation of resources, rent-seeking activities and unharmonious trade relations due to the overvaluation of the naira exchange rate, etc. Although empirical evidence shows that between 1970 and 2004 the Nigerian economy recorded surplus in its BOP almost double the number of its deficits, that is, 22 years of surplus as against 12 only years of deficit (see table 1-1). Yet, even a cursory look at the value of this surplus would reveal that on the average it could hardly finance 10 months of imports equivalent. In evidence to the case of overvaluation of the Naira exchange rate is the fact that since the deregulation of the foreign exchange market, the naira has been depreciating against the dollar - see the table A in the appendix on the trends of the naira exchange rate in Nigeria.

One of the main goals of deregulation is the attainment of domestic and external balance. Internal balance is achieved through budget discipline or through measures to reduce government spending/investment on economic sectors with a view to a successful take over by the private sector, while external sector balance is attained through price and exchange rate adjustment. The fact, however, is that the Nigerian BOP had seen more deficits after the introduction of SAP than during the era of controls; in other words, of the 12 instances of deficits in BOP, 7 happened after 1986, that is after SAP was introduced.

1.2 Objectives of the Research

The broad objective of this research against the above background is, to empirically assess the determinants of exports and imports demand functions and balance of payment implications in Nigeria using cointegration and error correction model. Other specific objectives include:

a) to estimate the income exchange rate and other elasticities from both Nigeria's import and export demand functions,

b) to ascertain the speed of adjustment in the Nigeria's BOP by testing the Marshall-Lerner adjustment condition in the balance of payments,

c) to offer, based on the findings of the research, concrete recommendations.

2.0 Literature review and Theoretical Issues

In view of the importance of foreign trade to economic growth and development, especially in developing countries, a number of empirical studies on the determinants of export and import demand functions have been carried out. The objective here is to review some of these studies as a guide to the choice of appropriate variables used in this study. The models that explain the determinants of exports and imports include those by Olayide (1968), Rhomberg (1968), Maizels (1968), Houthakker and Magee (1969), Khan (1974), Ajayi (1975), Ajakaiye (1985), Goldstein and Khan (1978), and Goldar (1989).

In Nigeria, the pioneering work of Olayide (1968) focused only on some selected commodities of Nigeria's imports between 1948 and 1964. Evidence from multiple regression models indicates that terms of trade, real income measured in terms of GDP and the index of trade restriction had fairly good estimates. In the same vein, Ajayi (1975) showed that real income, relative prices, and foreign exchange were the major determinants of total Imports in Nigeria during the period of 1960 - 1970.

In their models of export demand, Houthakker and Magee (1969) found that the level of real income in importing countries and price competitiveness in exporting countries are the principal determinants of exports for a number of developing countries. Khan (1974) adds that prices play an important role in the determination of exports for developing countries. He further states that if it is anything to go by, the size of the estimated price elasticities were fairly high for most of the 15 countries studied. Also, Bond (1985) in his empirical study on non-oil exporting developing countries found that real effective exchange rate, gross national product (GNP) in importing countries and output in exporting countries (measured by deviations from trend) as well as long term developments in both exporting and importing countries, play an important role in the determination of exports.

In consonance with the specification by Houthakker and Magee (1969), Goldar and Bharadwaj (1985) show that relative export prices and world income were important variables influencing the export market of iron and steel products. They found that on the one hand, estimates of price elasticities for developing countries were statistically significant and are near or above

unity. On the other hand, price elasticity estimates for developed countries are, in many cases, less than one. One of the major implications of these findings is that the exports demand of developing countries is elastic, meaning it is price responsive, while that of developed countries is inelastic and therefore not subject to variations due to changes in world market prices.

In view of developments in the area of econometric modeling and the fact that there is no universally accepted model of either imports or exports demand that can fit all or capture the dynamics in different countries; the models have undergone a number of refinements in recent times. Learmer and Stern (1970) note that there are no well defined criteria for choosing a particular functional relationship/specification. Rather it is the researcher who decides what functional form to use (influenced by the theoretical position chosen), provided the choice is not harmful to the results obtained. Concerned about the matters arising from the various functional imports demand models, Thursby and Thursby (1984) cited in Egwaikhide (1999) examined the appropriateness of alternative specifications, using five countries (Canada, Germany, Japan, United Kingdom and the United States) as case studies. They explored nine different models of aggregate imports demand from which 324 alternative specifications were derived. The general conclusion from this detailed research is that there is no single functional form that is universally appropriate across countries over time. In support of findings by Khan and Ross (1977), Thursby and Thursby (1984) further discover that logarithmic functional form is more appropriate.

Reinikka (1994) who studies the usefulness of modeling import demand says that it allows for the empirical measurement of price (using exchange rate as a proxy) and income elasticities. Egwaikhide (1999) in his dynamic specification model of import determinants in Nigeria from 1953-1989 discovers that short run changes in the availability of foreign exchange earnings, relative prices, and real output (income), significantly explain the growth in total imports. In all, the author concludes that the effect of foreign exchange availability is particularly remarkable. Furthermore, results from major components of import regression show that imports of raw materials responded significantly to foreign exchange earnings, relative prices and industrial output through an error correction mechanism. The imports of capital goods,

another imports component, is highly sensitive to the dynamics of relative price. The last component of import demand, that is the consumer goods imports, is basically determined by the foreign exchange availability.

