1978

Import demand in developing countries including Iran: a theoretical and empirical study

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POURMOGHIM, SEYED-JAVAD
IMPORT DEMAND IN DEVELOPING COUNTRIES INCLUDING IRAN: A THEORETICAL AND EMPIRICAL STUDY.

IOWA STATE UNIVERSITY, PH.D., 1978

Import demand in developing countries including Iran: A theoretical and empirical study

by

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A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of
The Requirements for the Degree of
DOCTOR OF PHILOSOPHY

Major: Economics

Approved:

Signature was redacted for privacy.

In Charge of Major Work

Signature was redacted for privacy.

For the Major Department

Signature was redacted for privacy.

For the Graduate College

Iowa State University
Ames, Iowa
1978

TABLE OF CONTENTS

I. INTRODUCTION

A. General Discussion

Of the various branches of economics, international trade is the one most surrounded by controversies and unsolved problems. Almost all the policy recommendations obtained thus far have, furthermore, been criticized on a number of grounds. One of these arguments concerns the change in demand for imports during development and the elasticity of various factors influencing the demand for imports. The implications of alternative estimates are large for balance-of-payments and policy to control demand, promote exports or adjust exchange rates. The need for international trade policy is closely related to the magnitude of change in import and export prices and income. From different studies, one can conclude that domestic income and prices of exports and imports are the most important variables in explaining import demand.[1] Hence, emphasis herein will be on the estimation of import price and income elasticities. The significance of import prices has been debated more than the significance of income and other variables.

These controversies may be due to ignorance and lack of general observation. Studying a sample of a few countries does not permit one to generalize to the world or derive valid inferences but will, undoubtedly, only lead to more controversy. Unrealistic assumptions

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[1] Other factors affecting import demand will be examined in detail in respective sections.

about those numerous international trade participants which are characterized as "developing"[1] leads to great dissension. For example, it has been assumed that the import demand of developing countries is generally determined by nonmarket forces. This assumption seems to be unrealistic. However, if it were true, commodities traded by these countries would appear to be relatively unaffected by change in prices. The hypothesis has been set out that variations in the volume of imports and exports of less developed countries are due primarily to variation in the real income of developed countries. According to Neisser and Modigliani [88, p. 5]:

> ...a rise in the industrial countries' income increases their imports of raw materials and food. Thereby increasing the exports of nonindustrial countries and enabling the latter, through their augmented purchasing power, to increase their imports of manufactured goods, which come primarily from the industrial countries; and a fall in the industrial countries' income produces the opposite effect.[2]

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[1]Although this group has been called by different names such as "less developed," "under developed," "poor," etc., we consider this group under the heading of "developing" countries.

[2]Many of these unrealistic assumptions are seen in economic literature. For example, Maizels, in his book [78, p. 108], assumes that "the working hypothesis on which this book is based that the economies of the main industrial countries constitute the essential dynamic element in the world economy. They represent, in a sense, the 'Leading Sector,' while the primary-producing countries are essentially reacting, in one form or another, to the economic development in the industrial countries." Similar assumptions can be seen in the study of others such as Chenery and Strout. See Chenery, H. B. and Strout, B. [12].

Various chapters of this study attempt to capture the more active role that the economies and policies of developing countries play in their own volume of international trade. It is our hope to relieve the existing ignorance and prevent invalid assumptions and inferences about the role of the less developed countries in their own international trade.

B. Objectives of the Study

The chief objective of the study is to increase the level of understanding about the international trade of developing countries. Thus, it attempts to make a quantitative study of the import demand in developing countries so as to fill the existing gap in knowledge in quantitative studies, between developed and developing countries. It seeks to discover the relative significance of prices, income, and other factors, theoretically and statistically, in trade behavior of developing countires, in order that they can receive the proper share of their contributions to international trade. We hope to reduce controversies by applying data, models and advanced econometric techniques for economic research.

C. Plan of the Study

Chapter I introduces the reader to the problems and quantitative gap related to the import demand in developing countries. An objective of study is to describe the trade behavior of these countries.

Chapter II is concerned with the review of literature, beginning with a general review in order to clarify the overall arguments, problems, views and methods in international trade. The discussion includes a review of specific articles as a basis of the estimation of import demand in developing countries.

Chapter III covers derivation of import demand, the relationship between domestic supply and import demand, stability condition, explanatory variables and finally, functional forms of import demand as a theoretical analysis of the study.

Chapter IV constitutes the empirical analysis of the study. Estimation problems, alternative approaches, time series estimate, the lines of refinement and specification, ordinary least-squares estimation and finally, two-stage least-squares comprise the basic sections of this chapter.

Chapter V reviews the findings of the study. It consists of a summary, conclusion and recommendations for further research.

II. REVIEW OF LITERATURE

This chapter is divided into two sections, i.e., general and specific review, respectively. Overall arguments, problems, views, and methods in international trade will be the subject matter of the general review, while in the specific review attention will be paid to those articles whose methods and approaches, of course with appropriate modification, are used to estimate import demand in developing countries.

A. General Review

A general review of the literature reveals a greater scarcity of information about the estimation of import demand in developing countries than about developed ones. Although a few studies, e.g., Khan [54], have been made recently for the developing countries, almost all of the import-demand studies and arguments concentrate on estimating the income and price elasticities of import demand and on improving statistical approaches in developed countries. This can be seen in the work of Adler [1], Morgan and Corlett [82], Ball and Marwah [7], Kreinin [64], Houthakker and Magee [41], Price and Thornblade [97], and Murray and Ginman [85]. The methods of estimation, the periods covered, and the variables being measured (except the countries involved) have been criticized and re-examined by other economists, including Orcutt [90], Harberger [33, 34], and Prais [96].

Traditionally, under the assumptions of the theory of demand, in which an individual consumer attempts to maximize his satisfaction under budget constraint, the quantity of total imports is a function of real income and relative prices. Mathematically, this may be written as:

$$M_t = M_t \left(\frac{Y_t}{PD_t}, \frac{PM_t}{PD_t}\right), \tag{2.1}$$

where

M_t = quantity of total imports during period t,

$\frac{Y_t}{PD_t}$ = real income during period t,

$\frac{PM_t}{PD_t}$ = relative prices during period t (ratio of import price index to domestic price index).[1]

Under the assumptions of the equation (2.1),[2] data have been analyzed in different ways to obtain quantitative estimates of the relation of imports--either total or/and disaggregated--with prices and income. This section attempts to clarify and re-examine what arguments and problems are involved; what methods have been utilized; and what different views exist.

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[1] Of course, imports consist typically of thousands of types of commodities; hence there exists the problem of aggregation which is examined in detail in section A of chapter IV. Moreover, index numbers of prices will be used as explanatory variables and also for purposes of deflation. Appendix D illustrates the property and various indices used in this study.

[2] Will be examined in detail in Section A, Chapter III, theoretical analysis.

The main argument in estimating the demand for import is a problem which may be called an "identification problem."[1] The quantity demanded and price are assumed to be inversely related; other things remain the same, with equilibrium, quantity and price determined by the interaction of supply and demand. Hence the relationship between prices and quantities may be due to one side--demand or supply--or both sides. The estimated elasticity will be influenced by the elasticity of demand and supply. In fact, it will be a combination of a negative demand elasticity and a positive supply elasticity [95, p. 561].

In spite of this problem, which has been treated by some appropriate assumptions, emphasis has traditionally been on price elasticity in the empirical studies rather than both, i.e., income and price elasticities. In most of these studies, income elasticity is significant and their numerical magnitudes and signs are acceptable. However, this emphasis was framed by the idea of improvement in the balance of payments. The basis of the idea was that depreciation would be highly effective in improving the trade balances of the depreciating countries. Any bias in the estimated price elasticity will lead to an underestimate (or overestimate) of the effectiveness, depending on the magnitude of the elasticity.

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[1] Solutions to this problem will be treated, either by economic assumption or/and by statistical approach, in the chapter on empirical analysis.

The result of most of these studies on price elasticities, in developed countries, has not been statistically significant, although almost all these studies have considered relative prices. For example, in Polak's study [94], of twenty-four import functions fitted, only four of them were found to be statistically significant [34, p. 506]. Houthakker and Magee in their study state that "the price variables do not perform nearly as well, with many insignificant estimates and a few incorrect signs" [41, p. 112]. On the other hand, Khan noted that "the equilibrium results show that the estimated price elasticities are generally high and therefore indicate that relative prices have a significant effect on imports of developing countries" [54, p. 687]. Thus, disagreement about the relative significance of prices in import demand appears.

Different methods--time series, cross section, and simultaneous equations--have been applied in estimating elasticities. Most empirical studies on import demand have been made by applying regression methods to the data on prices, quantities, incomes, and the like.[1] The primary estimations on the elasticities in international trade have been criticized by Orcutt [90], who points out that different sources of bias exist in the traditional least squares method. The consequences are a low estimation of price elasticity and may be summarized as follows:

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[1]For a detailed compilation, see Cheng, H. S. [13].

- bias due to shifts in demand;
- bias due to errors of observation;
- bias due to aggregation;
- short-run and long-run elasticities; and finally
- elasticities for large and small price changes.[1]

Harberger has made a similar point about error due to shift in the demand, arguing that "we should expect a positive correlation between demand shifts and price changes...[because] rightward shifts in demand tend directly to raise prices and leftward shifts to lower them" [33, p. 150]. Thus, we are faced with a violation of the traditional least squares.[2] He suggests that in order to find a "pure" import demand elasticities, it is necessary to make some a priori judgments about the size of the supply elasticity and its weights.

There have been different attempts, such as those by Morgan and Corlett [82], to estimate the elasticities by the simultaneous approach. However, other statistical problems involved, including that of multicollinearity, have caused this approach not to be

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[1] All these sources of bias and others which will be realized by the study, will be explained in detail in different sections, with respect to their natures. However, for further information about these biases, see Orcutt, G. H. [90].

[2] One of the assumptions underlying ordinary least square (OLS) is that the error element is independent of explanatory variables in the equation, i.e., $E \sim NID(o, \sigma_o^2)$. Harberger's point shed light on a correlation between errors and determining variables, thus ruling out this assumption.

utilized as much as the ordinary least squares approach. Nonetheless, the results of this former approach are not significantly different than those of the ordinary least squares (OLS), as the general conclusions of this study reveal [82, pp. 341-347]. Therefore, it seems that the classical methods may still be used, but with a greater awareness of the conditions under which they are valid and with the proper application of statistical tests [96, pp. 562-563].

A further argument is that of the selection of appropriate explanatory variables, either economical or statistical. In practice, time series analysis suggests the application of as few explanatory variables as possible, in order to preserve the statistical significance of the analysis. It seems, too, that there is a controversy about choosing the explanatory variables to be used. However, an explanation of this will be given to the theoretical chapter of this study.

Finally, "it may be said that further work is not ruled out in principle, but that it will have to be done subject to adquate statistical tests and with careful consideration of all the relationships at work that generate the observed data" [95, p. 565]. Moreover, the fact must be considered that almost all empirical studies, except for a few, have been done on the basis of data available in developed countries. Ignoring most partners, i.e., developing countries, in international trade and making some unrealistic assumptions leads to another source of bias in estimating

elasticities. It seems likely that successful results will be obtained if a wider range of experience is considered.

B. Review of Specific Works

The following section will examine those articles whose approaches, with appropriate modification, of course, have been adopted in this study.

1. Khan [54]

Khan provides estimates of import and export demand functions for 15 countries selected among those characterized as "developing." He assumes the import function, for two cases--equilibrium and disequilibrium--as a function of real income and relative prices for equilibrium, and, in addition, as a function of lagged imports for the disequilibrium case. He illustrates these relationships mathematically by a double-log form. In the log-linear form:

$$\log M_{it}^{d} = \alpha_0 + \alpha_1 \log \left(\frac{PM_i}{PD_i}\right)_t + \alpha_2 \log Y_{it} + u_t$$

where M_i is quantity of import of country i; PM_i is unit value of imports of country i; PD_i is domestic price level of country i; Y_i is real gross national product of country i. u_t is an error term, and superscript d refers to demand [54, p. 679].

The disequilibrium case, shown also by the log-linear form, is:

$$\log M_{it} = \gamma\alpha_0 + \gamma\alpha_1 \log \left(\frac{PM_i}{PD_i}\right)_t + \gamma\alpha_2 \log Y_{it} + (1-\gamma) \log M_{it-1} + \gamma u_t,$$

where γ is the coefficient of adjustment, $\gamma\alpha_1$, and $\gamma\alpha_2$, are the price and income elasticities, respectively [54, p. 681]. He argues that if either of these assumptions, i.e., quality of actual and desired imports, and infinite supply price elasticity, is not satisfied, estimation of the coefficients would be biased and inconsistent. Accordingly, he adopts the disequilibrium approach to clarify the behavior out of equilibrium due to the relaxation of either of these assumptions and the presence of any quantitative constraints.

Also, in order to eliminate the possible deficiency of the ordinary least-squares method, in which the relation between supply and demand is ignored, he applied two-stage least-squares for both equilibrium and disequilibrium. Doing this, he specified the supply of imports as a function of the price of imports, the world price level, and world income. He defines world income and prices as the real gross national product reported by the Organization for Economic Cooperation and Development and the OECD GNP deflation, respectively.

The results of the estimation reveal that relative prices influence trade flows of developing countries. In the case of imports, he specifies that "with the exception of Colombia and Pakistan, where the estimated price elasticity is fairly small, all estimated price elasticities that are significantly different from zero are also close to or greater than unity. This does not confirm the commonly expressed view that developing countries have a price--inelastic demand for import goods" [54, p. 687].

2. Houthakker and Magee [41]

In this paper it has been attempted to estimate prices and income demand elasticities both for imports and exports--mostly for developed countries. The ordinary least-squares method is used, with an annual observation. The following import equation is used:

$$\log M_{it} = A_{0i} + A_{1i} \log Y_{it} + A_{2i} \log (PM_{it}/WPI_{it}) + u_t$$

where M_{it} is the i^{th} country's imports during t in fixed price. Y_{it} is an index of the country's GNP; PM_{it} is a price index of imports into the i^{th} country; WPI is the country's wholesale price index, and u_{it} is an error term. A_{1i} and A_{2i} are the elasticities with respect to income and prices. The results of estimation suggest that income elasticities have appropriate magnitudes and proper signs, but the inferences with respect to prices are ambiguous, with many insignificant estimates and a few incorrect signs [41, p. 112].

The authors extend their study into the estimation of imports and exports for the United States, by commodity class. In so doing, they have used "a dynamic model of demand which combines the double-logarithms form with flow adjustment" [41, p. 120]. They come up with equation:

$$\log M_t = D_0 + D_1 \log M_{t-1} + D_2 (\log Y_{t-1} + \log Y_t)$$

$$+ D_3 (\log P_{1t-1} + \log P_{1t}) + \S_t$$

where D_2 and D_3 are short-run elasticities with respect to income

and prices. P_1 is the ratio of price of imports to wholesale price index.[1]

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[1]The complete adjustment mechanism will be examined in section E , functional forms of import demand. However, an equation similar to this, but for total imports, is used as an alternative in the disequilibrium case.

III. THEORETICAL ANALYSIS

The first part of this cahpter deals with the derivation of import demand in two cases; first, domestic commodities are perfect substitutes for imported commodities and, second, imported commodities as differentiated from domestic commodities. The second and third parts of the chapter are devoted to examining the relationship between domestic supply and import demand and stability condition. The fourth and fifth parts examine the various explanatory variables and functional forms of import demand, respectively.

A. Derivation of Import Demand

Generally, the behavior of an individual consumer is such that he makes his choices of commodity bundles--domestic or/and imported--in order to obtain the maximum satisfaction subject to his budget constraint. This section examines open economy under two cases, i.e., domestic commodities are perfect substitutes for imported commodities and imported commodities are differentiated from domestic commodities.

1. Open economy

In this economy the consumer is faced with domestic or/and imported commodities. Accordingly, two separate cases may be distinguished as:

Case one--Domestic commodities are perfect substitutes for imported commodities.

Case two--Imported commodities are differentiated from (incomplete substitute) domestic commodities.

The underlying reason for this separation is due to the fact that, in case one, domestic supply will directly affect the quantity of imports, while in case two, domestic supply will influence imports through its effect on domestic prices.

a. Case one--perfect substitute In a closed economy, in equilibrium, prices must be such that the demand for each commodity be equal to its supply. In an open economy, however, there is likely to be a gap between the amounts of different commodities demanded by domestic consumers by utility maximization and the amount supplied by domestic producers by profit maximization. This gap is filled by imports or exports, depending upon which is greater: domestic demand of domestic supply.

Under the assumptions of the traditional model of international trade, among which perfect substitution is the aim, import demand may be considered as a residual of domestic demand and domestic supply;[1] that is, each country produces domestically some of the commodities which it imports. In other words, with incomplete specialization, a country's import demand is the difference between its total demand for and domestic supply of the commodity concerned [76, p. 74]. Mathematically, this statement may be written as:

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[1]Among other assumptions, emphasis also will be on the assumption of the case of two countries, i.e., country under study, a, and rest of world, b. For the importance of this assumption, see pp. 27-29.

$$M_t = D_t - S_t, \tag{3.5}$$

where

M_t = total quantity imported in period t,

D_t = quantity of total demand in period t,

S_t = quantity of supply in period t.

From the assumptions that there exists just one of the selected developing countries and the rest of the world; that the importer unit--producer or consumer--purchases commodities competitively; that prices are perfectly flexible in both directions; and that there is no government intervention, the import demand for a given commodity can be shown graphically in terms of horizontal distance between the domestic demand and supply, Figure 3.1 [101].

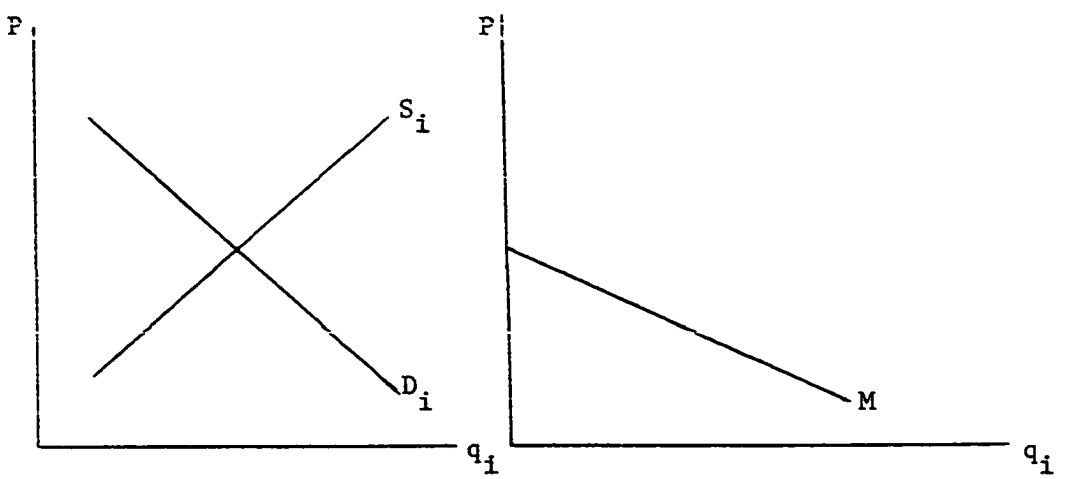

Figure 3.1. Graphic representation of import demand for commodity i

Once the demand for imports of an individual commodity is obtained, abstract from aggregation problems, an aggregate import demand can be obtained as:

$$M = M\left(\frac{Y}{PD}, \frac{PM}{PD}, S\right) \tag{3.6}$$

where

M = total quantity imported

$\frac{Y}{PD}$ = real income

$\frac{PM}{PD}$ = relative prices (ratio of import price index to domestic price index)

S = vector of supply factors that influence import demand.

Of course, hereafter, the vector of supply factors will be ignored; the reason underlying this is to eliminate the bias and inconsistency occuring in empirical analysis. Hence, import demand used in this study may be written as:

$$M = M\left(\frac{Y}{PD}, \frac{PM}{PD}\right) \tag{3.7-3.13}$$

b. Case two--differentiated commodities In this case a kind of imperfect substitution into case one has been introduced. Suppose that there exists a set of n commodities, in our two-country model, $q_1, q_2, \ldots, q_n$, where country "a" can produce $q_{1a}, q_{2a}, \ldots, q_{na}$ and "b", the rest of the world, can produce

q_{1b}, q_{2b}, ..., q_{nb}. The q_i is defined as a set of two commodities, i.e., $q_i \equiv [q_{ia}, q_{ib}]$. The assumption that q_{ia} and q_{ib} are not, in general, perfect substitutes in consumption is the reverse of the classical assumption of perfect substitution; that is, on the basis of classical assumptions, that a set of homogeneous commodities is producible in both countries, country "a" and the rest of the world, "b" (case one). In other words, q_i is generally differentiated with respect to the place of production [4].

Two important concepts may be realized from this assumption. First, although q_{ia} and q_{ib} are generally not perfect substitutes, they seem to be very close substitutes, called "directly-competing" commodities, satisfying the same want. Second, since q_{ia} and q_{ib} are not the same commodity, we may say that q_{ia} cannot be produced

in "b" and q_{ib} cannot be produced in "a". In fact, each country should be specialized in the products which it exports.[1]

Obviously, the elasticity of country a's demand for a particular imported commodity, q_{ib}, depends mainly upon the substitutability in a's consumption between q_{ib} and q_{ia}; and the elasticity of a's demand for all imports depends in large part on the substitutability in consumption between "b's" commodities and "a's" commodities. But analysis should be carried further in order to specify the import demand function.

Now, postulate country "a's" community welfare function[2] as

$$U = U\ (q_{1a},\ q_{1b},\ q_{2a},\ q_{2b},\ \cdots,\ q_{na},\ q_{nb}) \tag{3.14}$$

The budget constraint, in country "a", may be written as:

$$y_a \geq P_{1a}q_{1a} + P_{1b}q_{1b} + P_{2a}q_{2a} + P_{2b}q_{2b} + \cdots + P_{na}q_{na} + P_{nb}q_{nb} \equiv \sum_{i=1}^{n} P_{ia}q_{ia} + \sum_{i=1}^{n} P_{ib}q_{ib} \tag{3.15}$$

By applying a one-step maximization of equation (3.14) subject to the equation (3.15), we get the import demand for country "a";

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[1]The reason the q_{ia} cannot produce in country "b" might be due to an infinitely scarce resource in "b". This perhaps relates to one of the factors of production: capital, labor, and technology, or it may be attached to a certain right such as a certain label; such as good-will, a certain quality of management, or any other factors on the basis of which commodities are differentiated.

[2]As specified above (see p. 16), no welfare implications are intended: it is merely a "positive" interpretation of an economic activity.

namely;[1]

$$L = U(q_{1a}, q_{1b}, q_{2a}, q_{2b}, \ldots, q_{na}, q_{nb}) + \lambda[y_a - \sum_{i=i}^{n} P_{ia}q_{ia} - \sum_{i=1}^{n} P_{ib}q_{ib}] \tag{3.16}$$

Differentiating with respect to q_{1a}, q_{1b}, q_{2a}, q_{2b}, ..., $q_{na}q_{nb}$ and λ,

$$\begin{aligned} \frac{\partial L}{\partial q_{ia}} &= U_{ia} - \lambda P_{ia} = 0, \\ \frac{\partial L}{\partial q_{ib}} &= U_{ib} - \lambda P_{ib} = 0, \\ \frac{\partial L}{\partial \lambda} &= y_a - \sum_{i=1}^{n} q_{ia}P_{ia} - \sum_{i=1}^{n} q_{ib}P_{ib} = 0, \end{aligned} \tag{3.17}$$

where $U_{ia} = \frac{\partial U}{\partial q_{ia}}$,

and $U_{ib} = \frac{\partial U}{\partial q_{ib}}$,

$(i = 1, 2, \ldots, n)$.

The system (3.17) can be solved simultaneously. There exists $2n + 1$ equations with $2n + 1$ unknown variables. By presumption of given income and prices, we arrive at the import demand for country "a":

---

[1] Certainly the import demand, in this case, may be obtained by two-stage maximization process in which the consumer first decides how much to spend on the differentiated commodity q_i, and then allocates the resulting amount between the directly competing commodities q_{ia} and q_{ib}. However, the result of the two processes is the same. For further information about two-stage maximization, see George, P. S. and King, G. A. [24] and Solow [100].

$$q^a = q^a_{ib} \ (P_{1a}, P_{1b}, P_{2a}, P_{2b}, \ldots, P_{na}, P_{nb}, y_a) \tag{3.18}$$

By the same procedure we can derive the import demand in country "b":

$$q^b_{ia} = q^b_{ia} \ (P_{1a}, P_{1b}, P_{2a}, P_{2b}, \ldots, P_{na}, P_{nb}, y_b) \tag{3.19}$$

Further, it seems that for an empirical analysis, the following assumptions have been found to hold for the demand function:

1. By applying the assumption of independence; namely, the assumption that the marginal rate of substitution (MRS) between q_{ia} and q_{ib} is independent of q_{ja} and q_{jb}, for $j \neq i$. The relative value, at the margin, of any import and its domestic substitute is independent of the consumption of all other commodities.
2. By applying the assumption that expenditure on each commodity depends only on total expenditure, this reveals the fact that the elasticity of demand for q_{ia} and q_{ib}, taken together, is one. Moreover, it is a necessary condition for the omission of P_{ja} and P_{jb} ($j \neq i$) from the import function. Otherwise, cross elasticities will usually be nonzero because, according to Samuelson [98], the elasticity of demand for any product is equal to the sum of all the cross elasticities of demand plus the income elasticity of demand for that product [98, p. 105].

Considering this fact and equation (3.18) or (3.19), and postulating Euler's theorem for a homogeneous form, we find:

$$\frac{\partial q^a_{ib}}{\partial P_{1a}} \cdot P_{1a} + \frac{\partial q^a_{ib}}{\partial P_{1b}} \cdot P_{1b} + \frac{\partial q^a_{ib}}{\partial P_{2a}} \cdot P_{2a} + \frac{\partial q^a_{ib}}{\partial P_{2b}} \cdot P_{2b}$$

$$+ \ldots + \frac{\partial q^a_{ib}}{\partial P_{na}} \cdot P_{na} + \frac{\partial q^a_{ib}}{\partial P_{nb}} \cdot P_{nb} + \frac{\partial q^a_{ib}}{\partial y_a} \cdot y_a = 0.$$

where $(i = 1, \ldots, n)$.

Dividing through by q^a_{ib}, we have, in terms of elasticity:

$$e_{1a} + e_{1b} + e_{2a} + e_{2b} + \ldots + e_{na} + e_{nb} + e_{ya} = 0.$$

$(i = 1, 2, \ldots, n)$.

In the present case, all the cross elasticities are assumed to be zero, except for those relating to the price of the directly-competing commodities, i.e.,

$$e_{1a} + e_{1b} + e_{ya} = 0.$$

Regarding these assumptions and the assumption of the case of the two-country model which eliminates the possibility of competition among suppliers, we can reduce import demand (3.18) or (3.19) to:

$$q^a_{ib} = q^a_{ib} (y_a, P_{1a}, P_{1b}) \tag{3.20}$$

in the form of case one notation

$$m_a = m_a (y_a, P_d, P_m), \tag{3.21}$$

where

$$P_d = P_{1a}, \; P_m = P_{1b}.$$

in real forms

$$m_{ia} = m_{ia} \left(\frac{y_a}{P_d}, \frac{P_m}{P_d}\right). \tag{3.22}$$

In terms of the aggregate, regardless of aggregation problem, equation (3.22) may be written as:

$$M_a = M_a \left(\frac{Y_a}{P_D}, \frac{P_M}{P_D}\right), \tag{3.23}$$

where Y_a is real income at constant price, P_D and P_M are price indices of domestic supplies and imports, respectively; that is, on these conditions, the demand for import depends on total income, on the price of import, and on the price of its domestic substitutes; or in real terms, on real total income and relative prices.

The demand for import, derived in case two, may be illustrated by a three-dimensional diagram.

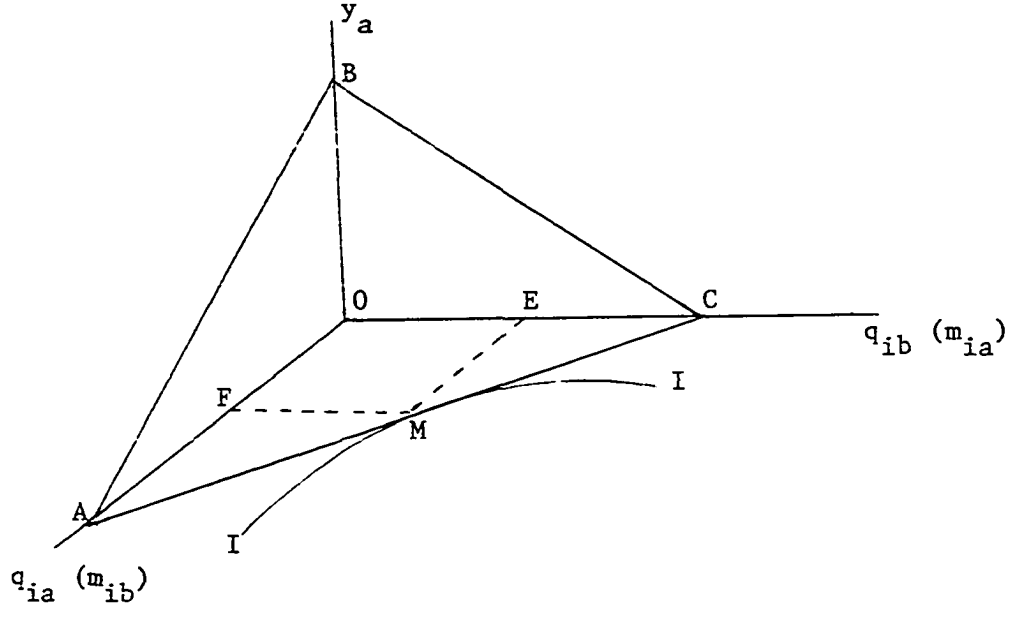

Figure 3.2. Three dimensional diagram of import demand

Quantities of commodities are measured on the horizontal axes, and the north axis measures expenditures on q_i. The distance OB corresponds to a given value of y_a. Projection of the community welfare function in the $q_{ia} - q_{ib}$ or $(m_{ib} - m_{ia})$ dimensions, of which the difference curve II is a part, is the same, regardless of what may be a's position along the other axis (due to assumption in independence). Hence, the indifference curve II is independent of all prices. Given $P_{ia} = (\frac{OB}{OA})$ and $P_{ib} = (\frac{OB}{OC})$, which is P_d and P_m, respectively, the demand for q_{ib} (m_{ia}) - OE and q_{ia} (m_{ib}) - OF is determined.

However, through the remainder of the theoretical analysis, emphasis will be on case one, i.e., in which perfect substitutability exists.

B. Domestic Supply and Import Demand

The previous section shed light on the fact that in deriving import demand, two cases may be distinguished: perfect substitution and differentiated case. In the former case, domestic demand and supply play a crucial role. Import demand was derived by the horizontal difference of domestic demand for and domestic supply of a commodity. If this relationship is expressed in terms of elasticities, it can be noted that in interational trade, elasticities are greater than domestic elasticities, i.e., elasticities of domestic demand and domestic supply, due to the property of excess demand.

Mathematically, considering equation (3.5) in which domestic demand and supply are a function of price alone, it may be rewritten as:

$$e_{MP} = e_{DP} + \frac{S}{M}(e_{DP} - e_{SP}),^{1,2} \qquad (3.24)$$

$$e_{DP} > 0, \quad \varepsilon_{SP} < 0,$$

where

e_{MP} = the elasticity of imports with respect to price,

e_{DP} = the elasticity of domestic demand with respect to price, and

e_{SP} = the elasticity of domestic supply with respect to price.

The second term in equation (3.24) reveals that import demand will always be more elastic than domestic demand so long as domestic supply, S, exceeds zero.

Now, consider a case in which domestic demand, D, is a function of price and income and domestic supply is a function of prices, namely:

$$M_t = D_t (Y, P) - S_t (P). \qquad (3.25)$$

Differentiating (3.25) with respect to price and multiplying by

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[1] e stands for total elasticity of demand and supply, and E stands for partial elasticity of demand and supply. However, in this equation, total and partial elasticities, e and E, are identical because of the existence of one explanatory variable in the demand and supply function, i.e., price equation (3.24) can be written as $E_{MP} = E_{DP} + \frac{G}{M}(E_{DP} - E_{SP})$.

[2] The mathematical procedure used is similar to one in p. 40.

words, if there were no domestic supply, $\frac{S}{M} = 0$, the import elasticity would be equal to the elasticity of the domestic demand. Otherwise, the imports depend on the reaction of both consumers and producers to price change [76, p. 17].

C. Stability Condition

In general, the stability condition in any market, under the Walrasian price adjustment mechanism, is that one tends to raise the price if excess demand is positive and tends to lower the price if it is negative. Mathematically, this may be written as:

$$\frac{\partial (ED)}{\partial P} < 0, \tag{3.27}$$

where ED is excess demand and P is price.

In international trade, stability is usually examined by either the elasticity of import demand or by geometric characteristic of the offer curve. In the former, a sufficient condition to guarantee stability is the Marshall-Lerner condition which states the sum of the elasticities of demand for a country's exports and of its demand for imports is greater than unity, namely:

$$e_D + e_S > 1 \tag{3.28}$$

[1]

where

e_D = the elasticity of demand for imports,

e_S = the elasticity of demand for exports.

---

[1] For mathematical procedure, see Grubel [29] and Kindleberger [57].

e_D is always negative; as price rises, imports decline. There is no presumption as to the sign of e_S[1]. The stability will be assured as long as the demand curve is negatively inclined and the supply schedule is positively inclined.[2]

In the latter, the stability condition is guaranteed when the offer curves of the country under study and rest of the world cut each other from below, or from the inside, viewed from the origin. However, the stability condition is examined within the comparative statics framework in both cases.

D. Explanatory Variables

This section examines the effect of various actual and potential independent variables on total imports separately. These may be specified in the following:

1. Real income
2. Prices
3. Foreign exchange reserves and export receipts
4. Lagged variables

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[1]This case is more common in international finance, rather than international trade. It is used in the elasticity approach to the balance of payments to find out the effect of devaluation.

