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Analysis of Egyptian commodity imports during the trade liberalization period

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ANALYSIS OF EGYPTIAN
COMMODITY IMPORTS
DURING THE TRADE
LIBERALIZATION PERIOD
"AN ERROR CORRECTION
FORMULATION"

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The American University in Cairo
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ANALYSIS OF EGYPTIAN COMMODITY IMPORTS DURING THE TRADE LIBERALIZATION PERIOD 'AN ERROR CORRECTION FORMULATION'

A Thesis Submitted to

Economics Department

in partial fulfillment of the requirements for

the degree of Mater of Arts

by

Amira Abd El-Rahim Sheha
Bachelor of Arts in Economics

under the supervision of
Dr. William Mikhail

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A DEDICATION TO.....

MY PARENTS

"THE ONES I LOVE MOST IN THIS WORLD"

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ABSTRACT

Given the crucial role of imports in the economy and the continuing trade deficit which all devaluation episodes so far have failed to reduce significantly, the foreign trade sector is faced with a structural imbalance problem that remains to be resolved. All currency devaluation episodes were stimulated by the rising trade deficit, with insufficient foreign exchange reserves to cover it, but despite these successive devaluations commodity imports continued to rise.

In this research we re-examine the response of imports to devaluation starting from the 1974 "Open Door" policy and until the most recent liberalization package, ERSAP I and II. By what degree, if any, do commodity imports respond to real exchange-rate changes, and what other factors influence this important macro variable? We approach these questions using recently founded econometric techniques, keeping in mind the traditional methodology. In the light of previous empirical studies performed on Egypt, we attempt to closely examine the behavior of the demand relation for aggregate commodity imports and imports of capital commodities.

We apply modern econometric techniques to find a cointegrating relation between import flows and their major determinants and, then, incorporate an error-correction mechanism into the relation. These techniques are known as the Engle-Granger method and the Johansen maximum likelihood procedure to cointegration. This permits us to model the short-run disequilibrium behavior of import demand, in addition to the long-run equilibrium relation. Our research is guided by a selection of recent empirical studies which have emerged in the late eighties and the

early nineties, where they were used to model trade flows in general and import flows in particular, in both developing and developed economies. To our knowledge this recently founded approach has not been applied before to the Egyptian economy nor has it been applied at a disaggregregated level.

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OVERVIEW OF THE EGYPTIAN FOREIGN TRADE SECTOR WITH EMPHASIS ON IMPORT RELATED DEVELOPMENTS FOR THE PERIOD 1970-1995

The Increasing Importance of Imports in the Economy

The importance of imports is derived from its relative structure. Almost a half of the economy's commodity imports consists of intermediate goods, reflecting the high import content of inputs to domestic production. Consumer and capital commodities interchange second and third places, with shares fluctuating around one fifth of total commodity imports. With respect to consumer imports, from 75-86% are non-durable commodities, mainly food products. These two groups are equally important to maintain standards of living and ensure food security. Raw materials and fuel, respectively, come last in shares and in importance.

Import rationing becomes a difficult task when imports play a crucial role in the economy. On can hardly argue that imports should be sharply reduced at the cost of lower standards of living, idle capacity and curtailed investment. This creates a dilemma for policy makers who are concerned with reducing the trade deficit and, simultaneously, avoiding the above costs. Keeping this in mind, imports are usually rationed through curtailing imports of luxury items or non-essentials on one hand, and encouraging import substitution industries on the other. This explains the bias of foreign trade policy in favor of import substitution and against export promotion. The current liberalization packages which attempt to reduce this bias have and will cause the economy to be even more dependent on imports since many of the existing import substitution industries were previously protected and will not survive against the international competition. Even export promotion increases the dependence on imports given the high import content of inputs to many export industries. In addition, uniforming tariff rates and steadily eliminating non-tariff barriers will add more import categories which could not be imported before . The only aspect of trade liberalization which could be in favor of a reduction in imports is the unification-cum-devaluation of the exchange-rate which increases the cost of importing in domestic currency.

We start our review with 1970 as it represents a political turning point as President Sadat took office. The new president brought with him new ideas which were directed towards the external sector in particular. The external sector was seen as an area of opportunity for liberalizing the economy and accelerating economic growth, and so it became the center of attention. But liberalization was not possible before the war years were over. Until 1973, there was a continuance in the centralized foreign trade regime of the previous decade with all its regulatory instruments, such as the foreign exchange budget and import quotas and tariffs. This pre-liberalization period witnessed both a negative service account and a rising trade deficit. One important reason behind the rising deficit was the overvalued exchange-rate discouraging exports and encouraging imports. Another reason was that much of the public sectors' external trade was carried out by publicly owned foreign trade companies that could only maximize profits by maximizing their imports. Also, as odd as it seems, centralized control over the external sector did not involve any planning, meaning that the State brought in consumer goods but did not monopolize their supply or set their optimum value. As a result, the supply of imported luxury goods and kits for local assembly increased dramatically from 1970 onwards until they were curtailed by foreign exchange shortages. This demonstrated the use of imports to deal with short-term political and economic problems since domestic industry was not capable of producing such goods from scratch. Before moving on we should mention that in 1973 there was a break in the continuity of the external trade position, which was caused by the change in economic outlook. Before 1973 the current account deficit was in the range of 0-7% of GDP. After 1973, it jumped to the range of 15-20%.

After the October 1973 war, the economy changed directions towards liberalization and outward orientation, and hence the policy of "economic opening" was introduced in 1974. It was seen as a necessary requirement for providing the financial and technological assistance required for modernizing and restructuring the Egyptian economy. Under this policy the own exchange system was introduced. This system increased the freedom of using foreign exchange. Traders and individuals who held foreign currency generated by transactions that fell under the parallel market were allowed to use it for direct importing of goods and services. Funds for this system were mainly derived from Egyptian workers' remittances. This system amounted to implicit approval of a free market for imports. There also came gradual reductions in import duties without differentiation between basic foodstuffs, raw materials and consumer durable goods which included luxury items. This had the effect of shifting import demand outwards.

Undoubtedly, the engines of growth at the time were all foreign exchange earners which allowed for a comfortable foreign exchange situation. They resulted from favorable external conditions and were directly related to the rise in the oil prices. These consisted of oil exports, Suez Canal tolls, workers' remittances, tourism, and loans and other transfers to the Government.

Despite the change in political leadership in 1982 the economic and foreign policies were maintained from the seventies. However, the mid-eighties brought a turn of the tide with the sudden drop in oil prices. This was immediately reflected in a worsening of the trade deficit and the current account as a whole, although imports remained roughly constant.

From then on the government could no longer afford its previous relaxed attitude towards economic policy, and was forced to call upon the international institutions for assistance.

From 1986 onwards there began a series of trade policy reforms under the supervision of the IMF. These reforms involved a gradual reduction of non-tariff barriers and import duties, successive devaluations, and a simplification of the exchange rate system. By 1991 significant reductions were made and the exchange rate was unified. This resulted in a positive impact on external trade performance. In 1991, a final agreement was reached with the IMF and the World Bank under the name of "Economic Reform and Structural Adjustment Program (ERSAP)". The program was of longer duration that previous agreements and devoted a large part of its attention to redressing the external trade imbalances through a continuation of trade liberalization measures.

Having given a brief outline of the external trade position just before and during the period of this study, it is now necessary to highlight certain issues which directly affect the position of imports.

Exchange Rate Developments and Devaluation

Since 1973, Egypt has had a system of multiple exchange rates for both imports and exports. This system of multiple rates was brought about by the creation of the parallel market for foreign exchange in September 1973.

On the import side, the parallel market was largely intended for the private sector and was confined to certain categories of imports, mainly services and some intermediate goods.

In addition to the official and parallel markets, a third foreign exchange market was formed in 1974 for transactions that fell under the "own-exchange" import system.

Due to foreign exchange shortages during 1976, import demand was dampened by widening the scope of the parallel market to include all imports except food, medicines and fertilizers. This in effect implied a 43% devaluation of the exchange rate. In addition, the own-exchange rate moved closer to the parallel market rate.

These rates were unified in January 1979 at the higher parallel market rate through a shift of all remaining transactions to this market. Again this implied another substantial devaluation of almost 80% and a number of smaller devaluations.

In 1981, there was a return to the complex multiple rate system with at least six exchange rates. These were eventually narrowed down to four in 1986 and then to two in 1987. These two rates are the Central Bank pool rate and the free banking pool rate. The Central Bank pool rate dealt with imports of basic foodstuffs, insecticides and fertilizers. In addition, there was a special exchange rate for transactions under bilateral trade agreements.

From then on a series of large devaluations took place. In February 1991, there was a move to a dual exchange rate system (primary and free market) with the aim of eventually achieving unification which was finalized at the free market rate in October of the same year. Since then, the exchange rate has been considerably stable.

During the period under study, and even after the numerous devaluations, the exchange rate remained to be an overestimate, which had the effect of understating the real cost of imports. Also if devaluations are calculated with respect to real and effective exchange rates they are likely to contract in value and may even be totally canceled out. The Egyptian pound continued to be overvalued even after the most recent devaluation-cum-unification episode of 1991 due to the financial liberalization which accompanied trade liberalization and which caused a huge inflow of short-term capital, raising the demand for the home currency and pushing it further from its equilibrium value.

The exchange rate developments as described above show that the Egyptian Pound has suffered actual devaluations of varying magnitudes. We restrict ourselves here to the effect of devaluation on the import side of the trade balance.

Devaluation in the seventies was an indivisible part of all stabilization packages, even during favorable external conditions. It was seen as an appropriate and convenient tool for dealing with current account deficits and foreign exchange shortages. Although there was a drop in the current account deficit after devaluing in 1979, this was due to the fact that the rental sectors flourished in 1979-80. This led to an improvement in the balance of payments on the whole, which was additionally attributed to the large inflows of capital which the Government indulged in borrowing at the time. The achievement of devaluation became more apparent during the crisis period of the mid-eighties when the current account deficit took an upward trend despite all the devaluations that took place. This is why the 1987 stand-by agreement was severely criticized for its total disregard of country-specific circumstances and the effect of exogenous conditions on the economy. It is also not surprising that devaluation was unsuccessful given the inconsistency in adopting import liberalization, which began with the 1977 stand-by agreement, and given the composition of imports as will be seen later. This was the reason why Egypt faced major difficulties in coming to terms with the IMF on the exchange rate policy in 1989.

The Composition of Imports, Major Trading Partners and Terms of Trade Developments

Given the abundant foreign exchange during the early years of "Economic Opening", imports were turned to as an easy short term solution to internal imbalances between domestic supply and demand. They were also a means of replacing depleted stocks of food and intermediate commodities at the end of the war period. Thus, part of the trade and investment policy after 1973 was aimed at sustaining the very high level of food requirements of the economy and importing larger quantities of intermediate and capital commodities to increase the productive capacity and also enhance the existing capacity utilization.

The import basket may be divided according to various criteria. If we divide imports on the basis of the degree of processing and use, we will find ourselves with six major groups. These are fuels, raw materials, intermediate commodities, capital commodities, consumer durable and non durable commodities.

Comparing 1995 with 1970 we will find that the relative shares of these groups have hardly changed with the exception of the fuels and intermediate commodity groups. In 1970, 8.3% of total commodity imports were fuels, which followed a downward trend to become 2.6% in1974 and just under 1% by 1995.[1] This reduction, together with the fluctuations in between is of course attributed to the increase followed by fluctuations in

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[1]CAPMAS, Foreign Trade Monthly Bulletin, August 1972-July 1996. 1995 values are calculated from the absolute figures.

local oil production during this period. The change in intermediate imports was less dramatic and in the opposite direction. In 1970, 37.6% of total commodity imports were intermediate commodities falling to 34.3% in 1974, remaining roughly at that level until the mid-eighties when they began fluctuating around 40% from then onwards and took a sudden rise in 1995 to reach 44%.[1] Intermediate commodities have always occupied the largest share in total commodity imports. However it is believed that this share is overestimated because it contains parts and kits imported for the local assembly of consumer durable commodities. The other side of the coin would be that the share of consumer durables in total imports is underestimated.[2] With capital commodities we find that from 1974 to 1978 their share increased from 13.5% to 32.6% in order to meet the requirements of much higher investment growth with very high import content.[3] The share of consumer non-durable commodities, most of which are food products, was 14.1% in 1970 and remained at that level until 1976 when it rose to 17.1% and continued to rise to reach its highest of 21% in 1981. This is partly due to insufficient domestic food production. We should note that these shares underestimate total food imports because they exclude wheat grain, corn and other agricultural crops, imported as raw materials. Imports of consumer durable commodities took an upward trend until the mid-eighties to reach a high of 7% in 1984 and then declined abruptly to reach a low of 2.7% in 1990. This was partly due to

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[1]Ibid.

