

Determinants of imports in Nigeria: A dynamic specification

By

Festus O. Egwaikhide
*Department of Economics
University of Ibadan
Nigeria*

AERC Research Paper 91
African Economic Research Consortium, Nairobi
March 1999

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Acknowledgments

This research project was done when I was at the Nigerian Institute of Social and Economic Research (NISER), Ibadan. I am indebted to Benno Ndulu, Ademola Oyejide, Abdul Rasaq Olopoenia, Olu Ajakaiye, Stephen Yea, Dean Derosa, William Lyakurwa and other resource persons in the AT Group for thorough discussions and suggestions. The constructive comments and reactions of the participants in the workshop series (between December 1992 and December 1993) organized by the African Economic Research Consortium and two anonymous referees are gratefully acknowledged. I wish to thank the AERC for financial support. The usual disclaimer applies.

Abstract

This study examines the determinants of aggregate imports and its components in Nigeria between 1953 and 1989. The estimated equations rest on the stock adjustment import exchange model that has its roots in the balance of payments theory and in the consumer theory of demand as in the traditional import demand function. Quantitative estimates, based on integration and error correction specification, indicate that foreign exchange earnings, relative prices and real income all significantly determine the behaviour of total imports in the reference period. Findings also show that the short-run import decisions are determined by the dynamics of foreign exchange, which is tied to the long-run effect through the feedback mechanism. The results of the disaggregated imports also reveal the importance of foreign exchange. Thus, it is concluded that if the Nigerian government wishes to increase imports, it is essential to implement economic policies that will enhance foreign exchange availability. The near unity of the price elasticity of demand suggests that exchange rate policy can be used to influence imports in the country.

I. Introduction

The importance of foreign trade in the development process has been of interest to development economists. Indeed, this has been stressed in the two-gap programming model developed by McKinnon (1964) and Chenery and Strout (1966). Imports are a key part of international trade and the import of capital goods in particular is vital to economic growth. Imported capital goods directly affect investment, which in turn constitutes the motor of economic expansion. This may have prompted several authors to be preoccupied with the determinants of imports in developing countries, with the result that a number of functional specifications have been explored. These studies have undoubtedly provided considerable insights into the quantitative effects of aggregate economic activity (proxied by real income) and import prices relative to domestic prices on total imports.

Available evidence generally suggests that most developing countries registered a persistent decline in their foreign exchange earnings from the early 1980s. This is attributed largely to the collapse of commodity prices in the world market. Combined with this are two principal factors. First, is reduced foreign lending, probably influenced by the inability of Mexico to meet its debt obligations by 1982. Second is the increased cost of external borrowing, provoked by the deficit financing of the Reagan Administration in the United States.

This triggered a series of developments in most developing countries. Students of public finance are agreed that income from external trade dominates government revenue in these countries. Both exports and imports of developing countries are subject to periodic fluctuations in the world market, and revenue from this source tends to oscillate accordingly. Thus, it was not surprising that the collapse of commodity export prices in the early 1980s engendered fiscal crises in most African countries, as reflected in their huge budget deficits². In part, this led to the adoption of economic reform programmes.

Economic reform is expected to affect imports, part of the strategy to restore external balance. According to Moran (1989), this policy decision is positively harmful to investment and output in developing countries. Perhaps, this is a demonstration of the reliance on imports for domestic production. Simultaneously, it reveals the role played by foreign exchange availability in the growth process.

This study examines the determinants and major components of aggregate imports and its major components in Nigeria. A dynamic specification of import demand model is explored³. In particular, cointegration and error correction model (ECM) that has gained currency is pursued. Findings show that foreign exchange earnings, relative prices and real income all significantly influenced import behaviour in the period 1953 to 1989.

Given the principal role of foreign exchange in import demand, it is suggested that economic policies should focus on those factors that inhibit foreign exchange availability.

The sequence of this paper is clear. The growth of imports in Nigeria is discussed. Import control measures implemented since the early 1960s are pursued. Thereafter, evidence of import demand is reported. The theoretical foundation on which the models are predicated is developed and the various equations specified. Next is the methodology of estimation. These are followed by the estimation results and the concluding remarks.

II. The growth of imports in Nigeria

Nigeria's aggregate imports have grown substantially since the country's political independence in 1960. The nominal value of merchandise imports leapt from ₦432 million in 1960 to ₦757 million in 1970 and therefore surged to record about ₦9 billion in 1980. Following the foreign exchange crisis of 1981–1986, engendered by the collapse of crude oil prices, the magnitude of imports waned. From ₦15.7 billion in 1987, imports increased by about a factor of two in 1989. Thus, the growth rate of imports, which had averaged 2.5% annually in the 1960s, climbed to an annual average of 33% between 1970 and 1989.

The index of openness has fluctuated between 23% and 56% over the years, 1960–1989. Imports alone as a proportion of GDP did not fall below 10%, except in 1974 and 1986, throughout this period. Considering that the index of openness has been consistently above the 15%–20% mark often suggested in the literature,⁴ the Nigerian economy can be said to be relatively open. This possibly explains why any disequilibrium in the external sector is transmitted promptly and widely to the rest of the economy.⁵

The growth of imports is attributable to several factors. These include the need to pursue economic development, the expansion in crude oil export that considerably raised foreign exchange earnings and the over-valuation of the local currency, which artificially cheapened imports in preference to local production⁶. The astronomical expansion of domestic absorption is a key factor that should not be ignored. It has been argued by Schatz (1984) that there was inadequate supply of goods during this period. As a result, part of the growth in domestic absorption had to be satisfied by imports. In Figure 1, the growth of real domestic absorption mirrors the growth of real imports. The growth of the economy, proxied by the real GDP growth rate can be juxtaposed against this. Figure 2 suggests that a weak relationship exists between economic growth and total imports.

Statistics reveal that the import of consumer goods dominated aggregate imports up to 1965, though their relative share declined from 60% in 1950 to 41% by 1965. During this period, the import of capital goods, which was next to consumer goods, fluctuated between 24% and 40%, while the share of raw materials generally increased from 10% to 23%. From 1970, the distributional pattern of imports changed dramatically, with the import of capital goods leading and followed by raw materials after 1980. Data show that the contribution from consumer goods fell from 40% to 27% between 1980 and 1990.