[2]Demand and supply factors will be examined in detail in the empirical analysis section. Some appropriate assumptions, economical or statistical, will be made in order to find out the "pure" import demand elasticity. If import elasticity depends on both demand and supply elasticities, it is called "mixed" elasticity; otherwise, it is called "pure" elasticity when supply elasticity is ignored by appropriate assumptions [32].

5. Dummy variables (for unusual and seasonal variations)

6. Other variables

1. Real income

Various statistical and theoretical investigations of the relation between real income and trade have been undertaken in connection with the foreign trade multiplier theory. However, the impact of imports on the real income or output of a country has been explained by using the concept of "marginal propensity to import"; i.e., the changes in imports that typically result from a unit of change in income.

According to this theory, imports have been related to the given country's level of income, and exports have been considered as given data. In fact, in this theory, the general level of economic activity, which is represented by real income, has in most cases proved to be the main import-attracting agent. In order to clarify the basic concept of foreign trade multiplier theory, regardless of the deficiencies, a model is illustrated. In the model, income is shown by the sum of the value of consumption, investment, exports, and imports. It is further assumed that consumption and imports are a linear function of income. Exports and investments are supposed to be exogenous. The system is as follows:

$$
\begin{aligned}
Y &= C + I + (X - M), \\
C &= C_0 + C_1 Y, \\
M &= M_0 + M_1 Y, \\
X &= \bar{X}, \\
I &= \bar{I},
\end{aligned}
\tag{3.29}
$$

where Y is national income; C is consumption expenditures; I is investment expenditures; X and M are exports and imports, respectively. C_1 and M_1 stand for the marginal propensity to consume and the marginal propensity to import. Bar over X and I represents the assumption of exogenity. Reducing this system (3.29) to one equation, we came up with:

$$Y = \frac{\bar{X} + I}{1-C + M_1} + \frac{C_0 - M_0}{1-C + M_1} \tag{3.30}$$

where $\frac{1}{1 - C_1 + M}$ is the foreign trade multiplier.[1]

Thus, on the basis of the suggestion of the theory of foreign trade multiplier, the income coefficient, either in terms of marginal or elasticities, in the import demand function must be "positive unless imports are inferior in consumption" [77, p. 188], and exports are regarded as exogenous or predetermined in the model. But several points should be made about the stability of import-income relationship.

It was inferred that in the nonprice model of international trade, the marginal propensity to import should be positive, and accordingly a positive sign was generally expected in the estimation of import demand function (3.13). However, considering a case in which relatively close domestic substitutes exist, the marginal

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[1]For a complete treatment and different (simple and sophisticated) models, see Machlup, F. [75] and Polak [93], [94].

propensity to import may be negative; namely, theoretically, a situation may be derived in which the relation between the growth of real income and growth of the imports may not be necessarily positive [77, p. 188]. This can be illustrated by a graphic representation. Figure (3.3), where M, importable commodities, is shown on the vertical axis and X, exportable commodities, on the horizontal axis. Before income changes, from OI to OI′ expressed in terms of commodity X, the quantity imported is equal to AB. After income change, consumption may move from C_0 to point C_1, and production from P_0 to P_1. Hence, the quantity of real imports is actually reduced from AB to A′B′ [77, p. 188].[1] In a case in which import demand is the excess of domestic demand over domestic supply, the variation in domestic supply can dominate variations in the domestic demand.

Thus, there is a conflict between pure theory and the nonprice model of international trade. Of course, at the aggregate level, the possibility of a negative sign is very rare. Almost all the studies have shown a significant positive sign. For example, according to Houthakker and Magee [41, p. 112], "regression coefficients of income are invariably significant, and their numerical magnitudes are plausible."

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[1]This is certainly true in the case of a small country. It seems that developing countries under study satisfy this condition. Hence, it is theoretically possible to arrive at a negative income elasticity of import demand.

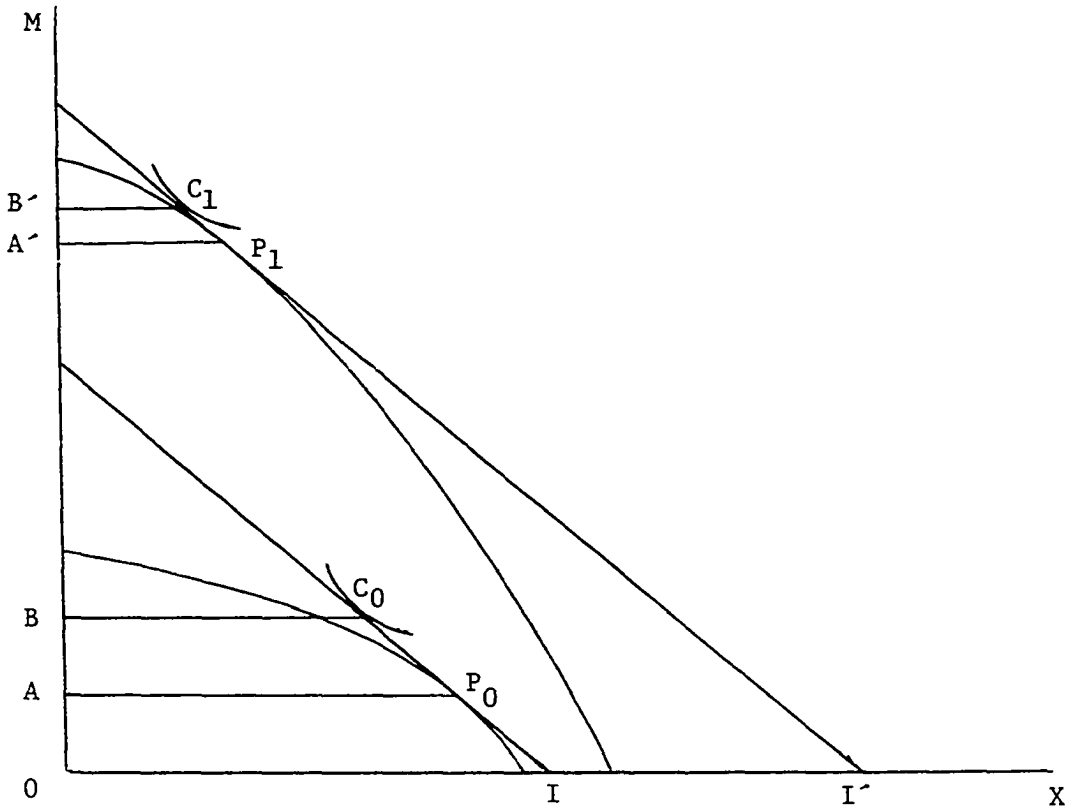

Figure 3.3. Case negative income elasticity of import demand[1]

[1]Adopted from Magee [77, p. 189].

The underlying reason for this may be due to the summing together of the cyclical and secular income elasticities, since responsiveness of imports to short-run changes in income is quick and structural change needs more time, the cyclical component of the income elasticity should be eliminated from the secular component [77, p. 190]. Developing countries have a high tendency toward import substitution for their development purposes; hence, the elasticity of domestic supply will increase and the result may be a pressure on elasticity of demand for imports toward zero or even negative. Khan [54], by applying two-stage least-squares, comes up with different signs in income elasticity. Low and less significant income elasticity, in developing countries, may indeed exist because of other factors, such as foreign exchange, which will be examined later.

Considering exports as a predetermined or dependent variable is another point which should be cleared up. Polak [94] and Neisser and Modigliani [88], in their study, have assumed that exports depend primarily on the income of other countries. Houthakker and Magee [41] assume an equation for exports similar to the import-demand equation. The export-demand function can be written analogously as:

$$X_t = X_t \left(\frac{Y^*_t}{PY^*}, \frac{PX_t}{PY^*_t}\right), \tag{3.31}$$

where: X_t = quantity exported to the rest of the world in year t,

Y^*_t = income of other countries (rest of the world) in year t,

PY^*_t = prices of the rest of the world in year t,

PX_t = export price in year t.

In addition to the above mentioned points, there is a possibility of instability in demand for the import function, as a result of having the property of excess demand. Any changes in the components of import demand bring about changes in income elasticity as well.

2. Prices

There are other factors, in addition to income, which are equally important in determining the variation of imports. The quantity of imports varies with changes in price levels. In other words, prices should be considered as an explanatory variable in the import-demand function. If a case in which imports have domestic substitution, i.e., considering import as an excess of demand over domestic supply and assuming demand and supply are functions of prices, a relationship between import demand and domestic demand and supply in terms of elasticities can be derived.

$$M(P) = D(P) - S(P) \tag{3.32}$$

Taking the derivative (3.32) with respect to price and multiplying by $\frac{P}{M}$, we get

$$\frac{\partial M}{\partial P} \cdot \frac{P}{M} = \frac{\partial D}{\partial P} \cdot \frac{P}{M} - \frac{\partial S}{\partial P} \cdot \frac{P}{M} \tag{3.33}$$

or in terms of elasticity

$$e_{MP} = \left(\frac{D}{M}\right) e_{DP} - \left(\frac{S}{M}\right) e_{SP} = \frac{D}{M}\left(e_{DP} - e_{SP}\right) + e_{SP} \tag{3.34}$$

where

$$e_{Dp} < 0,\ e_{SP} > 0$$

e_{MP} is the price elasticity of import demand; e_{Dp} is the price elasticity of domestic demand; and e_{SP} is the price elasticity of domestic supply. M, D, and S are import demand, domestic demand and domestic supply, respectively.

Assuming a positive and negative elasticity for domestic demand and domestic supply, it seems there is no problem of ambiguity in the sign of the import price elasticity. However, it is worth mentioning that (i) biases the price coefficient toward zero if errors in the price data exist or if the country faces a rising supply curve of the commodity in question; (ii) price elasticities tend to be higher in the long-run than in the short-run. Time series analysis over a short period does not fully reflect the long-run effectiveness of price changes.

The stability problem may be more crucial for the import-price relationship than for the import-income relation. Several things should be pointed out: (i) the responsiveness of demand and supply, and their lags consequences, are to be stronger with respect to prices than they are with respect to income; (ii) the lags occurring in domestic supply are much longer than those referred to in domestic demand and hence, the price elasticity of import demand, which is a combination of demand and supply elasticities, seems to be more unstable in time series analysis; (iii) there exists the possibility

of interdependence between the own and cross price elasticities.[1]

3. Foreign exchange reserves and export receipts

It is argued that due to the behavior ascribed to developing countries in world trade models, demand for imports of these countries might be determined by their foreign exchange reserves and export receipts. For instance, changes in exports earnings, either by variations in the volume of exports or price changes, result in income changes in the export sector of the affected economies. These changes tend to lead directly to variations in the same direction in imports, as well as to a multiplier effect on the domestic economy which will bring about further changes in the import demand. Moreover, there may be a more direct relation between the import, demand and export receipts variations. Such foreign exchange reserves in developing countries generally are not enough and do not accept large downward variations; the authorities may be forced to tighten quantitative constraints on imports fairly promptly after a decrease in these variables, unless this decline is offset by an inflow of capital or foreign aid. When foreign exchange reserves and export earnings increase, quantitative constraints may be relaxed.

Hence, some people concentrate just on foreign exchange reserves and export earnings as the main explanatory variables in the import

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[1] A zero cross elasticity and zero degree homogeneity in section A.2 was assumed to derive import demand. See pp. 27-29 and Magee [77, p. 136].

demand of developing countries. But, as will be explained later, no a priori assumption should be made specifically when it is realized that the relative significance of price and income cannot be ignored in the import demand of these countries.[1]

4. Lagged variables

The existence of different factors such as inequality between desired and actual imports, quantitative constraints, distance, and speed-of-adjustment due to price changes may bring about the possibility of importance of lagged variables in the import demand. Of course, the shorter the time-period units utilized in the analysis, the more important the effect of lags will be.

Whatever the reasons may be, the usual way of introducing lagged variables is to consider the case in which the weights of past influences decrease geometrically. Consequently, the result will include the lagged value of the dependent variable as an explanatory variable.[2]

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[1] These variables and their relative significance will be explained in the next section and in section E on empirical analysis. Moreover, these variables, in this study, are included in the traditional form of demand for imports.

[2] Different ways of introducing lagged variables are suggested. See [69, pp. 23-28]. However, the relative importance of lagged variables will be examined in the following section.

5. Dummy variables

Another method of handling this source of inconsistency, i.e., the presence of quantitative restraints on imports, is to apply dummy variables to years in which restraints were present. However, this does not appear to be an appropriate approach because of i) the number of countries involved in the study with different quantitative restriction policies, and because of, ii) regardless of the number of countries, the improbability of finding the exact necessary data on different restraints with a wide range of intensity for each.

Finally, even if quantitative restraints are not correlated with these explanatory variables, if the restrictions are serially correlated, it can no longer be assumed that the error terms in the estimating equations are independent. However, one can approximate the effect of quantitative constraints by assuming an autoregressive process in the error term and by considering the coefficient of autocorrelation as an indicator of restrictions. It must be emphasized that this would be a relevant indicator only under the assumption that those above-mentioned equations are the exact equations and that inconsistency occurs only through the elimination of the role of restraints. Therefore, a first-order autoregressive process for the error terms is specified for each equation with the assertion that coefficient of first-order autoregressive, ρ, is less than one.

6. Other variables

Under this heading variables such as world-wide effects variables, nontraded items, and capacity-utilization may be mentioned. Logical acceptance of these variables is not deniable, but, due to empirical problems they bring about, they cannot be tested. The number of different variables that can be included in any quantitative study is limited by the quality of observations and data that are available.

Variables that have internationally common or world-wide effects may be such things as (1) a world-wide change in taste, (2) a change in the international price of a substitute or complement, or (3) technology factors. In general, these variables result in a shift in the domestic demand and supply and consequently in the demand for imports. Moreover, it is clear that the exclusion of any of world-wide influencing supply or demand side variables would lead to a downward bias in the price elasticity of the import demand.

It is argued that nontraded items such as services and constraction may be included in the aggregated import demand. Although it is an improvement of the traditional form of the import demand, it involves the same problem, specifically in developing countries, as the first one.

Moreover, the capacity-utilization variable represents an amendment to the traditional form of import demand insofar as it realizes that queues as well as prices may be used to allocate

commodities among consumers. Thus, an increase in domestic demand may not be met immediately by price increases. Rather, domestic producers may put constraint on the available supply by postponing deliveries or, in other words, compelling the consumer to queue to await the servicing of his order. In such cases, the buyer may look at foreign sources of supply to avoid postponement of deliveries. Accordingly, the import demand function should include variables that reflect the length of queues at home and abroad. Capacity utilization is a proxy for queue-length. When production is close to capacity, queues are likely to be long. In periods of excess capacity, orders are filled rapidly. The inventory variable may be interpreted as a proxy as well. However, this variable is not an exception from the two aforementioned variables, specifically with regard to the characteristic of this study in which an aggregate rather than disaggregate import demand is being considered.

Finally, the capacity of the import-competing industries may be considered as another explanatory variable in the import demand. The reason underlying this is that with assumption of infinite elasticity of the international supply, domestic investment increases the capacity of import-competing industries. Hence, domestic price will fall and imports will be reduced. The domestic and import price must be the same as long as some of both commodities are being sold. Accordingly, no price change is realized; yet at the same time, imports will be decreased.

E. Functional Forms of Import Demand

The purpose of this section is to deal with different functional forms of import demand to be tested in the empirical analysis. Generally, the appropriate functional forms of aggregate demand for import might not be observed if the microeconomic theory of utility maximization is used. Moreover, no means are realized to select within a class of functions which are homogenous of degree zero with respect to the independent variables. However,

> the final choice of a specific form prior to any empirical investigation, arrived at by whatever means, is important since any conclusion regarding a particular explanatory variable's influence quite often is significantly affected by the choice of the functional form. Thus, using one particular functional form may show that a variable exerts a strong influence on demand while using another effect may be judged to be negligible on conventional statistical grounds. [56, p. 1]

In international trade, there is little guidance as to the appropriate functional form to use when specifying and estimating an import demand. However, traditionally, two functional forms have been suggested for application: (1) linear form and (2) double-logarithms (linear in logarithms).[1] The choice between these two depends on convenience and empirical factors. The linear form, which is based on a strictly additive relationship, is applied for

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[1] For a more general approach to choosing appropriate formulation, see Appendix C. Of course, these two are considered as special cases of this general approach.

forecasting purposes. The coefficient of independent variables, marginal propensities, is obtained by choosing a linear form.

Double-logarithms which are based on a multiplicative interaction between determinant variables will be transformed into a linear-log form. The coefficients of determinant variables are in terms of elasticity. One of the properties of this form is that a constant elasticity over all ranges of explanatory variables is found; i.e., a constant ratio between the percentage change in imports and in respective explanatory variables.

Generally, import demand is derived under the implicit assumption which importers always place on their demand function; that is, desired imports are equal to actual imports--$M_t^* = M_t$--where M_t^* and M_t are desired and actual imports in period t, respectively. Desired import demand, M*, depends on variables determining how much people want to import. The actual demand for imports, M, is introduced on the assumption that people adjust their behavior to their desires only partially within the period. This is due to factors such as quantitative constraints, so that actual demand is a shorter run concept than desired demand, though dependent on the same factors. Ignorance of this assumption may create a problem. The source of this potential problem, however, may be specified by some functional behavior out of equilibrium. An adjustment mechanism is specified by which the changes in imports are related to the difference between the desired import demand in period t, M_t^*,

and actual imports in period t-1, M_{t-1} [55, p. 681].

Two separate cases are distinguished, on the basis of the presence of lags or not, disequilibrium and equilbrium.

1. The case of equilibrium (lack of lags)

The assumption of equality between desired and actual imports, $M_t^* = M_t$, in period t, reveals the fact that there should be no lags in import demand equations. In other words, all quantity demanded is imported in the same period.

It may be specified, as a starting point, that total import demand is a function of real domestic income and relative prices which is derived by a general utility maximization process.[1] In a functional form, it may be written as:

$$M_t = M_t \left(\frac{Y}{PD_t}, \frac{PM_t}{PD_t}\right), \tag{3.35}$$

where M_t = nominal income during period t,

PD_t = the domestic price levels,

PM_t = the import price levels,

$\frac{Y_t}{PD_t}$ = real domestic income (real gross domestic product),

$\frac{PM_t}{PD_t}$ = relative prices (ratio of the price of imports to the domestic price level).

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[1] Although some attempts will be made to find the effectiveness of prices and income separately on the quantity of imports, considering both explanatory variables seems to be the most general starting point.

The sign of the partial derivations is expected to be

$$\frac{\partial M_t}{\partial (PM_t/PD_t)} < 0, \quad \frac{\partial M_t}{\partial (Y_t/PD_t)} \gtrless 0$$

Considering more explanatory variables, among which foreign exchange reserves and export receipts are realized to be the most effective among unspecified explanatory variables,[1] then equation (3.35) may be rewritten as:

$$M_t = M_t \left(\frac{Y_t}{PD_t}, \frac{PM_t}{PD_t}, \frac{FER_t}{PM_t}, \frac{X_t}{PM_t}, E_t\right), \tag{3.36}$$

where:

$\frac{FER_t}{PM_t}$ = foreign exchange deflated by the import price index, both in period t,

$\frac{X_t}{PM_t}$ = exports deflated by the import price index, in period t,

E_t represents the random term which includes the effect of other explanatory variables not considered explicitly in this equation.

The signs of partial derivatives of $\frac{\partial M_t}{\partial (FER_t/PM_t)}$ and $\frac{\partial M_t}{\partial (X_t/PM_t)}$ are expected to be positive.

Equation (3.35) in a linear form:

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[1] For further explanation, see section D, explanatory variables, pp. 34-47.

$$M_t = A_0 + A_1 \left(\frac{Y}{PD}\right)_t + A_2 \left(\frac{PM}{PD}\right)_t + a_t, \tag{3.37}$$

where $A_1 \gtrless 0$, $A_2 < 0$,

and in a transformed double-log:

$$\log M_t = A_0' + A_1' \log \left(\frac{Y}{PD}\right)_t + A_2' \log \left(\frac{PM}{PD}\right)_t + a_t' \ ^{1}$$

where $A_1' \gtrless 0$, $A_2' < 0$. (3.38)

A_1 and A_2 are in terms of marginal propensity, while A_1' and A_2' represent the elasticities with respect to income and price, respectively. a_t is a random term following a normal distribution, and a_t' is also a random term but with the property of a log-normal distribution.

Similarly, equation (3.36) in a linear and double-log will be:

$$M_t = B_0 + B_1 \left(\frac{Y}{PD}\right)_t + B_2 \left(\frac{PM}{PD}\right)_t + B_3 \left(\frac{FER}{PM}\right)_t + B_4 \left(\frac{X}{PM}\right)_t + b_t, \tag{3.39}$$

where $B_1 \gtrless 0$, $B_2 < 0$, $B_3 > 0$, $B_4 > 0$

B_1, B_2, B_3, and B_4 represent marginal propensities to import with respect to changes in income, prices, foreign exchange, and exports, respectively. b_t is a random term with a zero mean and constant variances, i.e., $b_t \sim \text{NID}(0, \sigma_0^2)$.

---

[1] The original form of double-log can be written as:

$$M_t = A_0' \cdot \left(\frac{Y}{PD}\right)^{A_1'} \cdot \left(\frac{PM}{PD}\right)_t^{A_2'} \cdot a_t'.$$

$$\log M_t = B_0' + B_1' \log \left(\frac{Y}{PD}\right)_t + B_2' \log \left(\frac{PM}{PD}\right)_t + B_3' \log \left(\frac{FER}{PM}\right)_t$$

$$+ B' \log \left(\frac{X}{PM}\right)_t + b_t' ,^1 \qquad (3.40)$$

where the signs of the parameters are expected to be:

$$B_1' \gtrless 0,\ B_2' < 0,\ B_3' > 0,\ B_4' > 0.$$

These parameters are real income, relative prices, deflated foreign exchange, and deflated exports elasticities. b_t' has the same property of b_t, but in log form.

It seems that foreign exchange reserves and exports may affect the quantity imported with some degree of lag. Equations (3.39) and (3.40), considering the existence of lags in foreign exchange and exports become

$$M_t = C_0 + C_1 \left(\frac{Y}{PD}\right)_t + C_2 \left(\frac{PM}{PD}\right)_t + C_3 \left(\frac{FER}{PM}\right)_{t-1} + C_4 \left(\frac{X}{PM}\right)_{t-1}$$

$$+ c_t , \qquad (3.41)$$

and

$$\log M_t = C_0' + C_1' \log \left(\frac{Y}{PD}\right)_t + C_2' \log \left(\frac{PM}{PD}\right)_t + C_3' \log \left(\frac{FER}{PM}\right)_{t-1}$$

$$+ C_4' \log \left(\frac{X}{PM}\right)_{t-1} + c_t' \qquad (3.42)$$

However, the relative significance of the contribution of these explanatory variables either with or without lags will be tested

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[1] The original form may be specified as:

$$M_t = B' \left(\frac{Y}{PD}\right)_t^{B_1'} \cdot \left(\frac{PM}{PD}\right)_t^{B_2'} \cdot \left(\frac{FER}{PM}\right)_t^{B_3'} \cdot \left(\frac{X}{PM}\right)_t^{B_4'} \cdot b_t' .$$

in the empirical analysis of this study.

2. The case of disequilibrium (presence of lags)

The various equilibrium functional forms were set forth under the assertion that there is a competitive situation in the market, i.e., free flow of goods, services, and factors. Of course, tariffs or any other import constraints affect the competitive environment and, hence, the estimated coefficients in terms of marginals or elasticities, by changing the relative prices of imports and domestic prices. It seems that import restrictions in developing countries are crucial. Most developing countries, due to the implications of different development policies such as import substitution, industrialization, etc., have high constraints on their imports. Thus the assumption of equality of desired, M^*, and actual imports, M, will not usually hold. In sum, in the context of developing countries, a further source of misspecification occurs, when no consideration is given to the quantitative restrictions made on import flows.

A stock adjustment approach is adopted in order to take into consideration the international trade behavior of developing countries with the presence of quantitative abstracts. Obviously, ignorance of these restrictions brings about the possibility of obtaining biased and inconsistent coefficients of equations (3.37) and (3.38). Under this approach, two types of adjustment are used: discrete and continuous adjustment.

a. Stock-adjustment mechanism In order to take into account the latent sources of bias, due to different quantitative constraints, the possibility of behavior out of equilibrium with a stock adjustment mechanism is specified. To realize the adjustment process and, to some extent the effects of quantitative constraints, one must establish a time-lag variable, which is the most straight-forward procedure relating to this adjustment mechanism.

This approach is established on the basis of some expectation. Although expectations are not generally single-valued, but with the assumption of having a normal expectation of a variable, one may formulate a meaningful relationship between the influence of present and past behavior of a variable. However, on the basis of Hick's definition of elasticity of expectations and setting it equal to a constant, one can come up with a meaningful relation.[1] Let U_t^* be the expected normal level of a variable at time t, and U_t be the actual level. Then

$$U_t - U_{t-1} = \alpha (U_t^* - U_{t-1}), \quad 0 < \alpha \leq 1 \tag{3.43}$$

where α is the elasticity or coefficient of expectations according to whether equation (3.43) is expressed in logarithms or not. In other words, the equation (3.43) implies that in each period, people reconsider their notion of what is normal in proportion to the

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[1] According to Hicks [39, 205] "the elasticity of a particular person's expectation of the price of commodity X as the ratio of the proportional rise in expected future prices of X to the proportional rise in its current price."

difference between what actually happened and what they previously considered as normal.[1]

b. Discrete adjustment mechanism Time may be considered as either a continuous variable or as a discrete variable; in the former case, something is happening to the variable at each point of time, while in the latter, the variable undergoes a change only once within a period of time. Consequently, different types of disequilibrium import demand are determined.

Adjustment, under the assertion of the time as a discrete variable, specified in a linear form as a change in imports, is related to the desired import in period t and actual imports in period t-1, i.e.,

$$\Delta M_t = M_t - M_{t-1} = \partial\,[M_t^* - M_{t-1}], \tag{3.44}$$

∂ is a constant of proportionality which is called the coefficient of elasticity of adjustment according to whether the quantity imported is expressed in linear or logarithmic form.

Similarly the adjustment equation (3.44) in a log form is expressed as:

$$\Delta \log M_t = \partial\,[\log M_t^* - \log M_{t-1}] \tag{3.45}$$

$$0 \leq \partial \geq 1,$$

where $\Delta \log M_t = \log M_t - \log M_{t-1}$.

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[1] See Nerlove [89, pp. 302-304] and Leamer and Stern [69, pp. 23-24]. Further, for approaches other than stock-adjustment, see Leamer and Stern [69, pp. 22-238].

The reason underlying equations (3.44) and (3.45) may be due to the costs involved in the adjustment of imports to a desired flow and only part of this desired flow is satisfied within the period [56, p. 681].[1]

Substituting equation (3.44) into equation (3.37) and solving for M_t,

$$M_t = \partial A_0 + \partial A_1 \left(\frac{Y}{PD}\right)_t + \partial A_2 \left(\frac{PM}{PD}\right)_t + (1 - \partial) M_{t-1} + \partial a_t, \qquad (3.46)$$

This equation, which involves lagged imports, can be described as a disequilibrium import equation.

In the same manner, by substituting (3.45) into (3.38) we get:

$$\log M_t = \partial A_0' + \partial A_1' \log \left(\frac{Y}{PD}\right)_t + \partial A_2' \log \left(\frac{PM}{PD}\right)_t +$$

$$(1 - \partial) \log M_{t-1} + a_t' \qquad (3.47)$$

c. Continuous adjustment mechanism In this mechanism, actual imports adjust to desired imports according to the flow adjustment equation. This equation, under the assertion of continuous time, may be expressed in linear or logarithmic form. In linear

$$\frac{\partial M_t}{\partial t} = \alpha (M^* - M) \qquad (3.48)$$

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[1] Formulations such as (3.44) and (3.45) explicitly present a distributed lag relationship in the determination of imports. Distributed lags arise in the theory when any economic cause produces its effect only after some lag in time, so that this effect is not felt suddenly, at a single point in time, but is distributed over a period of time [89, 306]. See footnote cited on the same page.

and in logarithm

$$\frac{\partial \log M}{\partial t} = \alpha (\log M^* - \log M) \tag{3.49}$$

where α is a parameter detemrining the speed of adjustment.

Equations (3.48) and (3.37) can be approximated by estimating the equation for finite time periods as

$$M_t = D_0 + D_1 \left[\left(\frac{Y}{PD}\right)_{t-1} + \left(\frac{Y}{PD}\right)_t\right] + D_2 \left[\left(\frac{PM}{PD}\right)_{t-1} + \left(\frac{PM}{PD}\right)_t\right] + D_3 M_{t-1} + d_t \tag{3.50}$$

Similarly, in the case of double-logarithm, equations (3.49) and (3.38), we get

$$\log M_t = D_0' + D_1' \left[\log \left(\frac{Y}{PD}\right)_{t-1} + \log \left(\frac{Y}{PD}\right)_t\right] + D_2' \left[\log \left(\frac{PM}{PD}\right)_{t-1} + \log \left(\frac{PM}{PD}\right)_t\right] + D_3' \log M_{t-1} + d_t' \tag{3.51}$$

where income and price now appear as moving averages over two periods with short-run marginal propensities and elasticites D_1, D_2, D_1', and D_2' [41, p. 120].[1]

d. Extended functional forms An alternative functional form may be specified, specifically in the case of developing countries, due to the fact that quantitative constraints on imports are imposed in accordance with the foreign exchange reserves and/or exports. The reason underlying the assumption is that, whereas foreign exchange

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[1] For complete derivation of these equations, see Houthakker and Taylor [42, pp. 11-29].

or exports receipts are low, strict restraints will be imposed; they will be relaxed when reserves and/or exports increase. Thus, these two variables, which indeed represent a country's capacity to import, will act as proxies for the quantitative restraints.

With regard to the case of disequilibrium, the equations (3.41) and (3.42), in terms of discrete time adjustment, convert to the following, respectively:

$$M_t = \alpha C_0 + \alpha C_1 \left(\frac{Y}{PD}\right)_t + \alpha C_2 \left(\frac{PM}{PD}\right)_t + \alpha C_3 \left(\frac{FER}{PM}\right)_{t-1}$$

$$+ \alpha C_4 \left(\frac{X}{PM}\right)_{t-1} + (1 - \alpha) M_{t-1} + \alpha c_t \qquad (3.52)$$

and

$$\log M_t = \alpha C_0' + \alpha C_1' \log \left(\frac{Y}{PD}\right)_t + \alpha C_2' \log \left(\frac{PM}{PD}\right)_t + \alpha C_3' \log \left(\frac{FER}{PM}\right)_{t-1}$$

$$+ \alpha C_4' \log \left(\frac{X}{PM}\right)_{t-1} + (1-\alpha) \log M_{t-1} + \alpha c_t' \qquad (3.53)$$

And, further considering time as a continuous variable in the adjustment mechanism, the equations (3.41) and (3.42) may be written through the following estimating equations for finite time periods.

$$M_t = E_0 + E_1 \left[\left(\frac{Y}{PD}\right)_{t-1} + \left(\frac{Y}{PD}\right)_t\right] + E_2\left[\left(\frac{PM}{PD}\right)_{t-1} + \left(\frac{PM}{PD}\right)_t\right]$$

$$+ E_3 \left[\left(\frac{FER}{PM}\right)_{t-1} + \left(\frac{FER}{PM}\right)_t\right] + E_4 \left[\left(\frac{X}{PM}\right)_{t-1} + \left(\frac{X}{PM}\right)_t\right]$$

$$+ E_5 M_{t-1} + e_t \qquad (3.53)$$

and in logarithm forms

$$\log M_t = E_0' + E_1' \left[\log \left(\frac{Y}{PD}\right)_{t-1} + \log \left(\frac{Y}{PD}\right)_t\right]$$
$$+ E_2' \left[\log \left(\frac{PM}{PD}\right)_{t-1} + \log \left(\frac{PM}{PD}\right)_t\right] + E_3' \left[\log \left(\frac{FER}{PM}\right)_{t-1} + \log \left(\frac{FER}{PM}\right)_t\right]$$
$$+ E_4' \left[\log \left(\frac{X}{PM}\right)_{t-1} + \log \left(\frac{X}{PM}\right)_t\right] + E_5' \log M_{t-1} + e_t' \qquad (3.54)$$

where foreign exchange and exports, in addition to income and price, now appear as a moving average over two periods with short-run marginal propensities and elasticities E_3, E_4, E_3', and E_4'.

IV. EMPIRICAL ANALYSIS

An estimation of the coefficients of behavioral and technical relations would be a simple problem if the observations were in exact agreement with the relative postulates; however, such a situation is a very rare phenomenon, since estimation problems do occur. As a result of this, in considering economic systems, one is faced with a situation which is often referred to as "the gap between theory and empirical analysis".

Obviously, import demand is no exception; in other words, some gaps exist between the theoretical assumptions on the import demand and the empirical analysis. For instance, the value of imports in current currency has occasionally been used as a dependent variable, and this--on theoretical grounds--should be avoided.

In theory, certain postulates are specified and behavior of the variables is deduced through logic. In contrast, empirical studies deal with quantifiable phenomena. Often these two complement each other, i.e., the empirical analysis can be used to verify the validity of certain theories. Sometimes certain theories are reached by starting from an empirical analysis. Nonetheless, in the field of import demand, preoccupation with the empirical analysis, or the mechanics of estimates result in inadequate theoretical development of a trade model.

A. Estimation Problems

Estimation problems may occur due to the gap between theoretical and empirical analysis. Theories are usually established on the basis of individual behavior. Empirical analysis of economic actions, on the other hand, are nearly always on aggregative basis: they are restrained to the behavior of groups of individuals. Establishing a relationship referring to the reaction of a group instead of a single individual brings about problems of fundamental importance. Hence, one should consider the problems due to the connections between the functional relationships presumed by the microeconomic theory and the relationship of macroeconomic postulated, generally, by the empirical analysis. Section 1 attempts to realize the aggregation problems in general and extends to the problems devoted to the aggregated import demand. Section 2 is concerned with the time problems.