[2]Rivlin, 1985, 148.

[3]Rivlin, op.cit., 136.

the increase in luxury imports that came along with the "open-door" policy.

If we separate out agricultural imports from raw materials and consumer non-durable commodities, we will find that the discrimination against the agricultural sector during the period of analysis was reflected on imports. Egypt was heavily dependent on food grain imports and from 1974 onwards, became a net importer of agricultural products. Agricultural imports increased threefold by 1983 and were mainly comprised of wheat and flour. By 1981 Egypt was importing 48% of all staple food consumed domestically.[1]

Meat, milk and dairy imports were increased substantially by the government after 1980 due to bottlenecks in domestic supply of livestock which raised prices sharply. Although domestic poultry production was increased considerably throughout the period of study, it had to be complemented by an increase in imported hatcheries, feed mills and poultry feed.[2]

The public sector monopolized the imports of wheat, flour, edible oil, animal fats, tobacco, coal, petroleum and its products, military production inputs and weapons. Only recently was the private sector allowed to import some of these products together with fertilizers, sugar and tea.[3] On average, the public sector imported approximately 75% of total imports between 1983/84 and 1987/88.

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[1]Dethier, 1989, 16-20.

[2]Dethier, op. cit., 24.

[3]Kheir El-Din and El-Dersh, 1992, 218.

Rationalizing and restructuring imports have always been difficult tasks for Egyptian trade policy. In general, tariffs were assigned to restructuring imports by using different rates for taxing different groups as a means of encouraging some imports and discouraging others. This is evident from the wide tariff range that existed before trade liberalization policy narrowed it down. To begin with, the range was from 5% to 160% in 1986. This was narrowed to 1%-100%, in 1991 and then from 5% to 80% in 1993, with products classified into twelve groups. For the last range the weighted average rate was 18.5%.[1] This process of narrowing down, under the most recent trade liberalization measures, was considered to be quite fast. Various forms of non-tariff barriers were used for rationalizing imports. The most important reasons for rationalizing or restricting imports were protecting domestic industries and dealing with foreign exchange constraints. Total production coverage of non-tariff barriers on imports exceeded 90% in seven activities. These were food products, beverages and tobacco, clothing and ready-made fabrics, wood furniture and fixtures, footwear leather goods and furs; and transport.[2]

The previous examination of the import composition implies that imports as a whole are most likely to have a low elasticity of demand. This is evident from the high shares of raw materials, capital commodities and non-durable consumer goods in the import basket. Also, the high intermediate import content of inputs to domestic production reduces the elasticity of this group. Thus, it is expected for import demand to be inelastic with respect to a moderate devaluation of the exchange rate. In

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[1]IMF, 1993, 157.

[2]Kheir El-Din and El-Dersh, op.cit., 212, 215, 227.

addition, devaluation is likely to result in cost-push effects in the tradables sectors. In contrast, empirical evidence has shown that the relative price of tradables to non-tradables in Egypt has fallen by 20-25% during the first phase of ERSAP, 1991-1993. This adverse effect of devaluation, contrary to what was to be expected by theory, needs to be explained in the light of other evidence. One way of looking at this is to consider the relative price of tradables to non-tradables as an equivalent to the real exchange rate, a purchasing power parity definition. Thus a fall in the relative price of tradables to non-tradables equivalently means a rise of 20% to 25% in the real exchange rate. This means that devaluation has caused an appreciation in the real exchange rate.[1]

In order to study the direction and change in the real exchange rate we may calculate it using the widely known purchasing power parity definition according to which it is the nominal exchange rate deflated by an index measuring the excess of domestic inflation over world inflation. When calculating the real exchange rate we must be aware of who are the most important trading partners in order to use an appropriate price index to account for world inflation. Major trading partners have been affected to some degree by the changes in trade policy. In 1970, 49% of Egypt's imports and 74% of its exports were with countries that had bilateral trade or payments agreements.[2] At the end of 1973 Egypt was engaged in bilateral trade relations with more than thirty countries, twelve of which were with the Soviet bloc. Developing countries also had a considerable share of these agreements. These agreements were steadily eliminated

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[1]Abdel-Khalek, 1995, 14, 20-23.

[2]Rivlin, 1985, 354.

until by the end of 1978, agreements with only ten countries were left.[1] With the major trading partners being East European and developing countries the incentives for improved domestic production were weak due to lack of competition. A fall of bilateralism meant a decline in the relative importance of trade with these countries, and with the "open door policy" there was a change in the direction of trade to Western countries. This had the advantage of pushing domestic industry into competition with the high standards of the open markets of the West.

From this we should note that before 1974 the US wholesale price index would be a biased representative of all trading partners. From 1975-80, 65.8-72.5% of Egyptian imports came from industrial countries, with 19.2% from the US, rising to 72.5% in 1980, with the US's share considerably stable at 19.2%. In fact, the US's share has been considerably stable throughout the entire period of study, making it Egypt's most important trade partner. Italy has a larger share than Germany in total trade but this is largely due to oil exports from Egypt to Italy. Otherwise Germany would rank the second important trade partner, with a share fluctuating from 9.6-10.6% over the 1990-1995 period. Next comes Italy with a share of 7.6%, France with 7.5%, Japan with 5.1% and the U.K with 3.8%, in 1995. If we take the share of the European Union as a whole we will find that its share in imports has fluctuated around 39% during 1990-1994, while its share of exports was continuously rising from 37% in 1990 to 54% in 1994. If we divide trade partners into industrial and developing countries we will find that on the export side, trade was equally directed towards industrial and developing countries, from 1988 to

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[1]Ikram, 1980, 354.

1994, with a slight tilt towards industrial countries. But imports are mainly coming from the industrial countries, with a percentage as high as 72.2%, in 1994.*

As for terms of trade, they may also be used as an equivalent to the real exchange rate in the case of a simple trade model with two countries that completely specialize in production. A country's terms of trade, in general, depend upon the composition of both its exports and imports. Terms of trade may be measured with respect to all goods and services, goods only or just particular items in the export and import baskets. We may measure agricultural terms of trade or industrial terms of trade, commodity terms of trade or income terms of trade, single factor terms of trade or double factor terms of trade. Income terms of trade are important in measuring the ability of exports to finance imports.

Most non-oil developing countries suffer from deteriorating commodity terms of trade because of the dominance of raw materials and primary goods over exports and manufactures over imports. In the case of Egypt the commodity terms of trade deteriorated eleven times and improved only eight times across the period 1973-1993 and implied an overall deterioration. In fact the average growth rate of terms of trade for the period was calculated to be -2.25%. This deterioration was mainly caused by the rapid increase in world food prices especially wheat and flour, major Egyptian imports.

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* All figures in this section were calculated from the IMF, Direction of trade statistics, various issues.

Import Substitution

Proceeding with the trend from the sixties, and further encouraged by the liberalization of the external sector, economic policy discriminated against agriculture in favor of industry. Discrimination was also present within industry against export promotion and in favor of import substitution.

Industrialization has followed a typical import substituting pattern. Radical changes in the nature of Egypt's economic system from planning towards liberalization have not deflected industrialization from that course.

Import substitution industries have traditionally been highly protected through tariff and non-tariff barriers. The high nominal tariff rates led to even higher "effective" tariff protection mainly falling on consumer durable and non-durable industries. As for non-tariff barriers, their total production coverage is the highest in import-substituting activities (exceeding 80%). The most common form used for protection in this case is import bans with total production covering 52.1% of industrial activities. Despite this protection import substitution industries have faced failures of inappropriate technology and output.[1]

The gradual tariff reform that began in 1986 and resulted in reduced dispersion among tariff groups, together with successive devaluation have hardly reduced effective protection of import substitution industries. On the other hand the reduction in non-tariff barriers, particularly import bans, were found to be more effective. Reduction in non-tariff barriers was

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[1] Kheir El-Din and El-Dersh, 1992, 226-239.

partly through elimination and partly through tariffication and it is intended to continue under ERSAP II until these barriers vanish altogether.[1]

These liberalization measures were intended to eliminate the bias against export promotion. But the reduction of protection of import substituting activities may lead to shifting resources more to non-tradables than to exports which may cause an appreciation of the pound and thus a worsening of the trade balance. Falling export proceeds during 1991/92 and 1992/93 and rising imports in 1992/93 support this possibility. If this trend continues it will cause another real appreciation of the exchange rate as that which occurred during 1991-1993. We should also note that the presence of import substitution industries sets rigid limits on the appropriateness of devaluation as a means of improving the trade balance.[2]

However, it is not the issue of favoring import substitution over export promotion that we are concerned with here as much as it is what type of import substitution is favored. It is typical of most import-substituting patterns to discriminate against capital goods by protecting light industries more than the heavy industries. This has been the case for Egypt as well and it raises the concern over how devaluation might affect this discrimination and how it may be removed. It is also important to consider whether all import substitution possibilities have been exhausted.

To conclude, trade liberalization under ERSAPII is in effect import liberalization and is seen to be a neutral motive to industrialization and neglectful of important inter-linkages between export promotion and import substitution and with little coordination among policy tools.

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[1] Abdel-Khalek, 1995, 27-33.

[2] Ibid., 34.

Past experiences of other developing countries show that applying devaluation simultaneously with trade liberalization causes a real depreciation of the exchange rate and thus helps in improving the trade balance. But given the internal structure of the Egyptian economy with all specific interacting endogenous and exogenous factors and their effect on the external trade sector, and given the country's previous experience with devaluation since the seventies, we doubt the appropriateness of devaluation as a policy tool for curtailing imports and improving the trade balance.

Chapter II
ECONOMETRIC REVIEW FOR MODELING IMPORT DEMAND RELATIONS

Modeling international trade flows has been a favorite field for econometricians in their attempt to resolve debates over major trade policy issues. Modeling the demand side of exports and imports has attracted the most theoretical and empirical attention and devaluation has topped the list of policy tools in need of evaluation. The various elasticities generated from international supply and demand relationships have led the way in problems related to trade flow forecasts and policy evaluations. In international trade, demand elasticities have proven to be more useful as analytical tools than supply elasticities, and since imports in most developing countries are a bigger proportion than exports are, analyzing import demand is relatively more important.

We begin this chapter with a review of the methodological issues specific to the modeling of import demand. These may be divided into a first section of basic specification issues and a second section of the more detailed econometric issues that are encountered during estimation. It is seen appropriate to begin the second section with a summary of Guy Orcutt's pioneering contribution in 1950 regarding the econometric pitfalls of time series estimation of import demand relationships, since they remain to be the most important methodological pitfalls of specification and estimation preoccupying researchers despite the fact that more than 40 years have passed. It thus sets the floor for a discussion of the basic econometric issues that are prerequisite for efficient quantitative analysis of import demand.

In the second part of this chapter, we leave the traditional methodology to closely examine a new estimation technique and its possible applicability to our Egyptian case study. To be precise, we focus on the use of error correction mechanisms in analyzing the demand for commodity imports at both the aggregated and disaggregated levels.

(A) Review of Methodological Issues in Traditional Trade Modeling

i. Specification Issues

Before going into the econometric issues relevant for our estimation procedure the theoretical base on which we build necessitates a discussion of three main stages of specification.

In the first stage, we must specify the appropriate model framework. Then we move to the second stage of specifying the appropriate functional form and finally we move to determine the most relevant variables that should enter the functional form. This sequencing may differ during actual estimation.

Choice of model, functional form and variables is dependent upon various factors. These include the purpose behind estimation, the degree of aggregation, the structure and condition of the economy and the nature of the foreign trade regime being employed with all its institutional factors and any other country specific factors affecting it. Our choices should also take into consideration the type and final use of the imported commodity, when working on a dissaggregated level. Last but not least, the data availability may be a limiting factor in the choice of variables.

(1) Choice of model framework

Two general trade models have dominated empirical literature. The import demand function is extracted from either one. These models are viewed as complements when estimating on a dissaggregated level and as competitors when working at the fully aggregated level. They are the imperfect substitutes model and the perfect substitutes model.