Aliyu (2001) shows in three disaggregated import demand models for the Nigerian economy between 1970 and 1998, the influence of real income, real exchange rate level of foreign reserves, imports capacity and a dummy variable (for taste and preference) on the levels of imports demand. Obtaining the coefficients of the independent variables from a dynamic specification of the models using logarithmic values of the variables shows that the coefficients are in themselves the elasticities of the respective variables. Results show that only the income and error correction mechanism elasticity's are elastic while that of real exchange rate, real foreign research, real imports capacity and the dummy variable are all inelastic. All coefficients of the dynamic specification were correctly signed.

On the exports demand model, Iyoha (1995) discovers the power effect of foreign trade (using crude oil Exports only) on economic growth. In his modeling of export and import demand for the Nigerian economy, from 1970 to 1997, Yekini (1999) discovers that exchange rate, lending rate, gross domestic product and capacity to Imports are good determinants of imports and exports demand in the Nigerian economy. In the disaggregative form, imports are decomposed into 3 major categories: Imports of raw materials, of capital goods and of consumer goods. In all the three equations and for the entire coefficients, the elasticities of the independent variable were found to be inelastic. An important point missed by Yekini (1999) is the fact that a policy change designed to influence the three categories of Imports through the captured variables may not work because of the inelastic nature of the coefficients. The results were, however, correctly signed.

Level of export too was decomposed by the study into oil and non oil exports. Oil export equation was not estimated because of its exogeneity feature, while results from the non oil exports show that all the coefficients/elasticities except for the intercept were all inelastic. Two coefficients, namely that of real gross domestic product and real exchange rate, were incorrectly signed. The same observation made on the use of the exogenous variables as policy instruments also hold in this, because of the low elasticities. Balance of payments viability is

essential to foreign trade sustainability in any economy. A number of theoretical postulations were made to explain how adjustment process works to restore equilibrium condition in a country's BOP. Among these, Marshall and Lerner independently worked out conditions under which exchange rate changes restore equilibrium in BOP by devaluing a country's currency. This condition is popularly called the Marshall – Lerner condition and is stated as: When the sum of price elasticicities of demand for exports and imports in absolute terms is greater than unity, devaluation will improve the country's BOP, i.e.

$$e_x + e_m > 1$$

If the sum is equal to unity, devaluation will have no effect on BOP, and BOP disequilibrium will worsen when the sum (absolute) is less than unity. According to Marshall – Lerner, devaluation reduces the prices of exports in terms of foreign currency. At the same time it cheapens exports, the measure also makes imports dearer in the devaluing country and the sum of it will have corrective effect on BOP. Besides achieving a quantitative estimation of the determinants of imports and exports demand variables, the paper explores the Marshall-Lerner condition in the Nigerian economy for the period under review.

3. 0 Methodology of the Paper

The theoretical foundation on which the model is predicated is the simple linear relationship between exports and imports as dependent variables on the one hand and on the other hand, independent variables, which include, among others; exchange rate, income, imports capacity, level of foreign reserves, etc.

The theoretical foundation of the import and export demand models used here is rooted in the works of Khan (1974), Narasimhan & Pritchett (1993) and Thirlwall (1999) which were modified and used by Yekini (1999), Aliyu (2001) and Okoh (2002). The functional Imports and Exports demand can be expressed as:

$$TM_d = f\,(GDP, EXG, FRV, IOP, IMC, Dsap) \quad (1)$$

$$TX_t = f(GDP, WIC, EXG, IOP, Txt\text{-}1, Dsap) \quad (2)$$

The two equations can be expressed in log-linear form as:

$$In\ TM_d = \alpha_0 + \alpha_1\ In GDP + \alpha_2\ In EXG + \alpha_3\ In FRV + \alpha_4\ In[IOP] + \alpha_5\ ln IMC + \alpha_6\ In Dsap + U_t \quad (3)$$

$$ln\ TX_t = \beta_0 + \beta_1\ In GDP + \beta_2\ InWIC + \beta_3\ In EXG + \beta_4\ In[IOP] + \beta_5\ In TX_{t-1} + \beta_6\ In Dsap + U_t \quad (4)$$

Where: GDP = Gross Domestic Product.

EXG = Exchange Rate

FRV = Foreign Reserves

TX_t = Total Exports

TM_d = Total Imports

WIC = World Imports Capacity

IOP = Index of Openness

IMC = Index of Import Capacity

Dsap = Dummy Variable

Ut = Random error Term

α_1, α_2, α_3, α_4, α_5, and α_6 are the elasticities of income, exchange rate foreign reserves, index of openness, a dummy variable and Imports capacity of the Nigerian economy. On prior grounds, only $\alpha_2 < 0$; while α_1, α_3, α_4 and $\alpha_5 > 0$. On the other hand coefficients of equation (4) that is: β_1, β_2, β_3, β_4, β_5, and β_6 are the elasticities of income, world's Imports capacity, exchange rate, index of openness and lag of Exports. On a priori grounds, β_1, β_2, β_4, β_5, and $\beta_6 > 0$; while only β_3, < 0.