The proximate determinants of this outcome can be identified. A key factor is the import substitution industrialization pursued with vigour since the late 1950s. This strategy, which equated industrialization with development, relied mainly on imported

Figure 1: Annual growth in domestic absorption (GABR) and imports (GMTR)

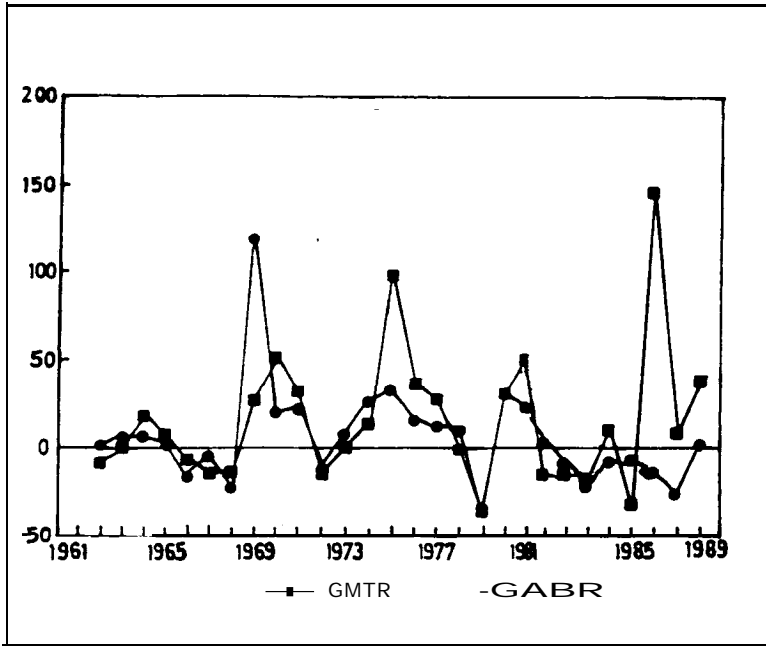
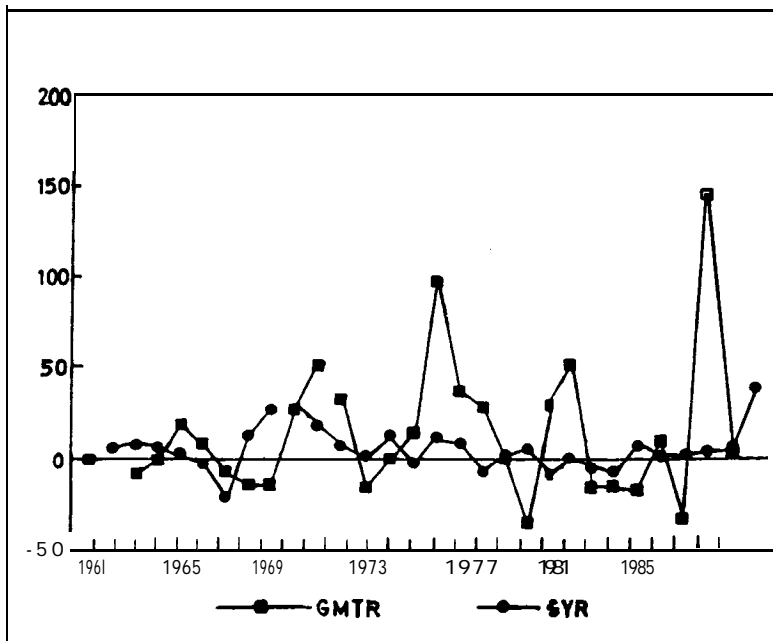


Figure 2: Annual growth in GDP (GYR) and imports (GMTR)



inputs, particularly raw materials. Moreover, the capital goods industrial subsector is at the threshold and weak. Of course, this meant dependency on imported machinery and equipment that are basic to production in the economy. The gradual decline in the import of consumer goods after 1980 was due largely to the foreign exchange crisis, precipitated by the collapse of crude oil prices in the world market. Following this was the implementation of import control measures. In this respect, a historical review of Nigeria's trade policies, with particular emphasis on import control measures, will certainly sharpen the understanding of the determinants of import behaviour in the last three decades

III. Trade policy trend - Import control measures

Import substitution industrialization, which is a logical outgrowth of the declining terms of trade thesis, has been pursued vigorously since the late 1950s in Nigeria. It was envisaged that this strategy would have Hirshman-type linkages with the rest of the economy, and consequently, import substitution was equated with development. Nigeria has historically and generally maintained highly protective trade regimes partly to support this development policy (Ekuerhare, 1980; Forrest, 1982). Trade policies were also substantially influenced by the periodic balance of payments difficulties and the need to generate revenue (Oyejide, 1975). The presentation here focuses on import policy since the 1960s.⁷

In general during the first half of the 1960s, customs duties were designed specifically to raise revenue for government and protect import substituting industries that were at their threshold. But by 1965, it was clear that measures needed to be taken urgently to correct the balance of payments difficulties. Consequently, an Official Committee on Balance of Payments was set up by the federal government in August of the same year. An important recommendation of this committee was the imposition of ad valorem import taxes of between 33% and 150% on non-essential goods. For the rest of the 1960s, customs duties on a number of items were raised.

The civil war that raged between 1967 and January 1970 increased aggregate demand and due to supply shortages prices accelerated. As part of the measures to reduce inflation, tariff rates on several imported items, particularly those associated with agriculture, reconstruction, road development and manufacturing, were substantially reduced.

Following the oil boom that started in 1973, import tariffs were reduced. Particular reference to import control measures in the two years, 1976/77 may provide some useful insight. Controlling rising prices, especially food prices, was central to the trade policy of this period. Thus, import taxes on food and items associated with agricultural production and processing were cut sizably. Examples of items that witnessed reduced import tariff rates in 1976 included groundnut oil, cotton seed oil, and all cooking oils, from 33.33% to 20%; and sardines, from 10% to 5%. Import duty on raw materials used to manufacture pipe, electronics, metal fabrications and kitchen utensils was abolished. However, there were finished products whose import taxes were raised by between 15% and 50%.

A civilian administration (with Alhaji Shehu Shagari as the President) was installed on 1 October 1979. Imports were liberalized in 1980. This probably contributed to the balance of payments difficulties during 1981–1983. The foreign exchange problem and the burgeoning external debt led to the adoption of the Economic Stabilization (Temporary Provisions) Act in April 1982.⁸ Under the act, several commodities were banned from

importation and some 29 other goods were placed under specific import licenses that were previously under the open general license system. This was influenced by the decision to control imports. In the 1983 budget, about 150 commodities were placed under specific license requirements.⁹ Also, industrial raw materials and other complementary inputs that were formerly under open general license were now treated under the specific import license system. Some imported items were not only reclassified, new customs rates were also imposed on them.¹⁰

The civilian administration was overthrown by the military on 31 December 1983. The principal objectives of trade policies under the Buhari/Idiagbon regime were to protect local industries and encourage greater use of local inputs. Import tariffs were rationalized, and Schedule II of the Customs Tariff (Consolidation) Act of 1973, which permitted the importation of several commodities duty free, was abrogated, with the result that only 20 items could now be imported duty free.

There was a related development. The approved user scheme (AUS) and the general concessionary rates of duty (GCD) were abolished.¹¹ Following this, raw materials and intermediate goods imported by manufacturers that previously attracted very low duty rates, had ad valorem rates of between 10% and 75% imposed on them. As a supplement to this, all goods imported into the country were placed under specific license. These restrictive import measures created supply shortages of manufactured goods and raw materials that fueled inflation. These measures were maintained until 1985, though with minor adjustments.

In 1986, just before introducing the structural adjustment Programme (SAP), the federal government reviewed existing import taxes and introduced new ones. Of particular significance was the import levy of 30% imposed on all imported items, with the exception of raw materials and other related inputs that are basic to export production. With the introduction of the SAP, that 30% import duty year was abolished. Predictably, duties on imported items (except capital goods) were reduced considerably, generally by between 5% and 60% points. By contrast, duty rates on imported capital goods were raised from 5-10% to 10-20%. On the import list, the number of commodities prohibited previously was 26. This was reduced to 16, however, in which we had manufactured goods.