The Imperfect Substitutes Model[a]

This model is the most widely accepted in time series modeling of international commodity trade flows. The full model in structural form is specified as follows;

$$Md_i = f(Y_i, PM_i, PD_i)^{b} \qquad \beta_1, \beta_3>0, \quad \beta_2<0, \qquad (II.1)$$

$$Xd_i = f(Y^*_e, Px_i, P^*e) \qquad \alpha_1, \alpha_3>0, \quad \alpha_2<0 \qquad (II.2)$$

$$Ms_i = f[PM^*(1 + S^*), P^*] \qquad \pi_1>0, \quad \pi_2<0 \qquad (II.3)$$

$$Xs_i = f[PX_i(1 + S_i), PD_i] \qquad \pi_3>0, \quad \pi_4<0 \qquad (II.4)$$

$$PM_i = PX^*(1 + T_i)e \qquad (II.5)$$

$$PM^* = PX_i(1 + T^*)/e \qquad (II.6)$$

$$Md_i = Ms_i.e \qquad (II.7)$$

$$Xd_i = Xs_i \qquad (II.8)$$

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[a] The assumption of imperfect substitution between traded and domestically produced commodities which is the basis for this framework is originally attributed to Armington(1969).

[b] It is implicitly assumed here that imports are used for final consumption purposes.

Where; β_1 , β_2, β_3 are the coefficients of Y_i, PM_i, PD_i, respectively, in the first equation.

α_1, α_2, α_3 are the coefficients of Y^*_e, Px_i, P^*e, respectively, in the second equation.

π_1 , π_1 are the coefficients of $PM^*(1+S^*)$ and P^*, respectively, in the third equation.

π_3 , π_4 are the coefficients of $PX_i(1+S_i)$, PD_i , respectively, in the fourth equation.

Here we have six behavioral relationships with the addition of two identities to close the model. The quantity of imports demanded (Md_i) is determined jointly with the quantity of imports supplied (Ms_i), the quantity of exports demanded (Xd_i) and supplied (Ms_i), the domestic currency prices paid by importers in the country, (PM_i), and in the rest of the world (PM^*), and domestic currency prices received by exporters in the two regions (PX_i, PX^*). The exogenous variables contained in the model are the level of nominal income in the two regions (Y_i, Y^*), the price of all domestically produced goods in the two regions(PD_i,P^*) and the proportional tariff (T_i,T^*) and subsidy rates(S_i,S^*)applied to imports and exports in the two regions, and the exchange rate(e) in units of the home currency.[1]

The model may be simplified through imposing a number of assumptions. We consider only those associated with the import demand

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[1] Goldstein and Khan, 1985, 1044-5.

equation and how it is estimated. Traditional time series modeling of trade flows frequently assumes an infinite supply of imports and exports. This would render exogenous import and export prices (PM_i, PX_i) . This makes estimation using single equation methods possible for both export and import demand. In the case of modeling trade flows in a small country it is fairly safe to accept that import supply is infinitely elastic. But for infinite export supply to exist in reality, there must be a large pool of unemployed resources in the economy . However without this assumption the full model must be estimated simultaneously or alternatively , the reduced form expressions for quantities and prices solved for and estimated.[1]

Another simplifying assumption is the exogeneity of prices of domestic substitutes of commodity imports. But empirical evidence refuses to approve of this assumption and assures the presence of a "feedback" effect between exchange rate changes and domestic prices. Thus if we impose this assumption and obtain high price elasticity estimates they do not guarantee that devaluation as an expenditure switching policy will actually be effective in altering the country's trade balance, since the presence of a "feedback" implies little or no change in relative prices, the variable which induces expenditure switching. Thus, this assumption may bias our results especially in the case of small highly open economies with wage indexation schemes where domestic price "feedback" is most evident.[2] Domestic price feedback increases with the increase in intermediate imports.[3] This is why we say that for devaluation

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[1] ibid., 1048.

[2] ibid., 1049.

[3] Katseli, 1983, 361.

to be effective it must be translated first into real terms, and since the relative price variable is used as a proxy for the real exchange rate, this means that a real devaluation must raise the relative price variable.

The demand equation for commodity imports as specified in the imperfect substitutes model is otherwise known as the "standard import function" and is equally applicable to aggregated and disaggregated imports. It is theoretically built upon micro economic consumer and producer theory. If imports are finished commodities for direct consumption purposes, the import demand function is derived from maximizing utility subject to a budget constraint[1], and if they are inputs in domestic production, in the form of fuel, raw materials, intermediate, or capital commodities, the import demand equation is derived from maximizing production subject to a producer's cost constraint. In the latter case the main arguments of the equation will change accordingly. The price of the domestic input will replace the price of domestic substitutes (PD_i) and the level of gross domestic product replaces the level of income (Y_i).

A common property among demand functions in consumer and producer theory is their zero homogeneity in prices and nominal incomes due to the assumption of no money illusion. In terms of the parameters this restricts their sum to be zero, i.e.:

$$\beta_1 + \beta_2 + \beta_3 = 0 \qquad \text{(II.9)}$$

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[1] Hentschell, 1992, 49.

Zero homogeneity allows the use of a real income variable and a relative price variable in the import demand equation, instead of nominal income and absolute prices:

$$Md_i = f(Y_i/PD_i, PM_i/PD_i) \qquad (II.10)$$

If we work with the log-linear functional form, the zero sum restriction would be imposed on the price and income elasticities of import demand. The zero homogeneity property is not always readily accepted in the case of import demand functions and we will see later on how it is a subject for debate.

With aggregate imports, there is complete assurance that the income and domestic price parameters are positive while the import price parameter is negative, as we know from economic theory, but once disaggregation is introduced there is no guarantee that the parameter signs will be consistent with economic theory.[1]

<u>The Perfect Substitutes Model</u>

Although the perfect substitutes model is less popular among empirical studies it is said to be the most suitable for application to "standard" commodities such as some raw materials (wheat, copper, sugar, etc.). It may also be suitable for some traded industrial goods that are closer substitutes than the "imperfect" price statistics would suggest.* This model is extended from the pure trade theoretical approach (the

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[1] Goldstein and Khan, 1985, 1046.

* Modeling aggregate commodity imports using this model is naturally ruled out.

Heckscher-Ohlin-Samuelson model) and not from micro economic theory as the previous one. It is specified as follows:

$$D_i = l(PD_i, Y_i) \quad l_1<0, \quad l_2>0^{**} \qquad (II.11)$$

$$S_i = n(PD_i, F_i) \quad n_1>0, \quad n_2<0 \qquad (II.12)$$

$$M_i = D_i - S_i, \qquad (II.13)$$

$$X_i = S_i - D_i, \qquad (II.14)$$

$$Pm_i = Pd_i = Px_i = e.P_w \qquad (II.15)$$

$$D_w = \Sigma D_i \qquad (II.16)$$

$$S_w = \Sigma S_i \qquad (II.17)$$

$$D_w = S_w \qquad (II.18)$$

where: D_i is the total quantity of traded goods demanded in country i.

S_i is the supply of traded goods produced in country i.

M_i, X_i are the quantities of country i's imports and exports respectively.

PD_i, PX_i, PM_i and P_w are domestic, export, import and world prices of traded goods, respectively.

D_w, S_w are the world demand and world supply of traded goods.

Y_i, F_i are money income and factor costs in country i.

** It is possible for l_2 to be negative when a commodity import has a perfect substitute if the domestic demand rises by a lower rate than the rise in domestic supply.

The same simplifying assumptions discussed earlier in relation to the imperfect substitutes model may be equally applied here. In this model there are no price differentials between domestic and foreign goods. In fact in this model there is only one traded goods price. The import demand function is simply the excess demand for domestic goods. This means that estimating or forecasting the quantity of imports demanded for a perfectly substitutable good is really a matter of forecasting the quantities demanded and supplied of domestic goods with imports emerging as the residual. From this emerges an important empirical difference with respect to the effect of domestic supply. In the previous imperfect substitutes model domestic supply influenced imports only through its impact on domestic prices and hence the relative import price variable. In this model domestic supply will directly influence imports since the import demand equation explicitly includes domestic supply variables even in the case of imports of final consumption goods. Assuming an infinitely elastic world supply of a particular import, an increase in domestic investment causing an increase in the capacity of import competing industries will directly influence imports and so must be incorporated as an argument of import demand. Thus Leamer and Stern specify the import demand equation in the perfect substitutes model.[1]

Just as the quantity of imports demanded is deduced from the quantities of domestic supply and demand, the import price elasticity of demand (ε_{MD}) may be deduced from domestic price elasticities of demand and supply (ε_D, ε_S respectively) as follows:

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[1]Leamer and Stern, 1970, 11.

$$\varepsilon_{MD} = (D_i/M_i).\varepsilon_D - (S_i/M_i).\varepsilon_S \qquad \text{(II.19)}$$

If we are working with the log-linear functional form ε_D and ε_S would be estimated by the "l_1" and "n_1" parameter estimates. The ratios D_i/M_i, S_i/M_i represent the inverse of the degree of openness of the economy. Thus the more open the economy is, the lower are these ratios and the import price elasticity of demand. The above relation shows that the import price elasticity of demand is directly related to the domestic demand and supply price elasticities. It also allows the import price elasticity of demand to exceed the domestic price elasticity of demand and so there is a chance for domestically "inelastic" goods to be import "elastic" with respect to price changes. If an income term is added to the supply equation, S_i in the model, similar deductions can be made with respect to the income elasticity of demand for imports.[1] If domestic production is more income elastic than domestic consumption, then the income elasticity of imports may attain negative values even at the fully aggregated level. This result could not have been possible under the imperfect substitutes model.[2]

(2) <u>Choice of functional form</u>

Efficient estimation of the import demand relation necessitates the appropriate choice of functional form. Different functional forms will give different price and income elasticity estimates and hence lead to

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[1]Goldstein and Khan, 1985, 1052-3.

[2] Moran, 1989, 281.

different conclusions about the impact of changing trade policy or trade policy tools. The most common forms are the linear and log-linear forms. The linear form is given by:

$$Md_i = \beta_0 + \beta_1.Y_{it} + \beta_2.Pm_{it} + \beta_3.Pd_{it} + U_{it} \quad \text{(II.20)}$$

(for country i at time t)

The parameter β_1 here represents the marginal propensity to import. U is the error term accounting for other minor disturbances not accounted for by the explanatory variables. The income and price elasticities calculated from this functional form vary from zero to infinity as the values of the dependent variable and its determinants change. Because of this price elasticity estimates obtained from the linear function will continue to fall as imports rise while income elasticity estimates will tend to unity. To avoid these drawbacks of drastically changing point elasticity estimates the elasticities are often calculated at midpoints and at the maximum and minimum price values in the data set, to get a rough idea of how wide the range of estimates is.

The log-linear form is given by:

$$\log Md_{it} = \beta_0 + \beta_1 \log Y_{it} + \beta_2 \log Pm_{it} + \beta_3 \log Pd_{it} + \log U_{it} \quad \text{(II.21)}$$

The log-linear form is favored for its generally superior fit and ease of interpretation. This form constrains the import price and income elasticities to be constant over the sample range and may be considered too restrictive.[1] Both forms may equally be used in specifying demand for aggregate and dissaggregate commodity imports.

Misspecification may arise if we use the log-linear form to estimate a linear relationship or vice versa, resulting in biased and inconsistent parameter estimates but unfortunately there are no clear-cut criteria to be relied on when choosing the functional form.[2] We may also face cases where the true import demand relationship is curvilinear and thus both of the above forms will give a poor fit and may render the relationship as a whole or the price variable alone as statistically insignificant. We should not mistake this latter possibility to be an indication that the import price is irrelevant in determining the quantity of imports but should experiment with alternative functional forms. In this case we may apply Ramsey's RESET test which involves testing for a high-order polynomial to represent a different functional form.[3] Curvilinearity may also be introduced into the import demand function by specifying dummy variables which permit the function to have different slopes or elasticities for chosen price intervals.[4]

Empirically, we may determine whether the function may be specified in linear or log-linear terms by applying the Box-Cox procedure. Assuming that import demand is in equilibrium, i.e. $Md_t = M_t$, the functional form for import demand is transformed into the generalized form of:

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[1]Murray and Ginman, 1976, 75.

[2]Leamer and Stern, 1970, 16.

[3] Cuthbertson et al, 1992, 117.