Two dummy variables were included, one each in the import and export demand models to capture the period before and after the introduction of structural adjustment programme in the country in 1986. Both imports and exports were liberalized and the liberalization was further enhanced by Nigeria's membership of the World Trade Organization (WTO). The dummies are binary 0, 1 variable. 1 is for post SAP and WTO and 0 for pre – SAP and WTO agreement. Their coefficients are expected to assume any value between greater than or less than zero.

A dynamic representation of the long run relationship of equations (3) and (4) using a linear ordinary least squares regression model specified as error correction model, (where all variables are found to be stationary or co-integrated at the first level of differencing) is specified as follows:

$$d\ln TM_d = \alpha_0 + \alpha_1\, d\mathit{In}GDP + \alpha_2\, d\mathit{In}EXG + \alpha_3\, d\mathit{In}FRV + \alpha_4\, d\mathit{In}[IOP] + \alpha_5\, d\mathit{In}Dsap + \alpha_5\, ECM_{t-1} + U_t \quad (5)$$

$$d\ \ln TX_t = \beta_0 + \beta_1\, d\ \mathit{In}GDP + \beta_2\, d\ \mathit{In}WIC + \beta_4\, d\ \mathit{In}EXG + \beta_4\, d\ \mathit{ln}[IOP] + \beta_5\, d\ \mathit{In}Tx_{t-1} + \beta_6\, \ln Dsap + \beta_7\, ECM_{t-1} + U_t \quad (6)$$

Equations (5) and (6) are estimated and the results would forms the basis for the interpretation of the co-efficient in the model and of the entire model.

3.1 Estimation Procedure and Data Used

The Augmented Dickey Fuller Unit root test is to establish the order of integration of the time series variable hand in hand with Philip-Perron test and co-integrated Durbin Watson Statistic. The aim of any statistical analysis is to draw inference regarding the configuration of the population using sample observations. Most time series variables are non-stationary, and to obtain the level of stationary, they need to be differenced *d* time(s), expressed as I*(d)*. Egwaikhide (1999) states that regression analysis in which one or more non-stationary variables are used in the model produces baised estimates or spurious results.

The Engle-Granger two-step procedure is used to test the order of stationarity or co-integration. This involves testing for unit root (DF, ADF and SBDW) on the individual series. The second stage of the estimation involves evaluating the order of integration of the residuals generated from the static model. The level or order of co-integration of the residual error term should be one step lower than that of the variables in order to qualify as an error correction variable. For example, if all variables are stationary at the level of first differencing, i.e. I*(1),* then the residual term should be integrated at order zero, i.e. I*(0)*.

4.1 Empirical Analysis

This section presents the regression results of conventional/static model, stationarity tests for all the regression variables and the error term. It also contains regression results of the dynamic specification of the model and other relevant empirical tests.

Table 1 presents the results of conventional regression of equations (3) and (4). Equation (3) is on Imports demand function and the results show that five out of the six coefficients were all

statistically significant at 1 percent level and have correct signs; theoretically. The coefficient of multiple determination, that is, the adjusted R^2 is very strong at 0.87. This shows a very strong explanatory power of the independent variables in explaining change in the dependent variable, which is import demand.

Table 1

Conventional Regression Results of Import and Export Demand Functions

Dependent/Indep. Variable	Coefficient	t-values	Other Statistics	
Ln TMd				
C	-0.83	-0.38	R^2	0.89
Ln GDP	0.76*	3.88	Adj. R^2	0.87
Ln EXG	-0.35*	-2.94	F- stat.	33.94
Ln FRV	0.28*	5.70	D.W.	1.02
Ln IMC	-0.20*	-2.79		
Ln IOP	0.36	1.89		
Dsap	-0.69*	-3.08		
Ln TXt				
C	-50.38*	-6.61	R^2	0.92
Ln GDP	-1.12	-1.93	Adj. R^2	0.91
Ln EXG	1.44*	2.91	F- stat.	63.33
*Ln*IOP	1.71*	3.78	D.W.	1.41
Ln WIC	3.66*	5.71		
Dsap	-1.88**	-2.16		

* Indicates significance at 1%, while ** indicate significance at 5%
See appendix for more results

Furthermore, the value F – statistic shows that all the independent variables are non zero at 99 percent level of confidence. We thus reject the null hypothesis that the coefficients have zero value. D.W. statistic, however, reveals the presence of negative autocorrelation problem at 1 percent. This is not unconnected to the characteristic of the Data used in the regression.

Equation (4) results show that Nigeria's export demand can be effectively explained using the specified independent variable. Virtually all the variables are significant at 1 percent level. Gross domestic product (GDP) and exchange rate variables have, however, incorrect signs. Adjusted R^2 reveals a very strong explanatory power of the independent variables. This defines the fitness of the regression line. F – statistic also shows that the coefficients of the independent variables in the model are all non zero. D.W. statistic shows no autocorrelation at

1 per cent level. Generally, the implications of these results show that both the imports and exports demand models in Nigeria can be predicted using the specified independent variables. Prominent in the import demand model were the GDP and the exchange rate variables and index of openness and World's import capacity in the export demand model. The findings are consistent with those of Reinikka (1993), where he estimated Kenya's import demand and Aliyu (2001) on Nigerian import demand as well as Yekini (1999) on Nigerian export demand functions.