A number of export promotion incentives were enunciated in the SAP policy document.¹² For instance, export taxes were abolished in the 1987 budget. Concomitant with this was a comprehensive review of customs tariff in line with the philosophy of SAP.¹³ The increased use of local raw materials by manufacturers was thus stressed. A duty draw-back/suspension scheme in which exporters/producers could import raw materials, spare parts and related inputs for export manufactures duty free was approved by government. Other charges, including indirect taxes on these inputs, were also eliminated. In consonance with economic liberalism, in 1989 several items were removed from the import prohibition directory, though high import tariffs were placed on them.

Up to 1970, the local currency was fixed and a system of independent exchange rate (i.e., the naira exchange rate was independently fixed against the U.S. dollar and the British pound sterling) was in use.¹⁴ But, from 1978, the exchange rate was based on a basket of currencies of Nigeria's major trading partners.¹⁵ A system of floating exchange rate was adopted from late September 1986. The naira was over-valued during the oil

boom of the 1970s (Ajayi, 1988; Ogun, 1990), which artificially cheapened imports in relation to local substitutes, with increased imports as a direct consequence (Schatz, 1984).

In sum, there have been frequent changes in import control measures in Nigeria. This is probably because of the conflict between raising revenue and maintaining a favourable balance of payments, on the one hand, and between these and the need to protect import substituting industries, on the other. Indeed, emphasis on a particular objective varies from time to time. Import control measures under the adjustment programme were generally less restrictive than those implemented before it. This is evident in Table 1. Expectedly, the nominal tariff rate declined from 0.30 of the 1960s to early 1970s to 0.16 in 1989.¹⁶

Table 1: Customs duties adjustment for selected years in Nigeria (percent)

Items	Old ¹	New ²
Primary cells and batteries	30	25
Newsprint	50	45
Buses	30	10
CKD components		
- CKD Lagos	20	10
- CKD Ibadan, Enugu	15	7.5
- CKD Kano, Bauchi and Kaduna	10	5
Outboard engines and boats	15	10
Parts and accessories of motor vehicles	10	5
Marble, slate, ecaussine, granite, pebbles, dolomite, gypsum and natural magnesium	33.3	15
Asbestos, mica, natural steatite, natural cryolite, sodium borates, feldspar, strontianite	33.3	15
Floor coverings, copying papers (carbon), correspondence cards, envelopes, letter cards	66.6	20
Register, exercise books, memorandum blocks, receipt books, diaries and stationeries	66.6	25

Source: Official Gazettes of the Federal Republic of Nigeria (1988 and 1990).

¹ Import duty rate before the introduction of SAP in 1986.

² Import duty rate during SAP.

IV. Some evidence on import demand

There is a vast body of empirical literature on the determinants of aggregate imports and the focus here is on articles that are directly relevant to the chosen theme. It is convenient to begin with the empirical evidence on Nigeria. To date, only a few studies have specifically examined the determinants of aggregate imports in Nigeria. The pioneering effort of Olayide (1968) focused on only some selected commodities of Nigeria's imports in the period 1948–1964. Evidence from multiple regression models indicates that terms of trade, real income (measured by GDP) and the index of trade restriction had fairly good parameter estimates.¹⁷ The study by Ajayi (1975), also fairly extensive, can be divided into two parts. The first part considered aggregate imports and its determinants. The second part examined the factors that determine the components of total imports. The model specification reveals that it is an extension of the traditional import demand model. Estimates of the alternative specifications indicate that real income, relative prices, and foreign exchange were the major determinants of total imports in Nigeria during the years from 1960 to 1970.

Possibly motivated by the results of earlier studies, Ozo-Eson (1984) decided to investigate the same phenomenon using a monetarist import demand model. Thus, excess supply of real money balances was incorporated into the traditional import demand equation. For him, the omission of monetary variables in the aggregate import demand model could lead to biased estimates. Empirical results of this research show that relative prices and money supply significantly influenced import demand between 1960 and 1979 in Nigeria. The coefficients of real income in the alternative models attempted were not statistically significant even at the 10% level. A policy conclusion from this work is that disequilibrium in the money market directly affects total imports. It was noted that a reduction in money supply tended to reduce aggregate imports.

Apart from these studies, which focused specifically on the demand for imports, there are others that considered the demand for imports within a larger model (see, for example, Uwujaren, 1977; Olofin et al., 1986; Egwaikhide, 1989; Olopoenia, 1991).¹⁸ Of these, the estimates of Olopoenia are singled out for discussion since the study is relatively more recent. Here, the demand for import is functionally related to real expenditure and real exchange rate, a formulation based on the monetary approach to the balance of payments, as in Aghevli and Sassanpour (1982). The choice of these variables was largely dictated by the objectives of the macroeconometric model developed. The findings from an over-parameterized import demand model show that each of these variables not only had the theoretically expected sign, but was also statistically significant at the 5% level. The estimation procedures of this research draw on recent developments in cointegration and error correction specification.

Elsewhere, several authors have undertaken empirical investigations of the factors affecting imports demand.¹⁹ The work by Hemphill (1974) is particularly striking. He developed the stock adjustment import-exchange model that has its roots in the balance of payments theory. Statistical evidence from the application of this model, which ignored real domestic income and relative import prices as in the traditional import demand model, drawing data from eight developing countries, suggested that the results were generally consistent with the hypothesized relationship (i.e., between import and foreign exchange receipts).²⁰ Thus, this study supports the proposition that foreign exchange earnings are a major factor influencing aggregate imports in developing countries.

Prior to this research, the basic import demand model that relates imports to income and relative prices was used in several empirical investigations (e.g., Leamer and Stern, 1970; Houthakker and Magee, 1969). But the use of this model has been criticized by several authors. For instance, Burgess (1974) argued that although the traditional import demand model is able to provide measures of income and price elasticities, it assumes that total imports consist of final commodities that are not separable from those other goods that serve as inputs to the consuming sectors.

Even the appropriate measures of both the dependent and independent variables are not provided by theory. Thus, it is not surprising that various authors have used different price indexes and functional forms in the aggregate import demand model. However, Leamer and Stern (1970) noted that there are no well defined criteria for choosing a particular functional specification. Rather, it is the researcher who decides what functional form to use (this is probably influenced by the theoretical position chosen), provided the choice is not harmful to the results obtained. Several models explaining the determinants of imports have been used so as to provide an appropriate specification (e.g., Murray and Ginman, 1976; Khan and Ross, 1977; Goldstein, Khan and Officer, 1980; Thursby and Thursby, 1984).

A modification to the general import demand function attempted by Goldstein et al. (1980) is one in which imports are determined by income, prices of imports, non-tradeables and tradeables. The price indexes of tradeables and non-tradeables were constructed by the authors and estimates suggest that the price of non-tradeables significantly influenced imports in the sample countries. On the basis of this result, Goldstein and his associates argued that “one should not constrain price elasticity of demand for imports to be equal as between domestic tradeable goods and non-tradeable–goods a consideration which argues against, say, the income deflator as a proxy for the price of import substitutes” (Goldstein et al., 1980: 198).

Concerned about the matters arising from the various functional import demand models, Thursby and Thursby (1984) examined the appropriateness of alternative specifications, using five countries (Canada, Germany, Japan, UK and the United States) as case studies. They explored nine models of aggregate import 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 and over time. It was also revealed that for all the countries (except Canada) the accepted models were in logarithmic specification. This reaffirmed an earlier finding by Khan and Ross (1977) for Canada, Japan and the United States that logarithmic functional form is more appropriate.