1. Aggregation problems

According to Green [27, p. 1], "aggregation is a process whereby a part of the information available for the solution of a problem is sacrificed for the purpose of making the problem more easily manageable." The import demands specified earlier (see Chapter III, Theoretical analysis) were derived according to the behavior of individuals, i.e., on the level of micro-theory. But, in empirical analysis, the behavior of a group of individuals is considered. Hence, one is faced with the question of deriving

theories on aggregate (macro) relationships based on individual (micro) relationships. It is necessary to specify a consistent procedure for aggregation and to then verify the nature of the aggregation bias involved in the procedure adopted.

An aggregation will be consistent, "when the use of information more detailed than that contained in the aggregates would make no difference to the results of the analysis of the problem at hand" [27, p. 1]. Grunfeld and Griliches [30, p. 1] argue that aggregation may sometimes decrease the specification error and thus bring some gain in accuracy.[1] However, according to them,

> in practice we do not know enough about micro behavior to be able to specify micro equations perfectly. Hence, empirically estimated micro relations, whether those of individual consumers or of individual producers, should not be assumed to be perfectly specified either in an economic sense or in a statistical sense. Aggregation of economic variables can, and in fact frequently does,

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[1] Much of the discussion of econometrics has relied heavily upon the assumption that the model to be estimated is correctly specified. Once the correct specification of the model is assumed, model estimation and model testing become relatively straightforward. In reality, however, we can never be sure that a given model is correctly specified. Two kinds of misspecification may occur. The first, when irrelevant variables are omitted from the linear regression, and the second when irrelevant variables are added to the equation. In sum, the term "specification error" covers any type of error in the specification of the model being estimated, but it has come to be used particularly for errors in specifying the data matrix, i.e., independent variables. For further explanation, see Pindyck and Rubinfeld [92, pp. 187-193] and Johnston [48, pp. 168-169].

> reduce these specification errors. Hence, aggregation does not only produce an aggregation error, but may also produce an aggregation gain.

The microtheory and macrotheory may have different functional forms. Accordingly, it is possible to distinguish between various kinds of aggregation by means of a suitable classification of types of equations [105, p. 3]. However, on the basis of objects, aggregation may take place over individuals, commodities, or both.[1]

a. Aggregation over individuals In chapter III, it was verified that an individual's import demand is a function of the price of the imported commodity, price of other commodities--domestic and/or imported--and income. By assuming a linear relationship and the same price for all individuals and some definitions, one may come up with an aggregate import demand over individuals in which the aggregate quantity imported is the sum of individual quantitites imported; the intercept of the aggregate relationship is the sum of individual intercept; and the aggregate marginal propensity to import is the average of individual marginal propensities. Aggregate income is defined as a weighted average of individual incomes, the weights being proportional to the individual propensities; therefore, the aggregate income will differ from commodity to commodity due to some specified definitions. Obviously, changes in assumptions and definitions bring about different types of aggregated results.

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[1] Theil has recognized another type of aggregation--aggregation over time period. For more details, see Theil [105, Ch. IV].

b. Aggregation over commodities Imports usually consist of thousands of different kinds of commodities. Hence, on the aggregate level, the homogeneity property is no longer valid, and it is not possible to add up the quantities imported and their prices. In this case, a standard approach is to establish index numbers of quantities and prices with respect to some basic quantities and prices. Of course, these indices play not only the role of explanatory variables, but also apply for deflating purposes. Here a simplified case is illustrated.[1]

Suppose that there is only one individual facing k commodities. The import demand relationship, ignoring other prices for simplification, can be written as

$$m_j = a_j + b_j P_j \qquad (4.1)$$

$$(j = 1, \ldots, k)$$

where

m_j = quantity imported of j^{th} commodity, and

P_j = Price of j^{th} commodity.

With reference to the base value (say m_{j0} and P_{j0}), equation (4.1) can be written as

$$\frac{m_j}{m_{j0}} = a_j + b_j \frac{P_j}{P_{j0}} \qquad (4.2)$$

using Laspeyres index numbers as,

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[1] A more sophisticated case will be explained later. See pp. 65-66.

$$m_j^* = \frac{w_{j0}}{\Sigma w_{j0}} \frac{m_j}{m_{j0}} \text{ and} \tag{4.3}$$

$$P_j^* = \frac{w_{j0}}{\Sigma w_{j0}} \frac{P_j}{P_{j0}} \tag{4.4}$$

where $w_{j0} = P_{j0}\ m_{j0}$ and

m_j^* and P_j^* are transformations of m_j and P_j when using index numbers. Now inserting (4.3) and (4.4) into equation (4.2), it can be written as

$$\frac{\Sigma w_{j0}}{w_{j0}} m_j^* = a_j + b_j \frac{\Sigma w_{j0}}{w_{j0}} P_j^* \ . \tag{4.5}$$

Dividing by $\frac{\Sigma w_{j0}}{w_{j0}}$

$$m_j^* = a_j \frac{w_{j0}}{\Sigma w_{j0}} + b_j\ P_j^* \ , \tag{4.6}$$

$$= a_j^* + b_j\ P_j^* \ .$$

where

$$a_j^* = \frac{w_{j0}}{\Sigma w_{j0}} a_j \ .$$

c. Aggregation over individuals and commodities In this case, the procedure presented in the previous two cases is no longer applicable, due to the presence of cross effects. The suggested solution to this case is to adhere to either microtheory and to avoid macro relations, or to use only macrotheory and to ignore microtheory.[1]

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[1]For further information, see Allen [3], Fox [22], and Theil [104].

Now, in a more specific and sophisticated case, suppose that individual i decides to purchase import commodity j on the basis of the following demand function

$$m_{ij} = m_{ij}\,(P_{m1}, P_{m2}, \ldots, P_{mn}, P_{d1}, P_{d2}, \ldots, P_{dp}, y_i), \qquad (4.7)$$

$$(i = 1, \ldots q \text{ and } j = 1, \ldots, n;\ k = 1, \ldots, P)$$

where

m_{ij} = quantity of j^{th} commodity demanded by i^{th} individual,

P_{mj} = import price of j^{th} commodity,

P_{dk} = domestic price of k^{th} commodity,

y_i = income of i^{th} individual.

The equation (3.37) in section E (p. 51) was derived to specify the reaction of the constant value of imports to the variation of real aggregate income, $(\frac{Y}{PD})$, and changes of relative price indices, $\frac{PM}{PD}$. It implies, accordingly, the behavior of individuals in purchasing different commodities, i.e.,

$$M_t = \sum_j P_{i0}\, m_j = M\,(P_{m1}, P_{m2}, \ldots, P_{mn}, P_{d1}, P_{d2}, \ldots, P_{dp},$$

$$y_1, y_2, \ldots, y_q) \qquad (4.8)$$

Equation (4.8) is quite general, and the number of explanatory variables exceeds the number of available observations. In order to come up with a solution, one should establish a set of index numbers to be used as an explanatory variable.[1]

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[1] Of course, it also will be used as a deflator in an aggregate import-demand function.

Leamer and Stern (69, pp. 42-47) illustrate that to a linear approximation, M_t may be a function of an aggregate income index and import and domestic price indexes as

$$M_t = A_0 + A_1 Y_t + A_2 PM + A_3 PD . \tag{4.9}$$

where

$$Y_t = \sum_{i=1}^{q} w_i \frac{y_{it}}{y_{i0}}, \quad \sum_i w_i = 1$$

$$PM_t = \sum_{j=1}^{n} w_j \frac{P_{mjt}}{P_{mj0}}, \quad \sum_j w_j = 1$$

$$PD_t = \sum_{k=1}^{p} w_k \frac{P_{dkt}}{P_{dk0}}, \quad \sum_k w_k = 1$$

In other words, on an aggregate level, income and prices should be weighted by the income and price elasticities of imports.[1]

Due to the possibility of more potential errors in this sophisticated case, the lack of complete required information in the selected developing country, and finally complicated computation to find proper weights, the usual unweighted income aggregate and the usual Laspeyre's value-weighted price indices are used.[2] By applying unweighted income and the Laspeyre price indices, it is implicitly assumed that:

i) All individuals have identical marginal propensities.

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[1] For complete mathematical proof, see Leamer [68, pp. 441-449] and Leamer and Stern [69, pp. 42-47].

[2] For a complete explanation on indices, see Appendix D.

ii) All cross elasticities be equal to zero and have equal direct elasticities.[1]

One further point should be made on the aggregation problem. In analyzing a country's total imports, no attention is made to the differing elasticities of the component commodities. As mentioned above, one of the sources of error is using aggregative index numbers of quantities and prices. All the estimated income and price elasticities dealt with in this study relate to the total import demand. Hence, the possibility of a bias exists. For instance, it is possible to come up with a situation in which if we have an aggregate price elasticity that is a weighted average of several disaggregated price elasticities, and we calculate an average price change from the disaggregated prices, the resulting aggregate quantity change may be greater than, equal to, or less than the product of the aggregate elasticity and the price change [77, p. 235].[2]

In general, the aggregate approach gives unbiased results if (i) an unvarying rate of price change exists at the disaggregated level, or (ii) the disaggregated price changes are more or less uncorrelated with the product of the component elasticities and

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[1] Leamer and Stern [69, p. 48] have summarized their argument on the aggregate problem. Appendix D clarifies the reasons underlying the choice of unweighted aggregate income and Laspeyre's price indices.

[2] For complete mathematical proof of this statement, see Magee [77, pp. 236-239].

the component weights.

2. Time dimension

The time dimension in economic theory may be explained in "run" concept. Short-run and long-run are realized, but the distinction between these two is frequently used in a loose way.

Briefly, on the supply side, the distinction has generally been made on the basis of an assumption about the supply of factors of production. The argument is that, in the shortest of all short runs, most, or all, factors of production are fixed, while--as time goes on--gradually more of these limits are relaxed. Under this interpretation of the concept of different runs, it can be shown that the short-run elasticities of supply are always less than or equal to the long-run one and that the longer the time or run allowed for adjustment, the closer the short-run elasticity to the long-run.

On the demand side, the theory of consumer behavior is similar to the theory of the firm: a firm maximizes profits subject to different restraints and a consumer maximizes utility subject to budget constraints. A consumer produces satisfaction with stocks of different commodities, of durable, semi-durable, and/or perishable natures. Due to the fact that stocks of durable or semi-durable commodities have greater elasticities of supply in the long- than in the short-run, the elasticity of demand is greater in the long- than in the short-run.

To have a better understanding of the effect of the time dimension on the demand side, consider a demand schedule, $D_L D_L$, figure (4.1). Suppose E is a point on the long-run demand, $D_L D_L$, i.e., complete adjustment has occurred. q_2, q_3, q_4, q_5 are a sequence of quantity changes due to a successive rise in the price from P_0 to P_1 and P_1 to P_2. Of course, the subscripts 2 to 5 denote the appropriate time period in which quantity is completely adjusted.

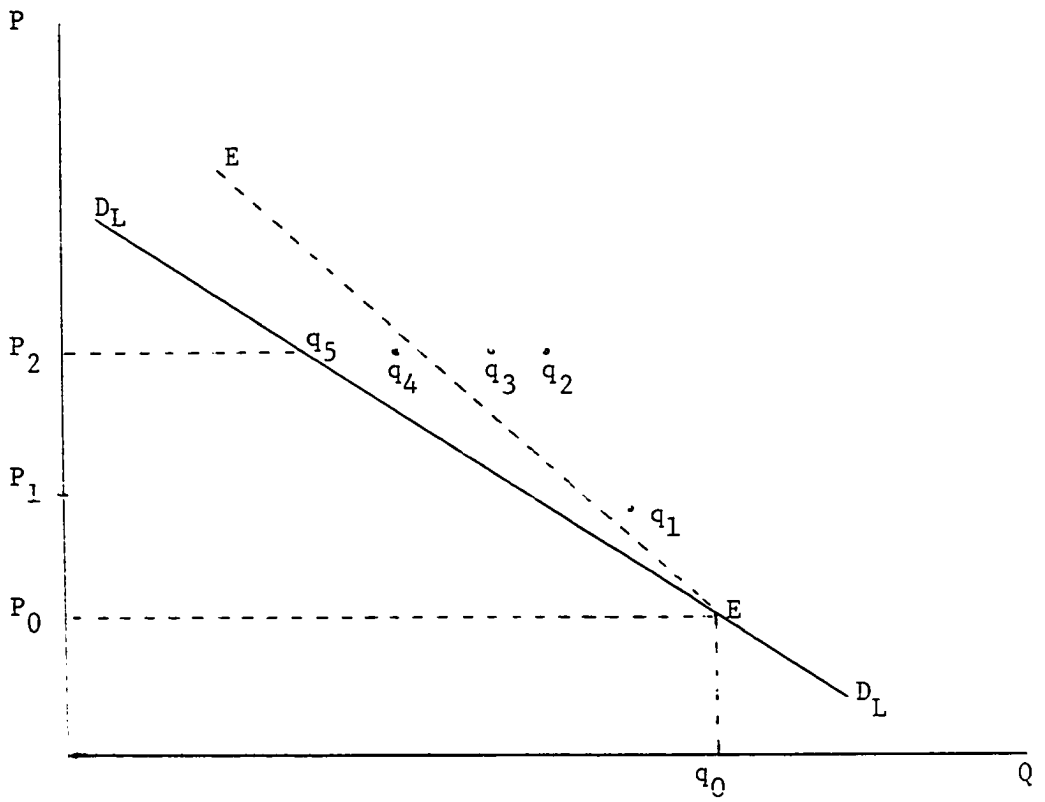

Figure 4.1. Adjustment of quantity to a successive change in price and linear regression fit to quantities adjusted to a change in price[1]

[1]Adopted from Leamer and Stern [69, p. 22].

What is important in this argument is that the adjustment in quantity results from both price changes--P_0 to P_1 and P_1 to P_2. In other words, an attempt has been made to show "that the adjustment of quantity depends on the past history of price changes and the sequence of price changes within the relevant period as well as on the total price change within the period" [69, p. 21].

With regard to the import demand, it was earlier realized that the import demand depends on domestic supply and on domestic demand schedules. Moreover, it has been widely recognized that, specifically on the supply side, any change in the explanatory variables, e.g., prices, in one period may be continued to more than one period. It follows from this that the long-run elasticities of imports are larger than the short-run ones and that those studies, in which estimates have been based on relating the imports to the explanatory variables in the same period, involve a bias.[1] For instance, suppose it is attempted to estimate the following equation

$$M_t = M_t \left[\left(\frac{Y}{PD}\right)_t, \left(\frac{PM}{PD}\right)_t, \ldots\right] \tag{4.10}$$

namely, each period's quantity of imports is a function of the variables in the same period. In figure (4.1), EE represents the regression estimate fitted to these points and implies no information about the demand schedule, $D_L D_L$, or the process of adjustment. Hence,

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[1] In fact, this is a source of bias which was mentioned by Orcutt. For a mathematical treatment of this point, see Orcutt [90, Appendix 3, pp. 548-550].

it must be recognized that the time dimension poses quite serious problems in estimating the import demand.

To solve time dimension and the respective adjustment process, one must establish a time lag variable which is the most straightforward procedure relating to the adjustment process.[1]

B. Alternative Approaches

Attempts have been made to examine different approaches to estimate the coefficients--either in terms of marginal propensities or elasticities--of independent variables involved in import demand functions. This is shown, in this and the following section, to the extent that it clarifies which method appears to be a better fit to the trade behavior of developing countries.

However, due to some potential problems with time series estimates (see Section C below), a number of studies have been made using various methods such as cross-sectional, input-output, and simultaneous approach. In the following, it has been attempted to clarify these methods and their inherent deficiencies so as to consider some parts of reasons underlying the selection of the approach in this study, i.e., time series estimates.

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[1]Since the introduction of different approaches of establishing lagged variables due to the time dimension is similar to the introduction of those variables due to disequilibrium. See Section E, pp. 53 - 60. Moreover, alternative approaches have been discussed by Leamer and Stern. For further details and a mathematical approach, see Leamer and Stern [69, pp. 22-28].

1. Cross-section estimates

Cross-section data relate to the behavior of a given sample of the population at a given point of time. Instead of examining how a given country behaves in international trade over time, it is possible to examine the behavior by comparing how different countries during a given period have adopted their foreign trade to changes occuring in that period. Specifically, in the case of import demand, cross-section estimates examine the import behavior of different countries during a given period of time with regard to changes in predetermined variables involved in the import demand function.[1]

The cross-sectional estimates have not yet been well investigated in international trade. In fact, devaluations have been, to a large extent, the basis of involvement in a cross-sectional analysis, i.e., comparison of the consequences of devaluation on different countries' foreign trade in a certain time.

Among these studies, those of Polak [93] and Harberger [34] may be named.[2] Harberger made a comparison of trade in the first quarter of 1950 with the first quarter of 1949 among different countries. An elasticity of demand for imports was estimated by comparing the proportionate change in imports from each source with

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[1]Indeed, most studies apply a method which is, strictly speaking, a quasi-cross-section rather than a cross-section estimation, since it is not based on a comparison of countries.

[2]For more details, see Polak [93] and Harberger [34].

the change in its relative prices. While individual elasticities were determined for each country, no statistical tests of significance were made.

A cross-sectional analysis using a longer period of time was made by Fleming and Tsiang. They attempted to find changes between 1948 and 1953 in the exports' share of some countries, relating these changes to the changes in prices. However, according to their conclusions, "these estimates, ...are subject to a considerable margin of error...when applied to any particular country, the likelihood of error would be even greater" [21 , p. 244].

Another kind of cross-section estimate was made by MacDougall [74], who tried to determine the elasticity for a country's total exports by a type of commodity grouping. In sum, one of the many difficulties of MacDougall's approach is that a classification used by one country may include commodities not included at all in the most closely-corresponding classification(s) of another. Thus, there is no clear way of reaching the magnitude of the elasticity for a country's total imports; consequently, this method does not seem to be appropriate for the current study.

Generally speaking, there are four major weaknesses in the cross-sectional approach. First, with this approach, as with the time-series estimate, there is the possibility that supply relationships may affect the result so that pure demand elasticities are not estimated. Nonetheless, the method may still have advantages over

the time-series approach for a certain country, since a wider range of variation may be covered by the analysis. Furthermore, comparing data with different methods of collecting creates an inconsistency in inferences concluded by this approach. Lastly, comparing the changes in imports of one country with another may be expected to have a meaningless result. However, a comparison of quantity changes with the price changes will yield demand elasticities only on the basis of special assumptions, such as equal cross-elasticities of demand for all of a certain set of competing countries and zero cross-elasticities with respect to the remaining countries.

2. Input-output approach

This approach, like that of cross-section estimates, has not been fully investigated in international trade. It is realized that import demand derived under the assumptions of consumer theory may not be considered an explanation of the demand for productive inputs.

The traditional import functions, which use real income or a component of it as an explantory variable, implicitly assume either that the unit import requirements of all components of real income are equal or that unit import requirements of several components of real income are negligible. According to input-output approach, this assumption seems to be wrong for most commodity groups, and hence, the classical approach implies an inconsistency, consequently

concluding in biased results [102, pp. 674-675]. However, this approach is used to develop an import demand function, for the input-output framework may predict the direct and indirect import requirements of a commodity from given components of aggregate final demand, either in the short-run or the long-run.

Sundararajan and Thakur [102] mention that, in general, although the input-output approach provides a better fit with the observed data than does the classical approach, when the import demand functions are estimated in the log-linear form, the input-output and classical approach yield identical R^2.

In short, there are two main weaknesses of this approach which may be specified. On the one hand, this approach does not seem to be of practical value in a general study such as this. On the other hand, although trade data for developing countries have been recorded with much greater accuracy than for other economic activities for decades, this has not been done in sufficient detail so as to realize the end use of components of the total imports.

However, if income term is considered as a productive activity of various industries in the import demand function, the traditional import demand function may be used for raw materials and intermediate goods.[1]

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[1]For further detail on the input-output approach, see Sundararajan, V., and Thakur, S. [102], and for the possibility of using the classical import demand for inputs, see Leamer and Stern [69, Ch. I].

3. Simultaneous-estimation (models of world trade) approach

Until the present, various approaches have been established on the basis of one relation out of a system of interwoven relations in isolation and have thus produced some biased and inconsistent estimates of structural parameters. The simultaneous-equations approach considers, on the contrary, all the relations in a complete system, which together is usually regarded as a model.

The basic economic theory underlying this system is that "what one person disburses, another person receives." In general, the model is a set of one or more mathematical equations representing some part of this transformation. The equations may be behavioral, technological, or definitional. The equations show relationships among a number of economic forces which may be determined either outside of the system or in a time period previous to the one under immediate consideration (predetermined), or by the endogenous system. Of course, how to distinguish between these two types of variables depends on what particular questions are being studied.

Attempts have been made to build different models under the world trade system. An import-export matrix will help to explain the differences between the models. Such a matrix has a row and a column for each of the countries or regions under consideration. Each row illustrates the exports of a country to other countries, and the sum of the entries in a row equals the country's total exports. The entries in each column show the imports of the country

listed in the column heading, and the sum of the column entries equals its total imports.

Let x_{ij} be the flow of commodities exported from country i to country j. The i and j may be regions or countries. The matrix then gives all flows of world trade. If we set the $x_{ii} = 0$, the

T	M_1	M_2	...	M_j	...	M_n
X_1	x_{11}	x_{12}	...	x_{1j}	...	x_{1n}
X_2	x_{21}	x_{22}	...	x_{2j}	...	x_{2n}
⋮						
X_i	x_{i1}	x_{i2}	...	x_{ij}	...	x_{in}
X_n	x_{n1}	x_{n2}	...	x_{nj}	...	x_{nn}

i^{th} row represents all of country i's exports; hence $X_i = \sum_{j=1}^{n} x_{ij}$. The j^{th} column shows the j^{th} country's total imports, $M_j = \sum_{i=1}^{n} x_{ij}$. Obviously, total world imports will be equal to total world exports if all countries in the world are included, i.e., $\Sigma M_j = T = \Sigma X_i$.

The different models will result from applying each component of this import-export matrix. Neisser-Modigliani [87] and Polak [94] have separate functions for total imports, M_j, and total exports, X_i of each country, while other studies view the individual flows, x_{ij}, directly. Thus this approach--with some limiting assumptions--becomes an input-output or a cross-sectional method.

The import-export matrix may be applied as an input-output approach. In such an approach, the columns show the origin of different inputs used by certain industries, and the rows illustrate the destination of the outputs. For each industry the ratios of inputs to its output given a set of technical coefficients which can be assumed to remain constant. By denoting a target output level to the matrix of technical coefficients, the demand for different inputs can be determined.

This method has two limitations. First, there exists no theoretical reason why the ratios should remain constant. Second, in order to predict, the system presumes a knowledge of either total trade or one of its country flows.

On the other hand, the import-export matrix may be converted into a cross-sectional analysis. In which the individual trade flows, x_{ij}, expressed as a function of potential exports and imports, income, population size, and a parameter for distance between countries i and j.

This model has the limitation of the constant-share method. Moreover, prices are eliminated due to the fact that it is, indeed, a cross-sectional analysis, using data for each country at the same point of time. Prices are not relevant variables in cross-section analysis since each country is faced with the same set of prices. Furthermore, in equilibrium there exists an equality of supply and demand on the world market.

The other studies relating to the approach have attempted to establish the major relationships between the level of domestic economic activities in different countries and their international transactions. So as to find how variations in the former influence the latter. For instance, Metzler concentrates on changes in investment; Modigliani and Neisser on income and capital flows; and Polak on autonomous investment and price changes. In the Rhomberg model, income, prices, and capacity in the developed countries are the predetermined variables.[1]

The simultaneous-equations approach, in any form, is faced with some weaknesses as are the other approaches. In addition to those mentioned above, the following may be specified: the cost involved in building such a comprehensive method and the lack of complete data on import-export of developing countries.

A variety of approaches to this study have been surveyed, with each method having increased our knowledge of the structure of international trade. Nevertheless, each approach has fallen short of the mark of explaining the trade behavior of developing countries. The following section is devoted to the approach used in this study--time series estimates.

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[1]For further explanation of these studies, see Taplin, G. B. [103, pp. 443-450] and the respective references cited in this article.

C. Time Series Estimate

The ordinary least squares method was applied in most studies in which statistical estimates have been made of the income and price elasticities of import demand of developed countries.[1] In order to better understand the method to be used in this study, it may be assumed that a linear relationship exists between a dependent variable; i.e., imports, m explanatory variables, i.e., income, price, and ..., and a disturbance term. This relation in a matrix notation may be written as:

$$M = XA + E \tag{4.11}$$

where

M = n x 1 - vector of dependent variable

X = n x m - vector of explanatory (predetermined) variables or it is fixed by the inherent characteristics of the units of observations.

A = m x 1 - vector of unkown parameters (coefficients)

E = n x 1 - vector of disturbance term

n in these vectors is the number of observations, i.e., the period under study.

The problem is to estimate the unknown parameters which may be in marginal or elasticity terms, depending on whether the relationship is simple or log linear, respectively. The least-squares solution

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[1] Specifically using annual aggregative time series. For further explanation, see Cheng's compilation [13].

would be determined by

$$\hat{A} = (X'X)^{-1} X'M \tag{4.12}$$

where $\hat{A}$ is the vector of the estimated magnitude of unknown parameters.

Generally, in this method it is assumed that:

1. the expected value of the random term is equal to zero;
2. the random term has a constant variance;
3. there exists no correlation between the random term and the explanatory variables;
4. import is considered as an endogenous variable, other being predetermined;[1]
5. The random terms are serially independent; i.e., there is no autocorrelation; and
6. There are no interrelationships among the predetermined variables;
7. The number of parameters to be estimated must be less than the number of observations.[2]

Assumption 1 means that each random variable, including each unspecified nonrandom variable, is assumed to have zero mean.

Assumption 2 in matrix form is really a double assumption.

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[1]The objective of an equation system is to describe a subset of its variables in terms of the other variables. The former variables are called endogenous, the latter predetermined. Predetermined variables can be exogenous or lagged endogenous variables; e.g., lagged import is entered in the import demand equation as a predetermined variable.

[2]For details, see Johnston [48].

First, it implies that each random term has the same variance; hence, the term homoscedasticity is used for this condition. Second, for any pair of random variables, covariance should be equal to zero. This means that the random disturbance terms, e.g., E_i and E_j are not correlated.

Obviously, ignoring one or more of these assumptions brings about some kind of downward or upward bias in the estimated parameters. This method has been criticized according to different purposes and interpretation.

In most of the studies in which price and income elasticities of import demand were estimated, the estimated price elasticities were substantially less than one. Accordingly, in the frame of exchange-rate adjustment, a devaluation would tend to worsen rather than improve the balance of trade, due to the fact that the sum of the elasticities of demand for a country's imports and exports might together add up to less than one. Now, if it is assumed that the supply has infinite elasticity, the Marshall-Lerner condition necessary for a devaluation to improve the balance of trade will not be met. Hence, this "elasticity pessimism" suggests that, for adjusting the balance of trade, measures other than change in relative prices may be considered.

Objections to ordinary least-squares analysis in international trade were first set forth systematically by Orcutt. He argued

that different sources of bias exist in the ordinary least squares method, based on annual aggregative time series, which tended to give too low an estimate of the price elasticity. That is, the method and data applied cause a bias in calculating price elasticity toward zero. It is worthwhile to discuss each of these sources in detail.

Consider the linear form of import demand:[1]

$$M_t = A_0 + A_1 \left(\frac{Y}{PD}\right)_t + A_2 \left(\frac{PM}{PD}\right)_t + a_t, \tag{4.13}$$

where M_t is the quantity of imports, $\frac{Y}{PD}$ is real income, $\frac{PM}{PD}$ is the relative prices, and a_t is a random term associated perhaps with those explanatory variables which have not been included explicitly in the equation (4.13). According to the assumption (3), the estimated coefficients will be unbiased only if the random term, a_t, is not correlated with independent variables.

The first source of bias, according to Orcutt [90], is due to shifts in the demand. It is argued that there will be changes in tastes and also in technology during a period of 15-20 years. These changes bring about some shifts in the domestic demand and domestic supply, which constitute the import demand. As Orcutt [90, p. 533] states:

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[1]Of course, the discussion applies equally to the log-linear or any other functional forms.

> One way of dealing with (this) situation in which both the demand and supply schedules shift over time is that of incorporating the other variables influencing demand into the relation which is to be fitted to the data and thus attempt to fit a surface in several variables instead of a straight line to the data. By this means a demand surface which has not shifted materially over the historical time period studied might be obtained.

Including this fact, it is, moreover, argued that income and relative prices tend to move together. Now if real income is not included in the relationship, then there will be an error in the estimated price coefficient. That is, the random term will cover the excluded income term, and, hence, the assumption (3)--that there is dependency between error term and explanatory variable--is violated. Even if both relative prices and real income are considered, there may still be a dependency between prices and random term. This expression can be illustrated by Figure 4.2:

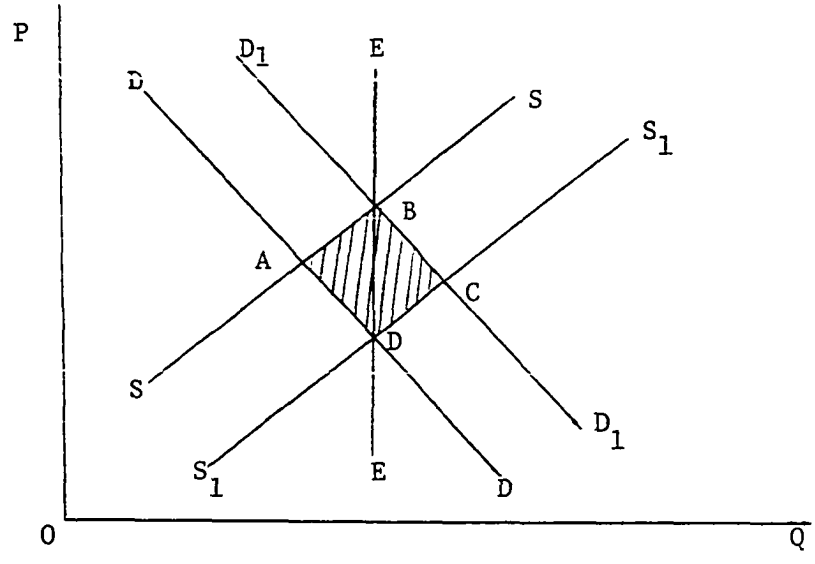

Figure 4.2. Downward bias in the estimated price coefficient[1]

[1]Adopted from Leamer and Stern [69, p. 30], and also see their explanation.

Where DD is demand and SS is the supply schedule, and the horizontal axis indicates that part of the quantity variation not explained by income, the vertical axis shows that portion of prices not explained by income. In fact, both axes are the net of what can be explained linearly by variation in income. Supposing a random disturbance bringing about a shift of the DD to the D_1D_1, and considering SS unchanged, there will be an increase in price, therefore, there is a relationship between random term and prices, which violates the assumption (3).

The bias in the estimate can be shown by assuming that random term shifts both demand, DD, and supply, SS, schedules to the D_1D_1 and S_1S_1. This will result in the parallelogram ABCD, within which the data points for prices and quantities will be limited. An attempt to fit any regression line through these points would create an underestimated line in comparison to the "pure" elasticity on the underlying demand schedule.

It seems that shifts in demand curves have not, in general, been independent of shifts in supply curves. Rather, it seems that generally import demand and supply schedules for these imports shift together. As pointed out above, the import demand is an excess demand. That is, problems arise from the simultaneous operation of a supply relationship; the estimated price coefficient obtained from observations of quantities and prices is thus a "mixed" estimated coefficient. Of course, the bias may be eliminated

completely with some proper assumptions, to be discussed in Section D.

A second argument about using the least squares method is the creation of bias due to error of observation. It is obvious that this error will, in any case, reduce the accuracy of estimated import demand. That is, if the data are subject to errors of measurement, the estimated coefficients will not be as accurate as they otherwise might be. The errors of measurement may be due to misclassification, falsification, and faulty methods of index number construction.[1]

A third point is that, in time series estimates, there is the possibility of error due to aggregation. In analyzing series of a country's total imports, it seems that no attention is paid to the differing estimated coefficients of the component commodities. There is the possibility of a case in which some commodities with relatively low elasticities may show the greatest price fluctuation, hence resulting in a predominant effect on the aggregative indexes. Therefore, the existence of such aggregation may underestimate the pure elasticity.[2]

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[1]See Orcutt [90] and Leamer and Stern [69].

[2]It would thus appear on these grounds that there is a strong argument for using aggregative data. However, the aggregation problem and the possibility of there being differences between aggregated and average disaggregated coefficients will be discussed in sections C and E for Chapter III, Empirical Analysis, respectively.

Consideration of short-run and long-run elasticities is a fourth argument, for, on the supply side, short-run price elasticities are likely to be much smaller than long-run price elasticities, as import demand, in general, relates to the domestic supply as well as to domestic demand. It may be realized from this that short-run price elasticities are probably smaller than long-run ones. Now, if annual data are analyzed, the resulting estimated elasticities tend to take into account only that part of the reaction that occurs within a year. By ignoring complete adjustment that may continue for more than one year, short-run estimates rather than long-run ones may be brought about.[1]

A final argument is about errors due to the calculation of elasticities for large and small price changes. The reasons underlying this point is that it takes time for taste to adjust and that the price changes should be large enough to dominate the cost of switching. According to Orcutt [90, p. 542]:

> Thus small price changes and particularly those which appear to be of a temporary nature will be ignored. Little shifting will take place until the differential is at least sufficient to cover the cost of switching,

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[1]Indeed, by introducing lagged variables (see Section E, Chapter III), one can make clear whether the long-run elasticity is significantly greater than that obtained by the simple models without lagged variables.

whereas a large and fairly permanent change produced by depreciation would result in substantial substitution.

D. The Lines of Specification

As a guide for the following sections of this study, and in order to interpret the results of estimations in a managable way, some specfications must be made. The first subsection is devoted to data specification, while explanation of a general framework of different hypotheses being tested will be made in the second subsection.