To establish long run relationship in the models, the order of cointegration of the regression variables and the residuals obtained from the conventional regression are established. This is based on the first level of differencing of the coefficients and zero level for the residual term.

Table 2

Augmented Dickey Fuller and Phillip-Perron Stationarity Tests

	ADF-Test				Phillips- Perron Test			
Variable/ Coefficient	Slope	t-Stat.	Critical Value*	CRDW	Slope	t-Stat.	Critical Value*	CRDW
Ln TMd	-1.04	-3.90	-2.64	2.07	-0.88	-5.01	-2.63	1.96
Ln TXt	-1.80	-5.10	-3.67	1.91	-1.65	-11.55	-3.66	2.09
Ln GDP	-1.24	-4.40	3.65	1.89	-1.08	-5.84	-3.64	1.96
Ln EXG	-1.04	-4.31	-2.64	2.01	-0.85	-4.76	-3.64	1.94
Ln FRV	-1.13	-4.33	-3.66	1.99	-0.98	-5.37	-3.65	1.99
Ln IOP	-1.44	-4.47	-3.68	2.00	-1.35	-7.74	-3.67	2.04
Ln WIC	-1.18	-4.06	-3.65	2.01	-1.24	-7.09	-3.65	1.97
Ln IMC	-1.17	-3.99	-3.65	1.95	-1.11	-6.22	-3.64	1.98
Ln Dsap	-1.07	-4.00	-3.65	2.00	-1.03	-5.76	-3.64	2.00

Note: Researchers Computations from data presented on appendix 1
*****MacKinnon critical values for rejection of hypothesis of a unit root.

Table 2 above presents the results of cointegration test of the time series of all the nine variables. The ADF test shows that the calculated t – statistic is less than the Mackinnon test statistic at 1 per cent. This provides the basis for the rejection of the alternative hypothesis of non-stationarity in the series. The regression models of the variables show no autocorrelation.

Phillips – Perron test, a confirmatory test also establishes stationarity in all the series at first level of differencing. Similarly, the co integrated Durbin Watson statistic reveals no autocorrelation in the cointegration models.

Table 3

Residual Stationarity Test on Error Term

Equation/ Coefficient	Slope	t-Statistic	Critical Value	Decision
Equation 1	-0.77	-4.36	-3.68	*I*(0)
Equation 2	-0.74	-3.86	-2.64	*I*(0)

Note: Researcher's Computations from data presented on appendix 1
*****MacKinnon critical values for rejection of hypothesis of a unit root.

Results of cointegration of residual term are presented in table 3. Both equation (3) and (4) yield residuals that are stationary at zero level of differencing, that is, the residuals are both I (0) series. An important implication of these findings is the existence of a long run relationship between the dependent and the independent variables. Meaning, in the long run, the dependent variables; imports and exports demand can be efficiently predicted using the specified independent variables. The next step is estimate the two models; the import and export demand with an error term introduced as an error correction mechanism.

4.2 Dynamic Models

Table 4 presents the results of the Nigeria's error correction import demand model and this can be interpreted in the following way:

That the coefficients of the constant, current and past (lag 1) GDP, coefficient of lag of foreign reserves policy variable in a dummy form, current index of openness and the adjustment coefficient of error correction variable all maintain a negative sign. This means that a unit change in any of these variables will impact negatively on the level of import demand. Except for the adjustment variable, however, is theoretically incongruent. It is worthy to note that out of the seven coefficients, only two are statistically insignificant and these are the coefficient of the current GDP and that of dummy variable. The result further reveals that coefficients of the

current and past level (lag 1-2) of exchange rate, current and past (lag 1-2) index of Imports capacity, past index (lag 1-2) of openness are all high with positive sign.

Table 4

Dynamic Import Demand Model: Import as Dependent Variable

Variable	Coefficient	Std. Error	t-Statistic
Constant	-17.89398*	1.703075	-10.50687
DLNGDP	-1.224893	1.026458	-1.19332
DLNGDP(-1)	-3.341920*	1.021139	-3.272737
DLNEXG	2.319947*	0.759392	3.055004
DLNEXG(-1)	3.270256*	0.555428	5.887814
DLNEXG(-2)	1.048781*	0.402440	2.606056
DLNFRV(-1)	-0.366849*	0.176553	-2.07784
DDSAP	-1.598947	1.171835	-1.364482
DLNIMC	2.152687*	0.542865	3.965416
DLNIMC(-1)	3.654891*	0.514494	7.103857
DLNIMC(-2)	0.986422*	0.270839	3.642099
LNIOP	-1.899158*	0.849180	-2.236460
LNIOP(-1)	1.498790**	0.821826	1.823731
LNIOP(-2)	4.917989*	0.867198	5.671128
ECM_1	-3.134629*	0.853193	-3.673998
R-squared	0.958948	D-W Statistic	1.789451
Adjusted R-squared	0.917895	F-Statistic	23.35906