Due to the importance of foreign trade in economic growth, as shown in several surveys (e.g., Magee, 1975; Goldstein and Khan, 1985), Moran (1989) attempted a comprehensive study of imports under a foreign exchange constraint. He developed two main import demand models. The models consider government policy measures (e.g., exchange rate and tariff policy) concerned with foreign exchange shortages (experienced particularly in the 1980s by developing countries) that directly influence total imports. The first model is a marriage of the basic traditional and Hemphill import demand functions; the model considers real income, relative prices, foreign exchange receipts and international reserves as determinants of imports. It follows, therefore, that both the traditional and Hemphill models are now special cases of the general import demand function. An F test was used to evaluate whether the general model which is an innovative creation—dominated both the traditional and Hemphill models. In general, statistical results suggest that the general import demand specification strongly dominated the sub-models in the various country groups examined.²¹

In the second model, an alternative to the first, both import volume and relative prices were endogenously determined. Again, the results obtained were quite consistent with the hypothesized behaviour. One striking conclusion, which Moran derived from the quantitative estimates of the different country groups, is that while real income and relative prices are important in the determination of total imports, the role played by foreign exchange constraints is central to import behaviour in developing countries.

V. The model and estimation method

The stock adjustment import-exchange model developed by Hemphill (1974) largely forms the basis of the estimated equations. Thereafter, the estimation procedures explored are developed.

The model

The theoretical foundation of the import demand model used here is well developed in the article by Hemphill (1974) and modified in Moran (1989). This begins by assuming that the basic objective is to minimize the costs of discrepancies between actual and desired levels of both imports and international reserves, which is expressed in a quadratic cost function as:²²

$$C_t = \alpha_1 (M_t - M_t^*)^2 + \alpha_2 (R_t - R_t^*)^2 + \alpha_3 (M_t - M_{t-1})^2 \quad (1)$$

where M and M^* represent actual and long-run equilibrium levels of imports, respectively; R stands for current level of international reserves; and R^* is the desired level of external reserves. It is expected that in a steady state, the current and desired levels of imports will be equal and will both equal the long-run foreign exchange (F^*).

Theory suggests that economic decision makers tend to minimize the cost of deviations from the long-run equilibrium level of imports. The argument is also advanced that international reserves are held essentially not to pay for imports but to finance the difference between imports and receipts. In this sense, international reserves are maintained basically to smooth out the volume of imports over time. But it has been hypothesized that the desired level of external reserves is directly related to the level of foreign receipts, so that:

$$R_t^* = \beta_0 + \beta_1 F_t^* \quad (2)$$

$$0 \leq \beta \leq 1$$

In the long run, $F^* = M^*$; in the short run, both variables are related through the balance of payments identity:

$$M_t + \Delta R_t = F_t \quad (3)$$

$$\text{or } \Delta R_t = F_t - M_t'$$

where F stands for short-run foreign exchange receipts.

In general, it is often assumed that F^* is estimated from recent data. This derives from the notion that the future is likely to reflect developments in the past. Thus, if short-run foreign exchange (F) remains fairly constant over time, it can be equated with long-run foreign exchange earnings. Changes in the short-run foreign exchange affect the perception of the decision makers as to whether F is a representative of the long-run foreign exchange receipts. Such changes also influence the authorities' judgement on whether the change in F will be short-lived or permanent. Following this, it is assumed that:

$$F_t^* = F_t - \lambda \Delta F_t \quad (4)$$

where λ represents the way in which changes in foreign exchange receipts are perceived by the authorities. A positive value of λ corresponds with the belief that changes in foreign exchange earnings are seen by the authorities as transitory; when it assumes a negative value, it means that changes in receipts are perceived as a phenomenon that may persist (permanent). For simplicity, and following Moran (1989), the current level of foreign exchange earnings is equated with the long-run receipts; this implies that $\lambda = 0$

The aggregate import demand function is generally specified as:

$$M_t = a_0 + a_1 y_t + a_2 (P_m/P)_t + a_3 M_{t-1} \quad (5)$$

$$a_1 \leq 0; a_2 \leq 0, 0 \leq a_3 \leq 1$$

where y is real income, P_m denotes import prices taking into consideration both tariff and non-tariff measures, and P stand for domestic price index. When this equation is estimated in logarithmic form, the coefficients a_1 and a_2 are read directly as short-run income and price elasticities of import demand, respectively; $a_1/(1 - a_3)$ and $a_2/(1 - a_3)$ are the corresponding long-run elasticities.

However, this specification has a micro foundation, for it is based on the consumer theory of demand, which states that the aim of the consumer is to maximize satisfaction and so income is allocated among competing goods to obtain maximum satisfaction. This argument is extended to the demand for imports; that is, the demand for imports by a consumer is influenced by income, import prices themselves and prices of other commodities. The sum total of individual demand for imports constitutes the aggregate imports for the economy.²³

Most empirical works take the income coefficient to be "positive unless imports are inferior in consumption". Although evidence of negative income elasticity of demand for imports is hard to come by, it does exist theoretically. Since imports are the excess of

domestic consumption over domestic supply, then income elasticity for imports could be negative if domestic supply is more income-elastic than domestic consumption. Further, the possibility of a negative income elasticity of demand for imports has been demonstrated using a trade-growth framework. The argument is straightforward: That a growth in income could lead to ultra pro-trade-biased growth of domestic production, with a fall in imports as the inevitable concomitant (see Magee, 1975: 188–9).

Another import demand function could be derived by substituting Equations 2 and 5 into Equation 1 and minimizing this function subject to foreign exchange limitations represented by Equation 3.²⁴ This becomes:

$$M_t = b_0 + b_1 F_t + b_2 R_{t-1} + b_3 M_{t-1} + b_4 \left(\frac{P_m}{P}\right)_t + b_5 y_t \quad (6)$$

and $b_1, b_5 > 0$; $0 \leq b_2, b_3 \leq 1$; $b_4 \leq 0$.

This is the estimated equation by Moran (1989) in which the traditional and Hemphill import demand models are now special cases of this general import demand function. Ignoring lagged imports, relative prices and real income, Equation 6 becomes the Hemphill import demand function.

The main modification to this model is the use of a dynamic lag structure, as in Hendry, Pagan and Sargan (1986). The general model form can be represented as:

$$\alpha(L)M_t = \alpha_1(L)Y_t + \alpha_2(L)(Pm/P)_t + \alpha_3(L)F_t + \alpha_4(L)R_t + V_t \quad (7)$$

where $\alpha(L)$, $\alpha_1(L)$, $\alpha_2(L)$, $\alpha_3(L)$ and $\alpha_4(L)$ denote lag specification. Clearly, this suggests an over-parametarized import demand model that will then be reduced to a more desirable specification using well known statistical criteria as a guide.²⁵

A refinement of the general model structure (Equation 7) is attempted, since not all the explanatory variables in this equation may be directly relevant. The assumption is that what is true of the whole may not be true of the component parts—the fallacy of composition. The import of consumer goods is hypothesized to depend on total consumption and the ratio of import to domestic prices, which captures the trade-off between imported consumer goods and their local counterparts.²⁶ Also included in this equation are foreign exchange earnings. This consideration is based on the fact that even if there is increased private consumption that has to be met from imports, the availability of foreign exchange receipts could be a constraining element.

$$1nMC_t = d_0 + d_1 1nTC_t + d_2 1n\left(\frac{Pm}{P}\right)_t + d_3 1nF_t \quad (8)$$

$d_1, d_3 \leq 0$; $d_2 \leq 0$

where MC and TC represent real import of consumer goods and real total consumption,

respectively.