[4]Ibid., 48-50.

$$(Md_t^{\lambda} - 1)/\lambda = \beta_1[(Y_t^{\lambda} - 1)/\lambda] + \beta_2[(PM_t^{\lambda} - 1)/\lambda] + \beta_3[(PD_t^{\lambda} - 1)/\lambda] + U_t \quad \text{(II.22)}$$

If λ is set equal to one, the previous equation reduces to the basic linear form with Md_t-1 as the dependent variable and (PM_t-1), (PD_t -1) and (Y_t-1) as the explanatory variables. If λ is set equal to zero, through a Taylor series expansion, we would have $(Md_t^{\lambda}-1)/\lambda = \log Md_t$ and similarly for PM_t , PD_t and Y_t. This would reduce the previous equation into the basic log-linear form. Using a maximum likelihood procedure and comparing the values of the log likelihood function when $\lambda=0$ and $\lambda=1$ allows us to choose the form which has the maximum value for the log likelihood function as the one best fitting the data.[1]

Equivalently, we may normalize the original Md_t, PM_t, PD_t, and Y_t observations by their respective geometric means given by;

$$\log Z_g = [\Sigma(\log Z_{gt})]/N \quad \text{(II.23)}$$

where; $Z_g = Md_g, PM_g, PD_g, Y_g$

Then we may estimate both the linear and log-linear forms in terms of the normalized variables using OLS and choose the specification with the best goodness of fit.[2]

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[1]Boylon, Cuddy and O'Muircheartaigh, 1980, 563-4.

[2]Pyndick and Rubinfeld, 1991, 241-242.

(3) Choice of variables

So far we have been specifying the import demand relation only in terms of two basic variables; prices, either in absolute or relative terms, and income. We may regard this as the skeleton equation and here we intend to add some flesh to it by introducing new variables to specify the relation more accurately for both aggregated and disaggregated commodity imports. We will also be considering variations of the same two basic variables.

There is no question that the best choice of the dependent variable in an import demand equation would be the "quantity" of commodity imports but data limitation or difficulty of aggregation among heterogeneous groups may force us to settle for second best and use the constant value of imports or a value or quantity index for imports in actual estimation. Using the value of imports will generate a "value" elasticity of demand from which we subtract one to obtain the volume price elasticity with respect to the quantity of imports. If the constant value of imports is obtained using poor measures of import indices or deflators the elasticity estimates will be adversely affected and cannot be relied on for any policy implications. Popular deflators used for this purpose are the GDP deflator, the wholesale price index or the import price index. In any case working with current values must only be turned to as a last option. Choice of the appropriate dependent variable and/or deflator is less of a problem at disaggregated levels of commodity imports and the problem diminishes as we increase the level of disaggregation.[1]

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[1]Goldstein and Khan, 1985, 1054-6.

Choice of the explanatory variables is more complicated. Most of the debate concerning their choice has been centered around the choice of an appropriate price variable. The two major questions that arise here are: Should we use absolute prices or relative prices? And should we include the price of non-tradables in the import demand equation?

For accurate estimation, the import price variable, as one of the price variables should be the landed domestic currency price inclusive of all charges(tariffs, transportation, etc.) actually paid by the purchaser in index number form. At a completely disaggregated level, it is preferable to use price quotations If we consider modeling imports as perfect substitutes for domestic production, at whatever level of aggregation, the import price index would not enter the equation at all.

When imports are perfect or imperfect substitutes for domestically produced commodities we must include a domestic price variable in index number form in the import demand equation. The elasticity associated with this variable is the cross price elasticity of demand for commodity imports. If we divide these two variables by each other we obtain a relative price variable which is the most commonly used in empirical studies. This has the effect of restricting the own and cross price elasticity estimates to be exactly equal and opposite in sign. Use of this relative price variable in actual estimation conveniently reduces collinearity among the price variables and thus decreases standard errors. It is also supported by the zero homogeneity property of consumer demand functions. Despite this researchers are still not totally convinced of its applicability to import demand, especially at high levels of aggregation. The appropriateness of using this variable may be tested empirically through testing the restriction it imposes on the equation.[1] The real exchange rate, defined in purchasing power parity terms, is often used as an alternative to the relative import price variable. Under the purchasing power parity hypothesis the real exchange rate is the nominal exchange rate deflated by the ratio of domestic to world price levels. We face five different versions of the real exchange rate under this hypothesis by taking different measures for world and domestic price levels. These measures are consumer price indices, GNP deflators, wholesale price indices, indices of normalized unit labor costs, and export price indices.[2]

Sometimes a price index to represent prices of non-tradables is entered into the equation for imports at the fully aggregated level. Normally, the price of non-tradables is excluded from the equation by assuming "separability" in consumption but if we use the GDP deflator as the domestic price variable in the import demand equation this will implicitly incorporate the price of non-tradables and restrict its coefficient to be equal to that of tradables. To empirically study the relevance of the price of non-tradables in the import demand equation, price indices for tradable and non-tradable goods are constructed and entered as separate arguments in the demand equation. This permits testing for the individual significance of each variable. When this procedure was followed in one study it turned out that imports were unaffected by variations in the price of non-tradable goods for seven out of ten industrial countries. An even more important result was that the statistical properties of the estimated

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[1]Murray and Ginman, 1976, 75-80.

[2] Isard, 1995, 58-63.

price elasticities improved when the domestic price variable was restricted to cover only tradables.[1]

The basic income variable we have specified so far belongs to a large family of activity variables. There is a wide range of activity variables to be chosen from and it is possible for import demand equations to contain more than one of these variables. Choice of the appropriate activity variable(s) depends on several factors. When imports are modeled as perfect substitutes the demand specification must include an activity variable to take into account the capacity of import competing industries, even at the fully aggregated level.

When imports are disaggregated into commodity groups, the activity variable must be adjusted accordingly and disaggregated as much as possible to the same level of the particular commodity group being modeled. Even in an imperfect substitutes framework, if there exists an import competing industry, its capacity should be included in the specification as an activity variable in the form of value added or investment in that particular industry.[2] Imports of raw materials and intermediate commodities require inclusion of the production level in industries using these imports as inputs. Similarly, if aggregate imports are mainly composed of such commodities total domestic output should be included in the specification.[3]

The population variable may be included explicitly or via the use of imports and activity variables in per capita form. This variable is

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[1]Goldstein, Khan and officer, 1980, 190-99.

[2]Leamer and Stern, 1970, 12-13.

[3]Goldstien, Khan, and Officer, op.cit., 191.

especially relevant for non-durable consumer imports. Dummy variables also have a role to play in an import demand specification especially if it is estimated using a long time series. They are usually used to account for unusual occurrences such as a strike, war, or natural disaster . They may also be used to account for seasonal variations, political and economic structural breaks.

For developing countries, additional variables are required to improve the specification. A variable should be included to reflect the foreign exchange constraint which is often binding for such countries, causing import capacity to have a great influence on import demand. Proxies for the foreign exchange constraint and capacity to import include the level of international reserves and overseas assets[1], export proceeds and other foreign exchange inflows. Since restrictions for foreign exchange availability frequently lead to the imposition of import controls and foreign exchange rationing the ratio of international reserves to imports, preferably lagged one period, may also be used as a proxy for import controls.[2] Alternatively, a tariff equivalent variable may be included in the specification to account for all tariff and non-tariff barriers.[3]

To sum, first, although price and income effects are important in the analysis of import behavior in developing countries, it is agreed upon that foreign exchange constraints also play a critical role in determining import demand as they strongly affect import volumes. However, what is not

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[1]Ghazal, 1989, 21.

[2]Haque, Lahiri and Motiel, 1990, 541.

[3]Moran, 1989, 283.

agreed upon is how to enter this variable into the analysis, as there exist several alternatives, and how it may affect other parameter estimates in the specification, since it is thought that its presence constrains the income and price parameter estimates. If a proxy is used to account for the presence of the foreign exchange constraint, there is disagreement on whether this proxy should be assumed endogenous or exogenous.[1]

Second, since governments are likely to increase domestic prices of imports in the face of these constraints, import demand estimation should also account for the endogeneity of these prices. Import models that neglect either of these factors will yield biased estimates for developing country imports.[2]

ii. Econometric Issues

The econometric issues we will be dealing with here were first set out systematically in an influential article by Orcutt (1950) in his attempt to verify why both export demand and import demand elasticities estimated in studies performed during the thirties and forties were biased downwards, which in turn led to a downward bias in the estimated Marshall-Lerner condition for improvement in the trade balance, misleading most studies into the wrong conclusion that devaluation was ineffective as a policy tool in improving the trade balance. Five different reasons were cited.

To begin with, when important explanatory variables are not accounted for there will be large shifts in the demand relation as a whole

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[1] Faini et al, 1992, 279-297.

[2] Ibid., 287.

and this will show in the form of large serially correlated error terms. This violates a basic assumption of the OLS estimation method and so the parameters from which we deduce elasticities will not be BLUE. Likewise, if there is an observed pattern between the direction of these shifts and changes in the specified explanatory variables. The explanatory variables will not be exogenous and this is another violation of a basic OLS assumption. In the case of import demand it is usually noticed that shifts in demand are positively correlated with the changes in the price variable producing a simultaneous equation bias in the parameter estimates. Thus the smaller the relative shift in the demand relation, as compared to the shift in supply, the smaller the bias in elasticity estimates and vice versa. However it is rarely true that shifts in import demand are negligible in size because in addition to all the usual demand factors import demand is also dependent upon factors affecting competing domestic supply.

The second reason for biased elasticity estimates is the presence of measurement errors in the data. Data contain errors of measurement due to misclassification, falsification and faulty methods of index number construction. Sometimes such errors cannot be avoided but knowing their source still helps in determining the direction of the bias. Assuming that error terms are serially independent and uncorrelated with the explanatory variables, errors of measurement in the price variable have been shown to cause a downward bias in the estimated elasticities. Likewise a measurement error in the income variable has been shown to cause a downward bias in the estimated income and price elasticities. However if the measurement errors are confined to the dependent variable, it is possible to obtain unbiased elasticity estimates. We have mentioned in the previous section that data availability restricts our choice of variables to some degree, especially the price and import variables, and so a bias in the estimate is to be expected.

Thirdly, aggregation may bias the estimates downwards because goods with relatively low elasticities may show the greatest price variation and would therefore exert a strong effect on the aggregated price indices. The same may occur with respect to the activity variable.[1] This bias would be minimal if imports were mainly composed of goods with similar elasticity estimates such as capital goods and food.

The fourth source of bias arises from assuming an instantaneous relation between import demand and the explanatory variables. This results in a downward bias because the elasticities estimated from an instantaneous relation will be short-run estimates which are known to be lower that their long-run counterparts. With annual observations the bias may be easily reduced explanatory variables with one period lags and/or a lagged dependent variable in the relation.

Finally, the price elasticity of demand for imports is known to be larger for large price changes than for small price changes. This may be attributed to the psychological and economic consumer costs involved in shifting from one source of supply to another (e.g. difficulty of changing habits, cost of establishing new trade connections or modifying machinery and techniques). Also large price changes may move products from luxury markets to mass markets or the opposite. They may even bring entirely new commodities into international markets.

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[1]Goldstein and Khan, 1985, 1070.

Studies which followed Orcutt's article accused him of overstating his objections to the estimation procedures used at the time. One drawback on his analysis was that it was entirely based on the inter-war period with all its special characteristics and instability which was partly responsible for the unreliable statistical results. Some studies provided ways of dealing with some or all of these sources of bias.* Orcutt himself suggested some techniques for avoiding the bias. For example, aggregation errors may easily be avoided by estimating the demand relation for individual commodities to obtain individual elasticity estimates. Then they could be combined in an appropriate way for any price changes to obtain an aggregate elasticity estimate. To be more practical, it is also possible to work with commodity groups which are known to have close elasticities and avoid lumping together commodities with widely varying elasticities. Simultaneous equation bias may easily be avoided through use of one of the various simultaneous equation estimation techniques. The OLS procedure is not completely ruled out as a method of estimation for the import demand relation. It is applicable in special cases when countries are relatively small, thereby facing infinitely elastic import supply and exogenous import prices, and also when demand is relatively stable. Also long-run elasticities may be estimated by introducing lagged explanatory variables into the specification.

Moving to the econometric issues which have emerged from the previous discussion, we specify four main issues:

Dynamics and time lags

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* Examples of such studies are Harberger, 1953, 148-159; and Prais, 1962, 560-573.