* Indicates significance at 1%, while ** indicate significance at 5%
See appendix for more results

This also implies that a unit change in any component of these independent variables will result in a positive change in the level of import demand. For some like the index of import capacity and that of openness, their signs conform to the *a priori* expectations, while the sign of for the exchange rate coefficient does not. It is pertinent to note that seven out of the eight coefficients were all statistically significant, and only one, which is past (lag 1) index of openness, is not. Other virtues of the model are its strong coefficient of multiple determination, absence of AR(1) serial correlation and a very high and strong value of the F-statistic. One key economic implication of the result is that it shows the existence of a long run relationship between import

demand and a vector of all the independent variables. Furthermore, when we consider the absolute values of the coefficients, the result show high values of income (GDP) and exchange rate elasticities which are principal to BOP equilibrium and its stability.

On the other hand, the results from the short run error correction export demand model presented in table 5 show that the coefficients of log of current and past (lag 1-3) levels of GDP are all incorrectly signed. Nonetheless, lag 1-2 are statistically significant at 99% level of confidence. Others, however, including the intercept of the model, are not. Furthermore, the coefficients of the current and past (lag 1-3) stationary series of exchange rate are all correctly signed except that of lag 3, and while the coefficients of the current variable, DLNEXG, along with its past level (lag 2) are significant at 1% level others, however, are not.

Table 5

Dynamic Export Demand Model: Export as Dependent Variable

Variable	Coefficient	Std. Error	t-Statistic
Constant	-0.105412	0.069880	-1.508470
DLNGDP	-0.547161	0.378827	-1.444357
DLNGDP(-1)	-1.207630*	0.385753	-3.130582
DLNGDP(-2)	-1.284839*	0.365138	-3.518781
DLNGDP(-3)	0.345084	0.324989	1.061832
DLNEXG	1.287804*	0.289499	4.448395
DLNEXG(-1)	0.387461	0.300421	1.289726
DLNEXG(-2)	0.454196*	0.167542	2.710932
DLNEXG(-3)	-0.130486	0.168747	-0.773263
DLNIOP	0.456654	0.457883	0.997317
DLNIOP(-1)	-0.571121**	0.314325	-1.816973
DLNIOP(-2)	0.629949**	0.318628	1.977068
DLNWIC	3.264734*	0.697797	4.678633
DLNWIC(-1)	2.285685*	0.596714	3.830457
DLNWIC(-2)	1.951046*	0.682402	2.859085
DDSAP	-2.133639*	0.456472	-4.674193
DDSAP(-1)	-0.288356	0.679011	-0.424671
ECM_2	0.378560*	0.159873	2.367873
R-squared	0.959858	D-W. Statistic	2.118412
Adj. R-squared	0.891615	F-Statistic	14.06546

* Indicates significance at 1%, while ** indicate significance at 5%
See appendix for more results

Index of openness coefficients both current and past (lag 1-2) are all insignificant statistically and they have mixed signs. While lag 1, for instance, has a negative sign, others have positive signs. Three coefficients of the index of the world Imports capacity performed very well at both current and lag levels. They all have correct signs and are significant statistically at 99% level of confidence. This implies that as the world's income increases, Nigeria's exports rise and vice-versa. In the same line, the coefficient of dummy variable, that is, a policy variable in the model is statistically significant and it maintains a correct sign. And this, when corroborated with the results of index of openness measure, adds to the hard fact that the outward policy in the country is inimical to the growth of the country's foreign trade sector. This has serious implications on BOP stability.

Lastly, the adjustment parameter, that is, the error correction coefficient, is a good fit in the model. It has correct sign and is significant statistically. This shows that Nigeria's export demand model adjusts to changes in the independent variables in the model. This further confirms the existence of a long run relationship, which earlier was established in the preceding sections of the paper. In confirmation to the above, the coefficient of multiple determination is strong and the model is corrected from first order autocorrelation with a value of D.W within the region of no autocorrelation. F-statistic is very strong and its probability is zero.

From the empirical results, although the exchange rate coefficient at both current and lag levels the demand model maintain an incorrect sign, the sum of the two elasticities from the two models is significantly greater than one. This fulfils the famous Marshall-Lerner condition of the necessary condition for BOP adjustment. The two elasticities are both highly elastic. This is, however, notwithstanding the fact that Nigeria has an inelastic income elasticity of exports and very weak (inelastic) exchange rate elasticity for exports in the lag periods. The implication of this is that the Nigeria's export is not stimulated by changes in domestic income and exchange rate, to the extent that exports decline as exchange rate depreciates or as income rises.

4.3 Stability Test

Employing the recursive residuals test, which is only applicable to the ordinary least squares (OLS) model, we test the stability of the overall model of Imports and Exports demand within the period under review. Figure 1 shows that in 1995, the recursive residuals of the Imports demand went beyond the ± 2 s.e. bands; while the residuals of 1992, 1996 and 1999, although are within the bands, are yet very close to the upper band.