The import of raw materials is affected by the availability of foreign exchange. Thus, raw material imports are functionally related to this variable, output of the industrial sector, which serves as a proxy for the production needs of imported raw materials by the country. It also represents the phenomenon of import substitution, a development strategy that relied heavily on imported inputs for production. Thus, the estimated equation becomes:

$$\ln MR_t = e_0 + e_1 \ln F_t + e_2 \ln YM_t + e_3 \ln (P_m/P)_t \quad (9)$$

$$e_1, e_2 > 0; e_3 < 0$$

The variable *YM* stands for real output of the industrial sector and *MR* represents import of raw materials in real terms.

Next are capital goods imports. These are basically non-competitive imports for which there are virtually no local substitutes. In this sense, even though foreign exchange could affect their importation, the volume of investment is a major factor that cannot be ignored. Investment is often regarded as the engine of growth. This is because it enlarges the capacity to produce goods and services in an economy, and it is also seen as a vehicle for the introduction of technical progress. In consequence, the volume of investment, which represents the requirement for machinery and equipment needs for production, is basic to explain capital goods imports. The ability to import this group of imports should also be influenced by movement in relative prices.

$$\ln MK_t = g_0 + g_1 \ln F_t + g_2 \ln I_t + g_3 \ln (P_m/P)_t \quad (10)$$

where: MK = import of capital, real
 I = real gross investment

Estimation procedures

The estimation procedures draw on the recent developments in cointegration analysis and the error correction model (ECM) that have been used to explore several economic phenomena. Central to this framework of analysis is the determination of the time series characteristics of the variables. Basically, the idea at this stage is to ascertain the order of integration and, therefore, the number of times a variable has to be differenced to arrive at stationarity.

This exercise is necessary because the aim of statistical analysis is to draw inferences about the configuration of a population that is usually unknown to the researcher. The current thinking in time series econometrics about economic variables that are stationary (also called $I(0)$ series) is that the mean and variance computed from such variables would be unbiased estimates of the unknown population mean and variance. However, the same argument does not hold for those series that are non-stationary such as random

walk (i.e., I(1) series), for example. It has been argued that using one or more non-stationary series in a regression equation could produce biased estimates, thereby leading to incorrect statistical inferences when such series are estimated at their levels, except in the case of a cointegrating relationship. Therefore, identifying the time series properties of model variables enables the researcher to avoid the problem of spurious estimates.

Among the fairly sophisticated methods for evaluating the time series characteristics of macroeconomic variables are the Dickey-Fuller (DF), Augmented Dickey-Fuller (ADF), and Sargan-Bhargava Durbin-Watson (SBDW) tests, which we have also used in this research. The DF test is a test against the null hypothesis that there is a unit root of I(1) series; the test equation is of the form:

$$\Delta X_t = aX_{t-1} + \sum_{i=1}^n bi\Delta X_{t-i} + e_t$$

This test uses the t-statistic on the coefficient of the lagged level of X_{t-1} and the result obtained is compared with the critical t-values given in the Fuller (1976) distribution table. It may be relevant to note that the critical value for the rejection (or acceptance) of the null hypothesis is a function of the sample size and the functional form of the model used for the test.

Typically, the ADF is the same as the DF test, except that the lag length has to be long enough to reflect the additional dynamics that may not have been captured by the DF test; and also possibly to ensure that the error term is white noise. These tests are generally weak for a small sample size. To that extent, they should not be considered as final in assessing the time series characteristics of economic variables. Rather, they should be seen as providing vital information about the underlying properties of the data.²⁷

Although economic variables may be individually non-stationary, there could still exist a mechanism that prevents some of the variables from diverging significantly from each other. The existence of such a relationship is labeled cointegration (Granger, 1981). The theoretical foundation for this, which derives from the minimization of a quadratic loss function over a long period of time, is well developed in many articles (Salmon, 1982; Nickel, 1985; Domowitz and Elbadawi, 1987).

Furthermore, robust methods for testing whether macroeconomic variables are cointegrated have been put forward (see Engle and Granger, 1987; Johansen and Juselius, 1990; Stock and Watson, 1989). The Engle-Granger two-step procedure is used to test the existence of cointegrating relationship due to its simplicity. This required testing for unit root (DF, ADF and SBDW) on the individual series; and when the variables of interest were found to be I(1), a static model was estimated for the cointegrating regression. The second stage involved evaluating the order of integration of the residual generated from the static model. The satisfaction of a battery of tests justified the application of the error correction model. The sources of the data for the model estimates are indicated in Appendix A.

VI. Model estimation and interpretation

This section discusses the results of the unit root tests, as well as estimates of aggregate imports and its components. For ease of understanding, these are discussed in turn.

Data characteristics

In accordance with the preceding section, the order of integration of each variable was determined. The results of the test statistics are reported in Table 2. All the variables are in real terms. Also, the series are all expressed in natural logarithmic form prior to the statistical computations and other subsequent analyses.

It is evident from Table 2 that the results of DF and ADF tests fail to reject the null hypothesis that these variables are non-stationary, and they are particularly of a random walk (i.e., I(1)). Even the low value of the SBDW statistic for the data is indicative of this order of integration. The DF and ADF results of foreign exchange (F)—also called the capacity to import—and the ratio of import price to domestic price level (P_m/P) are positive, contrary to expectation. Consequently, a cascading test was conducted on these variables. The test statistics of the logarithmic first difference of these data are significantly high, thereby rejecting the null hypothesis that their first difference is non-stationary. Thus, these variables are I(1) series.

The results of total imports

Given that all the variables in the model are I(1) series, the Engle-Granger two-step method was then adopted to determine any cointegrating relationship between the dependent and independent variables. This approach, however, ignores other possible cointegrating relationships between the regressors. Different static cointegrating regression models were tried for this exercise and only the result of the static cointegrating regression is reported in Equation 11. The figures in parentheses are the standard errors of the coefficients.

Table 2: Results of unit root tests

Variable	SBDW	DF	ADF	No. of Lags
M	0.0721	-0.1758	-0.0626	3
(Pm/P)	0.0389	1.5133	2.4575	2
$\Delta(Pm/P)$	1.1086	-4.0872	-2.6869	3
F	0.0841	1.056	0.6536	4
ΔF	2.3506	-3.5101	-1.9818	4
Y	0.0347	-1.2358	-1.6500	4
YM	0.0220	-1.3229	-1.5753	4
MC	0.1096	-0.5368	-0.2115	4
MR	0.0482	-0.5445	-0.8105	3
MK	0.0861	-0.2661	-0.2791	5
ECM	0.9711	-3.1791	-2.5890	3
ECMR	1.3103	-4.2425	-3.0549	3
ECMK	0.1531	-3.6728	-2.8452	3

Notes: DF and ADF are the Dickey-Fuller and Augmented Dickey-Fuller tests, respectively; SBDW is the Sargan-Bhargara Durbin-Watson test. These were estimated with an econometric software called PC-GIVE developed by Hendry (1989). For both the DF and ADF tests, the critical values at the 5% level of significance are -1.95 for the sample of 25. The critical value for SBDW test is 0.78 for a sample of 60. However, the critical values of cointegration tests for DF and ADF at the 5% level are -3.67 and -3.29, respectively.