In reality the import demand relation is not instantaneous. So there is no question that lags should be incorporated in the demand relation for commodity imports. The most common procedure to do this is to introduce a "Koyck" type of distributed lag structure by specifying import demand as follows:

$$M_t = \beta \sum (1 - \beta)^j M^d_{t-j} \qquad \text{(II.24)}$$

The mean-time lag required for adjustment of imports to their equilibrium values is given by $(1-\beta)/\beta$

A simplified version of the Koyck model is the partial adjustment model which states that imports adjust to the difference between the demand for imports and actual imports in the previous period:

$$\Delta M_t = \gamma[M_t^d - M_{t-1}] \qquad \text{(II.25)}$$

This partial adjustment framework introduces a geometric lag structure into the determination of imports, and a lagged import term. In terms of the last log-linear form we have specified, it would be transformed into:

$$\log Md_t = \gamma\beta_0 + \gamma\beta_1 \log Y_{it} + \gamma\beta_2 \log Pm_{it} + \gamma\beta_3 \log Pd_{it} + (1 - \gamma) \log Mi_{t-1} + \gamma \log U_t \qquad \text{(II.26)}$$

This lag structure is accused of unrealistically restricting the nature of the adjustment lag to be equal for all explanatory variables, and that adjustment in each variable decays in a geometric fashion, while in reality we may have adjustment building up rather than decaying.[1] This geometric lag transformation will automatically cause the error term to be autocorrelated.[2]

Less restriction is possible if we introduce an alternative Almon lag structure into the functional form. Almon lags are polynomial lags with the shape and form of the lag pattern being dependent on the degree of the polynomial.[3]

Introducing time lags into the specification opens the door for the use of time-series analysis, which is favored for its accuracy in the choice of the lag distribution by letting the data series itself determine the form and length of the lag process. Once implicit dynamics are captured adequately, the resulting equation can then be used for predictive purposes.

Aggregation

We mentioned in passing that disaggregation reduces the bias in elasticity estimates. However it is not always that way. Sometimes disaggregated data are subject to larger measurement errors than are aggregate data. Also, disaggregated functions are more likely to be misspecified than aggregate relationships. If this is the case then the bias may arise from the other mentioned sources. This makes predictions from disaggregated models not as reliable as they should be. In addition to this, if we are working with the log-linear functional form, obtaining the

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[1] Goldstein and Khan, op.cit., 1067.

[2] Leamer and Stern, op.cit., 25.

[3] Ibid., 26-7.

elasticity from the different commodity elasticities is not as straightforward as may seem. In this form the component elasticities for both income and prices have to be adjusted by the variation in the component real incomes and prices relative to the variation in their respective aggregates.[1]

Simultaneity

If we are not dealing with the small country case, it is advisable to test for simultaneity before choosing the estimation procedure. Several statistical tests are available for this. The most popular ones are the regression specification error test and the Hausmann specification test (1978) which detect the presence of a non-zero disturbance term in general. Also the Granger causality test may be applied to serve this simply by testing whether the explanatory variable "Granger causes" the dependent variable or not through a Lagrange multiplier test statistic. Once simultaneous equation bias is detected through one way or another we have one of two choices to correct for it. The first is to solve for the reduced form of the relation and then estimate it using OLS. This is the well-known indirect least squares procedure. However if the equation we are estimating is over-identified the structural parameters would not be uniquely identified if we use the indirect least squares procedure and we turn to the two stage least squares procedure to give us consistent and unique structural parameter estimates.

The second choice we have that allows for simultaneity is to specify and estimate a complete model of import demand and supply using three stage least squares, or full information maximum likelihood

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[1] Goldstein and Khan, 1985, 1070-1.

methods. These would yield both efficient and consistent parameter estimates. Such procedures are preferred to the former if we suspect correlation between the import demand and supply equations. However this requires specific knowledge of the import supply equation and care must be taken because equation system estimation is particularly sensitive to specification error in any of the model equations.

Simultaneity should be accounted for when modeling developing countries' imports subject to a foreign exchange constraint, even in the small country case, because it is said to cause import prices to be endogenously determined. In such cases if we wish to apply one of the above system equation methods we may specify a traditional import demand equation with an import supply equation that includes a proxy for the foreign exchange constraint as an explanatory variable.

Lately the endogeneity of the import capacity variable and the income variable has been questioned, so it is advisable to test for the exogeneity of all explanatory variables entered into the import demand equation and then choose a suitable estimation technique.[1]

Stability of the relationship

We have seen that shifts in import demand may frequently occur. This is a source of instability. Another source of instability is the change in the price elasticity with the change in the size of the price change. If this is the case then we lose confidence in the consistency of our parameter estimates with the true parameters. Widely varying unstable elasticity estimates will widely vary just by changing the sample period used in estimation. Additional sources of instability are, a gradual change in the

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[1] Moran, op.cit., 292-3.

pattern of trade as a result of economic development or a sudden change in the exchange rate or exchange rate policy. Choice of an appropriate stability test depends on the source of instability, whether it is due to gradual or sudden changes. Several testing procedures are available and it is not advisable to rely on just one test result. Once instability of parameter estimates is detected it may be reduced through use of dummy variables to isolate the point(s) which is the source of instability or through subdividing the estimation period and estimating each period separately, or through further specifying additional explanatory variables which are seen responsible for the shifts in demand or, in other words, the source of instability.[1]

The problem of instability arises mainly in the case of developing countries, for it was found that in almost 40% of developing countries income and price elasticity estimates are found to be unstable. The main reason behind this is the exclusion of the foreign exchange constraint as an important explanatory variable. In this particular case, adding an indicator of import capacity or any other proxy for the foreign exchange constraint would remove, or at least reduce, the instability.[2]

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[1] Goldstein and Khan, 1985, 1073-75.

[2] Faini et al, op.cit., 285.

(B) The Modern Approach to Modeling Import Demand

After reviewing the traditional approach to the problem of modeling import flows, the floor is set for a presentation of the new econometric approach to the same problem, in search of more trustworthy results and further insight into their behavior. This involves the use of recently developed econometric concepts, namely, general to specific modeling, cointegration and error-correction mechanisms and how the relation between all three concepts can be put to use. The general to specific approach has been directed towards the modeling of macroeconomic aggregates, and single equation error correction mechanisms have proved successful in modeling the demand for money and aggregate consumption, and has begun to show similar success in modeling trade flows. What concerns us here is the use of this approach to fit a model to the behavior of Egyptian commodity imports to re-examine the effect of devaluation on imports after correcting the data for non-stationarity. When an economically and econometrically sensible specification is reached, it may be employed to analyze the effect of exchange rate devaluation on the volume of commodity imports that flows into the economy. In this section we will outline the methodology behind cointegration and error-correction mechanisms (ECM's) as applied to import demand, since to build an error correction specification we must first establish a cointegration relation among the variables of the model.

i. Stationarity

To avoid spurious regression we must begin with investigating the properties of all the time-series that will be used in the regressions. To be specific, we must investigate the stationarity of the time-series for the dependent variable and each of the explanatory variables and determine, individually , their order of integration. Our discussion here is in terms of weak stationarity. A series is defined to be weakly stationary if it has a constant mean and a constant finite variance.[1]

Spurious regressions often result from the use of non-stationary or non-cointegrated series in OLS regression. Two or more non-stationary variables may appear to have a relation only because they have similar time series properties.[2] This shows in a Durbin-Watson statistic tending to zero and leads to inconsistent parameter estimates, due to the violation of the Gauss-Markov theorem. Spurious regression may also be reflected in a very high goodness of fit coefficient.[3] Even if diagnostic test statistics are acceptable, we should not be misled into accepting the model because spurious regression carries no meaning, and when time-series properties of variables are properly taken into account in regression, a parameter estimate which was significant before may turn insignificant, or change altogether in direction and value.

Most economic series are subject to some kind of trend. In the presence of a deterministic trend, detrending is enough to convert the series into a stationary process, but in the presence of a stochastic trend, stationarity may be achieved only through differencing. Studies show that non-stationarity of macro variables is caused by the presence of a stochastic trend

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[1] Cuthbertson et al, 1992, 129-30.

[2] Reinhart, 1995, 298.

[3] Pindyck and Rubinfeld, 1991, 459-60.

in the form of a random walk with a drift or just a random walk.[1] Exchange rates have also been shown to follow random walks. Recent empirical studies on both developing and developed countries have shown time series data of import volumes, real and nominal GDP, wholesale, import, and world price indices to be integrated of the first order. Thus we can expect the variables that we will be working with to be non-stationary. Once we have chosen the set of variables to be used in estimation, guided by our choice of model framework and data availability, we may proceed with investigating the stationarity of each variable, and hence, its order of integration. The three well-known tests for stationarity, otherwise known as unit root tests, are the Dickey-Fuller, augmented Dickey-Fuller, and integrated Durbin-Watson tests. It is advisable to perform all three tests to ensure the validity of our test results. In particular, we should not solely depend on the latter one because it only gives a quick guide.

The simplest form of a Dickey-Fuller test consists of testing the significance of the parameter "δ" in the following OLS regression:

$$\Delta Z_t = \mu + \delta \cdot Z_{t-1} + U_t \qquad \text{(II.27)}$$

where; Δ is a difference operator,

μ represents a drift term,

Z_t represents the variable series being tested.

Here we do not use the standard t-statistic. Instead, a specific simulated t-statistic is constructed for this purpose. If a drift is not included

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[1] Urbain, 1992, 241.

in the test equation different critical values have to be used. Rejection of the null hypothesis of a unit root, i.e. $\delta = 0$, against the alternative hypothesis of no unit root, i.e. $\delta<0$, means that the series is stationary or integrated of order zero. If the null hypothesis cannot be rejected the series is differenced and the same test procedure is repeated with this differenced series. Rejection of the null hypothesis here means that the original series, being stationary in first differences, is integrated of the first order, i.e. it is *I(1)*.

We may also use the Dickey-Fuller procedure to test for the simultaneous presence of stochastic and deterministic trend components in a time-series. This time the OLS regression equation would be:

$$\Delta Z_t = \mu + \alpha t + \delta \cdot Z_{t-1} + U_t \qquad \text{(II.28)}$$

where; t is a linear deterministic time trend.

Here it is possible to test simultaneously for the absence/presence of a stochastic trend ($\delta=0$; $\delta<0$, respectively) and the absence/presence of a deterministic trend ($\alpha=0$; $\alpha\neq0$, respectively) by imposing the respective restrictions on the above regression, re-estimating the equation, and computing the usual F-test or Lagrange multiplier test for validity of restrictions. Again, non-conventional critical values are used. Both these simple Dickey-Fuller tests were criticized for not taking into account the possibility of autocorrelated error terms which may bias test results, so they were augmented by adding lagged terms of the L.H.S variables. The same critical values used before will equally apply here.[1]

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[1] Charemza and Deadman, 1992, 130-6.

ii. Cointegration Analysis And Error-Correction Mechanisms

Let us assume that we have identified the integration order of all the variables relevant to our specification. For cointegration analysis to apply in the first place, these individual variables must be of the same order of integration. If we find a sub-set of the explanatory variables to be integrated of a higher order, then our only hope for applying cointegration is for a linear combination of this sub-set to be integrated of the same order as the remaining explanatory variables and the dependent variable. Of course if all variables are originally stationary then we would not be talking about cointegration in the first place.

Cointegration makes it possible to produce an economically sensible specification from a set of non-stationary variables. The idea is that when two or more non-stationary variables, integrated of order d, are found to follow the same pattern across time, they may be combined together to produce a long-run relation where deviations from this long-run relation are integrated of a lower order. More formally, if there exists an $n \times 1$ vector, α, such that $X'_t \cdot \alpha \sim I(d\text{-}b)$, we define α to be the cointegrating vector and we say that the time series forming the matrix X_t, which includes the explanatory variables and the dependent variable of the long run relation, are cointegrated of order d, b where $d \geq b \geq 0$. This is denoted by:

$$X'_t \cdot \alpha \sim CI(d, b)$$

The most common case among macroeconomic specifications is to have all variables integrated of the first order with stationary deviations from the long-run path, i.e.; $X'_t \cdot \alpha \sim CI(1, 1)$. We are concerned with this case alone because otherwise we would not be able to establish an error-correction representation, which is what we want to reach eventually, to account for the short-run fluctuations in the relation. The cointegrating vector, α, is either known *a priori* from economic theory or it is estimated using the simple OLS procedure which is known to yield an excellent approximation to the true vector with consistent, but inefficient, parameter estimates as opposed to the GLS procedure. However, it is shown that there is a small-sample bias present in the OLS estimators of the cointegrating vector and that for certain simple models, the bias is inversely related to the goodness of fit coefficient.[1]

In the case of import demand α must be estimated. We estimate it by first specifying the long run equilibrium relation. This may be done in a simple single equation framework, known as the Engle and Granger two-step approach (1987), or in a much more complicated system equation framework, known as Johansen's multivariate approach (1988), which involves the estimation of VAR based models using maximum likelihood methods. Each approach has its own advantages and disadvantages. The most important drawback given on single equation estimation is that α is not uniquely determined when there is more than one explanatory variable in the relation.[2] The most important drawback given on VAR estimation in general is its lack of economic meaning in many cases, since all regressors are entered in all equations with equal lag length. Although we prefer the more meaningful and simpler single equation framework, it might here be desirable to seek an empirical reconciliation of the two approaches.