1. Data specification

a. Countries involved The countries involved were selected so as to represent a fairly wide geographical coverage in three regions: Asia, Latin America, and Aftica. Table 4.1 shows the number of countries in each region as well as the total. Indeed, this wide geographical coverage provides some general background for this study.

b. Description of variables Total imports. The most readily available data on imports are presented in value rather than quantity terms. The concern herein is with volume rather than value magnitudes, however. The term volume denotes the result obtained by eliminating

Table 4.1. Numbers and regions of countries involved[a]

Region	Country	Number
Asia	Iran, Republic of Korea, Philippines, Pakistan, and Thailand	5
Latin America	Colombia, Dominican Republic El-Salvador, Guatemala, Honduras, and Panama	6
Africa	Morocco and Tunisia	2
Total		13

[a]We attempted to select samples on the basis of random such that be proportional to the number of countries in each region. But, because of limitation of data on some variables--specifically prices--selected countries are distributed as shown in this table. However, they represent a wide geographical coverage appropriate to this study.

the effect of price fluctuation from the given values. In mathematical form:

$$M_t = \frac{V_M}{P_M},$$

where, P_M is import price index, V_M is value of imports, and M_t is the volume (quantity) of imports.

Real income. Although it is argued that a subdivision of this variables is preferable for specific categories of import, it seems, that in this study, aggregate real gross domestic product, GDP, must be chosen to conform with the general fluctuation of total imports. Underlying reasons may be, first, the nature of this study and second, the avoidance of any further inconsistency due to the characteristics of data in the selected developing countries. Real income, real GDP, is obtained by dividing current GDP and GDP deflators with 1970 as a base year.

Prices. This study does not deal with individual commodities, but rather with the aggregate, the price changes of which can be determined only by price indices. Relative price is always a ratio of two prices: the import price index and the domestic price index. The import price index as a unit value is used for the former, while the wholesale price index (WPI) is used as a representative

of the latter.

Even if the unit value indices accurately reflected the price movements of actual imports, they would still be deficient indicators in international trade. One weakness which they share is that the weights by which various commodities are combined differ from one country to another; therefore, it is difficult to say whether an apparent change in price relations results from differences in price movements or from differences in the weighing of identical price movements. Moreover, it would have been better to divide this unit value by the prices of import-competing commodities, although it was not possible with the existing available data in the selected developing countries. These indices and respective formula will be explained in Appendix D. Finally, 1970 was considered as base period equal to 100.

Foreign exchange reserves and export earnings These two variables--current and lagged--as explanatory variables are introduced to establish an extended form of the traditional import demand. The values of these two are deflated by import price index to obtain the real values.

c. Period of observation The observed values on which the import demand models--both equilibrium and disequilibrium--rest are those applying to the period of 1959-1974, with 1970 as a base year and 14 years of annual data on the above forementioned variables.

d. Statistics Most statistics referred to in this study

are t-student, F-ratio, coefficients of multiple determination, R^2, and Durbin-Watson, D, statistics. t-student value is used to find the relative significance of each explanatory variable in the import demand models. The F-ratio tests are applied to test the overall significance of the models and, R^2 is used to realize the goodness of the fit and, moreover, as an indicator for selecting the one which fits the best. Finally, the Durbin-Watson D-statistic is used to test for serial correlation. Serial correlation would indicate a tendency for the models to underestimate for certain years and over-estimate for others; such a tendency could be due to structural changes not approximated by linear of transformed-double-log relations.

As a matter of practical convenience, the probability levels of 5% (0.05) and 1% (0.01) are commonly used in deciding whether to reject the null hypothesis. However, the statistical significance of each estimated coefficient is indicated by asterisks on the t-ratio. A coefficient which is significant at the one percent level is denoted by **; a 5 percent level is denoted by *, and no asterisks indicate that the coefficient was nonsignificant at the 5 percent level or higher.

e. Data sources All import quantity and different price indices were obtained from the International Monetary Fund, International Financial Statistics, various issues.

Nominal gross domestic product (GDP) data were taken from International Financial Statistics, real GDP data from the United Nations, Statistical Yearbook, various volumes.

World income and prices are defined as real GNP reported by the Organization for Economic Cooperation and Development (OECD) and the OECD GNP deflator, respectively. Data were taken from OECD, Main Economic Indicators.

Data on the total imports, gross domestic products, real world income were converted to U.S. dollars in the selected developing countries for a period of 16 years--1959 to 1974. Where a series was only available in domestic currency, it was converted by use of the current official exchange rate. In cases of multiple rates, an implicit rate for conversion was constructed by use of the trade balance in domestic and in foreign currency.

2. Specification of hypotheses

On the basis of the relevant economic theory and past studies, examined in the previous chapter, the following hypotheses are to be tested.

a. Price hypothesis Through previous sections, one can realize that price, as an explanatory variable, has an arguable place in the import demand. Due to a low price-elasticity estimation, specifically in developed countries, it was suggested that the price

mechanism has rather limited power to bring about adjustment in the balance-of-payments. On the other hand, with respect to the criticism of the estimating method, there is a belief that higher price elasticity can bring about an adjustment in the balance of payments. Moreover, with regard to ignorance of the power of the price mechanism in developing countries, the hypothesis of relative significance of the prices is established.

Traditionally, in testing the relative significance of prices, two explanatory variables--price and income--have been employed. In this study the same procedure will be followed in order to discover the power of the price mechanism in developing countries.

b. Hypothesis of other explanatory variables Testing the relative significance of the other explanatory variables such as exports and foreign exchange reserves is the subject matter of this subsection. It is argued that a country uses its foreign exchange earnings obtained from either exports of commodities or else to pay for its imports.[1] Hence, imports depend on exports. But whether this occurs with or without lag should be investigated.

The distance from import markets, type of payments, and the like are fundamental potential factors of delay in obtaining

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[1]Although a country may finance a balance of trade deficit through capital inflow or aid, from a long-run equilibrium point of view, a country can only produce as much as it can afford.

earnings for financing imports. Hence, one may arrive at the two possibilities: (i) the effect of exports on imports in the same period, as when the relationship between import and explanatory variables are expressed at the same period; (ii) the effect of exports on imports with some lagged effect, as when the relationship between import and explantory variables are expressed in different periods.[1]

The same line of analysis may be applied for foreign exchange reserves. Nonetheless, no specific reasons exist to specify a priori which kinds of exports and foreign exchange earnings--current or lagged--affect the import demand function.

In the following sections, different equations--both in terms of linear and transformed double-log--are to be estimated to find the relative significance of exports and foreign exchange earnings--both current and lagged.

A further point is the indirect impact of these variables on imports. For instance, if export earnings fall or if capital inflows are reduced, the authorities have little choice other than to tighten quantitative restrictions on imports in the short-run; similarly, the restrictions on imports may be eased if export

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[1]It is possible that import demand depends on both current and lagged forms of exports and foreign exchange earnings. For simplicity, it is assumed that import demand is a function of current or lagged variables.

receipts and/or capital flows increase.[1] In the same manner, when foreign exchange reserves are low, restrictions will be tightened, while they will be relaxed as reserves increase. All of these trends result in the presence of lagged imports as well as lagged explanatory variables in the import demand function of the developing countries.

c. Quantitative constraint hypothesis The purpose of this hypothesis is to test the possibility of disequilibrium due to quantitative constraints. This is done by testing the relative significance of lagged imports in the import demand function.

Usually, the effect of quantitative constraints is tested by introducing a dummy variable into the import demand function.[2] Such variables would assume a value of one for the existence of the quantitative constraints and zero otherwise. But in a study such as this, the possibility of employing dummy variables has been ruled out because of the number of countries involved, and the lack of

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[1]Generally, exports and capital flow are called "capacity to import." The capacity to import indicates the purchasing power of exports in terms of a unit of imports. Thus, it is equivalent to the value of exports divided by the price of imports. Now, if capital flows are added to exports and the total deflated by the movement in import unit values, an index of the capacity to import which is adjusted for capital is obtained. For more details, see Maizels [78, pp. 42, 87, and 101].

[2]Dummy variables are also used in cases such as a strike, war, or natural disaster.

precise data from year to year policy variations. Hence, lagged imports as an aproxy are used to represent the effect of quantitative constraints on the import demand function of developing countries. The presence of lagged imports is because of the adjustment mechanism.

E. Ordinary Least Squares (OLS) Estimation of the Total Import Demand

In previous sections, it was recognized that the import demand is related to domestic demand and supply. Application of the OLS method tends to bring about a bias in the estimated coefficients, either in terms of marginals or elasticities, if one of the assumptions of the OLS and/or the effect of the supply side factor are ignored.

1. Supply side assumptions

To have a "true" estimation, by the OLS method, not only must the assumptions of OLS (see pp. 80-82) be held but also some specific assumption should be made on the supply side.[1] To eliminate the source of the bias due to the effect of the supply side, different remedies, to be examined below, have been suggested.

a. A priori judgment According to Harberger [33, pp. 149-150].

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[1]The reason underlying this assumption is to eliminate the identification problem.

> There are two quite distinct ways by which the least-squares procedure...might be defended in terms of assertions about the nature of demand shifts. On the one hand, in cases where there is reason to believe that the function to be estimated is very stable, shifting hardly to all over time, no line which fits the observed points well is likely to yield a poor estimate. Hence, in such cases, the least-squares "line of best fit" can hardly be rejected.
>
> ...the second possible justification for the least-squares method. It can be shown that least squares yields correct estimates if the shifts in the function to be estimated are, over time, uncorrelated with changes in the variables treated as "independent" in regression.

But instances in which the demand function is highly stable over time are rare in economics. The possible case is when all demand factors are included explicitly which, specifically in developing countries, have no empirical values. Even the assertion that the shifts in import demand are uncorrelated with changes in both relative price and real income may not be confirmed, since "rightward shifts in demand tend directly to raise prices and leftward shifts to lower them" [33, p. 150]. This correlation arises from the existence of a supply schedule, i.e., the presence of an upward supply schedule.

As a first step toward better estimates, an attempt may be made to separate the true demand elasticity from the mixture of demand and supply elasticities. In order to do this, it is possible to make an a priori judgment on the supply elasticity and its weight in the mixture.[1]

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[1] In fact, this procedure has been followed by Harberger. For full treatment, see Harberger [33].

One point which should be made about this approach is that there may be the possibility of error due to guessing about the size of the supply elasticity.

b. Perfect elastic supply schedule Another remedy is the assumption of perfectly elastic supply. It is noticed that bias due to the presence of upward sloping supply disappears completely if supply is infinitely elastic and the shifts in demand are independent of the shifts in the supply. Figure (4.3) illustrates this fact.

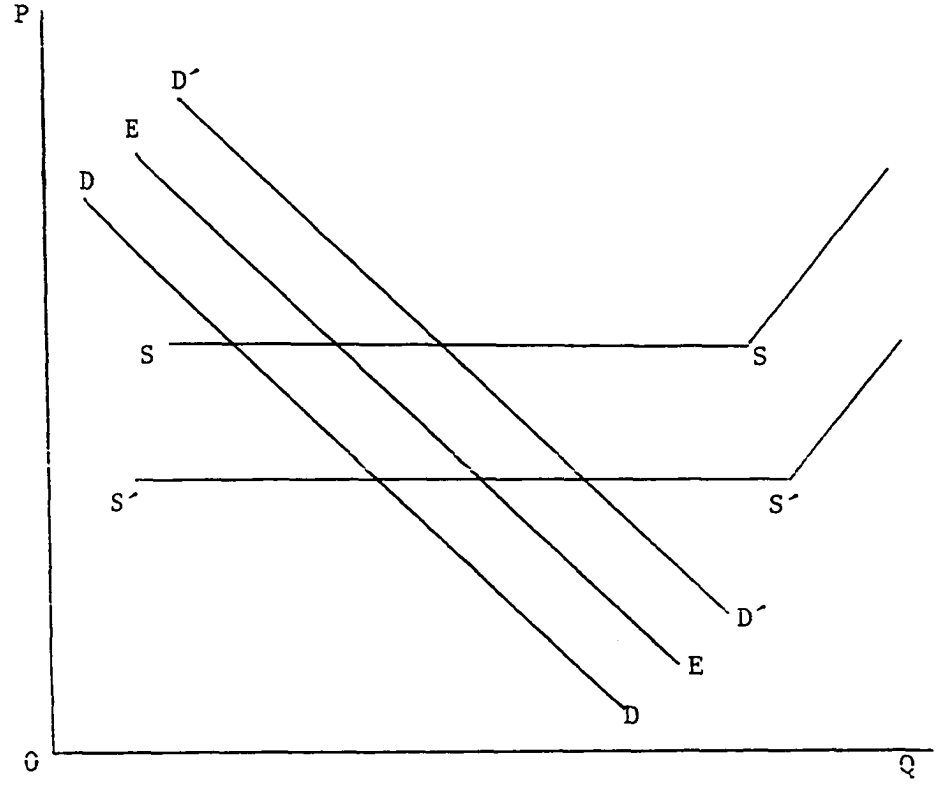

Figure 4.3. Unbiased estimate of price coefficients[1]

[1]Adopted from Leamer and Stern [69, p. 31].

Any shift in the demand, from DD to D´D´, is not related to any shift in the supply curve, from SS to S´S´. Moreover, any line fitted, as EE, will illustrate a true estimate of the demand, i.e., the estimated and true coefficient will coincide.

Indeed, the assumption of an infinite elastic supply is identical with the expression that a small country which imports constitutes only a relatively small portion of total world exports. Generally, it is an inherent characteristic of the developing countries.

c. An intermediate case It is argued that if the shifts of the supply curve were larger relative to those of the demand curve, one would come up with an unbiased estimate. Referring to Figure (4.2), if supply shifts more than the demand, the regression line fitted will be closer to the demand curve. In other words, estimated coefficients appear to be approximately equal to true coefficients.

On one hand, possible bias due to guessing in (a) and uncertainty about the size of the shift in supply in (c), increases the relative importance of the assumption (b)--infinitely elastic supply schedule. On the other hand, with regard to the countries under study, it seems the assumption (b) is more realistic than the others. Hence, this assumption as well as the assumptions of the OLS (see pp. 80-82) are maintained through the remainder of this section.

2. Equilibrium models

On the basis of the details described in the previous sections, it is recognized that, due to elasticity pessimism and statistical problems, arguments were concentrated on improving the technique of estimating rather than on the theoretical aspects of the import demand. Consequently, a good deal of empirical anlaysis in the import demand of developed countries has been directed at estimating price and income elasticities. Further, there was ignorance of a positive and direct participation of developing countries in the price arguments. Accordingly, two sets of questions on prices may be involved in the case of developing countries: first, a set having low or high coefficients, in terms of marginal or elasticity; and second, one considering significance of prices in import demand of developing countries.

a. Test relative significance of prices The purpose of this section is to find the relative significance of prices in developing countries compared to income, foreign exchange earnings, etc. in an equilibrium condition, namely, when equality exists between desired and actual imports, $M_t^* = M_t$.

Referring to the equations (3.37) and (3.38), i.e.,

$$M_t = A_0 + A_1 \left(\frac{Y}{PD}\right)_t + A_2 \left(\frac{PM}{PD}\right)_t + a_t,$$

$$\log M_t = A_0' + A_1' \log \left(\frac{Y}{PD}\right)_t + A_2' \log \left(\frac{PM}{PD}\right)_t + a_t'$$

where equation (3.37) represents a linear form relationship between

imports and income and prices. The estimated coefficients are in terms of marginals. Equation (3.38) expresses a transformed double-log coefficients of which show the elasticities with respect to income and price.

The OLS estimated price and income coefficients, in terms of marginals and elasticities, are presented in Table 4.2 and 4.3, respectively. Moreover, the multiple coefficients of determination, R^2, F-ratio and Durbin-Watson D statistic are presented in these tables.

We will first examine the estimated coefficients to determine which is the more appropriate functional form of import demand--linear or double-log--in testing the relative significance of prices in the import demand of developing countries. The numerical results such as high R^2 and more significant coefficients reveal that the double-log form is more appropriate than linear form. Therefore, although we present and use, to some extent, the linear form, our concentration in testing the relative significance of prices, will be on the double-log form of import demand of developing countries.

The estimated price coefficients in the linear form vary from country to country. Four of seven are statistically significant. The range of significant estimated price coefficients is -19.65 to -7.55 unit of account due to change in one unit change in the ratio of import prices to domestic prices.

The numerical magnitude of two of these estimated linear

Table 4.2. OLS estimated price and income coefficients in countries with accepted D.W. statistic under a linear form and equilibrium condition (two variable equations)[a]

Country	Constant	Coefficients[b]		R^2	F-ratio**[c]	D.W.[d]
		Income	Price			
Thailand	14.84	.19**	-13.85**	.92	73.5	1.67
	(3.12)	(8.41)	(-3.58)			
Colombia	-.69	.10**	1.14	.91	61.5	2.45
	(-.22)	(8.46)	(.32)			
Dominican Rep.	6.50	.25**	-7.55**	.91	61.7	1.69
	(2.36)	(4.96)	(-3.35)			
El-Salvador	7.26	.29**	-7.63**	.93	84.3	1.92
	(7.83)	(6.93)	(-9.83)			
Guatemala	6.96	.33**	-10.54**	.87	41.2	2.07
	(2.89)	(8.16)	(-3.37)			
Morocco	18.60	.22**	-19.65**	.72	15.2	1.54
	(3.81)	(3.41)	(-4.22)			
Tunisia	-.15	.33**	-1.32	.77	19.9	1.48
	(-.04)	(4.91)	(-.52)			

[a]Source: Table 8.1.

[b]The number in parentheses below each coefficient is a t-ratio; * = significant at the five percent level; ** = significant at the one percent level; and no sign = nonsignificant at the above levels.

[c]All F-ratios are significant at the one percent level.

[d]Durbin Watson D statistics.

Table 4.3. OLS estimated price and income elasticities in countries with accepted D.W. statistic under a double-log and equilibrium condition (two variable equations)[a]

Country	Constant	Elasticities[b]		R^2	F-ratio**[c]	D.W.[d]
		Income	Prices			
Thailand	-.67	.99**	-1.35**	.96	153.2	2.29
	(-5.10)	(12.96)	(-4.56)			
Colombia	-.81	.97**	.33	.89	49.4	2.66
	(-3.71)	(7.72)	(.73)			
Dominican Rep.	-1.55	1.67**	-1.38*	.93	80.5	2.31
	(-6.56)	(7.74)	(-2.14)			
Guatemala	-1.99	1.90**	-3.27**	.92	70.0	2.23
	(-8.15)	(10.42)	(-4.17)			
Morocco	-.52	.86**	-2.30**	.79	22.4	1.47
	(-1.77)	(4.28)	(-4.94)			
Tunisia	-1.05	1.32**	-.33	.84	31.8	1.67
	(-3.98)	(6.12)	(-.56)			

[a]Source: Table 8.2.

[b]The number in parentheses below each coefficient is a t-ratio; * = significant at the five percent level; ** = significant at the one percent level; and no sign = nonsignificant at the above levels.

[c]All F-ratios are significant at the one percent level.

[d]Durbin-Watson D statistics.

coefficients are less than 10 units of account, while the remaining significant coefficients vary between 10 to 20 units of account. In other words, one unit increase in the relative price; namely a one percent change in the ratio of import price to domestic price, brings about a 10 unit of account decrease in the total imports of the Dominican Republic and El-Salvador, and 10 to 20 unit of account decrease in total imports of Thailand, Guatemala and Morocco, other things remain the same. The linear coefficients are more difficult to interpret and not as significant as the double-log coefficient.

The relationship between changes in imports and real income can be expressed in two ways: 1) the fraction of a unit of account of imports that result from a one unit of account change in real income that is marginal propensity to import, and 2) the proportion which is the percentage change in imports due to one percentage change in income, i.e., the income-elasticity of demand for imports. The former is presented in Table 4.2 and the latter in Table 4.3.

Estimated marginal propensities in these seven countries are statistically significant. The range of numerical magnitude of significant marginal propensity is 0.10 to 0.33 unit of account. One unit increase in the real income (GDP) results at least 0.10 unit of account increase in the imports of Colombia and about 0.33 unit of account increase in the imports of Guatemala and Tunisia, ceteris paribus. Within this range, the imports of two countries

will increase 0.10 to 0.20 unit of account, of three countries between 0.20 to 0.30 units of account, and finally of two countries, more than 0.30 units of account due to one unit increase in the real income.

In terms of elasticity, first, negative signs were obtained in all cases except in the case of Colombia, thus confirming the theory of demand, i.e., a decrease in the quantity imported is associated with an increase in the price of imports compared to domestic prices, ceteris paribus. Second, price elasticity is greater than one for four of seven which all are statistically significant and their D.W. D statistics within the accepted range indicating zero autocorrelation.

The range of these significant estimated price elasticities is -3.27 to -1.35 of which two are between one and two and the remaining vary between two and three. Among these significant elasticities, two are between one and two, one is between two and three, and finally, one is more than three. The price elasticities in Thailand and the Dominican Republic are between one and two. Morocco denotes a price elasticity between two and three. Finally, Guatemala's price elasticity is greater than three. These high responseness in prices shed light to the fact that developing countries, in general, are sensitive to any changes in the prices.

Income elasticities (see Table 4.3), are statistically significant at the common levels of one and five percent. Signs

of income elasticities are positive and consistant with the theory of income demand.

The numerical magnitudes of the income elasticity of imports in Thailand, Colombia, and Morocco are lower than unity. And, this elasticity is higher than one and varies between one and two in the rest of developing countries in Table 4.3.

It would be nice, but it is not possible, to partition the total variation in imports into that due to the coefficient of price and the coefficient income variable. This is done by determining the extent to which variations in imports, during the period of observation, were caused by fluctuation in income and the extent to which they were caused by changes in prices. Obviously, the importance of price relative to income in determining imports depends not only on the relative significance of the coefficients, but also on the relative amplitude of variations of these explanatory variables during the period of observation. Of course, the amplitude of variations of the explanatory variables have a descriptive nature rather than measurable concept in this study.

In most literatures--specifically Houthakker and Magee study--income and price coefficients are in terms of elasticity which is obtained directly by using a double-log form of import demand in developed countries. Hence, double-log form of import demand in developing countries will be used to compare the significance of real income and relative prices, i.e., the ratio of import price

to domestic price, in import demand of these two groups of countries.

In comparing the price elasticities for developed countries from the literature with those for developing countries, in this study, it appears that a larger proportion of the sampled developing country's price elasticities are statistically significant than the portion significant in the developed countries. Houthakker and Magee reported the price variables for fifteen developed countries but found ten either had nonsignificant estimates or had incorrect signs [41, p. 112]. Five out of fifteen had incorrect signs, and five of the ten with correct sign were not statistically significant. For the developed countries, as Table 4.4 shows, the numerical magnitude of the price elasticity ranged between -.72 to -1.62. In developing countries, according to this study, just one of six price elasticities had incorrect signs, and four of the five with correct sign were statistically significant. For the developing countries, this study found numerical magnitudes for the price elasticities of -1.35 to -3.27. Although the number of countries in the sample is small, this study finds a larger portion of significant price elasticities with correct sign among equations with accepted Durbin-Watson (4 of 6) than did Houthakker and Magee for developed countries (5 of 15).

The regression coefficients of income are invariably significant in both this study and Houthakker and Magee. Their numerical magnitudes are similar and plausible for both developed and developing

Table 4.4. Comparison of the OLS estimated price and income elasticities in developed and developing countries[a]

	Number of countries and period	Price			Income		
		Sign	Significant[b]	Range[c]	Sign	Significant	Range
Developed countries	15	10 (-)	5	-.72 to	all (+)	All	.90 to
(Houthakker & Magee study)	1951-66	5 (+)		-1.66			2.19
Developing countries	6	5 (-)	4	-1.35 to	all (+)	All	.86 to
(this study)	1960-74	1 (+)		-3.27			1.90

[a]Sources: Houthakker and Magee [41], Table 1 and Table 4.3, this study.

[b]Significant level covers both one and five percent.

[c]Indicates the lowest and highest magnitude of price and income elasticities of those with correct sign and statistically significant.

countries. The income elasticities estimated by this study for developing countries were all statistically significant and their magnitudes ranged from .86 to 1.90 compared with .90 and 2.19 reported by Houthakker and Magee for developed countries.

The range of variation of income elasticities is only slightly wider in developed countries than in developing ones. In the developed countries the range is from .90 to 2.19, while in the developing countries it ranges from .86 to 1.90. Lower income elasticities in developing countries may be a reason to hypothesize that there is also an effect of other explanatory variables such as exports earnings and foreign exchange reserves.

For foreign trade policy, if a country's price elasticity of imports is between or higher than -.5 to -1.0, then policy makers can be assured that, unless trading partners retaliate, devaluation of currency will be effective in improving the trade balance. Of course, the effect of devaluation can be nullified by retaliatory action by trading partners such as counter devaluation or increased restrictions on imports. All the significant estimated price elasticities for the developing countries, as Table 4.3 indicates, are more elastic than -1.0 and actually between -1.35 and -3.27, revealing that currency devaluation would reduce significantly total expenditures on imports. Although prices of imports would rise by the percentage of devaluation, the total quantity of imports would fall by a greater percentage. Hence, this study

indicates that the potential effect on the trade volume and balance of payments of developing countries can be changed by devaluation (or by price changes due to other factors). Reduction in imports will be large if the volume and cost of imports is freely determined by market forces in response to import price increase. In other words, the price variable is a very significant variable in determining the quantity of commodities imported by these developing countries. The quantity of their imports can be strongly affected by changes in currency exchange rates or import prices as set by tariffs, transportation costs of the selling prices of their trading partners.

Finally, by looking through the equations for the country, and by considering the significantly high coefficient of multiple determination, R^2, and the significant F-ratios at the one percent level, it seems that the specified explanatory variables, price and income, can explain much of the variation in the import demand functions of developing countries. In other words, traditional import demand functions--imports as a function of real income and relative prices--can be equally well employed in developing countries. Moreover, the Durbin-Watson D statistics (D.W.) are such that, with two explanatory variables and fourteen observations, seven equations in linear form and six equations in double-log form fall into ranges that reject the possibility of serial correlation. For other equations--both linear and double-log--the Durbin-Watson D statistics

are in the inconclusive region. The low Durbin-Watson statistic in these estimated total import demands reveals the fact that some of the equations are too simple to capture the dynamic aspect of import demand.

b. Test the significance of foreign exchange reserves and export earnings Due to some general assumptions such as the behavior ascribed to developing countries in world trade models, the foreign exchange constraints in the two-gap programming models for economic growth, and the low numerical magnitudes of income elasticity of import demand in these countries, we want to test the influence and significance of export earnings as well as foreign exchange reserves in the import demand of developing countries. We want to find the significance of export earnings and foreign exchange reserves with the presence of price and income variables in the import demand of developing countries.

The aforementioned assumptions assume that import demand of developing countries is a function of foreign exchange reserves, either current or lagged; $M_t = M(FER)_t$. Since the previous section of this study indicates strongly the significance of the price and income, these cannot be ignored in developing countries. Therefore, the most reasonable test is to include foreign exchange reserves and export earnings variables as additional variables in the import demand equations already estimated, namely, imports as a function of aggregate income and relative prices.

The general form of import demand is that it should be a function of real income, relative prices, real foreign exchange reserves, and real export earnings:

$$M_t = M\left[\left(\frac{Y}{PD}\right)_t, \left(\frac{PM}{PD}\right)_t, \left(\frac{FER}{PM}\right)_t, \left(\frac{X}{PM}\right)_t\right]$$

Four alternative equations, in the equilibrium case, are derived:

1. Import demand as a linear function of income, price, exports, and foreign exchange earnings at the current time.
2. Import demand as a linear function of current income and price and of lagged exports and foreign exchange earnings.
3. Import demand as a transformed double-log function of income, price, export earnings, and foreign exchange reserves at the current time.
4. Import demand as a transformed double-log function of current income, prices and of lagged exports and foreign exchange earnings.

The estimated coefficients of all variables in current term, both in linear and double log, are presented in Tables 4.5 and 4.7. Estimated coefficients in the case of two current and two lagged variables, both in terms of linear and double-log, are shown in Table 4.6 and 4.8. And, a summary of the number of equations with accepted D.W., positive sign and significant coefficients of export earnings and foreign exchange reserves, both in current and lagged, are presented in Tables 4.9 and 4.10.

Table 4.5. OLS estimated income, price, current foreign exchange reserves, and current export earnings coefficients under a linear form and equilibrium condition (four current variables equations)[a]

Country	Constant	Coefficients[b]				F^2	F-ratio**[c]	D.W.[d]
		Income	Price	Foreign exchange	Export earnings			
Iran	29.34	.12	-28.56	-.24	.08	.96	54.8	1.83
	(1.17)	(2.12)	(-1.14)	(-.41)	(.26)			
Philippines	-7.91	.21**	2.04	-.77*	.47	.91	26.7	2.00
	(-.82)	(4.94)	(.43)	(-2.56)	(1.23)			
Korea (Rep. of)	5.98	.00	-3.48	1.43	1.31*	.96	62.6	2.04
	(.56)	(.06)	(-.56)	(1.31)	(2.62)			
Thailand	5.04	.07*	-5.77	.57*	.47**	.97	103.1	2.16
	(1.32)	(2.62)	(-1.87)	(2.82)	(3.59)			
Colombia	1.14	.16**	-.34	-.85	-.54	.94	42.2	1.95
	(.29)	(5.05)	(-.09)	(-1.86)	(-1.03)			
Dominican Rep.	-.42	.15	-1.02	.64	.68*	.94	42.1	1.73
	(-.09)	(1.96)	(-.26)	(.45)	(2.28)			
El-Salvador	2.33	-.10	-1.75	1.00*	1.03**	.98	144.7	2.70
	(1.90)	(-1.27)	(-1.38)	(2.19)	(4.49)			
Guatemala	6.18	.17	-8.66	-.73	.85	.91	25.9	2.17
	(1.88)	(.95)	(-1.64)	(-.96)	(1.86)			
Morocco	.04	.07*	.04	.42	.65**	.97	73.6	2.10
	(.01)	(2.33)	(.01)	(1.92)	(7.62)			
Tunisia	-1.40	.14*	1.14	-.30	.72**	.98	136.8	2.32
	(-.92)	(2.58)	(1.19)	(-1.31)	(9.45)			

[a]Source: Table 8.3.

[b]The number in parentheses below each coefficient is a t-ratio; * = significant at the five percent level; ** = significant at the one percent level; and no sign = nonsignificant at the above levels.

[c]All F-ratios are significant at the one percent level.

[d]Durbin-Watson D statistics.

Table 4.6. OLS estimated income, price, lagged foreign exchange and lagged export earnings coefficients under a linear and equilibrium condition (two current and two lagged varibles equations)[a]

Country	Constant	Coefficients[b]				R^2	F-ratio**[c]	D.W.[d]
		Income	Price	Lagged foreign exchange	Lagged export earnings			
Korea (Rep. of)	13.57	.05	-10.83*	2.33*	.89*	.98	117.5	2.23
	(1.71)	(1.32)	(-2.22)	(2.39)	(2.88)			
Colombia	2.95	.10*	-1.62	.60	-.38	.92	28.2	2.62
	(.57)	(4.55)	(-.32)	(.71)	(-.89)			
Dominican Rep.	2.77	.22**	-4.42	.30	.48	.92	28.1	1.89
	(.56)	(3.12)	(-1.06)	(.23)	(.92)			
Guatemala	4.72	.11*	-5.96*	1.00*	.45	.96	70.6	2.41
	(3.26)	(2.18)	(-2.99)	(2.56)	(1.82)			
Honduras	-.76	.19	.19	2.09	.35	.94	37.6	2.19
	(-1.21)	(1.32)	(.45)	(1.71)	(.80)			
Morocco	-8.58	.08	3.44	.77	1.67**	.94	41.2	1.95
	(-1.54)	(1.96)	(.72)	(2.08)	(6.23)			

[a]Source: Table 8.5.

[b]The number in parentheses below each coefficient is a t-ratio; * = significant at the five percent level; ** = significant at the one percent level; and no sign = nonsignificant at the above levels.

[c]All F-ratios are significant at the one percent level.

[d]Durbin-Watson D statistics.

Table 4.7. OLS estimated income, price, current foreign exchange and current export earnings elasticities under a double-log form and equilibrium condition (four current variable equations)[a]

Country	Constant	Elasticities[b]				R^2	F-ratio**[c]	D.W.[d]
		Income	Price	Foreign exchange	Export earnings			
Thailand	-.36	.53**	-.75*	.32*	.24	.98	129.5	2.25
	(-2.57)	(3.32)	(-2.49)	(2.58)	(1.86)			
Colombia	-1.42	1.49**	-.05	-.08	-.58	.91	26.8	2.21
	(-3.29)	(4.08)	(-.10)	(-.88)	(-1.44)			
Dominican Rep.	-1.47	1.58**	-1.10	.02	.10	.93	33.7	2.26
	(-2.99)	(3.34)	(-.78)	(.15)	(.24)			
El-Salvador	.21	-.11	-.70	.08	.84*	.98	105.1	2.00
	(.72)	(-.28)	(-1.39)	(1.99)	(2.73)			
Guatemala	-1.06	.98	-2.35	-.03	.51	.94	37.5	2.50
	(-1.06)	(1.18)	(-1.79)	(-.15)	(1.61)			
Morocco	-.07	.29	-.07	.07	.60*	.93	36.4	2.19
	(-.35)	(1.62)	(-.12)	(2.04)	(4.15)			
Tunisia	-.34	.55	.49	-.06	.54**	.94	37.5	2.21
	(-.87)	(1.61)	(1.03)	(-.91)	(3.92)			

[a]Source: Table 8.4.

[b]The number in parentheses below each elasticity is a t-ratio; * = significant at the five percent level; ** = significant at the one percent level; and no sign = nonsignificant at the above levels.

[c]All F-ratios are significant at the one percent level.

[d]Durbin-Watson D statistics.

4.8. OLS estimated income, price, lagged foreign exchange and lagged export earnings elasticities under a double-log form and equilibrium condition (two current and two lagged variables equations)[a]

Country	Constant	Elasticities[b]				R^2	F-ratio**[c]	D.W.[d]
		Income	Price	Lagged export exchange	Lagged export earnings			
Korea (Rep. of)	.86	-.11	-.57**	.64**	.37**	.99	541.3	2.00
	(6.87)	(-1.42)	(-3.40)	(8.87)	(9.95)			
Thailand	-.34	.48	-.69	.16	.49	.97	91.1	2.73
	(-1.58)	(1.85)	(-1.61)	(1.18)	(1.82)			
Colombia	-.85	1.03**	.26	.00	-.20	.90	22.1	2.63
	(-3.05)	(5.44)	(.46)	(.05)	(-.76)			
Dominican Rep.	-1.77	2.00**	-3.08**	-.09	-.72*	.96	58.5	2.26
	(-6.87)	(8.61)	(-3.46)	(-1.12)	(-2.49)			
Guatemala	-1.05	1.03*	-2.56**	.06	.41	.95	49.9	2.17
	(-2.37)	(2.76)	(-3.49)	(.51)	(1.80)			
Honduras	-.30	.76	-.10	.24	.39	.96	57.8	1.83
	(-.80)	(1.34)	(-.38)	(1.56)	(1.07)			
Morocco	-.52	.41*	.13	.12*	1.03**	.93	32.7	1.67
	(-2.78)	(2.37)	(.20)	(2.72)	(4.13)			

[a]Source: Table 8.6.