The residuals generated from this model were then tested using the SBDW, DF and ADF tests. The results of these are reported in Table 2 under ECM. The results of DF and ADF are below the critical values, which indicates that the residuals are non-stationary. The relatively high values of these test statistics motivated further investigation into the time series properties of the residuals of Equation 11.

$$M_t = 0.870 F_t + 0.241 \quad (11)$$

(0.041) (0.155)

$$R^2 = 0.93 \quad DW = 0.95$$

and

$$ECM_t = M_t - (0.870 F_t + 0.241) \quad (11')$$

As a consistency check, an unrestricted ADL of Equation 11 was estimated and the solved long-run solution of this model was then compared with the results of the static regression. Equation 12 presents the solved static long-run results of the ADL model.

$$M_t = 0.931 F_t + 0.186 \quad (12)$$

(0.418) (0.151)

A comparison of the coefficients of the two equations (11 and 12) reveals that they are very close, with the coefficients of the ADL lying within two standard errors on either side of those of the static regression and vice versa. By implication, the coefficients of the equations are coming from the same model and that the residuals of the two equations are not significantly different from each other. In addition, the coefficient of determination of the ADL model is very close to unity (0.97); this supports the existence of a cointegration relationship. Arising from this is the need to develop an error correction model.

A “general-to-simple” methodology is adopted. Thus, an over-parameterized error correction model is pursued. The results of this are reported in Table 3 and using the information criterion as a guide, this estimated equation was reduced to a more preferred specification (see Table 3b). Estimates show that the coefficients of all the regressors have the hypothesized signs and are statistically significant at the 5% level. A dummy variable was used to capture trade liberalization policy of the period, but the sign of its coefficient is contrary to expectation, as it is negative and also not statistically significant. This variable was then ignored. The results of a few diagnostic tests indicate that there is no error autocorrelation and conditional heteroskedasticity, and that the errors are normally distributed. This evidence indicates that short-run changes in the activity variable, relative prices and foreign exchange receipt play a remarkable role in shaping import behaviour between 1953 and 1989 in Nigeria. The coefficient of the error-correction variable shows the speed at which aggregate imports adjust to foreign exchange availability in the long run.

These results carry some important policy implications. The price elasticity of demand for import though large (-0.895), is less than unity. This finding seems to support the conclusion of Harberger (1957) that the price elasticity of demand for import is generally within the range of -0.5 to -1.0 or above this limit. It can be inferred from this that a devaluation of the local currency may significantly reduce import demand, particularly when there is no strong preference for imports.

The activity variable exerts considerable influence on the demand for imports, but with a lag. Although, the value of the income elasticity is relatively high, the economics of this may not be interpreted in isolation. It has been argued, essentially correctly that a country may face a difficult policy choice if the income elasticity of demand for imports is significantly higher than that for exports. Under this scenario, a country may decide to maintain the same growth rates with its major trading partners and record an unfavourable balance of trade. The alternative to this is to accept a low growth rate relative to its trading partners and witness a favourable trade balance. However, this submission follows the argument in the international trade literature that when income elasticities are the same for both imports and exports, a country with a faster growth record would suffer a secular deterioration in its external trade balance relative to its trading partners (Goldstein and Khan, 1985).

The short-run influence of foreign exchange stringency on total imports is demonstrated by the coefficient of the F and is tied to the long-run effect via the feedback mechanism (see the result of the ECM variable).

Table 3a: Modeling M^t by OLS

Variable	Coefficient	Std Error	t-Value
ΔM_{t-1}	.754	.357	2.111
ΔM_{t-2}	.647	.416	1.554
ΔM_{t-3}	-.520	.462	1.125
ΔM_{t-4}	-.259	.274	.944
ΔY_t	-.458	.564	-.812
ΔY_{t-1}	.097	.534	.182
ΔY_{t-2}	.287	.586	.491
ΔY_{t-3}	-.049	.675	.072
ΔY_{t-4}	.408	.680	.599
ΔF_t	.243	.175	1.390
ΔF_{t-1}	.544	.439	1.241
ΔF_{t-2}	-.912	.525	1.737
ΔF_{t-3}	-.642	.558	1.150
ΔF_{t-4}	-.170	.360	.473
$\Delta(Pm/P)_t$	-.889	.671	1.327
$\Delta(Pm/P)_{t-1}$	1.227	.607	2.021
$\Delta(Pm/P)_{t-2}$	-.105	.811	.129
$\Delta(Pm/P)_{t-3}$	-.203	.798	.255
$\Delta(Pm/P)_{t-4}$	-.210	.646	.325
DUM	-.132	.169	.779
ECM $_{t-1}$	-.871	.399	2.234
Constant	-.247	.219	1.128

R2 = 0.8439 F(21,10) = 2.57 (0.0624) SE = 0.1932 DW = 2.15
 SC = -2.069

Put more explicitly, the short-run import decision is determined by the dynamics of foreign exchange, which are affected by (M/F) ..., the feedback of the previous (M/F) ratio to ensure coherence with the long-run equilibrium target outcome. Although relative prices and income exert an important influence, the role played by foreign exchange availability seems to be more significant when judged by their respective t-values. This result should be of interest to policy makers who want to increase import demand. Efforts should focus on macroeconomic and sector-specific policies that can considerably relax those factors inhibiting foreign exchange earnings, in both the short run and the long-term.

A comparison of the short-run price and income elasticities shows that the results obtained from the current model are close to the estimates of Khan (1974) for Ecuador (see Appendix B) but differ significantly from those reported for Nigeria by Ajayi (1975). Based on the estimates, the long-run elasticity can only be reported for the foreign exchange variable. The value of the long-run elasticity of imports with respect to foreign exchange is about 0.9; this is obtained from the coefficient of equation 12.

Table 3b: Modeling Mt by OLS - Preferred specification

Variable	Coefficient	Std Error	t-Value
ΔY_{t-1}	.5878	.3121	1.883
ΔF_t	.3081	.1032	2.9863
$\Delta(P_m/P)_t$	-.8951	.3479	2.5730
ECM_{t-1}	-.4113	.1134	3.6261
Constant	0.0015	.0373	0.0397

R2 = 0.6076, F(4,30) = 11.61 (0.000), SE = 0.1777, DW = 1.51
 SC = -3.1018

A: Serial correlation

AR(1) F(1, 29) = 3.95

AR(2) F(2, 28) = 2.09

B: Normality $\chi^2(2) = 1.18$

C: ARCH(1) F(1, 28) = 4.65

Forecast $\chi^2(12)/12 = 2.1$; Chow test (12, 18) = 1.26

A: Lagrange multiplier test of residual serial correlation.

B: This is Jarque-Bera error-normality test (it is based on a test of skewedness and kurtosis of residuals).

C: Autoregressive conditional heteroscedasticity test of residuals.