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[1] Cuthbertson et al, op.cit., 135.

[2] Urbain, op.cit., 243.

To specify the long run equilibrium demand relation we may apply the traditional methodology as described in the previous section or, alternatively, apply general to specific modeling. Since there is no unique equilibrium long run specification for modeling imports, it may be preferable to use the general to specific approach to dynamic modeling, widely known as the London School of Economics tradition. We saw that the traditional methodology accounted for dynamic and disequilibrium long run behavior of import demand flows, more commonly, through partial adjustment mechanisms and, less commonly, through a polynomial lag structure imposed on the original theoretical specification. This new approach is regarded as an advancement on the dynamics of the relation because, unlike any of the previously reviewed dynamic specifications for import demand, which are more or less arbitrarily chosen, this approach lets the data generating process itself determine the dynamics of the relation.

The procedure starts with a general dynamic autoregressive distributed lag class of models (ADL), completely unrestricted, and then restrictions are imposed sequentially to reach an economically sensible specification. The static and partial adjustment forms commonly employed in the traditional methodology are all nested, among other common forms, within the general ADL(1), and thus become testable through the testing of the restrictions each one imposes on the general form which may undergo several stages of model reduction. A general ADL(k_1,k_2 ,k_3 ,k_4, k_5 ,k_6) for the import relation would take the following form:

$$Md_t = \beta_0 + {}_{i=1}\sum{}^{k_1}\gamma_i Md_{t-i} + \sum\beta_{1(i+1)}Y_{t-i} + \sum\beta_{2(i+1)}PM_{t-i} + \sum\beta_{3(i+1)}Pd_{ti} + \sum\beta_{x(i+1)}X_{t-i} \qquad \text{(II.29)}$$

where X_t represents any additional explanatory variables besides the standard ones. We must note here that when dynamics are introduced into the specification the price homogeneity assumption becomes even more restrictive than in the static case, and hence even more severely attacked, because it further imposes symmetry in the dynamic response pattern of domestic (PD) and import (PM) prices.[1]

The same tests applied in testing for unit roots are used to test for cointegration. All procedures involve testing for the stationarity of the residual series representing the deviations from the long-run equilibrium relation. Thus the null hypothesis of unit root residuals is otherwise defined to be no cointegration versus the alternative hypothesis of cointegration. The Durbin-Watson statistic for testing cointegration is known as the CRDW statistic and it simply consists of computing the Durbin-Watson statistic on the residuals of the cointegration regression.[2] We should also note that for the DF and ADF test statistics the critical values of the cointegration tests depend heavily on the number of unknown cointegrating coefficients, in the cointegrating vector, estimated. In our case all cointegrating coefficients are unknown since the entire cointegrating vector is being estimated.

Failure to accept cointegration may reflect a fundamental misspecification in the model, possibly arising from the omission of one or more variables.[3] If we manage to establish a cointegration relation between the import demand on one side and the relevant explanatory variables on the

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[1] Urbain, op.cit., 238.

[2] Urbain, op.cit., 243.

[3] Reinnart, 1995, 299.

other, then we will avoid spurious regression and we will also be able to re-parameterize our specification in the form of an error correction representation, following the Granger representation theorem.[1]

The Granger Representation Theorem

Granger established the connection between error-correction mechanisms and the concept of cointegration in 1987, showing that every set of cointegrated series with stationary deviations from their long-run relation have an error correction representation and, conversely, every error-correction model must consist of a cointegrated set of variables.[2]

Due to lack of short-run disequilibrium theory, this modeling strategy for modeling the short run dynamics of import demand functions is considered an advancement in modeling strategies, as it takes into account the information provided by both economic theory and by the time series properties of the data. This is done by incorporating the deviations obtained from the long-run relation as an ECM into the short-run dynamics of the relation, which specifies each variable in first differences. This is given by:

$$ECM_{t-1} = Md_{t-1} - (\beta^*_1.Y_{t-1} + \beta^*_2.\ PM_{t-1} + \beta^*_3.\ PD_{t-1} + \beta^*_X.X_{t-1}) \qquad (II.30)$$

$$\Delta\ Md_t = \alpha_{11}.\Delta Y_t + \alpha_{12}.\Delta PM_t + \alpha_{13}.\Delta PD_t + \alpha_{14}.\Delta X_t + \alpha_2.ECM_{t-1} + U_t \qquad (II.31)$$

where u_t is the error term.

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[1] Charemza and Deadman, op. cit., 154.

[2] Ibid.

What is interesting about (II.36) is that it contains terms in levels, implicitly incorporated in the ECM term, and in differences as well. Thus, containing terms with different integration orders, the equation cannot be estimated directly using OLS. To start with, we must make sure that the ECM term is extracted from the correctly specified long-run cointegrating relation. Then we must examine the stationarity of the remaining variables present in the short-run relation when they are different from those present in the long-run cointegrating relation. Unless the variables in (II.35) are cointegrated, the ECM term will be *I(1)*. In this case, the parameter α_2, known as the short-run feedback coefficient, will have an estimated value tending to zero and OLS estimation would be both inconsistent and inefficient.[1] Otherwise, when the model is correctly specified, α_2 should be negative and less than one in absolute value.

An obvious implication which follows from the set of variables in (II.36) being cointegrated in the same time period is that they would also be cointegrated with a time lag. In other words, both (II.35) and (II.36) may contain lagged terms of one or more of the explanatory variables without fear of violation of the stationarity condition. Another implication is that if Md_t is cointegrated with the explanatory variables and all variables are individually *I(1)*, then either they must Granger cause Md_t or vice versa. This follows essentially from the existence of the error correction model, which suggests that, at the very least, the lagged value of one variable must enter the other determining equation.[2]

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[1] Urbain, op.cit.

[2] Cuthbertson, op.cit.,134.

The Engle-Granger method has been criticized on the ground that it is unable to identify the multiple cointegrating vectors among a set of variables and that it is sensitive to the normalization rule. It has also been criticized for its inability to test the significance of the parameter estimates using the usual t-statistics. This is due to the inconsistency of the standard errors of the parameters which arises from the use of non-stationary data. This drawback can be overcome if strictly exogeneous explanatory variables are used in estimating the cointegrating vector.[1]

The Johansen Multivariate Approach

The Johansen technique (1988, 1989), further developed by Johansen and Juselius (1991), provides a more powerful test than the Engle and Granger technique for the detection and estimation of the number of cointegrating vectors. It is also known to more fully capture the underlying time series properties of the data and it may be applied as a further check on the results obtained under the Engle-Granger technique.[2] This approach involves a maximum likelihood estimation procedure that provides two reliable test statistics namely, the λ-max and trace statistics. However, it should be stressed that the Engle-Granger and Johansen procedures are based upon different econometric methodologies and cannot be directly compared. While the Engle-Granger procedure is performed in a simple single-equation OLS framework, the Johansen procedure is performed in a VAR multi-equation framework.

Vector Auto-regression (VAR) is one modern version of structural multi-equation modeling. The Johansen procedure applies VAR to

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[1] Ibid., 138-139.

[2] Charemza and Deadman, op.cit., 201.

cointegrated series through a generalization of the Granger representation theorem. For cointegration inference, an unrestricted VAR(k) model can be re-defined in terms of first differences as follows:

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \ldots + \Gamma_{k-1} \Delta X_{t-k+1} + \Pi X_{t-k} + \varepsilon_t \qquad (II.32)$$

$$\Gamma_i = -I + \pi_1 + \pi_2 + \ldots + \pi_i \qquad (II.33)$$

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

$$\Pi = -(I - \pi_1 - \pi_2 - \ldots - \pi_k) \qquad (II.34)$$

$$\Pi = \alpha.\beta` \qquad (II.35)$$

where: Δ is the difference operator

X_{t-k} is a vector containing all the variables of the model which must all be integrated of the same order,

ε_t is a vector of random errors,

I is the unit matrix,

π_i is the matrix of original coefficients

β is the $N \times r$ cointegrating matrix consisting of r possible cointegrating vectors, $\beta_1, \beta_2, \ldots \beta_r$ $(r \leq N\text{-}1)$

α is the $N \times r$ feedback matrix measuring the speed of adjustment of a particular variable with respect to a disturbance in the equilibrium relation.

K is the lag length corresponding to the length of adjustment to a deviation from a long-run path.

"K" is determined such that it is large enough to avoid autocorrelated error terms but not too large to be economically inconsistent. Hence, if the estimated cointegrating vectors are similar for two VAR models with different lag lengths, we may choose the model with the shorter lag length, since it is usually assumed that these corrections occur after a relatively short period of time.[1]

Before undergoing any estimation, we must establish first that X_t is I(1), the same pre-estimating condition in the single equation framework. This model can be regarded as an error correction reparameterization with the matrix X_{t-k} forming a set of *r* error correction mechanisms. There are three possible cases for the rank of Π. If it is equal to *N* then the matrix is of full rank and the vector process is stationary. If the rank is equal to zero, then Π is the null matrix and the model reduces to a traditional differenced VAR model. If the rank is between *N* and zero then there is a possibility of cointegration. The Johansen technique is based upon estimating the factorization, $\Pi = \alpha.\beta'$. The cointegrating vectors can be estimated as the eigenvectors associated with the "*r*" largest and significant eigenvalues (roots) found by solving the polynomial equation:

$$| \lambda S_{kk} - S_{ko} S_{oo}^{-1} S_{ok} | = 0 \qquad \text{(II.36)}$$

$$S_{ij} = T^{-1} \sum_{t=1}^{T} R_{it} R'_{jt} \qquad \text{(II.37)}$$

(i, j = o, k)

[1] Ibid.

where: R_{ot} is the set of residuals from regressing ΔX_t on the lagged differences of ΔX_t

R_{kt} is the set of residuals from regressing X_{t-k} on the lagged differences

The solution yields the eigenvalues, $\lambda_1, \lambda_2, \quad, \lambda_N$ and the associated eigenvectors. Johansen has shown that the estimated eigenvectors, $v_1, v_2,..,v_r$ are the maximum likelihood estimates of the columns of β, the cointegrating vectors. Using the eigenvalues obtained from solving the above determinant, Johansen proves that one can test the hypothesis that there are at most *r* cointegrating vectors by calculating the following two likelihood test statistics known as *trace* and *λ-max* tests respectively:

$$-2LnQ = -T\sum^{N}_{i=r+1} Ln(1 - \lambda_i) \qquad (II.38)$$

$$-2LnQ = - Tln(1 - \lambda_{t+1}) \qquad (II.39)$$

where: Q = (restricted maximized likelihood)/(unrestricted maximized likelihood)

$\lambda_{r+1}, \ldots, \lambda_N$ are the estimates of the N-r smallest eigenvalues.[1]

The asymptotic distributions of these statistics are not given by the usual χ^2 distributions, but as multivariate versions of the Dickey-Fuller distribution. When the hypothosis of cointegration is accepted for a given

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[1] Oskooee, 1995, 3.

rank, r, such that $r \leq N-1$, linear restriction hypotheses on α and β can be conducted using likelihood ratio tests and using the usual χ^2 distribution as an approximation.[1]

iii. Empirical Findings of the Modern Approach

Already ECM's have been used in modeling the import demand behavior of both developed and developing economies through the Granger representation theorem and Johansen's multivariate approach. In a pioneering article by Urbain (1992) which emerged out of his Masters thesis (Urbain, 1988), ECM's were used in modeling the import demand of two small and open dependent European economies using both approaches. For both countries, Belgium and the Netherlands, traditional import demand functions for aggregate imports were specified in log-linear form, with real income, import and domestic prices. The three methodological approaches, traditional OLS, single equation Engle-Granger ECM and multi-equation Johansen ECM, were applied to each equation. The volume of imports, import and domestic wholesale price indices, and GDP were all found to be I(1), depending on the DF, ADF and DW statistics. For the Netherlands all specified long-run relations were found to be cointegrating relations and the most favored was the one imposing the price homogeneity assumption. For Belgium only the latter was accepted as a cointegrating relation. The second set of specifications were in the form of an ADL(2,2) for both countries with the order K being chosen such that it is not too high to lose degrees of freedom and at the same time it is high enough to take care of any possible autocorrelation which may be present in the error term. After solving for the

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[1] Johansen and Juselius, 1990, 168-178.

long-run equilibrium relations, applying a set of dynamic tests, cointegration was tested for and accepted. The final reparameterizations were in the form of error correction models where the lagged disequilibrium term is obtained from the traditional long-run specifications.