[b]The number in parentheses below each elasticity is a t-ratio; * = significant at the five percent level; ** = significant at the one percent level; and no sign = nonsignificant at the above levels.

[c]All F-ratios are significant at the one percent level.

[d]Durbin-Watson D statistics.

Although not all estimated export and/or foreign exchange earnings coefficients, both in linear and transformed double-log form, have expected signs or satisfy the common levels of statistical significance, some useful impressions may still be derived.

As it appears in Table 4.9, out of thirteen linear form equations estimated with current export earnings, ten had accepted D.W. Nine of these ten had expected positive sign; and six had significant coefficients. The positive sign reveals that an increase in export earnings brings about an increase in imports when other things remain the same both when current and lagged export earnings, respectively, are considered. Among the ten and six estimated export earnings coefficients, six and two of them are statistically significant at levels of one and five percent. The results of estimated export earnings coefficients in double log (Table 4.9), whose coefficients are in terms of elasticities, four export elasticities of imports in current form and five in lagged form have the proper positive sign. But the number of significant elasticities are three in both current and lagged export earnings.

The number of expected positive sign of the estimated foreign exchange reserves coefficients, in terms of marginals and elasticities, are less than the estimated export earnings in all these four alternatives. The number of proper signs varies between four and six, while the number of significant coefficients, either in current or lagged, are less than three in linear and in transformed

Table 4.9. The number of import equations, linear or double-log transformed, including an export earnings variable, current or lagged, which has an accepted D.W., positive sign, and significant coefficients for export earnings[a]

	Linear form		Transformed double-log	
	Current	Lagged	Current	Lagged
Number of equations with accepted D.W.	10	6	7	7
Positive sign	9 (+)	5 (+)	4 (+)	5 (+)
Number of significant coefficients[b]	6	2	3	3

[a]Source: Tables 4.5, 4.6, 4.7, and 4.8.

[b]Covers both one and five percent levels.

Table 4.10. The number of import equations,linear or double-log transformed, including foreign exchange reserves, current or lagged, which have an accepted D.W., positive sign and significant coefficient for foreign exchange reserves[a]

	Linear form		Transformed double-log	
	Current	Lagged	Current	Lagged
Number of equations with accepted D.W.	10	6	7	7
Positive sign	6 (+)	6 (+)	4 (+)	6 (+)
Number of significant coefficients[b]	3	2	1	1

[a]Sources: Tables 4.5, 4.6, 4.7, and 4.8.

[b]Covers both one and five percent levels.

double-log forms. In linear form, the numbers of significant coefficients are three and two in equations with current and lagged foreign exchange reserves as an explanatory variable; while the number of significant foreign exchange reserve elasticity of imports is just one in both current and lagged forms of this variable.

The lack of complete response of these two variables, both their relative significance and their signs, may be due to the aggregate characteristic of the import demand used in this study. It seems that these variables will respond better when disaggregated import demands are considered. For instance, imports of capital goods or intermediate commodities are closely related to export earnings and foreign exchange constraints of developing countries.

Generally, one may reach the view that no specific a priori judgment can be made on the effect of either current or lagged (or both) export and foreign exchange earnings on the import demand function of developing countries. Specific arrangements should be made to test the relative significance of these variables for each developing country. Hence, generalization about the effect of foreign exchange constraint is not possible and true for all developing countries. It should be pointed out that most literature on economic development of developing countries, such as that about the two-gap model, has been generalized on the basis of experience in a few developing countries. For instance, the two-gap model had been generalized by experience in the case of Pakistan, for which price variables are not significant in the import demand.

But with regard to other developing countries with significant price variables and lack of complete response of foreign exchange reserves and export earnings in their import demand, it seems that the general assumptions on behavior of developing countries are not quite plausible. Moreover, comparison of the results of traditional import demand (two variables equation), and these four alternatives reveals that the traditional import demand--imports as a function of aggregate income and relative prices--is still applicable and responds better than those new alternatives, in spite of some minor deficiencies for a few, in developing countries. However, a more general comparison will be made after the disequilibrium models following the overall summary tables (see Tables 4.16 and 4.17).

3. Disequilibrium models

It was realized that the presence of disequilibrium (explained on pp. 53-56) introduces lagged imports in the import demand of developing countries. With the disequilibrium model we will test the significance of quantitative constraints and the lack of the assumption of $M_t^* = M_t$, that is, desired imports do not equal actual imports.

The disequilibrium models used in this study express the generally accepted idea that current decisions on imports are influenced by past behavior. Accordingly, a kind of stock adjustment was introduced. Two types of adjustment mechanism, discrete and

continuous, were applied both in linear and transformed double-log equations.[1] The estimated coefficients of adjustment were in terms of marginal and elasticity. The result of introducing either adjustment mechanism was that lagged imports appeared as an explanatory variable in the import demand. Other explanatory variables were current by applying discrete adjustment mechanism, while other explanatory variables were expressed as moving averages over two periods by employing the continuous adjustment mechanism.

Considering disequilibrium equations (3.46), (3.47), (3.50), (3.51), (3.52) and (3.53) and on the basis of the previous explanations, the coefficients of lagged imports were estimated in terms of linear and elasticity for the above mentioned disequilibrium equations. The results are presented in Tables 4.11, 4.12, 4.13, and 4.14 in the case of traditional import demand (imports as a function of aggregate income and relative prices). The sign and the number of country and the number of significant coefficients are shown in Table 4.15.

The assumption is that the coefficient of adjustment, γ, should be in the range $0 \leq \gamma \leq 1$, thus the coefficient estimated for the lagged imports $(1 - \gamma)$ must be between zero and one to provide a reasonable estimate of γ.

As Tables 4.11 and 4.13 indicate, the estimated lagged import

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[1] Described in detail in pp. 55-57.

Table 4.11. OLS estimated income, price and lagged import coefficients under a linear form and disequilibrium condition--discrete adjustment (two variables plus lagged import equations)[a]

Country	Constant	Coefficients[b]			R^2	F-ratio**[c]	D.W.[d]
		Income	Price	Lagged imports			
Iran	33.89	.06**	-34.30*	.55*	.98	219.6	2.64
	(2.93)	(4.97)	(-2.97)	(4.76)			
Korea (Rep. of)	9.81	.03	-7.30	.99**	.98	144.6	2.60
	(2.12)	(.81)	(-2.01)	(6.91)			
Pakistan	6.32	.00	-.56	.44*	.41	2.6	1.90
	(1.85)	(-.01)	(-.38)	(2.16)			
Thailand	15.30	.20**	-14.28*	-.04	.92	45.0	1.68
	(2.55)	(3.29)	(-2.79)	(-.14)			
Colombia	1.81	.13**	-.79	-.38	.93	48.3	1.94
	(.56)	(6.51)	(-.22)	(-1.69)			
Dominican Rep.	6.50	.25*	-7.55**	.00	.91	37.7	1.69
	(2.25)	(2.44)	(-3.09)	(.01)			
Guatemala	5.11	.20*	-7.87*	.62*	.91	37.6	1.99
	(2.26)	(2.83)	(-2.63)	(2.18)			
Honduras	-.37	.17	.09	.56	.91	35.3	1.48
	(-.79)	(1.32)	(.16)	(1.86)			
Tunisia	.12	.26	-1.62	.34	.77	12.5	1.53
	(.03)	(1.79)	(-.60)	(.47)			

[a]Source: Table 8.7.

[b]The number in parentheses below each coefficient is a t-ratio; * = significant at the five percent level; ** = significant at the one percent level; and no sign = nonsignificant at the above levels.

[c]All F-ratios are significant at the one percent level.

[d]Durbin-Watson D statistics.

Table 4.12. OLS estimated income, price, and lagged import coefficients under a linear and disequilibrium condition--continuous adjustment (two variables plus lagged imports)[a]

Country	Constant	Coefficients[b]			R^2	F-ratio**[c]	D.W.[d]
		Income	Price	Lagged imports			
Iran	41.88	.05**	-21.16*	.41*	.99	268.4	1.99
	(2.82)	(6.54)	(-2.88)	(2.95)			
Korea (Rep. of)	13.27	.03	-5.20	.88**	.98	149.5	2.31
	(2.13)	(1.36)	(-2.11)	(5.47)			
Pakistan	3.30	.01	.14	.38	.44	2.9	2.09
	(.91)	(.83)	(.16)	(1.66)			
Colombia	-2.53	.08**	2.05	-.62*	.91	38.7	2.06
	(-.66)	(5.68)	(.96)	(-2.18)			
Dominican Rep.	7.23	.14	-4.18*	-.07	.88	27.2	1.53
	(1.86)	(1.92)	(-2.49)	(-.12)			
Guatemala	11.33	.23**	-8.43**	-.28	.94	61.6	2.10
	(3.72)	(4.51)	(-4.00)	(-.79)			
Honduras	-.11	.10	-.11	.48	.90	34.5	1.50
	(1.34)	(1.50)	(-.31)	(1.44)			
Panama	4.35	.75**	-3.42	-2.81*	.94	56.6	1.81
	(.79)	(3.29)	(-1.23)	(-2.31)			
Tunisia	-4.35	.25*	.75	-.53	.79	13.6	1.92
	(-1.14)	(2.61)	(.52)	(-.58)			

[a]Source: Table 8.9.

[b]The number in parentheses below each coefficient is a t-ratio; * = significant at the five percent level; ** = significant at the one percent level; and no sign = nonsignificant at the above levels.

[c]All F-ratios are significant at the one percent level.

[d]Durbin-Watson D statistics.

Table 4.13. OLS estimated income, price, and lagged import elasticities under a double-log form and disequilibrium condition--discrete adjustment (two variables plus lagged imports)[a]

Country	Constant	Elasticities[b]			R^2	F-ratio**[c]	D.W.[d]
		Income	Price	Lagged imports			
Iran	-.46	.45**	-2.35**	.55**	.98	225.8	2.32
	(-4.02)	(3.79)	(-4.28)	(4.99)			
Philippines	-.74	.69**	.27	.51**	.94	55.9	1.65
	(-2.24)	(3.40)	(1.06)	(3.59)			
Korea (Rep. of)	.34	-.16	-1.86	1.00**	.97	137.4	2.00
	(1.58)	(-.97)	(-1.26)	(9.49)			
Pakistan	.68	-.01	-.14	.34*	.42	2.7	1.77
	(1.32)	(-.02)	(-.71)	(2.16)			
Thailand	-.59	.88**	-1.23**	.11	.96	95.8	2.25
	(-2.84)	(3.85)	(-3.16)	(.49)			
Colombia	-.98	1.16**	.13	-.33	.92	42.1	1.76
	(-4.57)	(7.14)	(.30)	(-1.97)			
Dominican Rep.	-1.92	2.06**	-1.45*	-.26	.94	59.7	1.99
	(-5.74)	(6.16)	(-2.34)	(-1.48)			
Guatemala	-1.50	1.39**	-2.68**	.35	.94	55.0	2.25
	(-3.99)	(4.01)	(-3.32)	(1.67)			
Tunisia	-.93	1.15*	-.38	.18	.84	19.9	1.72
	(-2.51)	(2.76)	(-.63)	(.49)			

[a]Source: Table 8.8.

[b]The number in parentheses below each elasticity is a t-ratio; * = significant at the five percent level; ** = significant at the one percent level; and no sign = nonsignificant at the above levels.

[c]All F-ratios are significant at the one percent level.

[d]Durbin-Watson D statistics.

Table 4.14. OLS estimated income, price, and lagged import elasticities under a double-log form and disequilibrium condition--continuous adjustment (two variables plus lagged imports)[a]

Country	Constant	Elasticities[b]			R^2	F-ratio**[c]	D.W.[d]
		Income	Price	Lagged imports			
Iran	-.64	.33**	-1.99**	.45*	.98	166.7	1.80
	(-4.36)	(4.38)	(-3.22)	(2.92)			
Korea (Rep. of)	.15	-.03	.08	1.00**	.97	118.3	1.91
	(.60)	(-.35)	(.28)	(7.84)			
Pakistan	.13	.14	-.01	.28	.43	2.8	1.95
	(.21)	(.82)	(-.10)	(1.51)			
Thailand	-.93	.67**	-.78*	-.31	.96	82.6	1.45
	(-3.22)	(3.68)	(-2.42)	(-.87)			
Colombia	-1.13	.71**	.41	-.66*	.89	30.0	1.69
	(-3.89)	(5.96)	(1.58)	(-2.77)			
Dominican Rep.	-2.12	1.16**	-.85	-.42	.90	32.9	2.08
	(-4.18)	(4.49)	(-1.70)	(-1.54)			
Guatemala	-2.89	1.35**	-2.59**	-.33	.95	77.4	1.99
	(-5.01)	(5.11)	(-4.26)	(-1.21)			
Honduras	-.44	.35	-.14	.52	.94	55.5	1.48
	(-1.03)	(1.14)	(-.54)	(1.48)			
Tunisia	-1.59	.95**	.09	-.31	.85	20.9	2.02
	(-3.41)	(3.51)	(.28)	(-.67)			

[a]Source: Table 8.10.

[b]The number in parentheses below each elasticity is a t-ratio; * = significant at the five percent level; ** = significant at the one percent level; and no sign = nonsignificant at the above levels.

[c]All F-ratios are significant at the one percent level.

[d]Durbin-Watson D statistics.

Table 4.15. The number of import equations, linear or double-log transformed, including lagged imports, discrete or continuous, which have an accepted D.W., positive sign and significant coefficients for lagged imports[a]

	Discrete time		Continuous time	
	Linear form	Transformed double-log	Linear form	Transformed double-log
Number of equations with accepted D.W.	9	9	9	9
Positive sign	7 (+)	7 (+)	4 (+)	4 (+)
Number of significant coefficients[b]	4	4	4	3

[a]Sources: Tables 4.11, 4.12, 4.13, and 4.14.

[b]Covers both one and five percent levels.

coefficient, both in linear and double-log forms, is about one for Korea, which indicates γ is equal to zero. This sheds light on the fact that import demand in country is determined in a perfect disequilibrium case not moving toward equilibrium. In other words, the current imports are equal to the past imports. That would also imply either that $M_t^* = M_{t-1}$, or desired imports have no effect. In contrast, for the Dominican Republic, γ is equal to one since the estimated coefficient is about zero in linear form; then one may conclude that adjustment of imports to a desired level is instantaneous.

With regard to the type of adjustment mechanism, discrete adjustment establishes a better response to the testing of the significance of quantitative constraints--both in linear and double-log forms (see Tables 4.16 and 4.17). Considering linear equations and under discrete adjustment mechanism, seven of nine have correct sign to satisfy the assumption on the coefficient of adjustment. Estimated lagged import coefficient $(1 - \gamma)$ in Iran, Korea (Rep. of), Pakistan, and Guatemala are significant with proper positive sign to ensure the assumption of $0 \leq \gamma \leq 1$. While under continuous adjustment mechanism, in which income, price, foreign exchange reserves, and export earnings appear as moving averages over two periods, estimated lagged import coefficients in Iran, Korea, Colombia and Panama are significant but the sign of the coefficient is negative in the case of Colombia and the numerical magnitude of the coefficient is greater than one in Panama which reveals the

Table 4.16. Summary of number of significant coefficients and ranges of different explanatory variables in linear equations[a]

Equation types	Number of accepted country	Income		Prices		Lagged imports	
		#	Range	#	Range	#	Range
Two variables	7	7	.10 to .33	5	-19.65 to -7.55	-	-
Four variables (all current)	10	5	.07 to .21	0	-	-	-
Four variables (two current two lagged)	6	3	.05 to .22	2	-10.83 to 3.44	-	-
Three variables (discrete adjustment)	9	5	.06 to .25	4	-34.30 to -7.55	4	.44 to .99
Three variables (continuous adjustment)	9	5	.05 to .75	3	-21.16 to -4.18	4	-2.81 to -.41

[a]Sources: Tables 4.2, 4.5, 4.6, 4.11, and 4.12.

Foreign exchange reserves				Export earnings			
Current		Lagged		Current		Lagged	
#	Range	#	Range	#	Range	#	Range
-	-	-	-	-	-	-	-
3	-.77 to 1.00	-	-	6	.47 to 1.31	-	-
-	-	2	.30 to 2.33	-	-	2	-.38 to 1.67
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

Table 4.17. Summary of number of significant elasticities and ranges of different explanatory variables in double-log equations[a]

Equation types	Number of accepted country	Income		Prices		Lagged imports	
		#	Range	#	Range	#	Range
Two variables	6	6	.97 to 1.32	4	-3.27 to -1.38	-	-
Four variables (all current)	7	3	.53 to 1.58	1	-.75	-	-
Four variables (two current two lagged)	7	4	.41 to 2.00	3	-3.08 to -.57	-	-
Three variables (discrete adjustment)	9	7	.45 to 2.06	4	-2.68 to -1.23	4	.34 to 1.00
Three variables (continuous adjustment)	9	6	.33 to 1.35	3	-2.59 to -.78	3	.45 to 1.00

[a]Sources: Tables 4.3, 4.7, 4.8, 4.13, and 4.14.

Foreign exchange reserves				Export earnings			
Current		Lagged		Current		Lagged	
#	Range	#	Range	#	Range	#	Range
-	-	-	-	-	-	-	-
1	.32	-	-	3	.54 to .84	-	-
-	-	2	.12 to .64	-	-	3	-.72 to 1.03
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

fact that the assumption on adjustment mechanism is not satisfied for these two countries.

Now, with regard to the double-log form and under discrete adjustment mechanism, the estimated lagged import coefficients in Iran, Philippines, Korea (Rep. of) and Pakistan are significant with appropriate sign. In the case of continuous adjustment, the estimated lagged import coefficients in Iran, Korea (Rep. of), and Colombia are significant, but sign of the coefficient in Colombia does not satisfy the assumption on the coefficient of adjustment, γ.

The coefficient of determination, R^2, shows a better fitness to disequilibrium rather than to equilibrium, in developing countries. R^2 in the table discloses that import demand should be considered and estimated using the disequilibrium model in these countries. One reason for sustained disequilibrium in import demand is the existence of tight quantitative constraints for development purposes. In general, Asian countries present a better response to disequilibrium models than do the two other regions, thus revealing tighter quantitative constraints in this region.

In order to come up with a more general comparison, different equations with various explanatory variables under equilibrium and disequilibrium conditions and both in terms of linear and double-log form are summarized in Tables 4.16 and 4.17. The equations are indicated by the number of involved explanatory

variables; two variables (traditional import demand); four variables equations with price, income, foreign exchange reserves, and export earnings; two current (price and income), two lagged (foreign exchange reserves and export earnings); three variables equation with income, price, and lagged imports. Two types of three variable equations are shown due to adopting discrete and continuous adjustment mechanism.

The income coefficient, Table 4.16, in all types of equations are low. The number of significant income coefficients, with regard to the number of countries with accepted D.W. statistics, are 100 percent in two variable equations, and about 50 percent in the other types. In terms of double-log, income elasticity of imports covers different ranges in various types of equations. The widest range relates to the three variable equation in case of discrete adjustment. But, on the average, income elasticity of imports is greater than one except for three variables cases with continuous adjustment. The number of significant income elasticities in terms of percentage of the accepted number of countries in each type of equation, is 100 percent for two variable equations, 80 and 60 percent for two cases of three variable equations, and finally, 40 and 50 percent for two cases of four variable equations.

Estimated price coefficients have proper negative sign. The number of significant coefficients in terms of percentage of the accepted number in each equation are about 70 percent in two variable

equations, and about 30 percent for other types of equations except in four current variable equations that the number of significant price coefficient is zero. In terms of double-log, price elasticity of imports are strongly elastic in cases of two variable and three variable (case of discrete adjustment) equations. Moreover, price elasticities in other equations are greater than one, on the average. The number of significant of price elasticity varies from one equation to another. In terms of percentage of countries involved in each equation, 60 percent is significant in two variable equations, 50 and 30 percent in three variable equations with discrete and continuous adjustment, respectively. Finally, 10 and 40 percent for cases of four variable equations.

The range of estimated lagged import coefficients, in linear form, is about the same in both types of three variable equations. They are between .40 and 1.00, revealing different speed of adjustment in developing countries. The number of significant lagged import coefficients is about half of the number of countries accepted in each equation. In double log form, the range and the number of significant coefficients are similar to the equations in linear form.

The range and number of foreign exchange reserves and export earnings in all types of equations, both in linear and double-log, are such that they cannot be judged for their relative significance in the import demand of developing countries. One point should be

made on the effect of foreign exchange reserves and export earnings on the number of significant income and price coefficients. It seems, whenever the number of foreign exchange reserves and export earnings are large, it reduces the number of significant price and income coefficients. For instance, in the case of four current variable equations, Table 4.16, larger numbers of significant foreign exchange (3 and 6), smaller numbers of significant income and price coefficients (5 and 0). This effect is not only on the number of significant coefficients, but also affects the range of significant coefficients.

Among these alternatives, it seems in equilibrium condition, two variables equation is a better alternative in estimating import demand of developing countries, namely, the traditional import demand is equally applicable to the developing countries. In disequilibrium cases, three variables equation--traditional import demand plus lagged imports--with discrete adjustment mechanism is preferable to other cases.

A summary for Iran of types of equations estimated for the import demand both in linear and double-log, are presented in Tables 4.18 and 4.19. Moreover, comparison of import elasticities obtained by double-log and discrete calculation is shown in Table 4.20.

Among different types of equations used to estimate the price, income, foreign exchange reserves, export earnings, and lagged imports, four variables and two cases of three variables are in the accepted range of D.W. statistics in linear form, while D.W. statistics of

Table 4.18. OLS estimated explanatory variables in import demand of Iran under linear conditions

Equation types	Constant	Income	Price	Lagged imports	Foreign exchange reserves		Export earnings		R^2	F-ratio	D.W.
					Current	Lagged	Current	Lagged			
Two variables	33.65	.11**	-31.79	-	-	-	-	-	.95	113.5	1.05[a]
	(1.73)[b]	(15.06)	(-1.64)								
Four variables (all current)	29.34	.12*	-28.56	-	-.24	-	.08	-	.96	54.8	1.83
	(1.17)	(2.12)	(-1.14)		(-.41)		(.26)				
Four variables (two current two lagged)	9.75	.07**	-10.37	-	-	-1.32*	-	.48**	.98	170.2	1.32[a]
	(.69)	(3.49)	(-.76)			(-2.95)		(4.52)			
Three variables (discrete adjustment)	33.89	.06**	-34.30*	.55**	-	-	-	-	.98	219.6	2.64
	(2.93)	(4.97)	(-2.97)	(4.76)							
Three variables (continuous adjustment)	41.88	.05**	-21.16*	.41*	-	-	-	-	.99	268.4	1.99
	(2.82)	(6.54)	(-2.88)	(2.95)							

[a] D.W. D statistics are in the inconclusive range.

[b] The number in parentheses below each coefficient is a t-ratio; * = significant at the five percent level; ** = significant at the one percent level; and no sign = nonsignificant at the above levels.

Table 4.19. OLS estimated explanatory variables in import demand of Iran under double-log equations

Equation types	Constant	Income	Price	Lagged imports	Foreign exchange reserves		Export earnings		R^2	F-ratio	D.W.
					Current	Lagged	Current	Lagged			
Two variables	-.87	1.00**	-2.81*	-	-	-	-	-	.95	109.1	.91[a]
	(-6.43)[b]	(14.65)	(-2.14)								
Four variables (all current)	-1.23	1.34**	-3.24	-	-.00	-	-.24	-	.95	51.8	1.25[a]
	(-3.53)	(4.05)	(-1.96)		(-.05)		(-.73)				
Four variables (two current two lagged)	-.65	.55	-2.23	-	-	-.07	-	.55	.96	59.7	.93[a]
	(-1.75)	(1.55)	(-1.39)			(-.65)		(1.66)			
Three variables (discrete adjustment)	-.46	.45**	-2.35**	.55**	-	-	-	-	.98	225.8	2.32
	(-4.02)	(3.79)	(-4.28)	(4.99)							
Three variables (continuous adjustment)	-.64	.33**	-1.99**	.45*	-	-	-	-	.98	166.7	1.80
	(-4.36)	(4.38)	(-3.22)	(2.92)							

[a]D.W. D statistic is in the inconclusive range.

[b]The number in parentheses below each coefficient is a t-ratio; * = significant at the five percent level; ** = significant at the one percent level; and no sign = nonsignificant at the above levels.

Table 4.20. Comparison of import elasticities obtained by double-log form and direct calculated form for Iran[a]

Equation types	Price[b]		Income		Lagged imports	
	Double log	Direct[c]	Double log	Direct	Double log	Direct
Two variables	-2.81*	-2.23	1.00**	.83**	-	-
	(-2.14)	(-1.64)	(14.65)	(15.06)	-	-
Four variables (all current)	-3.24	-2.00	1.34**	.91*	-	-
	(-1.96)	(-1.14)	(4.05)	(2.12)	-	-
Four variables (two current two lagged)	-2.23	-.73	.55	.53**	-	-
	(-1.39)	(-.76)	(1.55)	(3.49)	-	-
Three variables (discrete adjustment)	-2.35**	-2.41*	.45**	.45**	.55**	.48**
	(-4.28)	(-2.97)	(3.79)	(4.97)	(4.99)	(4.76)
Three variables (continuous adjustment)	-1.99**	-1.48*	.33**	.38*	.45*	.36*
	(-3.22)	(-2.88)	(4.38)	(6.54)	(2.92)	(2.95)

[a]Sources: Tables 4.18 and 4.19.

[b]The number under each coefficient is a t-ratio; * = significant at the five percent level; ** = significant at the one percent level; no sign = nonsignificant at the above levels.

[c]Calculated at the mean values of the variables.

Foreign exchange reserves				Export earnings			
Current		Lagged		Current		Lagged	
Double log	Direct	Double log	Direct	Double log	Direct	Double log	Direct
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-.00	-.09	-	-	-.24	.16	-	-
(-.05)	(-.41)	-	-	(-.73)	(.26)	-	-
-	-	-.07	-.19*	-	-	.55	.67**
-	-	(-.65)	(-2.95)	-	-	(1.66	(4.52)
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

just the two cases of three variables are within the accepted range in double-log form.

Estimated income coefficients are low and significant in all accepted equations. Income elasticities calculated directly in all cases are close to income elasticities obtained by double-log form. Income elasticity is less than one in the two cases of three variable equations with accepted range indicating zero autocorrelation.

Price coefficients--both in terms of marginal and elasticity--are significant in two cases of three variable equations. Price elasticities obtained both by double-log and direct forms are strongly elastic, but the estimated price elasticity by double-log is more elastic than obtained directly.

Estimated lagged import elasticity of import--both in discrete and continuous cases--obtained either by double-log or directly is significant. The numerical magnitudes of this elasticity is plausible and satisfies the assumption on the coefficient of adjustment, $0 \leq \gamma \leq 1$.

These findings about the various types of import demand in Iran reveal the fact that the appropriate equation is the three variable equation with discrete adjustment mechanism. This equation is the disequilibrium case of traditional form of import demand; namely, import demand as a function of income, prices and lagged imports. Hence, the import demand of Iran should be considered under disequilibrium rather than equilibrium case which shed light to the

fact of strong quantitative constraints on imports in Iran.

F. Two-Stage Least-Square Estimation

On the basis of details described in the above sections, in order to come up with an unbiased estimation of the demand for imports by the ordinary least-squares method, some kind of assumption should be made to eliminate the effect of the supply side. This was done by making either an a priori assumption on the size of supply elasticity and its weight or an assumption of perfect elastic supply. In this section, an attempt has been made to relax these assumptions; i.e., to assume there exists an upward slope supply and to test the aforementioned hypothesis.

Introducing an upward slope supply results in building a simultaneous equation system in which endogenous variables exist among the explanatory variables and the ordinary least squares method is no longer consistent. However, application of the same procedure to the reduced form given a consistent estimation of parameters. Different methods such as two-stage least squares, full information maximum likelihood, and three-stage least squares are suggested to solve the simultaneous equations. In this study two-stage least squares is used.

Two-stage least squares (2SLS) provides a very useful estimation procedure for obtaining the values of structural parameters in simultaneous equations. This method utilizes the information available from the specification of an equation system to obtain

a unique estimate for each structural parameter. Intuitively speaking, the first stage of two-stage least squares consists of fitting each reduced form equation by the least squares method. The second stage of the two-stage least squares is equally simple. In the structural function, original value is replaced by predicted value and the resulting equation fit by ordinary least squares.

Let us consider the functional form of import demand in period t.

$$M_t^d = M_t^d (Y_t, PM_t, PD_t) \tag{4.14}$$

and, moreover, assume that the upward supply of imports to country i (i = 1, ..., 13) is a function of the price of imports, the world price level, PW, and world income (WY) as

$$M_t^s = M_t^s (PM_t, PW_t, WY_t) \tag{4.15}$$

Assuming a linear-log function for both import demand and supply, the structural form may be as the following reduced forms:[1]

$$\log M_t = \alpha_0 + \alpha_1 \log PW_t + \alpha_2 \log WY_t + \alpha_3 \log PD_t + \alpha_4 \log Y_t + \alpha_t \tag{4.16}$$

$$\log PM_t = \beta_0 + \beta_1 \log PW_t + \beta_2 \log WY_t + \beta_3 \log PD_t + \beta_4 \log Y_t + \beta_t \tag{4.17}$$

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[1]The procedures will be the same with more explanatory variables and disequilibrium conditions.

From the first stage a predicted value of M_t, PM_t is obtained. And in the second stage these predicted values are replaced by original ones.

In a general form, assume there are n endogenous (dependent) variables $(DV)_1$, $(DV)_2$, ..., $(DV)_n$ and m exogenous (explanatory) variables $(IV)_1$, $(IV)_2$, ..., $(IV)_m$, then the structural equations can be written as

$$B\ (DV) = C\ (IV) + U \tag{4.18}$$

where

B = the coefficient of matrix of endogenous variables

DV = the vector of dependent variables

C = the coefficient matrix of exogenous variables

IV = the vector of exogenous variables

U = the vector of random terms.

In this section, for empirical analysis, the real gross national product of the members of the Organization for Economic Cooperation and Development (OECD) is considered as world income (WY), and the GNP deflator is regarded as a representative of world price level (PW). The first subsection is devoted to the case of equilibrium, the second subsection to the case of equilibrium. Obviously, the different above mentioned hypotheses will be examined.

1. Equilibrium models

The import equations 3.37 and 3.38 were estimated by the two-stage least squares method. The numerical results from estimating the equations by this method are shown in Table 4.21 and 4.22. The discussion of the estimates in Tables 4.21 and 4.22 will be within the framework of testing the relative significance of price and income in trade flow of developing countries. Tables 4.21 and 4.22 present the estimated coefficients of prices and income in terms of marginal and elasticities, respectively, in the equilibrium case. The comparison of two methods is shown in Table 4.23.

The general performance of the 2SLS is better than the OLS method. Seven out of eight in the former and five out of six in the latter agree with the expected negative sign for price coefficients. But the sign of all income elasticities is the expected positive sign in both methods. There is no change in the number of significant price and income coefficients, but the range of numerical magnitudes is improved. For instance the significant price elasticity of import demand ranges from -.36 to -3.60 in the 2SLS method, while the range is from -1.35 to -3.27 in the OLS method. Considering the significant price coefficients, numerical magnitude ranges between -.36 to -3.60 for El-Salvador and Guatemala, respectively.

On the country level, in the case of Pakistan, no changes occur.

Table 4.21. 2SLS estimated price and income coefficients under a linear form and equilibrium condition (two variable equations)[a]

Country	Constant	Coefficients[b]		R^2	F-ratio**[c]	D.W.[d]
		Income	Price			
Thailand	17.69	.19**	-16.31**	.93	85.4	2.22
	(3.63)	(8.60)	(-4.07)			
Colombia	-3.29	.10*	4.25	.91	61.2	2.44
	(-.22)	(2.60)	(.24)			
Dominican Rep.	10.84	.16*	-10.70**	.92	71.1	1.81
	(3.04)	(2.58)	(-3.80)			
El-Salvador	3.68	.30**	-4.12**	.96	163.6	1.83
	(3.82)	(9.60)	(-5.49)			
Guatemala	10.80	.39**	-15.75**	.86	37.5	1.66
	(2.81)	(6.66)	(-3.09)			
Honduras	-.01	.40**	-.84	.90	51.3	1.39
	(-.03)	(10.12)	(-1.82)			
Morocco	23.62	.20**	-24.32**	.80	24.4	1.72
	(5.12)	(3.73)	(-5.54)			
Tunisia	-.82	.33**	-.82	.76	19.5	1.62
	(-.19)	(4.61)	(-.26)			

[a]Source: Table 9.1.

[b]The number in parentheses below each coefficient is a t-ratio; * = significant at the five percent level; ** = significant at the one percent level; and no sign = nonsignificant at the above levels.

[c]All F-ratios are significant at the one percent level.

[d]Durbin-Watson D statistics.

Table 4.22. 2SLS estimated price and income elasticities under a double-log form and equilibrium condition (two variables equation)[a]

Country	Constant	Elasticities[b]		R^2	F-ratio**[c]	D.W.[d]
		Income	Price			
Korea (Rep. of)	-.72	1.15**	-3.40**	.79	22.2	1.39
	(-1.48)	(4.56)	(-3.79)			
Colombia	-.62	.82**	1.04	.89	48.9	2.65
	(-1.33)	(3.30)	(.66)			
Dominican Rep.	-1.27	1.41**	-2.08*	.94	90.8	2.22
	(-4.32)	(5.30)	(-2.56)			
El-Salvador	-1.04	1.43**	-.36*	.94	98.4	1.28
	(-9.99)	(13.17)	(-2.65)			
Guatemala	-2.60	2.33**	-3.60**	.90	55.1	1.70
	(-5.70)	(7.21)	(-3.41)			
Honduras	-1.14	1.69**	-.79*	.94	91.3	1.37
	(-11.39)	(13.42)	(-2.83)			
Morocco	-.44	.79**	-2.80**	.87	39.9	1.33
	(-1.90)	(5.03)	(-6.84)			
Tunisia	-1.09	1.36**	-.19	.84	30.9	1.82
	(-3.39)	(5.27)	(-.22)			

[a]Source: Table 9.2.