Empirical results of disaggregated imports

Beginning with the import of raw materials, tests of cointegration between the dependent variable and the regressors were examined. Equation 13 presents the estimates of the static cointegrating regression with the figures in parentheses representing the standard errors of the coefficients.

$$MR_t = 0.714 Y_{Mt} + 0.501 F_t - 1.924 \quad (13)$$

(0.086) (0.082) (0.126)

$$R^2 = 0.98 \quad DW = 1.24$$

and

$$ECM_t = MR_t - (0.714 Y_{Mt} + 0.501 F_t - 1.24) \quad (13')$$

The time series characteristics of the residuals derived from this equation were thoroughly evaluated using the various tests discussed earlier. The results of these can be read under ECMR in Table 2. While the SBDW and DF statistical tests tend to support the existence of cointegration, the result of the ADF is below the critical value of -3.29 at the 5% level. Further clarification was then sought by estimating an unrestricted ADL of the cointegration regression. The solved static long-run of the ADL is reported in Equation 14.

$$MR_t = 0.595 YM_t + 0.577F_t - 1.808 \quad (14)$$

(0.263) (0.243) (0.274)

To have confidence in the results obtained, the values of the parameter estimates of equations 13 and 14 were compared. The coefficients of the static cointegrating regression were found to lie two standard errors both sides the coefficients of those of the ADL, a result that supports cointegration.

Based on these findings, an error-correction specification was attempted for the import of raw materials. From the alternative estimates, the results of Equation 15 are preferred.

$$\Delta MR_t = 0.2784 \Delta MR_{t-1} + 0.4897 \Delta YM_t + 0.4025 \Delta F_t$$

(2.0576) (2.4585) (3.7296)

$$-0.9884 \Delta(P_m/P)_t + 0.1371 DUM - 0.7964 ECMR_{t-1} - 0.1400 \quad (15)$$

(2.4565) (1.7424) (4.1484) (1.8316)

$$R^2 = 0.6469; F(6,28) = 8.55 (0.000); SE = 1.789; DW = 1.77$$

$$\text{Normality Chi}^2(2) = 0.92; \text{AR}(1) (1.27) = 1.38$$

The results of this model indicate that all the parameters are significantly different from zero and have the theoretically expected signs. Clearly, short-run changes in output of the industrial sector, foreign exchange availability and movements in relative prices exert significant influence on the import of raw materials during the reference period. There is also the evidence that trade liberalization resulted in increased demand for this group of imports.

Since the effect of changes in industrial output is quite significant, it follows that any improvement in the industrial sector that manifestly raises its output growth rate would increase the demand for raw materials, especially in the absence of any increased domestic supply of these imported inputs. The coefficient of relative prices is relatively higher than that of the aggregate demand model. This is an indication of the relative price sensitivity of the demand for imported raw materials. Quantitative estimates also demonstrate that foreign exchange availability is very central to these imports. An important lesson is obvious from these. In the absence of the devaluation of the exchange rate, reduced tariffs and the elimination of non-tariff barriers are expected to raise these components of imports.

Tests of possible cointegrating relationships were carried out before the empirical estimation of the capital goods import demand model. None of the performed tests (except the result of the SBDW test) supported the existence of a long-run relationship between the import of capital goods and the availability of foreign exchange. Consequently, an error correction modeling strategy could not be pursued. Rather, an over-parameterized ADL model was attempted for the capital goods import. The results of the estimate are discussed in Equation 16. The coefficient of the dummy variable included to capture the effect of trade intervention of the periods was not statistically significant and had to be dropped.

$$\begin{aligned}
\Delta MK_t &= 0.4379 \Delta F_t + 0.6568 \Delta I_t - 0.9671 \Delta(P_m/P)_t \\
&\quad (3.2131) \quad (3.5266) \quad (2.1279) \\
&- 0.9245 \Delta(P_m/P)_{t-1} - 0.0670 \\
&\quad (2.1430) \quad (1.2656)
\end{aligned} \tag{16}$$

$R^2 = 0.557$, $F(4,29) = 9.11$ (0.000) S.E. = 233. DW = 2.07
Normality $\text{Chi}^2(2) = 0.06$, AR (1) $F(\) =$
ARCH (1) $F(1, 27) = 0.01$, ARCH (2) $F(2, 25) = 0.04$
Forecast $\text{Chi}^2(14)/14 = 1.74$ (1976 - 1989)
Chow Test (14, 15) = 0.88

Evidently, annual changes in investment, foreign exchange availability and relative prices constitute important determinants of capital goods import during the study period. The impact of relative prices is striking. It is apparent that current changes in the value of capital goods import responded remarkably to current changes in relative prices. There is also a significant spread effect of relative prices on the demand for these imported goods. A plausible translation of these results is that the demand for this group of import is very sensitive to relative prices in Nigeria. It is suggested from the significant coefficient of the aggregate investment variable that the growth of the economy, engendered by the dynamics of investment, would call for these imports. When evaluated on the basis of the t-statistic, the influence of investment is more significant than the availability of foreign exchange.

The estimation results of consumer goods imports are shown in Equation 17. The various statistical tests performed did not support the existence of any cointegrating relationships between the import of consumer goods and any (or a combination) of its explanatory variables; hence, the need to develop a parsimonious error correction model did not arise.

$$\begin{aligned}
\Delta MC_t &= 0.5720 \Delta F_t + 0.4217 \Delta F_{t-1} + 0.5587 \Delta TC_t - 0.5711 \Delta(PM/P)_t + 0.1311 \text{DUM} \\
&\quad + 0.02145 \\
&\quad (3.6731) \quad (2.9637) \quad (1.8651) \quad (1.7267) \quad (1.5150) \quad (.2717)
\end{aligned} \tag{17}$$

$R^2 = 0.425$, $F(5, 29) = 4.29$ (.0048), S.E. = 0.228, DW = 2.02
Normality $\text{Chi}^2(2) = 1.24$
ARCH (1) $F(1, 27) = 0.01$ AR (1).

Evidence from this model demonstrates that the availability of foreign exchange is critical to the import of consumer goods. The short-run dynamics of the effect of aggregate consumption is correctly signed and statistically significant at the 5% level. This is an indication that any rapid growth in domestic consumption will spill over to the external sector in the form of increased demand for consumer goods.

The coefficient of the ratio of import to domestic prices, which reflects a trade-off between local and imported consumer goods, has the theoretical negative sign. It follows that an increase in the price of imported consumer goods will lower their import and vice-versa. But the relatively low value of this coefficient suggests that a devaluation of the exchange rate may not appreciably affect the import of these goods, at least in the short run. The policy of trade liberalization pursued intermittently from the 1970s tended to raise the import of consumer goods. The dynamic effect of foreign exchange availability on consumer goods is substantial.

VII. Concluding remarks - Lessons for policy makers

This study has examined the determinants of aggregate imports and its major components in Nigeria, covering the period between 1953 and 1989. The model specification draws on both the traditional and the Hemphill import demand functions, while the estimation procedures take into consideration the recent developments in time series modeling. The results obtained are informative. Quantitative evidence indicates that short-run changes in the availability of foreign exchange earnings, relative prices and real output significantly explain the growth of total imports during the period under investigation. Particularly striking is the short-run impact of foreign exchange availability, which is tied to the long-run effect through a feedback mechanism. Thus, even though these variables all play an important role in sharpening import behaviour, the effect of foreign exchange availability is particularly remarkable.