For the Netherlands some non-constancy of the parameters was observed. Short-run elasticity estimates for domestic prices and incomes was found to be higher than their long-run counterparts, while the short-run elasticity of import prices was found to be lower in the short-run than in the long-run for both countries. Import demand was found to be elastic with respect to income changes and inelastic with respect to price changes, with different values in the long-run and in the short-run. An interesting finding was that price homogeneity was not present in the short-run although it was accepted for the long-run. For both Belgium and the Netherlands, domestic price elasticity was greater in the short-run, with a value of approximately 0.72-0.74, as compared to 0.42-0.44. The feedback coefficient in the Netherlands' reparameterization implied a rapid adjustment towards the estimated equilibrium state with a value of approximately 0.72 while the converse is true for Belgium.

The third and final form of estimation is that of Johansens' approach to cointegration. The obtained specification for both the long-run and the short-run were in confirmation with those obtained earlier.

An odd result of the study is for the short-run elasticities of domestic prices to be higher than their long-run counterparts. The authors stress on the appropriateness of using these new econometric concepts in thoroughly evaluating policy tools such as devaluation and differentiating between their short-run and long-run dynamic effects. The inelastic import price elasticities are said to reflect the high intermediate and capital goods content of imports. On the other hand, the elastic demand with respect to income was interpreted as a natural consequence of the high import/income ratios for the two countries.

In another recent article, the role of the relative price of imports to domestically produced goods is investigated, with evidence taken from a set of developing countries which have recently experienced major devaluations in the values of their home currencies. This study of the quantitative response of imports and exports to a real exchange rate devaluation covers the period, 1968-92. The more recent literature which employs the modern methodology of cointegration and ECM's has brought with it evidence to support the role of a real devaluation in reducing the trade deficit in developing countries. The relations are derived in an imperfect substitutes framework, the import and export demand functions are derived from Cobb/Douglas utility functions. After adjusting the values using a small sample correction factor, cointegration was tested for using both the trace test and the λ-max test in each pair of equations. Sub-samples are taken from Africa, Asia and Latin America, with a total of twelve developing countries. In most cases the simple relationships were supported by the data. The main purpose behind this paper is to re-examine the role of relative prices in determining the import and export flows. For each country, a pair of equations is estimated in Johansen's VAR framework, which tests for the presence of one cointegrating vector. Relative prices were found to be significant in ten out of twelve case studies, after correcting for nuisance parameters arising from simultaneity and serial correlation. The author assumed that nominal devaluations are translated into real terms in all cases and circumstances which means that relative prices must change accordingly. This assumption is based on the evidence given by Edwards (1989) and it does not include any restriction on the duration of this real effect. Further, the restriction of unit price and income elasticities imposed by the Cobb/Douglas utility function is tested for and rejected in most cases. This was explained by either the presence of measurement error due to data approximations, which is highly likely, or by the inappropriateness of the Cobb/Douglas specification and the need for a less restrictive utility function.

The classical Marshall-Lerner condition for the effectiveness of devaluation is also tested for using the elasticity estimates from the import and export demand functions and is found to hold in most cases. However, this condition is criticized for being "static". An alternate "inter-temporal" condition involving the elasticity of substitution between the imported and home goods is merely mentioned in passing.

Regional and aggregate evidence on the effect of relative prices on imports and exports was extracted by pooling together countries within each geographical region. This has the advantage of avoiding small sample bias and highlighting the broader stylized facts that do not show in country-specific analyses. When this is done it is found that the income elasticity of import demand on average for developing countries is almost half the income elasticity with respect to export demand, as confirmed by previous findings in the literature. However, the author sees part of this significant difference to be a measurement error caused by overstating developing countries income and understating industrial countries income when income is measured by GDP, which excludes net factor incomes abroad. Africa was an exception with an income elasticity of export demand as low as the income elasticity of commodity content of exports in this region. Africa was also an exception with a higher than unity relative price elasticity. Perhaps these results would have been different if North Africa or the Middle East was factored out as a separate region. In the remaining cases, the low relative price elasticities suggest that large relative price swings are necessary to produce an appreciable re-allocation of demand from imports to domestic goods.

One drawback on this study is its negligence of the foreign exchange constraints which are known to be restrictive for developing countries and possible causes of parameter instability. This is particularly true for Morocco where significant non-tariff barriers were known to exist and were recently eliminated. It was not mentioned whether parameter stability was tested for or not. In fact, none of the dynamic model test statistics were mentioned.

Comparing the results obtained here from this methodology with those obtained by applying the traditional methodology in another recent study for a subset of common countries between the two studies and with not much difference in the period of study which is from 1966-1985 in the recent study, we find that both employ the log-linear form but obtain different long-run elasticity estimates. This is clear from the following table which shows how misleading elasticity estimates can be when the data are not corrected for non-stationarity.

Table (II.1) A comparison of price and income elasticities estimated by the traditional and the modern methodologies.

	PRICE ELASTICITY		INCOME ELASTICITY	
	Faini	*Reinhart*	*Faini*	*Reinhart*
Kenya	-1.48	-0.65	1.37	0.095
Morocco	-0.42	0.28	1.38	1.2
Indonesia*	-1.5	-0.93	1.02	1.62
Pakistan	-0.48	-0.4	0.76	1.15
Argentina	-2.1	-0.47	2.56	1.09
Brazil	-1.1	-0.55	0.63	2.76
Columbia	-0.52	-1.36	1.25	1.14

Source: Faini (1992), and Reinhart (1995)

When a cointegration relation between import volume and its "traditional determinants" cannot be established, then it is usually the case that extra explanatory variables are needed to more accurately specify the relation. It is likely for studies to face such a situation. An example of this is a study by Mah (1994) on Japanese import demand behavior in which the relevant time series were found to be non-stationary and non-cointegrated, even after detrending and incorporating a known structural break, once with relative prices and once with separated import and domestic prices. This led the author to conclude that market force variables cannot explain Japanese import demand well and that there exists a peculiar distribution system of the Japanese import demand that should be included.

* Note that cointegration did not obtain for the Indonesian specification.

Somewhat different from what we want to model, some studies apply the cointegration technique to investigate the relation between exports and imports. In one of these studies an attempt was made to examine the sustainability of the long-run relation between Iranian imports and exports through identifying their orders of integration and testing for the presence of a cointegration relation between the two. Stationarity is tested for using an ADF test statistic in which exports and imports are rendered I(1) processes. Next, cointegration is tested for using both the λ-max and trace likelihood ratio tests within the Johansen and Juselius framework where the hypothesis that there exists at most one cointegrating vector is accepted and the normalized cointegrating vector is estimated to give a slope value very close to one.[1]

It has been noticed lately that there is a trend to model the behavior of the trade balance as a whole rather than model the behavior of imports and exports separately. An example of such studies have been performed on India to see how devaluation improves the trade balance after testing the variables for stationarity and examining the possibility of cointegration. This particular paper seeks to find out which of the three, monetary, absorption or elasticity approach to the balance of payments India has been following in the adjustment of her trade balance for the period 1985-92. All the variables in the balance of trade specification are I(1), including domestic and world income, money supply and the real exchange rate. Income was estimated to positively affect the trade balance while world income affected it negatively,

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[1] Bahmani and Oskooee, 1995, 1-9.

a result supporting the dominance of the monetary approach. The instantaneous effect of devaluation on the trade balance was found to be large and positive. Since cointegration could not be accepted the model was transformed into a difference equation in levels. No attempt was made to re-specify the equation or add other explanatory variables in search of a cointegrating relation. In the end the trade balance was found to follow an "M-curve" in response to devaluation, and not the expected "J-curve" effect followed by most developing countries. It was also shown that in the long-run, devaluation has a neutral effect on the trade balance, from the zero value of the lagged coefficient estimates of the real exchange rate variable in the specification. This result is another feature of the monetary approach and thus gives it further support. It also contradicts previously obtained results from earlier studies which had not tested for stationarity and estimated the model straight-away.[1] This shows us the worthiness of these new concepts in modeling the behavior, as they may completely reverse the estimated results on which evaluation of a particular policy tool depends.

[1] Buluswar et al, 1996, 429-432.

Chapter III

LITERATURE REVIEW OF STUDIES PERFORMED ON THE EGYPTIAN ECONOMY

Most of the recent empirical studies that analyze Egyptian trade flows in general and import flows in particular have been designed to deal with one aspect or another of the various liberalization policies considered under ERSAP. They have applied more or less the same traditional econometric methodology outlined in the previous chapter with only minor variations. However, it may still be worthwhile to discuss these studies here in order to highlight the differences between them and to compare their results and the points they particularly emphasize. Another, rather old, study is also included with a view to shedding some light on how the approach and the methodology have developed over the years.

Among the empirical studies we review there are two which have recently emerged from the Egyptian National Planning Institute. The first study, by Saleh (1994), attempted to analyze commodity imports in Egypt for the period 1981/2-1993/4. The ordinary least squares method was used to estimate elasticities of demand for imports of consumer, intermediate, and capital goods, with calculated average annual growth rates of 15%, 17.4%, and 14.6%, respectively. Through this classical, too simplistic approach an attempt was made to forecast import flows in the near future. The author argued, on the basis of some rather simplistic calculations, that discouraging imports would contribute more to reducing the trade deficit than encouraging exports.

Bivariate linear import demand equations for the three groups were estimated to be as follows:

$$Mc_t = 479 + 0.088\ AC_t \qquad \text{(III.1)}$$
$$(15.7)$$

$$Mm_t = -963 + 0.1295\ GDP_t \qquad \text{(III.2)}$$
$$(21.3)$$

$$Mi_t = 648 + 0.253\ GDI_{t-1} \qquad \text{(III.3)}$$
$$(5.7)$$

Consumer imports(Mc_t) were taken as a function of aggregate consumption(AC_t), intermediate imports(Mm_t) as a function of GDP(GDP_t) and capital imports(Mi_t) as a function of gross domestic investment with a one period time lag(GDI_{t-1}). Even before going into the econometric pitfalls behind these specifications, basic micro economic theory tells us that they are too naive and lack a sensible economic interpretation. Midpoint elasticity estimates for consumer, capital, and intermediate goods were reported to be 0.91* , 0.87, and 1.1, respectively. These elasticities are with respect to the activity variables of course. The closeness of the elasticity estimates for the three import groups to unity and to each other makes us wonder if the real values are significantly different from unity and if their confidence intervals overlap with each other. It turns out that the null hypothesis that import demand is unit elastic could not be rejected for all three import groups, at the 1% significance level, given the

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* The elasticity of consumer imports using the author's data and for the same observation period was calculated by us to be 1.1 while the author reports it to be 0.91!

relatively small number of degrees of freedom. This automatically implies that there is an overlapping between the intervals for the three values. This makes us doubt that demand for one group is significantly more elastic than demand for the other, and we therefore hesitate to agree with the author's deduction that demand for consumer and capital imports is inelastic with respect to changes in aggregate consumption and gross fixed investment, respectively, based on the evidence obtained from his exercise.

Each activity variable is chosen to suit the particular import group, but the author acknowledges that decomposing the consumption variable into private and public consumption would have been more appropriate for the purpose of fitting meaningful functions of import demand. The data, however, were not available to him. It is not clear why both domestic and import price variables, or a ratio of both, were omitted from the three estimated equations. This omission prevented, of course, the generation of import price elasticities, and may have resulted in underestimating the income elasticities.

None of the variables used were adjusted for price changes. This causes two other limitations on the income or, more generally , activity elasticities obtained from the study. First, the activity elasticities as calculated from this relation are incomparable with economic theory, where activity elasticity of demand is defined in terms of import quantities or real values. Second, they provide a misleading measure of the degree of response of imports to real changes in the economy, which the author considered them to be.

Apart from the goodness of fit and the significance of the parameter estimates and the relation as a whole, no other test results were reported. Although the value of R^2 is very high, ranging from 92% to 98%, it is seen that the import demand relations are too simplified to provide acceptable forecasts. In fact, R^2 may be high simply because we are dealing with time series data and so the two variables in each bivariate function are growing together over time and, additionally, incorporate a common inflation rate. Thus R^2 is not sufficient by itself as a condition for the model to be well specified.[1] It may even reflect spurious regression.

Traditional problems of estimation were only briefly mentioned. Multicollinearity, as one popular econometric problem, was avoided, rather naively, through the use of only one explanatory variable in each equation, as the author says in justifying his specification, although it would have been possible to include a relative price variable and still avoid the problem. Other problems mentioned were serial correlation and how to incorporate dynamics, which were introduced into the specification for capital imports only.