[b]The number in parentheses below each elasticity is a t-ratio; * = significant at the five percent level; ** = significant at the one percent level; and no sign = nonsignificant at the above levels.

[c]All F-ratios are significant at the one percent level.

[d]Durbin-Watson D statistics.

Table 4.23. Comparison of OLS and 2SLS estimated price and income coefficients (elasticities)[a]

	Price			Income		
	Sign	Number of[b] significant coefficients	Range[c] (numerical magnitudes)	Sign	Number of significant coefficients	Range (numberical magnitudes)
Ordinary least-squares method	5 (-)	4	-1.35 to -3.27	All (+)	All	.97 to 1.90
Two-stage least squares	8 (-)	6	-.36 to -3.60	All (+)	All	.79 to 2.33

[a]Sources: Tables 4.21 and 4.22.

[b]Significant level covers both one and five percent.

[c]Indicates the lowest and highest magnitude of price and income elasticities.

The price elasticity of imports is not only nonsignificant, but there is also no improvement in the coefficient of determination, R^2. The relatively low R^2 for this country, both in the OLS and 2SLS, may indicate that relevant variables have been omitted from the estimated equations or that imports have been influenced by variables other than domestic economic variables. With regard to other developing countries, the price elasticity of imports shows improvement using 2SLS, in some countries, while the numerical magnitude decreases in others. For example, the Dominican Republic, Guatemala, and Morocco have increased. In other words, a priori assumption on either case, that is, perfect elastic or upward slope supply, is not confirmed by comparing the results of these two estimation methods in developing countries. Hence, it is not possible to generalize any assumptions for all developing countries. By applying either method, however, one can recognize the relative significance of prices in the import demand of developing countries. Indeed, each method may be used to give emphasis to the other method for individual countries in order to prove the relative significance of prices and to reject the commonly expressed view that these countries have an inelastic price demand for imports.

With regard to testing the relative significance of other explanatory variables, the numerical estimates are presented in Tables 4.24 to 4.27. A summary of the number of signs and the number of countries and the number of significant export earnings

Table 4.24. 2SLS estimated income, price, current foreign exchange reserves and current export earnings coefficients under a linear form and equilibrium condition (four current variable equations)[a]

Country	Constant	Coefficients[b]				R^2	F-ratio**[c]	D.W.[d]
		Income	Price	Foreign exchange	Exports			
Iran	23.76	.10	-23.24	-.46	.20	.95	50.8	1.72
	(.74)	(1.85)	(-.72)	(-.85)	(.68)			
Philippines	-8.28	.22**	2.21	-.79*	.43	.92	27.2	2.04
	(-1.09)	(4.64)	(.61)	(-2.63)	(1.53)			
Korea (Rep. of)	11.20	-.01	-6.71	1.18	1.41*	.96	70.5	2.14
	(1.19)	(-.11)	(-1.25)	(1.26)	(2.95)			
Thailand	4.89	.08*	-5.67	.58*	.46**	.97	89.9	2.26
	(.96)	(2.37)	(-1.35)	(2.40)	(3.11)			
Colombia	9.67	.19**	-10.46	-.92	-.61	.95	44.0	2.07
	(.70)	(3.75)	(-.64)	(-2.06)	(-1.36)			
Dominican Rep.	1.98	.14*	-3.00	.35	.60	.94	42.9	1.74
	(.28)	(2.12)	(-.51)	(.23)	(1.79)			
Guatemala	6.53	.10	-8.43	-.23	.96	.90	23.5	2.27
	(1.45)	(.57)	(-1.26)	(-.35)	(2.07)			
Honduras	-.30	.49	-.91	1.46	-.37	.90	23.7	1.59
	(-.47)	(1.97)	(-1.03)	(.96)	(-.49)			
Morocco	-.83	.07*	.93	.44	.67**	.97	74.0	2.14
	(-.21)	(2.14)	(.23)	(1.98)	(6.49)			
Tunisia	-1.96	.15*	1.50	-.33	.72**	.98	136.3	2.40
	(-.97)	(2.47)	(1.17)	(-1.35)	(9.49)			

[a]Source: Table 9.3.

[b]The number in parentheses below each coefficient is a t-ratio; * = significant at the five percent level; ** = significant at the one percent level; and no sign = nonsignificant at the above levels.

[c]All F-ratios are significant at the one percent level.

[d]Durbin-Watson D statistics.

Table 4.25. 2SLS estimated income, price, lagged foreign exchange reserves and export earnings coefficients under a linear form and equilibrium condition (two current and two lagged variable equations)[a]

Country	Constant	Coefficients[b]		Lagged foreign exchange	Lagged exports	F^2	F-ratio**[c]	D.W.[d]
		Income	Price					
Korea (Rep. of)	2.69	.04	-4.27	3.59**	.57	.97	84.1	2.13
	(.37)	(1.05)	(-.88)	(4.23)	(1.84)			
Dominican Rep.	7.13	.16*	-7.71	.00	.36	.93	31.7	1.90
	(1.14)	(2.30)	(-1.55)	(.00)	(.77)			
El-Salvador	3.41	-.02	-3.66**	-.54	1.55**	.99	228.5	1.19
	(3.32)	(-.26)	(-4.88)	(-1.17)	(4.76)			
Guatemala	2.10	.06	-2.29	1.27	.44	.94	36.8	2.06
	(.54)	(.55)	(-.42)	(2.23)	(1.25)			
Honduras	-.77	.17	.24	2.15	.39	.94	37.5	2.22
	(-1.16)	(1.11)	(.42)	(1.65)	(.87)			
Morocco	-11.27	.07	5.88	.74*	1.81**	.94	42.4	1.76
	(-1.51)	(1.57)	(.90)	(2.29)	(4.91)			
Tunisia	12.36	-.01	-9.28	1.61	-.16	.84	12.9	1.90
	(1.70)	(-.06)	(-1.89)	(1.97)	(-.18)			

[a]Source: Table 9.5.

[b]The number in parentheses below each coefficient is a t-ratio; * = significant at the five percent level; ** = significant at the one percent level; and no sign = nonsignificant at the above levels.

[c]All F-ratios are significant at the one percent level.

[d]Durbin-Watson D statistics.

Table 4.26. 2SLS estimated price, income, foreign exchange reserves and export earnings elasticities under a double-log form and equilibrium condition (four current variable equations)[a]

Country	Constant	Elasticities[b]				R^2	F-ratio**[c]	D.W.[d]
		Income	Price	Foreign exchange	Exports			
Thailand	-.38	.55*	-.77	.33*	.19	.98	107.5	2.38
	(-2.41)	(2.91)	(-1.87)	(2.34)	(1.24)			
Colombia	-1.32	1.43**	.19	-.07	-.55	.91	26.9	2.25
	(-1.97)	(3.21)	(.12)	(-.79)	(-1.57)			
Guatemala	-.78	.74	-3.11	.12	.56	.94	36.8	2.17
	(-.88)	(1.00)	(-1.73)	(.81)	(1.83)			
Panama	-.55	1.06**	-1.44	-.03	.18	.98	120.6	1.23
	(-3.25)	(5.86)	(-1.33)	(-1.09)	(1.38)			
Morocco	-.09	.32	-.26	.07	.55*	.94	36.7	2.15
	(-.42)	(1.42)	(-.27)	(2.09)	(2.35)			
Tunisia	-.54	.72	.80	-.07	.52**	.94	37.5	2.34
	(-1.12)	(1.76)	(1.03)	(-1.04)	(3.99)			

[a]Source: Table 9.4.

[b]The number in parentheses below each elasticity is a t-ratio; * = significant at the five percent level; ** = significant at the one percent level; and no sign = nonsignificant at the above levels.

[c]All F-ratios are significant at the one percent level.

[d]Durbin-Watson D statistics.

Table 4.27. 2SLS estimated income, price, lagged foreign exchange and export earnings under a double-log[a] form and equilibrium condition (two current and two lagged variable equations)

Country	Constant	Elasticities[b]		Lagged foreign exchange	Lagged exports	R^2	F-ratio**[c]	D.W.[d]
		Income	Price					
Korea (Rep. of)	.79	-.08	-.49	.72**	.33**	.99	349.2	2.30
	(5.05)	(-.88)	(-1.99)	(9.18)	(7.11)			
Guatemala	-1.66	1.55	-3.77	.06	.22	.90	23.9	1.77
	(-1.02)	(1.19)	(-1.09)	(.30)	(.52)			
Honduras	-.35	.81	-.14	.23	.36	.96	57.7	1.78
	(-.79)	(1.28)	(-.36)	(1.39)	(.94)			
Tunisia	-.60	.97	-1.10	.80	-.01	.84	13.3	1.83
	(-.61)	(1.23)	(-.56)	(.49)	(-.02)			

[a]Source: Table 9.6.

[b]The number in parentheses below each elasticity is a t-ratio; * = significant at the five percent level; ** = significant at the one percent level; and no sign = nonsignificant at the above levels.

[c]All F-ratios are significant at the one percent level.

[d]Durbin-Watson D statistics.

and foreign exchange reserves coefficients are shown in Tables 4.28 and 4.29. A brief review of these numerical results and the results shown in Tables 4.9 and 4.10 indicate that the overall OLS results are preferable to those derived from 2SLS. Not only is the number of signs declined, but also the number of significant coefficients--both on the one and five percent--are reduced. In sum, variations in the results are such that any specific interpretation could not be made. Nor could a priori judgment be made on the relative significance of foreign exchange reserves and export earnings in this method. However, both methods may be applied as a reinsurance of each other.

2. Disequilibrium models

Considering disequilibrium equations (3.46), (3.47), (3.50), (3.51), (3.52), and (3.53), and on the basis of previous explanations, the coefficients of lagged imports were estimated by the 2SLS method in terms of marginal and elasticities. The numerical results are presented in Tables 4.30 and 4.31 in the case of the import demand as a function of aggregate real income and relative prices. The sign and the number of countries and the number of significant coefficients are shown in Table 4.32.

The 2SLS approach, in the case of disequilibrium, either with discrete or continuous adjustment in linear form, brings about better numerical results in the lagged imports of Iran, the

Table 4.28. The sign and number of countries and the number of significant estimated current and lagged export coefficients by 2SLS method[a]

	Linear form		Transformed double-log form	
	Current	Lagged	Current	Lagged
Number of countries	10	7	6	4
Positive sign	8 (+)	5 (+)	5 (+)	3 (+)
Number of significant coefficients[b]	4	2	2	1

[a]Source: Tables 4.24 to 4.27.

[b]It covers both one and five percent levels.

Table 4.29. The sign and number of countries and the number of significant estimated current and lagged foreign exchange reserves (FER) coefficients by 2SLS method[a]

	Linear form		Double-log form	
	Current	Lagged	Current	Lagged
Number of countries	10	7	6	4
Positive sign	5 (+)	8 (+)	3 (+)	4 (+)
Number of significant coefficients[b]	2	4	1	1

[a]Source: Tables 4.24 to 4.27.

[b]It covers both one and five percent levels.

Table 4.30. 2SLS estimated lagged import coefficients in linear and double-log with discrete time as partial adjustment mechanism[a]

Country[b]	Linear form		Transformed double-log form	
	Lagged import coefficient	t-ratio	Lagged import elasticity	t-ratio
Iran	.75	5.40**[c]	.95	7.38**
Philippines	.75	4.77**	.65	4.11**
Korea (Rep. of)	1.07	6.92**	1.07	8.86**
Pakistan	.43	2.23*	.34	2.24*
Thailand†	-.14	-.46	--	--
Colombia	-.36	-1.80	-.38	-2.49*
Dominican Rep.	-.19	.45	-.31	-1.93
El-Salvador†	.65	3.85**	--	--
Guatemala	.56	1.60	.19	.54
Honduras †	.41	1.22	--	--
Panama †	--	--	--	--
Morocco †	.72	1.15	--	--
Tunisia	.27	.38	.14	.34

[a]Sources: Tables 9.7 and 9.8.

[b]Countries with sign † have inconclusive region Durbin-Watson D statistics.

[c]* = significant at the five percent level; and ** = significant at the one percent level.

Table 4.31. 2SLS estimated lagged import coefficients in linear and double-log with continuous time as partial adjustment mechanism[a]

Country[b]	Linear form		Double-log form	
	Lagged import coefficient	t-ratio	Lagged import elasticity	t-ratio
Iran	.53	3.42**[c]	.70	4.33**
Philippines†	--	--	--	--
Korea (Rep. of)	.99	6.42**	1.02	7.26**
Pakistan	.34	1.60	.27	1.48
Thailand	-.65	-1.68	-.45	-1.58
Colombia	-.66	-2.28*	-.70	-2.82*
Dominican Rep.	-.74	-1.27	-.58	-2.14*
El-Salvador	.33	1.42	.07	.23
Guatemala†	.39	1.09	--	--
Honduras†	--	--	--	--
Panama	-2.18	-1.84	-.10	-.16
Morocco†	.53	.95	--	--
Tunisia	-.45	-.49	-.29	-.64

[a]Sources: Tables 9.9 and 9.10.

[b]Countries with sign † have inconclusive region Durbin-Watson D statistics.

[c]* = significant at the five percent level; and ** = significant at the one percent level.

Table 4.32. The sign and number of countries and the number of significant estimated lagged import coefficients with discrete and continuous time as partial adjustment mechanism in linear and double-log forms[a]

	Discrete time		Continuous time	
	Linear form	Transformed double-log	Linear form	Transformed double-log
Number of countries	12	8	12	9
Positive sign	9 (+)	6 (+)	6 (+)	4 (+)
Number of significant coefficients[b]	5	4	2	2

[a]Sources: Tables 4.30 and 4.31.

[b]Covers both one and five percent levels.

Philippines, and Korea. In linear form this coefficient has been changed to .75 from .41; to .75 from .55; and finally about one from .88 for Iran, the Philippines, and Korea, respectively. The response in transformed double-log is even better; doubled in the case of Iran, changed to .65 from .44 in the Philippines and no change for Korea. The higher lagged imports coefficient, the lower the coefficient of adjustment. Lower coefficient of adjustment sheds light on the fact of the strong disequilibrium or, in other words, the existence of strong quantitative constraints.

Otherwise, the results are such as to make any further judgment on the preference of 2SLS impossible. Moreover, variations in lagged imports coefficient with the presence of other explanatory variables--such as foreign exchange reserves and export earnings--will have the same results as with the former method. Any general interpretation on the possibility of bias due to ignorance of supply effect may not be made even with the introduction of new explanatory variables to the traditional form.

In sum, a priori generalization of the possible source of bias due to the assumption of perfect elastic supply could not be made. However, it seems reasonable to apply the 2SLS method, i.e., the assumption of upward sloped supply, to realize the possibility of the bias in each specific developing country.

V. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The following pages serve to review the main findings from previous chapters and to summarize the results in general terms. In presenting these results, an effort has been made to indicate the way in which the behavior of developing countries in international trade is determined. The study concludes with some recommendations for further research and policy.

A. Summary of Study

A general review of literature on import demand revealed: the existence of an ill-treated trade behavior of developing countries in trade models, such as the assumption that import demand of these countries has generally been determined by non-market forces. It also indicated no appropriate theoretical improvement of the import demand due to overoccupation with the estimation techniques. Further, when applying traditional import demand, almost all studies were undertaken within the framework of imports as a function of real income and relative price, i.e., $M_t = M_t \left(\frac{Y}{PD}, \frac{PM}{PD}\right)$. The literature also provided arguments on the relative significance of price due to its debatable position in international trade and balance-of-payments policy, as well as on the existance of methological controversies. The major argument was the application of the ordinary least-squares method, which was criticized due to the ignorance of supply side effects and the possibility

of other biases. The numerical results of estimated coefficients, especially price, by this method were such as to bring about argument and controversy over the efficiency of this method. Accordingly, most studies were framed to find the different biases either actual or potential.

More specific review sheds light on the existence of explanatory variables such as foreign exchange reserves and export earnings other than price and income in the import demand of developing countries. The rationale was given that when foreign exchange reserves are low, import restricitons will be imposed, whereas they will be relaxed when reserves increase. Moreover, a country uses its export earnings as purchasing power, to pay for its imports. Consequently these two variables have some impact on the demand for imports and an extended formulation involving these two variables was adopted.

Strong quantitative constraint in these countries exists to bring about the possibility of disequilibrium in their import demand. It was realized that traditional import demand was studied under the implicit assumption of equality of the desired and actual imports, although it was realized that that would not happen due to these quantitative constraints. Hence, these were several aspects of the study which departed from the traditional approach.

The relationship out of equilibrium by using time as a discrete and continuous adjustment mechanism was formulated. Underlying

reasons were the possibility of inequality between actual and desired imports, M and M*, and the possibility of quantitative constraints. The cases of disequilibrium and equilibrium, in the presence of lagged imports or not, were expressed in terms of linear and transformed double-log relations as no specific functional form would be realized.

The present study then proposed the three following main hypotheses:

1. The relative significance of price in the import demand in developing countries.
2. The relative significance of other explanatory variables — such as foreign exchange reserves and export earnings — in the import demand of developing countries.
3. The relative significance of quantitative constriants: in other words, the relative significance of lagged imports in the import demand of these countries.

In sum, these hypothesis basically covers almost all revealed arguments.

Before testing the aforementioned hypotheses, the empirical problems such as aggregation problems and time dimension problems involved in the estimation of the import demand were pointed out. Moreover, privileges and deficiencies of variety approaches such as cross-section, input - output, and simultaneous estimations were surveyed with each method having increased the knowledge of the

structure of international trade. Nevertheless, each approach fell short of the goal in explaining the trade behavior of developing countries. Accordingly, with respect to the nature of study, time series estimation was applied through the study.

In order to test the hypotheses respective data on the total imports, gross domestic products, import price index, domestic price index, world price level, and real world income in the selected developing countries for a period of 16 years --1959 to 1974 were gathered. The countries selected are Iran, the Republic of Korea, the Philippines, Pakistan, Thailand, Columbia, the Dominican Republic, El-Savador, Guatemala, Honduras, Panama, Morocco, and Tunisia.

The linear and transformed double-log forms of the import demand functions for the case of disequilibrium and equilibrium, both traditional and extended ones, were estimated by using the ordinary least-squares (OLS) and the two stage least-squares (2SLS) techniques in order to find the situations of developing countries fit into the methological controversies. By the former method, in which the assumption of perfect elastic supply is held, the coefficients were estimated by regressing imports on not only real income and relative price but also on the foreign exchange reserves and export earnings. With the latter technique, the coefficients were estimated by the relaxation of perfect elastic supply.

B. Conclusions

As mentioned above, the main objective of the study was to explain and measure the behavorial relationship -- theoretically and statistically --between total imports and main explanatory variables, such as real income, relative price, foreign exchange reserves, and export earnings of developing countries. Toward this end, it was realized that there exists a lack of general observation and a quantitative gap. Moreover, no adequate theoretical background exists. The reason underlying this is preoccupation with the mechanics of estimation and, specifically, with the properties of the price coefficient.

In spite of this inadequacy, it was attempted to derive import demand on the basis of consumer behavior assumptions. Two cases were distinguished; first, in which domestic commodities are a perfect substitute for imported commodities, and second, in which imported commodities are differentiated from (incomplete substitute) domestic commodities. The latter case was presented in order to realize the effect of place of production. However, under both cases, and some simplified assumptions, the same functional import demand function was reached. Due to the results obtained and in order to avoid any further bias from lack of adequate theoretical support, the study and respective hypotheses were carried out under the first case. Furthermore, the limitation of data, with the large number of commodities involved, made in necessary to concentrate on

the aggregate characteristic of import demand in developing countries. Since it is obvious that imports consist of different types of goods, of which each has its own special characteristics, exploration on a disaggregated basis was not possible.

On the grounds of the effect of domestic supply and import demand, it was concluded that, by considering import as a horizontal difference of domestic demand and domestic supply, in international trade elasticities are greater than domestic elasticities. Import demand will always be more elastic than domestic demand so long as domestic supply exceeds zero. From the point of view of stability, it was revealed that the Marshall-Lerner condition must hold, if the relationships were expressed in terms of elasticites. Otherwise, the offer curve of country under study and the rest of the world must cur each other from below.

A probe of the main possible explanatory variables established cleared that income, price, foreign exchange reserves, and export earnings are the chief important variables in the import demand of developing countries, although the last two did not show the response as strong as did the other two. In spite of expecting a positive sign between imports and income, the possibility of negative relation exists, and it may occur in case of developing countries. Thus, conflict appears to exist between pure theory and the nonprice model of international trade. Of course, at the aggregate level, the possibility of a negative sign is very rare. Almost all the studies

of developed countries have shown a significant positive sign. It is possible, however, that the elasticity of domestic supply, specifically in developing countries, increases due to high tendency toward import substitution for their development purposes, and that the result may be a presure on elasticity of demand for imports towards zero or even negative. However, is was concluded that cyclical and secular income elasticity may be the cause of this conflict. In order to prevent this conflict, these income fluctuations must be distinguished.

In the case of prices, assuming positive and negative elasticities for domestic demand and domestic supply, it is concluded that there is no probability of ambiguity in the sign of the import price elasticity. Conclusions about the relative significance of price in the import demand of developing countries will be discussed below.

The effects of foreign exchange reserves and export earnings are not deniable, although it is not possible to reach a unique interpretation of the effect of these variables. Because of this uncertainty, both lagged and current values of these variables were introduced into the import demand. The numerical results revealed that no a priori judgment may be made on the effect of these variables, either in terms of lagged and current. It was also concluded that the cause for the lack of complete response of these variables might be due to the aggregated level used in the study.

The possibility of the influence of other explanatory variables

such as world-wide effects, not-traded items, and capacity-utilization were omitted, since the existence of factors affecting the demand or supply of goods will tend to bias import price elasticity towards zero if these factors are not accounted for. However, any attempt to construct a complete consideration of all explanatory variables would fail from a lack of statistical and theoretical support and adequate data. Hence, it would be more reasonable, at the present stage of data knowledge, to construct the total import demand with the main explanatory variables for which data exist.

Little theoretical presentation or support exists regarding the appropriate functional form, and there appears to be no easy method of choosing between linear and double-log forms of the import demand. The numerical results of the estimated coefficients in the import demand, using both forms, emphasizes the lack of any preference as to the selection of a functional form for import demand in developing countries. Thus, both forms were considered and the relative significance of each form in each case was noted.

Import constraints, both for protection and revenue, have been in operation in developing countries as they attempt to achieve their goals. Of course, the degree and quantity of constriant depends upon the different policies. It was revealed, therefore, that there actually is no equality between desired and actual imports, an important implicit assumption in the import demand.

The result of this inequality would be a case of out-of-equilibrium in which, even with both types of adjustment mechanisms, lagged imports enter as an independent variable. The numerical results of the coefficient of lagged imports show that not only the variation of quantitative constraints in developing countries and the impossiblity of using dummy variables, but also the import demand of these countries, in the case of disequilibrium, gives a better response.

Different hypotheses, such as the relative significance of price, the relative significance of other explanatory variables, and the relative significance of quantitative constraints in the import demand of developing countries, have been examined with each adding to the knowledge of the structure of import demand and the forces determining it in these countries. For instance, under testing of the relative significance of prices in the import demand, it was concluded that prices do play an important role in the determination of imports of developing countries and consequently regret the unrealistic assumption of determination of imports of these countries by nonmarket forces. With regard to the estimated numerical magnitude of price elasticities, in all different introduced models, they were found to be fairly high and significant for most of the selected developing countries. This implies that in a number of these countries, the Marshall-Lerner condition for successful devaluation would be easily satisfied.

It was realized that the application of ordinary least-squares (OLS) to the estimation of import demand is valid only if the random term is uncorrelated with any of the explanatory variables. If quantity imported and import prices are simultaneously determined, a correlation between these two and a random term will be thereby set up, which violates the basic assumption of OLS. The results of OLS under such conditions will be inconsistent. The bias and inconsistency in the price coefficient are also obtained by ignoring the simultaneous relation. The reason is that weighted average of the negative demand elasticity with the positive supply elasticity is in fact what is being estimated. The identification problem has been solved in international trade studies by making the assumption that supply elasticity is infinite.

The OLS method is a valid procedure for estimating international trade relationships for a small country. On the world maket, a small country is a price taker. Moreover, specific developing countries are faced with a situation of less than full capacity, and so the bias caused by ignoring the simultaneity of the relationship is not serious at all.

On the other hand, in order to realize the effect of the supply side and reduce bias due to the nature of supply, or in other words, to realize the methodological controversies, the method of two stage least-squares was applied for the different models. Accordingly, an upward-sloped supply was assumed. The numerical results of OLS and 2SLS indicated that the OLS method can still be valid and, infact,

bias due to ignorance of the supply side is not so much as to bring about a large amount of deviation from pure estimated price elasticity.

C. Suggestions For Further Research

Just as other studies have been used in the preparation of this one, it is believed that the present study can serve as a basis for further research.

As was mentioned above, this study was carried out on a general level and an aggregated level, thus indeed involving some specific problems which may be solved with further research. Recent economic theory and statistical techniques have certainly been developed to such an extent that it might be possible to deal with some of these problems if the availability of data permits.

Because of aggregation problems and the possiblity of more potential errors in the more sophisticated aggregations cases, and the lack of complete required information for the selected developing countries, the usual unweighted income aggregate and the usual Lespeyre value-weighted price indices were used. These certainly may be improved to more adequately representative variables by further research.

It is suggested that in order to cover existing problems, more study must be done on the level of disaggregated import demand. Moreover, it would be reasonable to build appropriate indices more

acceptable to improved theory and statistical techniques for each specific country involved. Of course, the nature of the study will be changed to micro analysis.

Some numerical results of the foreign exchange reserves and export earnings coefficients suggest that for a better response of these variables the study must be undertaken at the disaggregated level and further research seems desirable.

It is suggested that the import demand in developing countries may be investigated on the basis of the case of disequilibrium, rather than the case of equilibrium. The relative significance of the quantitative constraints in these counties is such that it is deemed possible to come up with better results with disequilibrium. This, of course, would require further work.

The dynamic case in this study was made on the basis of annual data. It is suggested that, in order to find a better estimation, it is worth considering the data on a shorter period. Of course, although the possiblity of gathering such data is impossible in developing countries, more research and work are recommended. The statistical results obtained on the import demand thus far are helpful; there remain, however, certain theoretical aspects on which further research seems desirable.

Finally, it is conceivable that the results could be considerably improved if other special features of the selected countries, such as the stage of their development or the characteristic of

their trade structure, as well as special circumstances during the period of study, were incorporated into the different introduced models of import demand in this study.

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VII. ACKNOWLEDGEMENTS

I wish to express my appreciation to Dr. Arnold Paulsen for his guidance during my graduate study and the preparation of this dissertation. My appreciation is extended to other members of my committee, Dr. Walter Enders, Dr. Richard Weisskoff, Dr. John F. Timmons, and Dr. Clarence Bockhop. My deepest gratitude goes to my parents for their contribution to my higher education in numerous ways.

I want to thank Diana Grimm for typing this dissertation.

Last but not least, thank you my dear wife, Soheila, and my daughter, Salomeh, for your patience and encouragement.

VIII. APPENDIX A. SUPPLEMENTARY TABLES ON ORDINARY LEAST-SQUARES ESTIMATION

Table 8.1. OLS estimated price and income coefficients under a linear form and equilibrium condition [$M_t = A_0 + A_1 (Y/PD)_t + A_2 (PM/PD)_t + a_t$]

Country	Constant (A_0)	Marginal coefficients[a]		R^2	F-ratio	D.W.[b]
		Income (A_1)	Price (A_2)			
Iran	33.65	.11	-31.79	.95	113.5	1.05
	(1.73)	(15.06)	(-1.64)			
Philippines	2.27	.14	-.85	.86	36.1	.78
	(.35)	(3.62)	(-.24)			
Korea (Rep. of)	21.16	.29	-20.83	.86	39.4	1.18
	(2.21)	(7.80)	(-3.08)			
Pakistan	9.62	.02	-1.72	.16	1.2	1.12
	(2.74)	(.80)	(-1.11)			
Thailand	14.84	.19	-13.85	.92	73.5	1.67
	(3.12)	(8.41)	(-3.58)			
Colombia	-.69	.10	1.14	.91	61.5	2.45
	(-.22)	(8.46)	(.32)			
Dominican Rep.	6.50	.25	-7.55	.91	61.7	1.69
	(2.36)	(4.96)	(-3.35)			
El-Salvador	7.26	.29	-7.63	.93	84.3	1.92
	(7.83)	(6.93)	(-9.83)			
Guatemala	6.96	.33	-10.54	.87	41.2	2.07
	(2.89)	(8.16)	(-3.37)			
Honduras	-.36	.39	-.47	.87	42.5	1.18
	(-.70)	(9.17)	(-.99)			
Panama	7.88	.43	-8.26	.93	77.1	.98
	(2.06)	(11.86)	(-2.33)			
Morocco	18.60	.22	-19.65	.72	15.2	1.54
	(3.81)	(3.41)	(-4.22)			
Tunisia	-.15	.32	-1.32	.77	19.9	1.48
	(-.04)	(4.91)	(-.52)			

[a]The number in parentheses below each coefficient is a t-ratio in this and all subsequent tables.

[b]D.W. = Durbin-Watson D statistics in this and all subsequent tables.