It follows that to increase total imports, it is essential to implement the set of macroeconomic and sector-specific policies that can considerably relax the binding constraint on the availability of foreign exchange. Second, the near unity of the price elasticity of import demand suggests the high sensitivity of demand to imports. In this sense, assuming neutrality of other economic policies, devaluation can reduce the demand for aggregate imports.

With respect to the components of imports, regression results show that the import of raw materials responded significantly to foreign exchange earnings, relative prices and industrial output through an error correction mechanism. Thus, it is evident that in the absence of an increased domestic supply of raw materials, the growth of the industrial sector is expected to raise the demand for imported raw materials. Findings also demonstrate that changes in raw material imports show a high degree of responsiveness to trade liberalization in the period. This possibly indicates that import tariffs and non-tariff measures represent important policy instruments that should be considered in designing policy packages to influence the import of raw materials.

The import of capital goods is highly sensitive to the dynamics of relative prices; an indication that exchange rate management and the conduct of fiscal and monetary policies that alters relative prices has important effect on these imports. Investment constitutes the motor of economic expansion. Annual changes in the investment needs exert appreciable influence on the demand for imported capital goods during the study period. The inference that is derivable from this is that the growth of the economy tends to expand the demand for capital goods imports, especially in the absence of foreign exchange constraints and import restriction measures. Empirical estimates show that foreign exchange constraint is one of the chief determinants of consumer goods imports.

However, there is need to investigate further the determinants of aggregate imports using relatively more sophisticated statistical methods. This would require the application of such methods developed by Stock and Watson (1988) and Johansen and Juselius (1990), as applied by Wilkinson (1992). It is anticipated that such methodologies may reveal other possible long-run relationships that could not be established by the Engle-Granger two-step method.

Notes

1. A lucid discussion of the link between fiscal policy and developments in the external sector of less developed countries can be found in Tanzi (1986).
2. For example, Nigeria's crude oil which sold at about US\$41 per barrel in early 1981, fell dramatically to less than US\$9 by August 1986. This precipitated fiscal deficits that cumulated to about ₦17.4 billion in the four years, 1981-1984.
3. The need to adopt this modeling strategy is largely influenced by Moran's (1989) suggestion that future research on this theme should attempt a dynamic specification along the lines of Hendry, Pagan and Sargan (1986).
4. A comprehensive discussion of this is contained in Oyaide (1984).
5. A number of channels through which the external sector affects the domestic economy have been discussed in the literature. Trade in goods and services is one principal channel through which changes in economic activities in developed countries affect developing countries. On this, see Rhomberge (1968).
6. See Schatz (1984) for clarity on this.
7. This section draws on the various issues of the Annual Report and Statement of Accounts of the Central Bank of Nigeria and Egwaikhide (1997).
8. On the policies under the Act, see the Central Bank of Nigeria's 1982 Annual Report and Statement of Accounts, p. 6.
9. The commodities affected include louvre window frames, ladies' sanitary pads and children's disposable nappies, wheelbarrows, soap and detergents, prefabricated building of wood, baby food, mosquito coils, stationery, mosquito nets, and calculators.
10. Examples of the products with new rates are toilet soap and detergent, 100%; paper and paper labels, 200%; real madras (george), 200%; blankets, 100%; sheets and plates, 100%; and knives with cutting blades, 15%.
11. The approved use scheme (AUS) is built into the tariff structure specifically to allow

manufacturers to import relevant inputs at concessionary duty rates. An explanation of the operation of this scheme in the early 1960s is in Phillips (1967 :323-6)

12. See Federal Republic of Nigeria (1986).
13. Part of these policies are contained in the new industrial policy by the Federal Ministry of Industries (FMI, 1988).
14. In practice, the dollar/sterling cross rates actually determined the naira exchange rate against the U.S. and British currencies.
15. The countries were Britain, France, Japan, the Netherlands, Switzerland, the United States and Germany.
16. This is computed as the ratio of revenues from import duties to the value of total imports.
17. The different types of specifications attempted were linear, curvilinear and power functions.
18. It should be noted that the specification of the various import demand models of these authors are largely influenced by the focus of the macroeconomic model constructed. This causes it to deviate, probably significantly, from the determinants using the single equation models.
19. See, for example, Khan (1974, 1975).
20. Hemphill's study covered eight countries: Argentina, Burma, Chile, China, Colombia, El Salvador, India and Thailand.
21. The study by Moran (1989) pooled cross–section time series data from 21 less developed countries covering the period between 1970 and 1983. Apart from estimating the various models for all the countries combined, the same set of models was also applied to the four classification groups of the countries; these are low-income countries, major exporters of manufactured products, non fuel primary commodity exporters and oil exporters.
22. See Hemphill (1974: 651) and Moran (1989: 281).
23. For further elaboration, see Leamer and Stern (1970).
24. On the derivation, see Moran (1989).
25. An econometric software called PC-GIVE developed by Hendry (1989) is very

suitable for this exercise.

26. See Marzouk (1975: 349).

27. This is the view of Yoshida (1990: 26).

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Each of these macroeconomic variables were collected using the most recent publication as the starting point and then searching backwards. This methodology helps to take account of any revision that may have occurred annually. The GDP and its deflator have to be obtained from IFS because the series tend to be more consistent than those published by FOS, and the problems of reconciliation were minimized.

Appendix B

Table 1: Short-run price and income elasticities of aggregate demand for imports

Investigator	Price elasticity	Income elasticity
Moran (1989)	-0.08	0.24
Khan (1974) a	-0.819	1.371
b	-0.978	0.414
c	-1.836	1.943
Ajayi (1975)	-2.718	0.257
Current study	-0.895	0.588

Notes: The results of Moran are for several developing countries. Khan's results for a, b, c are Pakistan, Ecuador and Costa Rica, respectively; and are the estimates of the disequilibrium model explored by the author. Ajayi's results are on Nigeria.

Appendix A: The data

- Y_t = GDP at current prices. Data were obtained from Helleiner (1966) for 1953–59 period and from the International Monetary Fund. *International Financial Statistics* (IFS), for the remaining years. Its deflator was obtained from the same sources.
- M_t = Total merchandise imports. Data for this variable and its components MC_t , MR_t and MK_t were obtained from two sources. For the period between 1953 and 1959, they were collected from Helleiner (1966) and for the rest of the period from the Federal Office of Statistics (FOS), Lagos. Each of the variables was deflated using import price index.
- P_{im} = Import price index. This variable was collected from Helleiner (1966), for the seven years, 1953/57, and for the remaining years from UNCTAD, *Hand Book of International Trade and Development Statistics*, various issues.
- P_t = Consumer price index. From 1953 to 1959, the series was extracted from Helleiner (1966) and for the rest of the period for FOS.
- YM_t = Output of manufacturing. This, with its deflator was obtained from the same sources as in P_t .
- I_t = Total investment. This variable and its deflator were taken from the same sources as that of P_t .
- F_t = Foreign exchange earnings. It is defined as export earnings plus capital inflow. Export earnings were obtained from Helleiner (1966) and FOS, as in P_t ; data on direct private investment (FDI), the aspect of capital inflows for which consistent data are available, were collected from Helleiner (1966) for the earlier years, 1953/59 and from the Central Bank of Nigeria, *Economic and Financial Review*, Lagos, for the rest of the study period. This series was deflated using P_{im} .
- TC_t = Total consumption. This is the sum of private consumption and government consumption obtained as in P_t . It was deflated using P_t .