Figure 1

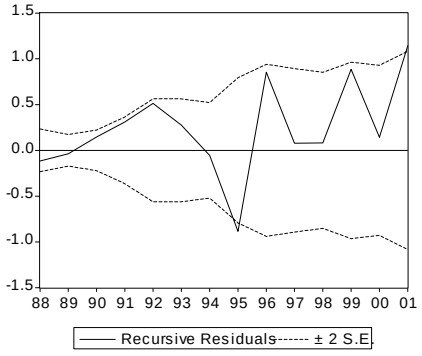
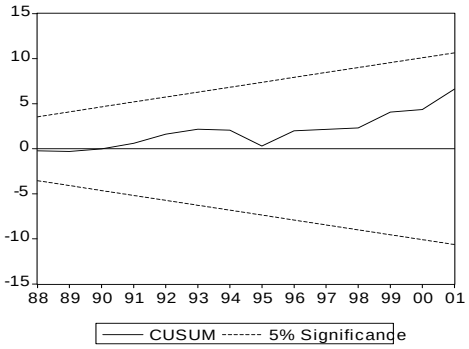


Figure 2

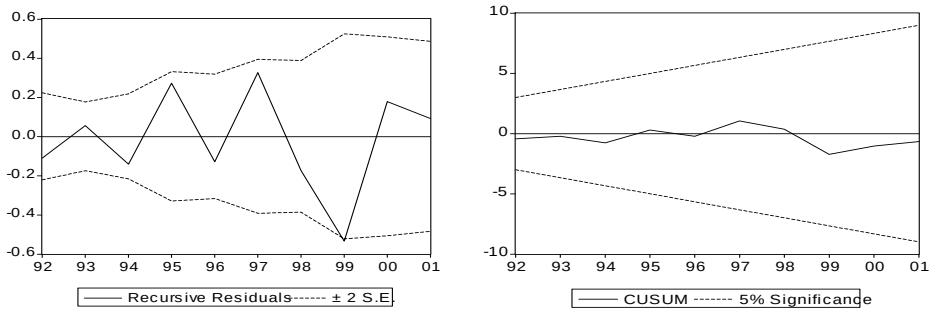


Thus, except for the year 1995, the model could be adjudged to be very stable. The CUSUM test, that is, the cumulative sum of residual test presented on figure 4.2.2 yields a better result. All the statistics fall within the critical lines at 5% level of significance. The figure on actual, fitted and residual plot presented under the appendix shows that while the fitted values move up and down along with the actual values, the residual plot, however, goes beyond the critical lines in 1975, 1985 and after 2000 periods.

On the stability of the export demand function, figure 3 shows that the model is also stable with the recursive value of residuals, except in the year 1995, all falling within the bands of ± 2 standard errors. The CUSUM test on the other hand presented on figure 4 shows that all the residual values fall within the critical lines at 5% level of significance. The actual, fitted and residual plot presented in the appendix further reveal that the fitted plot moves in a close match with the actual series while the residual series move below the lower band in 1978 and above it in 1984 and 1991 periods.

Figure 3

Figure 4



The above residual tests show that the two models are stable within the review periods and estimates from the models can be reliably used to analyze the two models.

5.0 Conclusions and Recommendations

This paper presented empirical analyses of the import and export functions in the Nigerian economy from 1970 to 2004. To situate this study within the context of existing ones and against the background of the main object of the paper, a detailed review of theoretical and empirical literature was carried out. This reveals that although there was no consensus on the specific factors affecting imports and exports demand models, most applications of these models to different countries adopt a similar approach, which is the ordinary least squares method (OLS) in either static or dynamic form.

Results from an empirical estimation of the static model reveal that the coefficients of virtually all the variables used in the model were fairly significant and consistent on a priori grounds. These would have been very useful for policy and forecast if not for the short memory problem and the apparent case of serial correlation of the residual term across the two models. These problems disappeared when the Augmented Dickey Fuller stationarity test was applied. Results show that all the series of the variables; including the residual term fulfilled the necessary conditions for cointegration and the models metamorphose into parsimonious dynamic models with error terms as correction mechanisms in the two functions. Results of the estimated dynamic speciation of the functions show that:

- Although current income exerts little influence on both Imports and Exports, past (lag) levels of income affect both. This is consistent theoretically, and

reflects the more natural imports and exports patterns in the country. As world income increases, Nigeria's export expands because of very high income elasticity.

- In absolute terms, exchange rate significantly affects imports more than exports and this largely, is due to the monocultural nature of Nigeria's exports and inexhaustible and multifarious nature of its imports.
- The Marshall-Lerner condition is said to hold in Nigeria. The absolute sum of coefficient of exchange is greater that one from the two models.
- It was further discovered that index of openness in the import model stimulates more imports while, SAP proxied by a dummy variable is anti exports.
- In the lung run, other factors not included in the model but captured by the error correction mechanism in imports model exert negative influence on imports, while the same in the exports model exert positive influence on exports. Thus, although disequilibrium in the short run is possible, but this suggests that there is room for convergence in the long run.