Table 8.2. OLS estimated price and income elasticities under a double-log and equilibrium condition [$\log M_t = A'_0 + A'_1 \log (Y/PD)_t + A'_2 \log (PM/PD)_t + a'_t$]

Country	Constant (A'_0)	Elasticities		R^2	F-ratio	D.W.
		Income (A'_1)	Price (A'_2)			
Iran	-.87	1.00	-2.81	.95	109.1	.91
	(-6.43)	(14.65)	(-2.14)			
Philippines	-.86	1.04	.08	.87	38.8	.85
	(-1.85)	(4.19)	(.23)			
Korea (Rep. of)	-.87	1.19	-2.67	.76	19.1	1.02
	(-1.71)	(4.47)	(-3.39)			
Pakistan	.58	.20	-.28	.18	1.3	1.01
	(.99)	(.70)	(-1.26)			
Thailand	-.67	.99	-1.35	.96	153.2	2.29
	(-5.10)	(12.96)	(-4.56)			
Colombia	-.81	.92	.32	.89	49.4	2.66
	(-3.71)	(7.72)	(.73)			
Dominican Rep.	-1.55	1.67	-1.38	.93	80.5	2.31
	(-6.56)	(7.74)	(-2.14)			
El-Salvador	-.88	1.27	-2.05	.94	96.5	.94
	(-6.97)	(9.66)	(-8.29)			
Guatemala	-1.99	1.90	-3.27	.92	70.0	2.23
	(-8.15)	(10.42)	(-4.17)			
Honduras	-1.14	1.68	-.54	.92	68.8	1.19
	(-9.94)	(11.72)	(-1.83)			
Panama	-.77	1.31	-2.35	.98	344.0	1.09
	(-15.44)	(24.87)	(-3.54)			
Morocco	-.52	.86	-2.30	.79	22.4	1.47
	(-1.77)	(4.28)	(-4.94)			
Tunisia	-1.05	1.32	-.33	.84	31.8	1.67
	(-3.98)	(6.12)	(-.56)			

Table 8.3. OLS estimated income, price, foreign exchange and export coefficients under a linear form and equilibrium condition
$[M_t = B_0 + B_1 (Y/PD)_t + B_2 (PM/PD)_t + B_3 (FER/PM)_t + B_4 (X/PM)_t + b_t]$

Country	Constant (B_0)	Marginal propensities coefficients				R^2	F-ratio	D.W.
		Income (B_1)	Prices (B_2)	Foreign exchange (B_3)	Exports (B_4)			
Iran	29.34	.12	-28.56	-.24	.08	.96	54.8	1.83
	(1.17)	(2.12)	(-1.14)	(-.41)	(.26)			
Philippines	-7.91	.21	2.04	-.77	.47	.91	26.7	2.00
	(-.82)	(4.94)	(.43)	(-2.56)	(1.23)			
Korea (Rep. of)	5.98	.00	-3.48	1.43	1.31	.96	62.6	2.04
	(.56)	(.06)	(-.56)	(1.31)	(2.62)			
Pakistan	4.55	-.01	1.59	-.64	.93	.54	3.0	1.63
	(.80)	(-.30)	(.67)	(-1.15)	(2.08)			
Thailand	5.04	.07	-5.77	.57	.47	.97	103.1	2.16
	(1.32)	(2.62)	(-1.87)	(2.82)	(3.59)			
Colombia	1.14	.16	-.34	-.85	-.54	.94	42.2	1.95
	(.29)	(5.05)	(-.09)	(-1.86)	(-1.03)			
Dominican Rep.	-.42	.15	-1.02	.64	.68	.94	42.1	1.73
	(-.09)	(1.96)	(-.26)	(.45)	(2.28)			
El-Salvador	2.33	-.10	-1.75	1.00	1.03	.98	144.7	2.70
	(1.90)	(-1.27)	(-1.38)	(2.19)	(4.49)			
Guatemala	6.18	.17	-8.66	-.73	.85	.91	25.9	2.17
	(1.88)	(.95)	(-1.64)	(-.96)	(1.86)			
Honduras	-.86	.23	.23	.95	.37	.89	21.4	1.52
	(-1.33)	(.91)	(.26)	(.60)	(.48)			
Panama	2.99	.24	-3.52	-.40	1.65	.95	43.2	1.06
	(.53)	(1.78)	(-.63)	(-1.66)	(1.39)			
Morocco	.04	.07	.04	.42	.65	.97	73.6	2.10
	(.01)	(2.33)	(.01)	(1.92)	(7.62)			
Tunisia	-1.40	.14	1.14	-.30	.72	.98	136.8	2.32
	(-.92)	(2.58)	(1.19)	(-1.31)	(9.45)			

Table 8.4. OLS estimated income, price, foreign exchange reserves and export earnings elasticities under a double-log form and equilibrium condition [$\log M_t = B_0' + B_1' \log (Y/PD)_t + B_2' \log (PM/PD)_t + B_3' \log (FER/PM)_t + B_4' \log (X/PM)_t + b_t'$]

Country	Constant (B_0')	Elasticities				R^2	F-ratio	D.W.
		Income (B_1')	Prices (B_2')	Foreign exchange (B_3')	Exports (B_4')			
Iran	-1.23	1.34	-3.24	-.00	-.24	.95	51.8	1.25
	(-3.53)	(4.05)	(-1.96)	(-.05)	(-.73)			
Philippines	-1.39	1.09	.47	-.05	.45	.89	19.7	1.62
	(-2.30)	(4.11)	(.86)	(-.93)	(1.23)			
Korea (Rep. of)	.92	-.20	-.27	.47	.58	.96	61.3	1.43
	(1.40)	(-.54)	(-.56)	(2.23)	(2.49)			
Pakistan	.70	-.08	.38	-.14	.62	.55	3.1	1.65
	(1.43)	(-.32)	(.97)	(-1.40)	(2.13)			
Thailand	-.36	.53	-.75	.32	.24	.98	129.5	2.25
	(-2.57)	(3.32)	(-2.49)	(2.58)	(1.86)			
Colombia	-1.42	1.49	-.05	-.08	-.58	.91	26.8	2.21
	(-3.29)	(4.08)	(-.10)	(-.88)	(-1.44)			
Dominican Rep.	-1.47	1.58	-1.10	.02	.10	.93	33.7	2.26
	(-2.99)	(3.34)	(-.78)	(.15)	(.24)			
El-Salvador	.21	-.11	-.70	.08	.84	.98	105.1	2.00
	(.72)	(-.28)	(-1.39)	(1.99)	(2.73)			
Guatemala	-1.06	.98	-2.35	-.03	.51	.94	37.5	2.50
	(-1.06)	(1.18)	(-1.79)	(-.15)	(1.61)			
Honduras	-.51	.88	.01	.10	.44	.93	35.4	1.61
	(-.87)	(.94)	(.02)	(.53)	(.70)			
Panama	-.69	1.22	-2.09	-.02	.07	.98	153.1	1.10
	(-4.01)	(6.53)	(-2.20)	(-.80)	(.49)			
Morocco	-.07	.29	-.07	.07	.60	.93	36.4	2.19
	(-.35)	(1.62)	(-.12)	(2.04)	(4.15)			
Tunisia	-.34	.55	.49	-.06	.54	.94	37.5	2.21
	(-.87)	(1.61)	(1.03)	(-.91)	(3.92)			

Table 8.5. OLS estimated income, price, lagged foreign exchange and lagged export earnings coefficients under a linear and equilibrium condition
$[M_t = C_0 + C_1 (Y/PD)_t + C_2 (PM/PD)_t + C_3 (FER/PM)_{t-1} + C_4 (X/PM)_{t-1} + C_t]$

Country	Constant (C_0)	Coefficients				R^2	F-ratio	D.W.
		Income (C_1)	Prices (C_2)	Foreign exchange (C_3)	Exports (C_4)			
Iran	9.75	.07	-10.37	-1.32	.48	.98	170.2	1.31
	(.69)	(3.49)	(-.76)	(-2.95)	(4.52)			
Philippines	-2.84	.12	.55	-.46	.68	.92	28.6	1.21
	(-.36)	(1.91)	(.14)	(-1.39)	(2.78)			
Korea (Rep. of)	13.57	.05	-10.83	2.32	.89	.98	117.5	2.23
	(1.71)	(1.32)	(-2.22)	(2.39)	(2.88)			
Pakistan	.86	.02	1.01	.50	.66	.29	1.0	1.45
	(.08)	(.88)	(.33)	(.48)	(1.19)			
Thailand	3.17	.05	-4.74	.26	1.26	.96	65.0	2.88
	(.56)	(.84)	(-1.04)	(.98)	(3.21)			
Colombia	2.95	.10	-1.62	.60	-.38	.92	28.2	2.62
	(.57)	(4.55)	(-.32)	(.71)	(-.89)			
Dominican Rep.	2.77	.22	-4.42	.30	.48	.92	28.1	1.89
	(.56)	(3.12)	(-1.06)	(.23)	(.92)			
El-Salvador	2.17	-.02	-2.63	-.97	1.62	.98	130.3	1.00
	(1.88)	(-.10)	(-2.37)	(-1.56)	(4.89)			
Guatemala	4.72	.11	-5.96	1.00	.45	.96	70.6	2.41
	(3.26)	(2.18)	(-2.99)	(2.56)	(1.82)			
Honduras	-.76	.19	.19	2.09	.35	.94	37.6	2.19
	(-1.21)	(1.32)	(.45)	(1.71)	(.80)			
Panama	10.12	.58	-10.91	-.03	-1.39	.94	42.6	1.51
	(2.60)	(5.13)	(-2.88)	(-.13)	(-1.36)			
Morocco	-8.58	.08	3.44	.77	1.67	.94	41.2	1.95
	(-1.54)	(1.96)	(.72)	(2.08)	(6.23)			
Tunisia	6.95	.16	-5.58	1.36	-.71	.83	12.1	1.31
	(1.40)	(1.16)	(-1.68)	(1.76)	(-.72)			

Table 8.6. OLS estimated income, price, lagged foreign exchange and lagged export earnings elasticities under a double-log form and equilibrium condition [$\log M_t = C_0' + C_1' \log (Y/PD)_t + C_2' \log (PM/PD)_t + C_3' \log (FER/PM)_{t-1} + C_4' \log (X/PM)_{t-1} + C_t'$]

Country	Constant (C_0')	Elasticities				R^2	F-ratio	D.W.
		Income (C_1')	Prices (C_2')	Foreign exchange (C_3')	Exports (C_4')			
Iran	-.65	.55	-2.23	-.07	.55	.96	59.7	.93
	(-1.75)	(1.55)	(-1.39)	(-.65)	(1.66)			
Philippines	-.66	.71	.02	-.03	.45	.91	26.3	.94
	(-.92)	(1.58)	(.06)	(-.58)	(2.20)			
Korea (Rep. of)	.86	-.11	-.57	.64	.37	.99	541.3	2.00
	(6.87)	(-1.42)	(-3.40)	(8.87)	(9.95)			
Pakistan	.13	.27	.11	.09	.36	.28	1.0	1.37
	(.15)	(.78)	(.25)	(.47)	(1.14)			
Thailand	-.34	.48	-.69	.16	.49	.97	91.1	2.73
	(-1.58)	(1.85)	(-1.61)	(1.18)	(1.82)			
Colombia	-.85	1.03	.26	.00	-.20	.90	22.1	2.63
	(-3.05)	(5.44)	(.46)	(.05)	(-.76)			
Dominican Rep.	-1.77	2.00	-3.08	-.09	-.72	.96	58.5	2.26
	(-6.87)	(8.61)	(-3.46)	(-1.12)	(-2.49)			
El-Salvador	.16	-.06	-1.06	.06	.94	.97	83.3	.91
	(.45)	(-.13)	(-2.44)	(1.07)	(2.54)			
Guatemala	-1.05	1.03	-2.56	.06	.41	.95	49.9	2.17
	(-2.37)	(2.76)	(-3.49)	(.51)	(1.80)			
Honduras	-.30	.76	-.10	.24	.39	.96	57.8	1.83
	(-.82)	(1.34)	(-.38)	(1.56)	(1.07)			
Panama	-.82	1.36	-2.52	-.02	-.04	.98	160.3	1.40
	(-5.56)	(8.80)	(-3.56)	(-.78)	(-.38)			
Morocco	-.52	.41	.13	.12	1.03	.93	32.7	1.67
	(-2.78)	(2.37)	(.20)	(2.72)	(4.13)			
Tunisia	-.87	1.21	-.66	.06	-.09	.84	13.7	1.60
	(-1.69)	(2.70)	(-.76)	(.54)	(-.23)			

Table 8.7. OLS estimated income, price and lagged import coefficients under a linear form and disequilibrium condition--discrete adjustment
$[M_t = \gamma A_0 + \gamma A_1 (Y/PD)_t + \gamma A_2 (PM/PD)_t + (1 - \gamma) M_{t-1} + \gamma a_t]$

Country	Constant (γA_0)	Coefficients		Lagged imports ($1 - \gamma$)	R^2	F-ratio	D.W.
		Income (γA_1)	Prices (γA_2)				
Iran	33.89	.06	-34.30	.55	.98	219.6	2.64
	(2.93)	(4.97)	(-2.97)	(4.76)			
Philippines	-4.69	.10	2.48	.62	.94	54.1	1.45
	(-.97)	(3.20)	(.95)	(3.70)			
Korea (Rep. of)	9.81	.03	-7.30	.99	.98	144.6	2.60
	(2.12)	(.81)	(-2.01)	(6.91)			
Pakistan	6.32	.00	-.56	.44	.41	2.6	1.90
	(1.85)	(-.01)	(-.38)	(2.16)			
Thailand	15.30	.20	-14.28	-.04	.92	45.0	1.68
	(2.55)	(3.29)	(-2.79)	(-.14)			
Colombia	1.81	.13	-.79	-.38	.93	48.3	1.94
	(.56)	(6.51)	(-.22)	(-1.69)			
Dominican Rep.	6.50	.25	-7.55	.00	.91	37.7	1.69
	(2.25)	(2.44)	(-3.09)	(.01)			
El-Salvador	5.23	.09	-5.30	.79	.97	115.5	1.44
	(5.99)	(1.35)	(-6.21)	(3.57)			
Guatemala	5.11	.20	-7.87	.62	.91	37.6	1.99
	(2.26)	(2.83)	(-2.63)	(2.18)			
Honduras	-.37	.17	.09	.56	.91	35.3	1.48
	(-.79)	(1.32)	(.16)	(1.86)			
Panama	6.47	.86	-8.01	-1.17	.93	49.8	1.26
	(1.50)	(1.53)	(-2.08)	(-.77)			
Morocco	6.45	.03	-8.45	1.19	.77	12.6	1.44
	(.75)	(.27)	(-1.06)	(1.66)			
Tunisia	.12	.26	-1.62	.34	.77	12.5	1.53
	(.03)	(1.79)	(-.60)	(.47)			

Table 8.8. OLS estimated income, price and lagged import elasticities under a double-log form and disequilibrium condition--discrete adjustment
$[\log M_t = \gamma A_0' + \gamma A_1' \log (Y/PD)_t + \gamma A_2' \log (PM/PD)_t + (1 - \gamma) \log M_{t-1} + a_t']$

Country	Constant ($\gamma A_0'$)	Elasticities		Lagged imports ($1 - \gamma$)	R^2	F-ratio	D.W.
		Income ($\gamma A_1'$)	Prices ($\gamma A_2'$)				
Iran	-.46	.45	-2.35	.55	.98	225.8	2.32
	(-4.02)	(3.79)	(-4.28)	(4.99)			
Philippines	-.74	.69	.27	.51	.94	55.9	1.65
	(-2.24)	(3.40)	(1.06)	(3.59)			
Korea (Rep. of)	.34	-.16	-1.86	1.00	.97	137.4	2.00
	(1.58)	(-.97)	(-1.26)	(9.49)			
Pakistan	.68	-.01	-.14	.34	.42	2.7	1.77
	(1.32)	(-.02)	(-.71)	(2.16)			
Thailand	-.59	.88	-1.23	.11	.96	95.8	2.25
	(-2.84)	(3.85)	(-3.16)	(.49)			
Colombia	-.98	1.16	.13	-.33	.92	42.1	1.76
	(-4.57)	(7.14)	(.30)	(-1.97)			
Dominican Rep.	-1.92	2.06	-1.45	-.26	.94	59.7	1.99
	(-5.74)	(6.16)	(-2.34)	(-1.48)			
El-Salvador	-.46	.69	-1.59	.46	.96	86.8	1.16
	(-2.03)	(2.37)	(-5.38)	(2.21)			
Guatemala	-1.50	1.39	-2.68	.35	.94	55.0	2.25
	(-3.99)	(4.01)	(-3.32)	(1.67)			
Honduras	-.39	.61	-.06	.58	.94	56.4	1.47
	(-.94)	(1.05)	(-.17)	(1.86)			
Panama	-.94	1.57	-2.38	-.20	.98	213.8	1.21
	(-2.35)	(2.55)	(-3.45)	(-.43)			
Morocco	-.36	.53	-1.70	.44	.80	15.2	1.32
	(-1.07)	(1.56)	(-2.20)	(.98)			
Tunisia	-.93	1.15	-.38	.18	.84	19.9	1.72
	(-2.51)	(2.76)	(-.63)	(.49)			

Table 8.9. OLS estimated income, price, and lagged import coefficients under a linear and disequilibrium condition--continuous adjustment

$$[M_t = D_0 + D_1 [(Y/PD)_{t-1} + (Y/PD)_t] + D_2[(PM/PD)_{t-1} + (PM/PD)_t] + D_3M_{t-1} + d_t]$$

Country	Constant (D_0)	Coefficients		Lagged imports (D_3)	R^2	F-ratio	D.W.
		Income (D_1)	Prices (D_2)				
Iran	41.88	.05	-21.16	.41	.99	268.4	1.99
	(2.82)	(6.54)	(-2.88)	(2.95)			
Philippines	-3.73	.05	.89	.55	.93	48.0	1.18
	(-.47)	(2.27)	(.43)	(2.78)			
Korea (Rep. of)	13.27	.03	-5.20	.88	.98	149.5	2.31
	(2.13)	(1.36)	(-2.11)	(5.47)			
Pakistan	3.30	.01	.14	.38	.44	2.9	2.09
	(.91)	(.83)	(.16)	(1.66)			
Thailand	15.72	.13	-7.39	-.32	.91	38.6	1.30
	(1.73)	(3.17)	(-1.88)	(-.70)			
Colombia	-2.53	.08	2.05	-.62	.91	38.7	2.06
	(-.66)	(5.68)	(.96)	(-2.18)			
Dominican Rep.	7.23	.14	-4.18	-.07	.88	27.2	1.53
	(1.86)	(1.92)	(-2.49)	(-.12)			
El-Salvador	7.46	.09	-3.92	.62	.95	67.6	1.12
	(4.40)	(1.72)	(-4.53)	(1.83)			
Guatemala	11.33	.23	-8.43	-.28	.94	61.6	2.10
	(3.72)	(4.51)	(-4.00)	(-.79)			
Honduras	-.11	.10	-.11	.48	.90	34.5	1.50
	(1.34)	(1.50)	(-.31)	(1.44)			
Panama	4.35	.75	-3.42	-2.81	.94	56.6	1.81
	(.79)	(3.29)	(-1.23)	(-2.31)			
Morocco	10.43	.04	-6.24	.94	.78	13.0	1.41
	(1.00)	(.57)	(-1.26)	(1.17)			
Tunisia	-4.35	.25	.75	-.53	.79	13.6	1.92
	(-1.14)	(2.61)	(.52)	(-.58)			

Table 8.10. OLS estimated income, price and lagged import elasticities under a double-log form and disequilibrium condition--continuous adjustment
$[\log M_t = D'_0 + D'_1 [\log (Y/PD)_{t-1} + \log (Y/PD)_t] + D'_2 [\log (PM/PD)_{t-1} + \log (PM/PD)_t] + D'_3 \log M_{t-1} + d'_t]$

Country	Constant (D'_0)	Elasticities		Lagged imports (D'_3)	R^2	F-ratio	D.W.
		Income (D'_1)	Prices (D'_2)				
Iran	-.64	.33	-1.99	.45	.98	166.7	1.80
	(-4.36)	(4.38)	(-3.22)	(2.92)			
Philippines	-1.09	.46	.23	.44	.93	47.9	1.24
	(-1.63)	(2.38)	(.91)	(2.57)			
Korea (Rep. of)	.15	-.03	.08	1.00	.97	118.3	1.91
	(.60)	(-.35)	(.28)	(7.84)			
Pakistan	.13	.14	-.01	.28	.43	2.8	1.95
	(.21)	(.82)	(-.10)	(1.51)			
Thailand	-.93	.67	-.78	-.31	.96	82.6	1.45
	(-3.22)	(3.68)	(-2.42)	(-.87)			
Colombia	-1.13	.71	.41	-.66	.89	30.0	1.69
	(-3.89)	(5.96)	(1.58)	(-2.77)			
Dominican Rep.	-2.12	1.16	-.85	-.42	.90	32.9	2.08
	(-4.18)	(4.49)	(-1.70)	(-1.54)			
El-Salvador	-.57	.42	-1.09	.39	.93	55.1	1.26
	(-1.94)	(2.15)	(-3.92)	(1.37)			
Guatemala	-2.89	1.35	-2.59	-.33	.95	77.4	1.99
	(-5.01)	(5.11)	(-4.26)	(-1.21)			
Honduras	-.44	.35	-.14	.52	.94	55.5	1.48
	(-1.03)	(1.14)	(-.54)	(1.48)			
Panama	-1.39	1.18	-1.49	-.81	.98	143.5	1.18
	(-2.73)	(2.83)	(-1.88)	(-1.26)			
Morocco	-.48	.33	-1.00	.33	.80	14.9	1.14
	(-1.34)	(1.57)	(-2.17)	(.70)			
Tunisia	-1.59	.95	.09	-.31	.85	20.9	2.02
	(-3.41)	(3.51)	(.28)	(-.67)			

Table 8.11. OLS estimated income, price, foreign exchange, export earnings and lagged import coefficients under a linear and disequilibrium condition--discrete adjustment $[M_t = \gamma F_0 + \gamma F_1 (Y/PD)_t + \gamma F_2 (PM/PD)_t + \gamma F_3 (FER/PM)_{t-1} + \gamma F_4 (X/PM)_{t-1} + (1 - \gamma) M_{t-1} + \gamma f_t]$

Country	Constant (γF_0)	Coefficients				Lagged imports ($1 - \gamma$)	R^2	F-ratio	D.W.
		Income (γF_1)	Prices (γF_2)	Foreign exchange (γF_3)	Exports (γF_4)				
Iran	17.70	.06	-18.82	-.88	.31	.38	.99	240.0	1.85
	(1.62)	(3.52)	(-1.76)	(-2.41)	(3.01)	(2.92)			
Philippines	-3.20	.08	1.41	-.09	.31	.47	.95	31.7	1.51
	(-.47)	(1.30)	(.43)	(-.29)	(1.15)	(2.10)			
Korea (Rep. of)	12.20	.04	-9.46	1.59	.62	.33	.98	89.6	2.32
	(1.46)	(.94)	(-1.77)	(1.12)	(1.23)	(.72)			
Pakistan	3.09	.00	.09	.53	-.04	.55	.44	1.4	2.08
	(.32)	(.15)	(.03)	(.55)	(-.06)	(1.59)			
Thailand	3.73	.07	-5.52	.45	1.36	-.29	.97	51.5	2.75
	(.65)	(1.11)	(-1.19)	(1.35)	(3.32)	(-.93)			
Colombia	6.90	.13	-5.25	1.03	-.21	-.47	.94	28.6	2.06
	(1.35)	(5.35)	(-1.06)	(1.30)	(-.53)	(-1.83)			
Dominican Rep.	1.19	.27	-3.39	.59	.71	-.35	.92	21.2	1.87
	(.21)	(2.47)	(-.74)	(.42)	(1.09)	(-.63)			
El-Salvador	2.60	.04	-3.17	-1.14	1.06	.39	.98	113.1	1.07
	(2.25)	(.32)	(-2.78)	(-1.88)	(2.03)	(1.35)			
Guatemala	4.87	.12	-6.09	1.03	.51	-.09	.97	51.5	2.42
	(3.07)	(2.10)	(-2.87)	(2.46)	(1.62)	(-.32)			
Honduras	-1.05	.15	.55	2.51	-.04	.43	.95	33.4	2.34
	(-1.67)	(1.10)	(1.13)	(2.08)	(-.09)	(1.41)			
Panama	9.94	.61	-10.81	-.04	-1.34	-.11	.94	30.7	1.53
	(1.95)	(.95)	(-2.46)	(-2.46)	(-.95)	(.06)			
Morocco	-7.60	.17	2.07	1.05	1.98	-.72	.95	36.9	2.14
	(-1.43)	(2.32)	(.45)	(2.61)	(5.89)	(-1.43)			
Tunisia	8.88	.02	-7.06	1.64	-1.01	.77	.85	10.2	1.63
	(1.71)	(.08)	(-1.20)	(2.05)	(-.99)	(1.12)			

Table 8.12. OLS estimated income, price, foreign exchange reserves, export earnings and lagged import elasticities under a double-log form and disequilibrium condition--discrete adjustment

$$[\log M_t = \gamma F_0' + \gamma F_1' \log (Y/PD)_t + \gamma F_2' \log (PM/PD)_t + \gamma F_3' \log (FER/PM)_{t-1} + \gamma F_4' \log (X/PM)_{t-1} + (1 - \gamma) \log M_{t-1} + \gamma f_t']$$

Country	Constant ($\gamma F_0'$)	Elasticities: Income ($\gamma F_1'$)	Prices ($\gamma F_2'$)	Foreign exchange ($\gamma F_3'$)	Exports ($\gamma F_4'$)	Lagged imports ($1 - \gamma$)	R^2	F-ratio	D.W.
Iran	-.32	.29	-3.46	.01	.16	.61	.98	118.5	2.13
	(-1.27)	(1.24)	(-3.21)	(.19)	(.69)	(3.89)			
Philippines	-.36	.42	.12	.02	.19	.44	.95	31.3	1.68
	(-.58)	(1.06)	(.40)	(.35)	(.95)	(2.31)			
Korea (Rep. of)	.83	-.17	-.46	.46	.31	.25	.99	584.2	2.33
	(7.56)	(-2.40)	(-2.93)	(4.53)	(7.60)	(2.11)			
Pakistan	.63	.00	-.18	.07	-.12	.45	.45	1.5	1.90
	(.74)	(.00)	(-.41)	(.38)	(-.30)	(1.68)			
Thailand	-.36	.51	-.72	.19	.52	-.08	.97	66.4	2.68
	(-1.54)	(1.77)	(-1.56)	(1.12)	(1.76)	(-.32)			
Colombia	-.90	1.17	-.16	.08	-.08	-.38	.92	22.2	1.67
	(-3.54)	(6.19)	(-.27)	(.76)	(-.33)	(-1.78)			
Dominican Rep.	-1.77	2.00	-3.09	-.09	-.72	.00	.96	42.0	2.27
	(-5.36)	(6.40)	(-2.97)	(-.88)	(-1.92)	(.00)			
El-Salvador	.14	-.04	-1.08	.05	.87	.05	.97	60.2	.92
	(.36)	(-.07)	(-2.26)	(.98)	(1.54)	(.15)			
Guatemala	-1.04	1.04	-2.60	.07	.45	-.07	.95	36.1	2.20
	(-2.23)	(2.63)	(-3.28)	(.53)	(1.46)	(-.21)			
Honduras	-.06	.43	.12	.25	.18	.37	.96	48.8	1.83
	(-.15)	(.69)	(.38)	(1.70)	(.47)	(1.22)			
Panama	-.93	1.54	-2.51	-.02	.00	-.17	.98	115.9	1.49
	(-1.68)	(1.61)	(-3.35)	(-.74)	(-.03)	(-.20)			
Morocco	-.68	.65	.02	.14	1.23	-.44	.94	28.3	1.95
	(-3.10)	(2.60)	(.03)	(3.10)	(4.28)	(-1.29)			
Tunisia	-.62	.91	-.88	.08	-.11	.27	.85	10.4	1.72
	(-.95)	(1.38)	(-.91)	(.68)	(-.29)	(.64)			

Table 8.13. OLS estimated income, price, foreign exchange reserves, export earnings and lagged import coefficients under a linear form and disequilibrium condition--continuous adjustment

$$[M_t = E_0 + E_1 [(Y/PD)_{t-1} + (Y/PD)] + E_2 [(PM/PD)_{t-1} + (PM/PD)_t] + E_3 [(FER/PM)_{t-1} + (FER/PM)_t] + E_4 [(X/PM)_{t-1} + (X/PM)_t] + E_5 M_{t-1} + e_t]$$

Country	Constant (E_0)	Coefficients: Income (E_1)	Prices (E_2)	Foreign exchange (E_3)	Exports (E_4)	Lagged imports (E_5)	R^2	F-ratio	D.W.
Iran	14.76	-.02	-7.51	-.54	.33	.55	.99	409.5	2.10
	(1.26)	(-1.17)	(-1.30)	(-3.50)	(4.02)	(3.78)			
Philippines	-27.35	.10	5.91	-.36	.66	.22	.97	59.8	1.68
	(-3.05)	(2.47)	(2.90)	(-1.83)	(3.57)	(.89)			
Korea (Rep. of)	3.64	-.01	-1.47	1.27	.49	.12	.99	343.5	2.50
	(.69)	(-.18)	(-.91)	(4.45)	(3.14)	(.73)			
Pakistan	-9.39	.01	2.76	.44	.58	.22	.61	2.8	2.24
	(-1.20)	(.84)	(1.75)	(1.06)	(1.73)	(.66)			
Thailand	3.85	.04	-2.55	.36	.42	-.26	.97	70.5	2.23
	(.65)	(1.13)	(-1.00)	(2.84)	(3.96)	(-.84)			
Colombia	-3.13	.09	2.35	-.33	-.12	-.59	.92	20.7	1.83
	(-.41)	(2.77)	(.75)	(-.71)	(-.17)	(-1.74)			
Dominican Rep.	-.54	.11	-.76	.29	.46	-.39	.93	24.2	1.92
	(-.09)	(1.77)	(-.30)	(.26)	(2.23)	(-.72)			
El-Salvador	1.97	-.17	-.41	.96	.96	-.21	.99	272.0	2.19
	(1.72)	(-4.11)	(-.69)	(2.76)	(7.82)	(-1.02)			
Guatemala	8.59	.13	-5.88	.09	.35	-.39	.95	34.7	2.21
	(1.50)	(.92)	(-1.32)	(.20)	(1.06)	(-.74)			
Honduras	-1.56	.13	.30	1.93	-.24	.51	.95	31.2	2.45
	(-1.92)	(.84)	(.71)	(1.63)	(-.44)	(1.63)			
Panama	1.97	.81	-2.28	-.44	1.08	-3.79	.97	58.3	2.32
	(.29)	(3.96)	(-.66)	(-3.03)	(1.82)	(-3.67)			
Morocco	-7.33	.00	3.00	.27	.51	.26	.97	57.4	2.11
	(-1.49)	(.19)	(1.25)	(2.15)	(6.90)	(.74)			
Tunisia	-3.36	.10	1.09	-.32	.64	-.27	.96	50.1	1.96
	(-1.10)	(1.10)	(1.19)	(-1.54)	(6.64)	(-.54)			

Table 8.14. OLS estimated income, price, foreign exchange reserves, export earnings and lagged import elasticities under a double-log form and disequilibrium condition--continuous adjustment

$$[\log M_t = E_0' + E_1'[\log (Y/PD)_{t-1} + \log (Y/PD)_t] + E_2'[\log (PM/PD)_{t-1} + \log (PM/PD)_t] + E_3'[\log (FER/PM)_{t-1} + \log (FER/PM)_t] + E_4'[\log (X/PM)_{t-1} + \log (X/PM)_t] + E_5' \log M_{t-1} + e_t']$$

Country	Constant (E_0')	Elasticities: Income (E_1')	Prices (E_2')	Foreign exchange (E_3')	Exports (E_4')	Lagged imports (E_5')	R^2	F-ratio	D.W.
Iran	-.22	-.04	-1.20	-.07	.36	.54	.98	113.6	2.00
	(-.57)	(-.17)	(-1.62)	(-1.53)	(1.83)	(3.48)			
Philippines	-1.78	.45	.76	.02	.38	.38	.97	70.1	2.05
	(-2.95)	(2.75)	(3.58)	(.76)	(3.21)	(2.18)			
Korea (Rep. of)	.61	-.08	.04	.28	.13	.34	.99	186.2	2.61
	(1.60)	(-.74)	(.23)	(3.04)	(1.94)	(1.84)			
Pakistan	-.39	.09	.67	.07	.59	.03	.70	4.3	2.19
	(-.71)	(.63)	(2.63)	(1.10)	(2.83)	(.15)			
Thailand	-.45	.33	-.42	.18	.20	-.29	.98	83.8	2.04
	(-1.54)	(1.69)	(-1.50)	(2.46)	(1.95)	(-.95)			
Colombia	-1.27	.76	.41	-.01	-.05	-.65	.89	14.9	1.64
	(-2.01)	(2.28)	(1.14)	(-.25)	(-.09)	(-2.18)			
Dominican Rep.	-2.08	1.12	-.62	.00	.09	-.44	.90	16.5	2.13
	(-3.04)	(3.33)	(-.56)	(.03)	(.28)	(-1.23)			
El-Salvador	.95	-.51	-.18	.08	.82	-.21	.99	253.8	2.24
	(4.48)	(-3.62)	(-.85)	(3.82)	(7.01)	(-1.54)			
Guatemala	-2.28	1.05	-2.38	-.03	.32	-.64	.96	47.8	2.21
	(-1.68)	(1.85)	(-2.50)	(-.25)	(1.45)	(-1.83)			
Honduras	.35	-.12	.28	.10	.30	.42	.96	47.4	2.19
	(.47)	(-.19)	(.84)	(.65)	(.65)	(1.37)			
Panama	-1.71	1.61	-.66	-.05	.29	-2.04	.98	121.3	1.89
	(-3.79)	(4.10)	(-.82)	(-2.21)	(2.35)	(-2.76)			
Morocco	-.08	.05	.33	.05	.43	.17	.95	35.5	2.05
	(-.37)	(.33)	(.84)	(2.89)	(3.97)	(.63)			
Tunisia	-.99	.58	.41	-.06	.30	-.18	.91	17.5	2.20
	(-1.05)	(1.16)	(1.13)	(-1.21)	(2.19)	(-.35)			

IX. APPENDIX B. SUPPLEMENTARY TABLES ON TWO-STAGE LEAST-SQUARES ESTIMATION

Table 9.1. 2SLS[a] estimated income and price coefficients under a linear and equilibrium condition

Country	Constant	Coefficients[b]		R^2	F-ratio	D.W.[c]
		Income	Prices			
Iran	28.92	.12	-27.11	.94	99.4	.78
	(1.04)	(14.03)	(-.98)			
Philippines	2.53	.14	-.99	.86	36.1	.78
	(.37)	(3.39)	(-.27)			
Korea (Rep. of)	18.70	.29	-19.22	.83	30.2	1.12
	(1.59)	(7.08)	(-2.27)			
Pakistan	10.13	.02	-1.95	.18	1.3	1.08
	(2.76)	(.72)	(-1.19)			
Thailand	17.69	.19	-16.31	.93	85.4	2.22
	(3.63)	(8.60)	(-4.07)			
Colombia	-3.29	.10	4.25	.91	61.3	2.44
	(-.22)	(2.60)	(.24)			
Dominican Rep.	10.84	.16	-10.70	.92	71.1	1.81
	(3.04)	(2.58)	(-3.80)			
El-Salvador	3.68	.30	-4.12	.96	163.6	1.83
	(3.82)	(9.69)	(-5.49)			
Guatemala	10.80	.39	-15.75	.86	37.5	1.66
	(2.81)	(6.66)	(-3.09)			
Honduras	-.01	.40	-.84	.90	51.3	1.39
	(-.03)	(10.12)	(-1.82)			
Panama	8.28	.42	-8.92	.92	64.9	1.14
	(1.51)	(10.45)	(-1.69)			
Morocco	23.62	.20	-24.32	.80	24.4	1.72
	(5.12)	(3.73)	(-5.54)			
Tunisia	-.82	.33	-.82	.76	19.5	1.62
	(-.19)	(4.61)	(-.26)			

[a] 2SLS = two-stage least-squares in this and all subsequent tables.

[b] The number in parentheses below each coefficient is a t-ratio in this and all subsequent tables.

[c] D.W. = Durbin-Watson D statistics in this and all subsequent tables.