To achieve a better foreign trade and exchange policy and promotion of balance of payment stability, the paper recommends that:

- Although openness is inevitable in today's global world, sequencing of phases of liberalization is highly desirable, especially in a developing economy like Nigeria's. this is especially so because the coefficient of dummy variable for SAP in the two model was consistently negative.
- Fulfillment of the Marshall-Lerner condition unveils the need for ensuring greater stability in the foreign exchange market for the attainment of a stable exchange rate.
- Income restriction and expenditure switching measures to free resources for direct investments in the former and to sway attention away from wasteful consumption in the latter should also be put in place.

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APPENDIX

Results of Conventional Regression

LS // Dependent Variable is LNTMd
Date: 06/16/06 Time: 14:16
Sample(adjusted): 1971 2001
Included observations: 31 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.832654	2.183098	-0.381410	0.7063
LNGDP	0.760012	0.195985	3.877898	0.0007
LNEXG	0.348227	0.151792	2.294108	0.0308
LNFRV	0.283000	0.049577	5.708295	0.0000
LNIMC	-0.200911	0.072083	-2.787231	0.0102
LNIOP	0.360916	0.191261	1.887032	0.0713
DSAP	-0.694899	0.225257	-3.084914	0.0051

R-squared	0.894581	Mean dependent var	10.65628
Adjusted R-squared	0.868226	S.D. dependent var	0.555085
S.E. of regression	0.201500	Akaike info criterion	-3.008255
Sum squared resid	0.974451	Schwarz criterion	-2.684452
Log likelihood	9.640862	F-statistic	33.94377
Durbin-Watson stat	1.019979	Prob(F-statistic)	0.000000

LS // Dependent Variable is LNTXt
Date: 06/16/06 Time: 08:44
Sample(adjusted): 1970 2001
Included observations: 32 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-50.37866	7.626176	-6.606018	0.0000
LNGDP	-1.123064	0.581096	-1.932664	0.0642
LNEXG	1.436184	0.492776	2.914477	0.0072
LNIOP	1.708722	0.451819	3.781872	0.0008
DSAP	-1.884452	0.873563	-2.157201	0.0404
LNWIC	3.659653	0.640696	5.711999	0.0000

R-squared	0.924123	Mean dependent var	6.199153
Adjusted R-squared	0.909532	S.D. dependent var	1.905384
S.E. of regression	0.573101	Akaike info criterion	-0.946026
Sum squared resid	8.539560	Schwarz criterion	-0.671201
Log likelihood	-24.26961	F-statistic	63.33218
Durbin-Watson stat	1.409224	Prob(F-statistic)	0.000000

Results of Dynamic Regression Model

LS // Dependent Variable is DLNTMd
Date: 03/29/07 Time: 22:48
Sample(adjusted): 1973 2001
Included observations: 29 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-17.89398	1.703075	-10.50687	0.0000
DLNGDP	-1.224893	1.026458	-1.193320	0.2526
DLNGDP(-1)	-3.341920	1.021139	-3.272737	0.0056
DLNEXG	2.319947	0.759392	3.055004	0.0086
DLNEXG(-1)	3.270256	0.555428	5.887814	0.0000
DLNEXG(-2)	1.048781	0.402440	2.606056	0.0207
DLNFRV(-1)	-0.366849	0.176553	-2.077840	0.0566
DDSAP	-1.598947	1.171835	-1.364482	0.1939
DLNIMC	2.152687	0.542865	3.965416	0.0014
DLNIMC(-1)	3.654891	0.514494	7.103857	0.0000
DLNIMC(-2)	0.986422	0.270839	3.642099	0.0027
LNIOP	-1.899158	0.849180	-2.236460	0.0421
LNIOP(-1)	1.498790	0.821826	1.823731	0.0896
LNIOP(-2)	4.917989	0.867198	5.671128	0.0001
ECMT1	-3.134629	0.853193	-3.673998	0.0025

R-squared	0.958948	Mean dependent var	0.415251
Adjusted R^2	0.917895	S.D. dependent var	1.891285
S.E. of regression	0.541928	Akaike info criterion	-0.919000
Sum squared resid	4.111604	Schwarz criterion	-0.211778
Log likelihood	-12.82372	F-statistic	23.35906
Durbin-Watson stat	1.789451	Prob(F-statistic)	0.000000

LS // Dependent Variable is DLNTXt
Date: 03/29/07 Time: 23:28
Sample(adjusted): 1974 2001
Included observations: 28 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.105412	0.069880	-1.508470	0.1624
DLNGDP	-0.547161	0.378827	-1.444357	0.1792
DLNGDP(-1)	-1.207630	0.385753	-3.130582	0.0107
DLNGDP(-2)	-1.284839	0.365138	-3.518781	0.0055
DLNGDP(-3)	0.345084	0.324989	1.061832	0.3133
DLNEXG	1.287804	0.289499	4.448395	0.0012
DLNEXG(-1)	0.387461	0.300421	1.289726	0.2262
DLNEXG(-2)	0.454196	0.167542	2.710932	0.0219
DLNEXG(-3)	-0.130486	0.168747	-0.773263	0.4573
DLNIOP	0.456654	0.457883	0.997317	0.3421
DLNIOP(-1)	-0.571121	0.314325	-1.816973	0.0993
DLNIOP(-2)	0.629949	0.318628	1.977068	0.0762
DLNWIC	3.264734	0.697797	4.678633	0.0009
DLNWIC(-1)	2.285685	0.596714	3.830457	0.0033
DLNWIC(-2)	1.951046	0.682402	2.859085	0.0170
DDSAP	-2.133639	0.456472	-4.674193	0.0009
DDSAP(-1)	-0.288356	0.679011	-0.424671	0.6801
ECMT2	0.378560	0.159873	2.367873	0.0394