Table 9.2. 2SLS estimated income and price elasticities under a double-log form and equilibrium condition

Country	Constant	Elasticities		R^2	F-ratio	D.W.
		Income	Prices			
Iran	-.88	1.00	-1.58	.93	81.9	.75
	(-5.66)	(12.81)	(-.73)			
Philippines	-.46	.83	-.25	.87	39.5	.78
	(-.71)	(2.38)	(-.48)			
Korea (Rep. of)	-.72	1.15	-3.40	.79	22.2	1.39
	(-1.48)	(4.56)	(-3.79)			
Pakistan	.64	.17	-.28	.17	1.2	1.00
	(1.05)	(.60)	(-1.18)			
Thailand	-.65	.98	-1.50	.96	157.0	2.77
	(-4.94)	(12.80)	(-4.64)			
Colombia	-.62	.82	1.04	.89	48.9	2.65
	(-1.33)	(3.30)	(.66)			
Dominican Rep.	-1.27	1.41	-2.08	.94	90.8	2.22
	(-4.32)	(5.30)	(-2.56)			
El-Salvador	-1.04	1.43	-.36	.94	98.4	1.28
	(-9.99)	(13.17)	(-2.65)			
Guatemala	-2.60	2.33	-3.60	.90	55.1	1.70
	(-5.70)	(7.21)	(-3.41)			
Honduras	-1.14	1.69	-.79	.94	91.3	1.37
	(-11.39)	(13.42)	(-2.83)			
Panama	-.76	1.29	-2.08	.97	233.5	1.16
	(-11.87)	(19.62)	(-2.19)			
Morocco	-.44	.79	-2.80	.87	39.9	1.33
	(-1.90)	(5.03)	(-6.84)			
Tunisia	-1.09	1.36	-.19	.84	30.9	1.82
	(-3.39)	(5.27)	(-.22)			

Table 9.3. 2SLS estimated income, price, foreign exchange reserves and export earnings under a linear form and equilibrium condition

Country	Constant	Coefficients				R^2	F-ratio	D.W.
		Income	Prices	Foreign exchange	Exports			
Iran	23.76	.10	-23.24	-.46	.20	.95	50.8	1.72
	(.74)	(1.85)	(-.72)	(-.85)	(.68)			
Philippines	-8.28	.22	2.21	-.79	.43	.92	27.2	2.04
	(-1.09)	(4.64)	(.61)	(-2.63)	(1.53)			
Korea (Rep. of)	11.20	-.01	-6.71	1.18	1.41	.96	70.5	2.14
	(1.19)	(-.11)	(-1.25)	(1.26)	(2.95)			
Pakistan	7.63	.00	.14	-.79	.70	.52	2.7	1.46
	(1.20)	(-.22)	(.05)	(-1.29)	(1.59)			
Thailand	4.89	.08	-5.67	.58	.46	.97	89.9	2.26
	(.96)	(2.37)	(-1.35)	(2.40)	(3.11)			
Colombia	9.67	.19	-10.46	-.92	-.61	.95	44.0	2.07
	(.70)	(3.75)	(-.64)	(-2.06)	(-1.36)			
Dominican Rep.	1.98	.14	-3.00	.35	.60	.94	42.9	1.74
	(.28)	(2.12)	(-.51)	(.23)	(1.79)			
El-Salvador	3.70	-.02	-3.32	.87	.81	.98	152.4	2.44
	(3.91)	(-.17)	(-4.13)	(1.95)	(2.79)			
Guatemala	6.53	.10	-8.43	-.23	.96	.90	23.5	2.27
	(1.45)	(.57)	(-1.26)	(-.35)	(2.07)			
Honduras	-.30	.49	-.91	1.46	-.37	.90	23.7	1.59
	(-.47)	(1.97)	(-1.03)	(.96)	(-.49)			
Panama	5.51	.21	-5.88	-.47	1.84	.95	47.2	1.13
	(1.03)	(2.25)	(-1.14)	(-2.05)	(2.28)			
Morocco	-.83	.07	.93	.44	.67	.97	74.0	2.14
	(-.21)	(2.14)	(.23)	(1.98)	(6.49)			
Tunisia	-1.96	.15	1.50	-.33	.72	.98	136.3	2.40
	(-.97)	(2.47)	(1.17)	(-1.35)	(9.49)			

Table 9.4. 2SLS estimated price, income, foreign exchange reserves and export earnings elasticities under a double-log form and equilibrium condition

Country	Constant	Elasticities				R^2	F-ratio	D.W.
		Income	Prices	Foreign exchange	Exports			
Iran	-1.25	1.23	-1.81	-.08	-.09	.94	38.5	1.07
	(-2.96)	(3.02)	(-.68)	(-.69)	(-.10)			
Philippines	-.76	.90	-.20	-.06	.18	.88	18.4	1.17
	(-1.01)	(2.40)	(-.33)	(-.98)	(.65)			
Korea (Rep. of)	.57	.02	-.68	.66	.34	.96	65.7	1.44
	(.76)	(.05)	(-1.01)	(2.90)	(1.33)			
Pakistan	.73	-.02	.14	-.16	.45	.52	2.7	1.47
	(1.37)	(-.09)	(.39)	(-1.47)	(1.83)			
Thailand	-.38	.55	-.77	.33	.19	.98	107.5	2.38
	(-2.41)	(2.91)	(-1.87)	(2.34)	(1.24)			
Colombia	-1.32	1.43	.19	-.07	-.55	.91	26.9	2.25
	(-1.97)	(3.21)	(.12)	(-.79)	(-1.57)			
Dominican Rep.	-1.42	1.62	-3.95	-.13	-.43	.94	40.5	2.44
	(-3.53)	(4.14)	(-1.61)	(-.69)	(-.81)			
El-Salvador	-.10	.13	-.19	.00	.97	.96	67.3	1.41
	(-.25)	(.24)	(-1.37)	(.16)	(2.47)			
Guatemala	-.78	.74	-3.11	.12	.56	.94	36.8	2.17
	(-.88)	(1.00)	(-1.73)	(.81)	(1.83)			
Honduras	-1.01	1.65	-.64	.14	-.04	.94	41.3	1.59
	(-2.06)	(2.10)	(-1.25)	(.76)	(-.09)			
Panama	-.55	1.06	-1.44	-.03	.18	.98	120.6	1.23
	(-3.25)	(5.86)	(-1.33)	(-1.09)	(1.38)			
Morocco	-.09	.32	-.26	.07	.55	.94	36.7	2.15
	(-.42)	(1.42)	(-.27)	(2.09)	(2.35)			
Tunisia	-.54	.72	.80	-.07	.52	.94	37.5	2.34
	(-1.12)	(1.76)	(1.03)	(-1.04)	(3.99)			

Table 9.5. 2SLS estimated income, price, lagged foreign exchange reserves and export earnings coefficients under a linear form and equilibrium condition

Country	Constant	Coefficients		Lagged foreign exchange	Lagged exports	R^2	F-ratio	D.W.
		Income	Prices					
Iran	-1.35	.08	.42	-1.51	.49	.98	160.7	1.47
	(-.07)	(3.71)	(.02)	(-3.63)	(4.45)			
Philippines	-9.29	.16	3.63	-.65	.75	.92	30.9	1.54
	(-1.05)	(2.53)	(.87)	(-1.82)	(3.00)			
Korea (Rep. of)	2.69	.04	-4.27	3.59	.57	.97	84.1	2.13
	(.37)	(1.05)	(-.88)	(4.23)	(1.84)			
Pakistan	1.65	.02	.74	.44	.62	.28	1.0	1.43
	(.13)	(.77)	(.20)	(.37)	(1.02)			
Thailand	3.53	.05	-5.04	.27	1.22	.96	63.0	3.09
	(.49)	(.78)	(-.87)	(1.02)	(2.68)			
Colombia	-11.32	.08	15.73	.38	-.51	.92	29.4	2.51
	(-.63)	(1.99)	(.71)	(.61)	(-1.10)			
Dominican Rep.	7.13	.16	-7.71	.00	.36	.93	31.7	1.90
	(1.14)	(2.30)	(-1.55)	(.00)	(.77)			
El-Salvador	3.41	-.02	-3.66	-.54	1.55	.99	228.5	1.19
	(3.32)	(-.26)	(-4.88)	(-1.17)	(4.76)			
Guatemala	2.10	.06	-2.29	1.27	.44	.94	36.8	2.06
	(.54)	(.55)	(-.42)	(2.23)	(1.25)			
Honduras	-.77	.17	.24	2.15	.39	.94	37.5	2.22
	(-1.16)	(1.11)	(.42)	(1.65)	(.87)			
Panama	12.06	.52	-12.58	-.19	-.93	.93	33.9	1.50
	(2.00)	(4.23)	(-2.18)	(-.63)	(-.84)			
Morocco	-11.27	.07	5.88	.74	1.81	.94	42.4	1.76
	(-1.51)	(1.57)	(.90)	(2.29)	(4.91)			
Tunisia	12.36	-.01	-9.28	1.61	-.16	.84	12.9	1.90
	(1.70)	(-.06)	(-1.89)	(1.97)	(-.18)			

Table 9.6. 2SLS estimated income, price, lagged foreign exchange and export earnings under a double-log form and equilibrium condition

Country	Constant	Elasticities		Lagged foreign exchange	Lagged exports	R^2	F-ratio	D.W.
		Income	Prices					
Iran	-.84	.63	-.58	-.15	.57	.95	50.0	1.13
	(-2.21)	(1.66)	(-.27)	(-1.48)	(1.59)			
Philippines	-.75	.75	.09	-.04	.46	.91	26.4	.96
	(-.80)	(1.44)	(.15)	(-.59)	(2.27)			
Korea (Rep. of)	.79	-.08	-.49	.72	.33	.99	349.2	2.30
	(5.05)	(-.88)	(-1.99)	(9.18)	(7.11)			
Pakistan	-.18	.36	.30	.15	.47	.30	1.1	1.50
	(-.17)	(.94)	(.55)	(.69)	(1.30)			
Thailand	-.33	.50	-.78	.19	.42	.97	87.4	3.10
	(-1.50)	(1.75)	(-1.44)	(1.45)	(1.27)			
Colombia	-.30	.81	2.21	.03	-.40	.91	25.3	2.75
	(-.57)	(3.14)	(1.24)	(.35)	(-1.46)			
Dominican Rep.	-1.31	1.57	-4.16	-.12	-.70	.97	80.0	2.44
	(-4.96)	(7.02)	(-4.44)	(-1.66)	(-3.02)			
El-Salvador	-.41	.44	-.35	-.05	1.00	.96	69.0	1.30
	(-1.28)	(.98)	(-3.02)	(-1.24)	(2.50)			
Guatemala	-1.66	1.55	-3.77	.06	.22	.90	23.9	1.77
	(-1.02)	(1.19)	(-1.09)	(.30)	(.52)			
Honduras	-.35	.81	-.14	.23	.36	.96	57.7	1.78
	(-.79)	(1.28)	(-.36)	(1.39)	(.94)			
Panama	-.74	1.26	-2.35	-.03	.02	.98	106.4	1.26
	(-4.03)	(6.68)	(-2.27)	(-.92)	(.12)			
Morocco	-.52	.48	-.33	.10	.86	.93	32.9	1.62
	(-2.74)	(2.04)	(-.28)	(2.72)	(1.86)			
Tunisia	-.60	.97	-1.10	.08	-.01	.84	13.3	1.83
	(-.61)	(1.23)	(-.56)	(.49)	(-.02)			

Table 9.7. 2SLS estimated income, price and lagged import coefficients under a linear form and disequilibrium condition--discrete adjustment

Country	Constant	Coefficients		Lagged imports	R^2	F-ratio	D.W.
		Income	Prices				
Iran	48.48	.05	-49.35	.75	.98	231.3	2.04
	(3.11)	(4.48)	(-3.13)	(5.40)			
Philippines	-10.71	.11	5.71	.75	.95	71.1	1.58
	(-2.11)	(4.28)	(2.10)	(4.77)			
Korea (Rep. of)	6.48	.01	-4.47	1.07	.97	115.0	2.51
	(1.16)	(.33)	(-1.02)	(6.92)			
Pakistan	7.20	.00	-1.06	.43	.43	2.8	1.84
	(2.09)	(-.09)	(-.72)	(2.23)			
Thailand	19.44	.21	-17.92	-.14	.93	53.3	2.26
	(3.09)	(3.72)	(-3.32)	(-.46)			
Colombia	-6.45	.11	9.13	-.38	.93	49.6	2.02
	(-.47)	(3.17)	(.56)	(-1.80)			
Dominican Rep.	11.30	.20	-11.23	-.19	.92	44.3	1.78
	(2.96)	(2.02)	(-3.58)	(-.45)			
El-Salvador	4.26	.12	-4.40	.65	.98	239.6	1.97
	(6.32)	(2.46)	(-8.52)	(3.85)			
Guatemala	6.99	.24	-10.47	.56	.89	29.1	1.89
	(1.62)	(2.18)	(-1.80)	(1.60)			
Honduras	-.13	.23	-.31	.41	.91	36.1	1.48
	(-.27)	(1.61)	(-.49)	(1.22)			
Panama	6.45	.91	-8.03	-1.34	.92	42.3	1.35
	(1.07)	(1.51)	(-1.47)	(-.81)			
Morocco	15.33	.09	-16.74	.72	.82	17.1	1.71
	(1.80)	(.89)	(-2.13)	(1.15)			
Tunisia	-.68	.28	-.99	.27	.77	12.1	1.66
	(-.15)	(1.92)	(-.30)	(.38)			

Table 9.8. 2SLS estimated income, price and lagged import elasticities under a double-log form and disequilibrium condition--discrete adjustment

Country	Constant	Elasticities		Lagged imports	R^2	F-ratio	D.W.
		Income	Prices				
Iran	-.27	.19	-6.08	.95	.99	316.3	2.00
	(-2.60)	(1.65)	(-5.47)	(7.38)			
Philippines	-1.25	.88	.79	.65	.95	66.9	1.94
	(-2.67)	(3.84)	(1.84)	(4.11)			
Korea (Rep. of)	.35	-.18	-.07	1.07	.97	136.4	2.04
	(1.61)	(-1.01)	(-.15)	(8.86)			
Pakistan	.72	-.03	-.16	.34	.43	2.7	1.76
	(1.37)	(-.10)	(-.76)	(2.24)			
Thailand	-.60	.90	-1.40	.08	.96	97.1	2.80
	(-2.87)	(3.91)	(-3.20)	(.35)			
Colombia	-.54	.96	1.78	-.38	.93	48.9	1.68
	(-1.40)	(4.47)	(1.33)	(-2.49)			
Dominican Rep.	-1.65	1.83	-2.29	-.31	.95	75.5	1.77
	(-4.99)	(5.66)	(-3.10)	(-1.93)			
El-Salvador	-.73	1.00	-.37	.35	.95	75.5	1.43
	(-3.43)	(3.54)	(-2.96)	(1.63)			
Guatemala	-2.17	1.94	-4.61	.19	.90	34.6	1.76
	(-2.33)	(2.43)	(-1.85)	(.54)			
Honduras	-.68	1.04	-.43	.36	.94	61.3	1.43
	(-1.48)	(1.59)	(-.96)	(1.01)			
Panama	-.87	1.47	-2.10	-.13	.97	143.4	1.18
	(-1.82)	(1.97)	(-2.12)	(-.23)			
Morocco	-.36	.63	-2.45	.23	.87	25.5	1.35
	(-1.39)	(2.12)	(-3.68)	(.68)			
Tunisia	-1.00	1.23	-.21	.14	.84	19.2	1.87
	(-2.47)	(2.86)	(-.24)	(.39)			

Table 9.9. 2SLS estimated price, income and lagged import coefficients under a linear form and disequilibrium condition--continuous adjustment

Country	Constant	Coefficients		Lagged imports	R^2	F-ratio	D.W.
		Income	Prices				
Iran	36.25	.04	-18.55	.53	.98	200.1	1.91
	(1.82)	(5.22)	(-1.86)	(3.42)			
Philippines	-9.31	.06	2.35	.63	.94	55.3	1.12
	(-1.36)	(3.24)	(1.32)	(3.30)			
Korea (Rep. of)	9.61	.02	-3.70	.99	.97	125.6	2.45
	(1.46)	(.86)	(-1.43)	(6.42)			
Pakistan	4.45	.01	-.23	.34	.45	2.9	2.06
	(1.20)	(.85)	(-.27)	(1.60)			
Thailand	26.81	.15	-12.24	-.65	.94	59.9	1.72
	(3.13)	(4.47)	(-3.31)	(-1.68)			
Colombia	-6.34	.08	4.36	-.66	.90	35.8	1.93
	(-2.16)	(2.55)	(.35)	(-2.28)			
Dominican Rep.	15.45	.16	-7.79	-.74	.91	37.5	1.66
	(2.99)	(2.47)	(-3.46)	(-1.27)			
El-Salvador	6.37	.12	-3.42	.33	.98	165.1	1.69
	(6.68)	(3.57)	(-8.15)	(1.42)			
Guatemala	10.05	.16	-7.40	.39	.90	33.0	1.54
	(1.89)	(2.54)	(-2.05)	(1.09)			
Honduras	.15	.13	-.31	.32	.91	35.9	1.44
	(.21)	(1.61)	(-.69)	(.80)			
Panama	-4.39	.63	1.03	-2.18	.93	49.6	2.21
	(-.57)	(2.85)	(.28)	(-1.84)			
Morocco	21.44	.07	-11.59	.53	.86	21.8	1.58
	(2.53)	(1.38)	(-2.87)	(.95)			
Tunisia	-3.58	.24	.45	-.45	.78	13.3	1.85
	(-.74)	(2.56)	(.25)	(-.49)			

Table 9.10. 2SLS estimated income, price and lagged import elasticities under a double-log form and disequilibrium condition--continuous adjustment

Country	Constant	Elasticities		Lagged imports	R^2	F-ratio	D.W.
		Income	Prices				
Iran	-.47	.22	-2.56	.70	.98	157.7	1.87
	(-3.10)	(2.78)	(-3.04)	(4.33)			
Philippines	-1.42	.52	.38	.52	.93	51.7	1.16
	(-1.96)	(2.76)	(1.30)	(2.90)			
Korea (Rep. of)	.14	-.02	.02	1.02	.97	117.4	1.87
	(.57)	(-.23)	(.06)	(7.26)			
Pakistan	.16	.14	-.04	.27	.43	2.8	1.94
	(.25)	(.80)	(-.28)	(1.48)			
Thailand	-.95	.71	-1.09	-.45	.97	124.0	2.03
	(-4.12)	(4.96)	(-3.74)	(-1.58)			
Colombia	-.83	.64	1.05	-.70	.88	26.2	1.54
	(-1.39)	(3.52)	(.98)	(-2.82)			
Dominican Rep.	-2.04	1.14	-1.41	-.58	.91	38.1	1.85
	(-4.25)	(4.72)	(-2.20)	(-2.14)			
El-Salvador	-1.05	.72	-.37	.07	.94	59.1	1.54
	(-3.48)	(3.55)	(-3.26)	(.23)			
Guatemala	-1.98	.89	-2.01	.28	.89	30.2	1.34
	(-1.50)	(1.62)	(-1.09)	(.69)			
Honduras	-.61	.47	-.25	.38	.94	57.1	1.36
	(-1.17)	(1.26)	(-.77)	(.88)			
Panama	-.86	.73	-.22	-.10	.97	108.1	1.65
	(-1.69)	(1.77)	(-.22)	(-.16)			
Morocco	-.46	.33	-1.41	.30	.87	24.7	1.12
	(-1.68)	(2.18)	(-3.59)	(.91)			
Tunisia	-1.53	.93	.00	-.29	.85	20.7	1.98
	(-3.28)	(3.51)	(.01)	(-.64)			

Table 9.11. 2SLS estimated income, price, lagged foreign exchange reserves, export earnings and lagged import coefficients under a linear form and disequilibrium condition--discrete adjustment

Country	Constant	Coefficients		Lagged foreign exchange	Lagged exports	Lagged imports	R^2	F-ratio	D.W.
		Income	Prices						
Iran	21.58	.06	-23.06	-.97	.27	.44	.99	222.6	1.47
	(1.39)	(3.72)	(-1.50)	(-2.63)	(2.37)	(2.86)			
Philippines	-13.36	.13	6.39	-.31	.36	.57	.96	44.6	2.02
	(-1.95)	(2.61)	(1.93)	(-1.08)	(1.54)	(2.89)			
Korea (Rep. of)	2.31	.03	-3.10	2.14	.17	.55	.97	69.0	2.27
	(.32)	(.62)	(-.63)	(1.37)	(.36)	(1.10)			
Pakistan	12.18	-.02	-2.85	-.16	-.61	.70	.48	1.6	2.12
	(.97)	(-.45)	(-.74)	(.14)	(-.70)	(1.82)			
Thailand	4.90	.07	-6.51	.47	1.30	-.31	.96	50.3	2.95
	(.67)	(1.10)	(-1.09)	(1.40)	(2.79)	(-.97)			
Colombia	-3.17	.12	12.96	1.48	.77	-.58	.95	34.8	2.23
	(-1.11)	(2.91)	(.61)	(1.58)	(.99)	(-1.61)			
Dominican Rep.	6.02	.23	-7.16	.32	.55	-.40	.93	24.7	1.80
	(.93)	(2.15)	(-1.40)	(.24)	(1.05)	(-.83)			
El-Salvador	3.31	.02	-3.61	-.62	.97	.35	.99	220.0	1.44
	(3.52)	(.22)	(-5.28)	(-1.47)	(2.44)	(1.73)			
Guatemala	2.04	.06	-2.25	1.26	.41	.04	.94	26.5	2.09
	(.50)	(.51)	(-.39)	(2.06)	(.95)	(.10)			
Honduras	-1.22	.08	.84	2.88	.04	.48	.95	34.6	2.55
	(-1.77)	(.54)	(1.27)	(2.20)	(.08)	(1.54)			
Panama	10.51	.85	-11.69	-.27	-.51	-1.02	.93	25.1	1.66
	(1.50)	(1.23)	(-1.86)	(-.76)	(-.36)	(-.49)			
Morocco	-11.80	.16	5.76	1.11	2.20	-.76	.96	39.8	2.08
	(-1.70)	(2.29)	(.95)	(2.94)	(5.25)	(-1.61)			
Tunisia	13.81	-.13	-10.40	1.78	-.27	.58	.85	10.3	2.00
	(1.83)	(-.56)	(-2.03)	(2.11)	(-.29)	(.89)			

Table 9.12. 2SLS estimated price, income, lagged foreign exchange reserves, lagged export earnings and lagged import elasticities under a double-log form and disequilibrium condition--discrete adjustment

Country	Constant	Elasticities		Lagged foreign exchange	Lagged exports	R^2	F-ratio		D.W.
		Income	Prices						
Iran	-.25	.17	-6.08	.00	.01	.96	.99	155.5	1.99
	(-1.11)	(.78)	(-4.03)	(.08)	(.06)	(5.33)			
Philippines	-1.06	.73	.69	.00	.20	.55	.95	37.9	2.11
	(-1.47)	(1.85)	(1.41)	(.00)	(1.11)	(2.86)			
Korea (Rep. of)	.78	-.18	-.30	.51	.28	.29	.99	345.6	2.38
	(5.48)	(-1.76)	(-1.18)	(3.78)	(5.50)	(1.83)			
Pakistan	1.05	-.16	-.42	.00	-.32	.54	.47	1.6	1.96
	(.87)	(-.33)	(-.63)	(.00)	(-.56)	(1.68)			
Thailand	-.36	.56	-.88	.23	.43	-.12	.97	64.4	3.01
	(-1.51)	(1.72)	(-1.46)	(1.41)	(1.25)	(-.46)			
Colombia	-.54	1.45	2.28	.15	.25	-.56	.95	39.0	1.87
	(-4.58)	(6.13)	(1.47)	(1.72)	(.71)	(-2.68)			
Dominican Rep.	-1.40	1.67	-4.01	-.09	-.62	-.10	.97	59.7	2.21
	(-4.38)	(5.71)	(-4.00)	(-1.03)	(-2.28)	(-.56)			
El-Salvador	-.46	.50	-.35	-.06	.82	.13	.96	50.7	1.45
	(-1.29)	(1.02)	(-2.92)	(-1.25)	(1.33)	(.41)			
Guatemala	-1.63	1.52	-3.65	.05	.16	.10	.91	17.3	1.78
	(-.95)	(1.10)	(-.99)	(.23)	(.33)	(.22)			
Honduras	.10	.23	.28	.29	.22	.42	.97	49.8	1.92
	(.18)	(.30)	(.58)	(1.74)	(.57)	(1.31)			
Panama	-1.13	1.96	-2.42	-.04	.14	-.66	.98	79.9	1.40
	(-1.70)	(1.71)	(-2.25)	(-1.08)	(.58)	(-.62)			
Morocco	-.68	.65	.00	.14	1.22	-.44	.94	28.3	1.94
	(-3.04)	(2.46)	(.00)	(3.03)	(2.30)	(-1.28)			
Tunisia	-.32	.66	-1.41	.10	-.01	.22	.85	9.9	1.93
	(-.27)	(.65)	(-.66)	(.59)	(-.03)	(.52)			

Table 9.13. 2SLS estimated income, price, lagged foreign exchange reserves, lagged export earnings and lagged import coefficients under a linear form and disequilibrium condition--continuous adjustment

Country	Constant	Coefficients				Lagged imports	R^2	F-ratio	D.W.
		Income	Prices	Foreign exchange	Exports				
Iran	18.98	-.03	-9.60	-.54	.33	.66	.99	423.3	1.98
	(1.40)	(-2.03)	(-1.43)	(-3.52)	(4.49)	(4.18)			
Philippines	-25.99	.10	5.56	-.36	.59	.28	.98	100.6	1.43
	(-4.65)	(3.34)	(4.46)	(-2.43)	(4.76)	(1.44)			
Korea (Rep. of)	4.41	-.01	-1.62	1.27	.54	.09	.99	354.2	2.59
	(.83)	(-.46)	(-1.06)	(4.82)	(3.24)	(.58)			
Pakistan	-12.80	.02	3.46	.54	.74	.03	.56	2.3	2.34
	(-1.06)	(1.21)	(1.36)	(1.06)	(1.48)	(.09)			
Thailand	6.64	.05	-3.74	.32	.38	-.29	.97	70.8	2.34
	(.78)	(1.20)	(-1.03)	(2.28)	(3.11)	(-.89)			
Colombia	-6.65	-.01	-.85	-.56	2.01	-.54	.92	19.4	1.65
	(-2.21)	(-.17)	(-.06)	(-.76)	(1.94)	(-1.60)			
Dominican Rep.	8.92	.14	-4.90	-.44	.27	-.62	.93	25.7	1.88
	(.62)	(1.93)	(-.78)	(-.30)	(.83)	(-1.08)			
El-Salvador	5.96	-.08	-2.69	.56	.70	-.05	.99	326.4	2.45
	(5.99)	(-1.80)	(-6.37)	(2.02)	(5.15)	(-.29)			
Guatemala	-2.84	-.11	2.93	.79	.50	.13	.94	29.8	2.64
	(-.40)	(.92)	(.56)	(1.70)	(1.44)	(.30)			
Honduras	-1.37	.18	.11	2.06	-.37	.50	.94	29.6	2.37
	(-1.54)	(.79)	(.16)	(1.59)	(-.56)	(1.38)			
Panama	3.88	.76	-3.13	-.52	1.38	-3.75	.97	60.7	2.44
	(.55)	(4.57)	(-.90)	(-3.08)	(3.25)	(-3.88)			
Morocco	-8.51	.02	3.60	.31	.54	.09	.97	54.9	1.95
	(-1.23)	(.55)	(1.06)	(2.29)	(5.45)	(.30)			
Tunisia	-5.97	.12	1.97	-.43	.68	-.19	.97	53.8	2.08
	(-1.41)	(1.32)	(1.47)	(-1.79)	(6.79)	(-.42)			

Table 9.14. 2SLS estimated price, income, lagged foreign exchange reserves, lagged export earnings and lagged import elasticities under a double-log form and disequilibrium condition--continuous adjustment

Country	Constant	Elasticities				Lagged imports	R^2	F-ratio	D.W.
		Income	Prices	Foreign exchange	Exports				
Iran	.54	-.12	-2.62	-.02	.00	.71	.98	116.2	2.03
	(1.06)	(-.68)	(-3.13)	(-1.70)	(1.82)	(3.90)			
Philippines	-2.18	.70	.79	-.01	.02	.24	.98	81.9	1.59
	(-4.15)	(4.35)	(3.60)	(-2.48)	(4.32)	(1.31)			
Korea (Rep. of)	-.19	.09	.11	.04	.00	.71	.98	77.7	1.82
	(-.47)	(.67)	(.32)	(1.73)	(-1.06)	(2.83)			
Pakistan	-.63	.22	.57	.02	.04	.12	.61	2.8	2.40
	(-.83)	(1.34)	(1.75)	(1.20)	(1.98)	(.52)			
Thailand	-.46	.45	-.39	.02	.00	-.41	.98	100.3	2.43
	(-1.23)	(2.02)	(-.83)	(2.36)	(.94)	(-1.30)			
Colombia	-1.42	.90	1.39	.02	-.04	-.57	.90	15.1	1.42
	(-1.53)	(2.69)	(1.21)	(.61)	(-1.17)	(-1.99)			
Dominican Rep.	-1.97	1.58	-6.71	-.53	-.12	-.91	.96	43.3	2.12
	(-5.49)	(7.00)	(-3.81)	(-3.17)	(-2.92)	(-3.87)			
El-Salvador	.46	-.44	-.09	.20	.14	-.06	.97	66.7	2.12
	(.61)	(-.78)	(-.67)	(1.11)	(2.35)	(-.20)			
Guatemala	1.55	-.66	1.64	.01	.09	.23	.93	24.1	2.34
	(.79)	(-.77)	(.70)	(.19)	(1.46)	(.53)			
Honduras	-1.21	.96	-.09	.55	-.14	.40	.96	48.2	2.21
	(-1.27)	(1.13)	(-.20)	(2.16)	(-.94)	(1.00)			
Panama	-.98	.74	-.26	-.04	.25	-.92	.99	173.9	1.72
	(-3.10)	(2.87)	(-.37)	(-2.98)	(4.39)	(-2.12)			
Morocco	-.11	.18	.32	.03	.02	.12	.96	41.3	1.94
	(-.43)	(1.39)	(.58)	(3.16)	(3.02)	(.53)			
Tunisia	-1.34	.76	.51	-.04	.05	-.24	.95	31.8	2.13
	(-1.75)	(1.99)	(1.01)	(-1.43)	(3.79)	(-.70)			

X. APPENDIX C: TITLE OF IMPORT DEMAND[1]

The Box-Cox procedure involves the specification of a general power function that contains both the linear and log-linear specifications as special cases. The power function would be in the case of import demand:[2]

$$\left[\frac{M_t^{\lambda} - 1}{\lambda}\right] = a_0 + a_1 \left[\frac{P_t^{\lambda} - 1}{\lambda}\right] + a_2 \left[\frac{Y_t^{\lambda} - 1}{\lambda}\right] + e_t \qquad (1)$$

For $\lambda = 1$, equation (1) becomes identical to the linear equation (3.37). For $\lambda = 0$, it becomes identical to the log-linear equation (3.38).[3] Equation (1) can be rewritten for notation l convenience as:

$$M_t(\lambda) = a_0 + a_1 P_t(\lambda) + a_2 Y_t(\lambda) + e_t \qquad (2)$$

Assuming that the errors, e_t, are normal, the values of the parameters

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[1] For details, see Khan and Ross [56, pp. 12-13].

[2] Assume that demand is equal to the actual volume of imports.

[3] It may appear that $\lambda = 0$ the expressions involving λ become indeterminate. However expanding, say the dependent variable, we obtain:

$$\frac{M_t^{\lambda} - 1}{\lambda} = \frac{1}{\lambda}\left[1 + \lambda \log M_t + \frac{1}{2!}(\lambda \log M_t)^2 + \ldots - 1\right] \qquad (1a)$$

$$= \log M_t + \frac{\lambda}{2!}(\log M_t)^2 + \ldots$$

For $\lambda = 0$

$$\frac{M_t^{\lambda} - 1}{\lambda} = \log M_t$$

can be obtained by maximum-likelihood methods.[1] The log of the likelihood function of (2) is:

$$L = (\lambda - 1) \sum_{t}^{T} \log M_t - \frac{T}{2} \log (2\pi) - \frac{T}{2} \log \sigma^2 \qquad (3)$$

$$- \frac{1}{2\sigma^2} \sum_{t}^{T} [M_t (\lambda) - a_0 - a_1 P_t(\lambda) - a_2 Y_t (\lambda)]^2$$

The liklihood function (3) is maximized with respect to the parameters, a_0, a_1, a_2, σ^2 and λ. For a given λ, equation (3) is simply the likelihood function of a standard least squares equation.[2] Therefore, the maximum-likelihood value of σ^2 is simply the estimate of the variance of the disturbances obtained in a regression of the dependent variable on the independent variables. This maximum-likelihood value can be defined as $\hat{\sigma}^2 (\lambda)$.

Replacing $\hat{\sigma}^2 (\lambda)$ in the logarithm of the likelihood function, the maximum log-likelihood, $L_{max} (\lambda)$, is:

$$L_{max} (\lambda) = - \frac{T}{2} \log \hat{\sigma}^2 (\lambda) + (\lambda - 1) \sum_{t}^{T} \log M_t \qquad (4)$$

The various values of $L_{max} (\lambda)$ can be plotted for different values of λ to determine the particular λ which leads to a maximum of $L_{max} (\lambda)$ over the parameter space.

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[1] We know that $\frac{de_t}{dM_t} = M_t^{\lambda-1}$ from (1).

[2] Except for a constant factor.

Box and Cox also show how an approximate confidence region for can be constructed:

$$L_{max}(\lambda) - L_{max}(\lambda) \quad \frac{1}{2}\chi_1^2(k) \tag{5}$$

where k is the percentage level of confidence.

This maximum-likelihood test has been described in the context of an equilibrium import demand equation but can of course be easily generalized to the case of the disequilibrium import demand equations that we have discussed above. The general disequilibrium function is:[1]

$$M_t(\lambda) = \psi a_0 + \psi a_1 P_t(\lambda) + \psi a_2 Y_t(\lambda) + (1 - \psi) M_{t-1}(\lambda) + \psi e_t \tag{6}$$

and exactly the same procedure as shown for the equilibrium case is applicable here as well.

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[1] If ψ is the coefficient of adjustment.

XI. APPENDIX D. SOME REMARKS ON THE APPLIED INDEX NUMBERS

Faced with an absence of adequate data for measure changes in prices, one generally turns to the closest available approximation; namely, the consumer price index, the domestic wholesale price index, and implicit price indices from national accounts in the domestic economy; and export and import unit value indices in international trade. Although there are many suggestions for selecting appropriate measurement of price indices for developed countries, those closest available approximations are still used by these countries; so in developing countries but with a lower degree of accuracy due to the nature of data in these countries.[1] In spite of all these problems and in order to prevent any further bias in calculating new indexes, the available approximations of indexes have been used in this study.

The purpose of introducing an index number, in general, is to reduce a large set of data describing a complex economic event into a single number that somehow captures the essential features of that event [69, p. 41]. Thus, the problem of how to construct

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[1]There is a wide variety of index numbers. In fact, measurement, calculating price indices are the subject matter of an entirely different title. However, for details see Allen [3], and Kravis and Lipsey [63]. Although this discussion mainly refers to price index numbers, it is to be remembered that practically everthing noted here applies to the parallel as matching case of quantity index numbers.

an index number is as much one of economic theory as of statistical technique.

Trade statistics are recorded only by quantity and value, providing background for the use of unit values as substitutes for prices. It is the official index which shows the average price of the aggregate imported commodities. Each index represents a change in price between the period to which the number referred, called the current, and a fixed period, respectively, in which the index is represented by the percentage 100.

$\frac{\Sigma\ p_n\ q_0}{\Sigma\ p_0\ q_n}$ -- Index with fixed weights (Laspeyre formula)

$\frac{\Sigma\ p_n\ q_n}{\Sigma\ p_0\ q_n}$ -- Index with current weights (Paasche formula)

The period denoted by the subscript 0 is here referred to as the base period, and that by the subscript n as the current period. The price term using base year weights (fixed weights) is a Laspeyres price index which has been used throughout this study. It represents not only price movements but also changes in the mix of trade quantity.