R-squared	0.959858	Mean dependent var	0.192632
Adjusted R-squared	0.891615	S.D. dependent var	0.736740
S.E. of regression	0.242548	Akaike info criterion	-2.577016
Sum squared resid	0.588296	Schwarz criterion	-1.720598
Log likelihood	14.34794	F-statistic	14.06546
Durbin-Watson stat	2.118412	Prob(F-statistic)	0.000082

APPENDIX

Table A

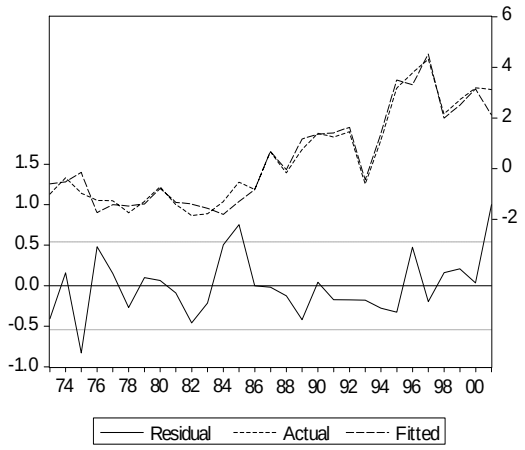
External Sector Statistics

Year	BOP Balance	Nominal Effective Exc. Rate	Official/ IFEM Exc. Rate	Parallel Exc. Rate	Premium
1970	-46.6	99.9	0.7143		
1971	-117.4	100.9	0.6955		
1972	-57.2	101.0	0.6579		
1973	-192	94.3	0.6579		
1974	-3102.2	100.8	0.6299		
1975	-157.5	100.4	0.6159		
1976	339.0	107.8	0.6265		
1977	527.2	102.6	0.6466		
1978	-1293.6	101.0	0.606		
1979	-1868.9	98.2	0.5957		
1980	-2402.2	106.3	0.546	0.9	0.354
1981	3020.8	110.4	0.61	0.926	0.316
1982	-354.9	109.9	0.673	1.136	0.463
1983	-349.1	109.8	0.724	1.818	1.094
1984	-354.9	113.2	0.765	3.25	2.485
1985	-349.9	100	0.894	3.79	2.896
1986	7843.3	51.9	2.021	4.17	2.149
1987	-159.2	14.7	4.018	4.194	0.176
1988	2294.1	13.0	4.537	6.048	1.511
1989	-8727.8	8.9	7.392	10.533	3.141
1990	-18498.2	7.7	8.038	9.607	1.569
1991	-5959.6	6.3	9.910	13.425	3.511
1992	-65271.8	3.7	17.298	20.340	3.042
1993	13615.9	3.0	22.111	36.229	14.12
1994	-7194.9	2.9	21.886	59.960	38.07
1995	15325.1	0.7	21.886	83.676	61.79
1996	-183952.6	0.8	21.886	83.107	61.22
1997	-251593.1	0.8	21.886	84.972	63.09
1998	36961.0	0.8	21.886	87.860	65.97
1999	-152361.0	0.2	96.120	99.260	3.140
2000	-453399.7	0.2	100.802	111.832	11.03
2001	-56531.9	0.2	111.900	132.585	20.69
2002	330792.5	0.18	120.470	137.790	17.32
2003	27595.1	0.15	129.223	141.790	12.57
2004	1266546.5	0.15	133.500	140.850	7.350

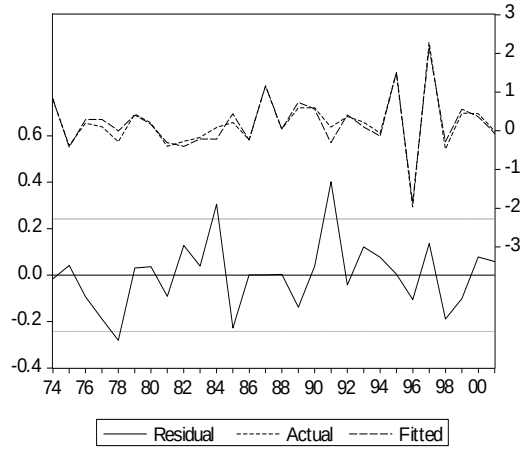
Source: Annual Reports and Statement of Accounts and Statistical Bulletin all from Central Bank of Nigeria (CBN) various issues. Negative sign indicates increase in reserves while Plus sign indicates decrease in reserves.

Note that parallel market operations started few years to the commencement of Structural Adjustment Programme (SAP) due to the weakening of regime of tight control.

Actual Import, Fitted and Residual Plot



Actual Export, Fitted and Residual Plot



Balance of Payments, Exports and Openness Plot