Finally, after ex-post forecasting, short-run economic forecasting was performed under two alternatives. The first assumes a continuation of present trade liberalization policies. The second alternative assumes certain realizations of future growth rates for GDP, consumption, and investment that are necessary for approaching internal and external balance. Results for capital imports gave a forecasted average growth rate of 5.8% under the first alternative compared to a forecasted 7.7% under the second alternative. Both alternatives gave very close forecasted

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[1]Pyndick and Rubinfeld, 1991, 62.

growth rates for intermediate imports, while the forecasted average growth rate for consumer imports was reported to be higher under the first alternative (5.9%) as compared to the second (4.2%). The higher forecasted growth rates for capital imports and the lower forecasted growth rates for consumer imports under the second alternative were attributed to the desire of raising the growth rate of investment and achieving external balance at the same time, which required increasing capital imports at the expense of consumer imports.

The study concludes by stressing the availability of good opportunities for rationalizing intermediate imports which have the highest demand elasticity. Consumer imports may also be rationalized through rationalizing domestic consumption and promoting agricultural production even with a low elasticity of import demand. But we have seen that it is not necessarily true that intermediate imports have the highest elasticity. In fact all three groups could have equally elastic demand. So this conclusion is not very well justified.

The author considers his study to be only a stimulus for more detailed and disaggregated work on the subject and that it only sketches in a broad manner the behavior of imports at present and in the near future. He suggests further detailed analyses using further disaggregation to the commodity level in order to obtain more specific policy implications. We, however, believe that at the same level of aggregation used in this study or even with a completely aggregated demand function for commodity imports, more reliable results and better forecasts may easily be obtained by introducing other relevant explanatory variables, working with adjusted variables in constant prices, and dealing properly with possible nonstationarity and with violations of the regression assumptions. For example, for intermediate and consumer imports, we could specify the production levels of the import substituting industries as additional activity variables. Using a proxy to account for non-tarrif barriers and other quantitative restrictions and taking account of the foreign exchange constraint is also likely to improve the specification. If relative prices were used we could have easily incorporated the effect of devaluation on imports. The exclusion of these variables from the specifications and the use of current values in estimation are serious limitations to the analysis.

The second study (Abdel Salam, 1993) overcomes the previous limitations to some extent and is much more sophisticated. It attempts to analyze the effect of devaluation on the trade balance through its effect on imports. The author uses the elasticity approach and builds an econometric model of log-linear import demand functions for the period 1975-1988. Numerous trials are performed to choose from the various specifications, and import demand is more thoroughly analyzed than in the previous study. All variables used are measured in constant 1975 prices. Disaggregation is done on a wider scale, with imports divided into fuel, raw materials, intermediate goods, capital goods, consumer durable and non-durable goods. Import flows, as the dependent variable, are represented by respective import quantity indices for aggregate imports and its divisions.

The author differentiates between short run and long run elasticities through use of a time lag in the import price variable and the exchange rate variable. Neutrality of money, otherwise known as the zero homogeneity assumption, is considered to be unrealistic and may result in biased estimates of the elasticities which may not carry much meaning. Therefore, the real exchange rate is seen by the author as a more appropriate price variable than the ratio of import to domestic prices, which is frequently used in other studies as an approximation of the real exchange rate.

The activity variable used differed from one equation to another according to the import commodity group. GDP was used with aggregate imports, investment with capital imports, per capita income with imports of consumer durables, value added in manufacturing and mining with imports of raw materials and intermediate goods, while private consumption was used as an activity variable for imports of fuel and non-durable consumer commodities.

A number of equations were estimated, all of which were in the log-linear form. These were considered under two alternatives. The first alternative assumes that imports are in equilibrium and uses lagged values of import prices and exchange rates to account for long run behavior. This allows for both long run and short run elasticities to be estimated. The three equations estimated under this alternative are as follows:

$$\ln M_t = K + \alpha.\ln PD_t + \gamma.\ln PM_t + \delta.\ln RER_t + \eta.\ln Z_t + \ln U_t \quad \text{(III.4)}$$

$$\ln M_t = K + \alpha.\ln PD_t + \gamma_1.\ln PM_t + \gamma_2.\ln PM_{t-1} + \delta_1.\ln RER_t + \delta_2.\ln.RER_{t-1} + \eta.\ln Zt + \ln U_t \quad \text{(III.5)}$$

$$\ln M_t = K + \alpha.\ln PD_t + \gamma_1.\ln PM_{t-1} + \gamma_2.\ln RER_{t-1} + \eta.\ln Z_t + \ln U_t \quad \text{(III.6)}$$

where: K is a constant,

M_t is the import quantity index,

PD_t is the price of domestic substitutes in domestic currency,

PM_t is the dollar price of imports,

RER_t is the real dollar exchange rate in units of domestic currency adjusted for domestic and dollar inflation,

Z_t is the activity variable,

U_t is the disturbance term.

The best results were obtained from equation (III.6) with the signs of the parameters supported by economic theory. It is also the equation with the best fit. From this equation, short run elasticity of demand with respect to the real exchange rate was greater than one for all import groups except for capital and aggregate imports, while with respect to the import prices it was much lower. Thus it was deduced that a real devaluation would be more effective in rationalizing imports than a rise in import prices. We consider this result to be theoretically justified by a well-known economic fact that a nominal devaluation is not effective unless it is translated into real terms. As expected, problems of multicolinearity and serial correlation arise but no attempt was made to correct for either.

In explaining the small negative elasticities with respect to the activity variables, the author adopts Magee's point of view that in developing countries imports are simply derived as a residual of excess domestic consumption over domestic production and so when domestic production rises, demand for imports falls. She justifies this by her belief that there is still potential for further import substituting investments in the light manufactures, consumer industries and to a lesser extent in the more heavy industries. We disagree on this point of view because it implicitly assumes perfect substitutability between imports and domestic production which is not the case for Egypt. Also, the current trend of trade liberalization makes the possibility of further import substituting opportunities too weak to consider. This is because import substituting industries now face severe competition from the developed countries which makes it too risky for private investment to enter into new business.

In addition to this, an important point is made by acknowledging the inverse relation between activity variables and exchange rate devaluation. This is particularly for the value added in manufacturing and mining and investment variables. Thus collinearity exists between the exchange rate and the real income variables as well as between the price variables and each other. This has not been accounted for during estimation, so the influence of the real exchange rate on import demand is seen to be underestimated. In the long run a real devaluation is estimated to cause only a limited import response. This response differs in value from one import group to the other.

The second alternative is a stock adjustment model in the following form:

$$\ln M_t = \lambda K + \lambda\alpha.\ln PD_t + \lambda\gamma.\ln PM_t + \lambda\delta.\ln RER_t + \lambda\eta.\ln Z_t + (1-\lambda).\ln M_{t-1} + \lambda \ln U_t \quad \text{(III.7)}$$

where λ is the adjustment coefficient.

Results show that the cross price elasticity of demand with respect to domestic substitutes is higher than in the first alternative for all groups. However, they are negative for fuel imports, capital imports, and non-durable consumer imports. We may explain this by the strong complementarity between the domestically produced and imported goods of these particular groups. Price elasticity of demand with respect to import prices is positive in both the short run and the long run except for intermediate and aggregate imports. No justification was given for this but it seems a reasonable result for imports of non-durable consumption goods and raw materials, where national security priorities outweigh the impact of price changes. Similarly for imports of capital goods, fear of trend deceleration growth and idle capacity prevent such imports from responding to price changes. In these cases imports will continue to rise even if their prices rise significantly. Intermediate imports have negative elasticities because they are more easily substituted for by domestic production. Aggregate imports also have negative import price elasticity implying that the response of intermediate imports outweighs the response of the rest of the categories, given it has the highest share in aggregate imports. The elasticity of demand with respect to the exchange rate is insignificant and less than one in the short run. The response to import prices and exchange rates varies widely among the import groups and no general trend was detected.

No significant improvement is found under this specification except in the case of consumer non-durable imports. Also serial correlation was detected in all the estimated equations, and so the lagged import variable was replaced by a time trend variable and estimation was repeated. Again the trend variable did not carry the same importance in all equations but it proved significant and reduced the autocorrelation. It is not clear why the author used this method when she could have dealt with serial correlation without leaving the partial adjustment framework. Several alternatives are available in this respect. The most popular of these are the non-linear least squares method(NLS) or the Hildreth-Lu iterative procedure.

In the end the conclusion reached was that foreign exchange rate policy is relatively less effective on import demand than other policies such as import substitution policies, especially in the long run. We should also mention that a function specified in terms of the relative price of imports gave the most insignificant results of all and so the hypothesis that imports respond identically to import and domestic prices was rejected.

A third study, emerging from the Central Bank of Egypt in 1992, analyzed the behavior of commodity imports for the period 1981/82-1991/92 by estimating an aggregate import demand equation, using ordinary least squares, with the purpose of obtaining reasonable short-term forecasts for commodity imports.

The linear functional form was preferred to the log-linear form which was reported to give insignificant results. The inclusion of world inflation rates and population as explanatory variables in the specification also gave insignificant results. Gross national product, in constant prices, was used as an income variable while the dollar exchange rate was used as a proxy for the price of imports relative to the domestic price level which is common practice in empirical literature and is fairly acceptable assuming purchasing power parity of the exchange rate holds. The final estimated equation was given by:

$$M_t = -468.2 + \underset{(5.44)}{0.43GNP_t} - \underset{(-2.67)}{21.39NER_t} \qquad \text{(III.8)}$$

(t-statistics are in parenthesis)

where: M_t is the nominal value of imports in US dollars,

GNP_t is real gross national product,

NER_t is the nominal exchange rate of the US dollar in units of domestic currency.

One drawback on the study is the use of the current dollar value of commodity imports as the dependent variable without deflating by an appropriate index. Gross national product and the exchange rate were estimated to explain 82% of the variations in nominal imports. Income and price elasticity estimates at midpoints were reported to be 1.4 and -0.3, respectively. From this, the study concludes that imports respond very weakly to exchange rate changes due to the composition of imports over the study period, being mainly necessary consumer and intermediate goods, while the response to changes in GNP was relatively strong. However, a point must be made about the price elasticity of demand calculated in this study. Since the dependent variable is the "value" of imports, care must be taken that the price elasticity calculated from this specification is the value price elasticity and to deduce the price and income elasticities with respect to the quantity or real value of imports we must subtract one.[1] It is not clear whether the author has taken this into account or not. If not, then the price and income elasticity estimates would change to -1.3 and 0.4, respectively, which completely reverses the author's conclusion.

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[1]Goldstein and Khan, 1985, 1056.

All of the previous studies were solely concerned with analyzing import demand. We now consider studies which estimate the import demand relation within a macro economic structural model framework. In the first study by Ghazal (1989), estimation of the import demand function was part of a nine equation short-term macro economic model of Egypt for the period 1950-1982. Apart from the aggregate import demand equation there were five other behavioral equations for private consumption, investment, money demand, money supply and short term capital flows. There were also three identities in the form of a balance of payments constraint, a monetary base constraint and a gross spending constraint. All equations were specified in nominal terms. The author used both LIML and 3SLS estimation procedures. The aim of the study was to provide short-term forecasts for the key variables via a restricted reduced form for the model. Here import demand was specified as a function of import prices relative to domestic prices, implicitly assuming substitutability between imports and domestic goods. Choice of an activity variable fell upon GDP at current prices. The dependent variable used was the current value of imports, as in the previous study and in Saleh's study. The study also introduces a partial adjustment mechanism to take into account the disequilibrium behavior of imports. This partial adjustment framework introduces a geometric lag structure into the determination of imports. Domestic credit is included in the specification as a proxy for quantitative restrictions and as a measure of import capacity, since the less the credit available the smaller the imports will be. We note here that it is more common to use domestic credit as a proxy for capacity utilization.

A more popular proxy for quantitative restrictions often used in empirical literature is the foreign reserve level. Omission of this variable from the estimated equation for the particular case of developing countries causes a specification error and so biases the slope parameter estimates. The omission of this variable also yields an inconsistent estimator. Only when the omitted variable is uncorrelated with all the included explanatory variables in the relation does the bias disappear.[1] The inclusion of a proxy for quantitative restrictions in the specification is known in the literature as the Hemphill model.[2]

A different treatment for the presence of quantitative restrictions in the literature is specifying a first-order autoregressive error term to account for the presence of an omitted variable in the specification, as a source of the autocorrelation.[3] This treatment is valid only if quantitative restrictions vary over time in a serially correlated way.[4]

Unavailability of a consistent data series dating back to 1950 for PM led the author to use the exchange rate as a proxy for (PM/PD), under the assumption that purchasing power parity theory holds, as was done in the previous study. Both LIML and 3SLS estimation results were reported after checking the consistency of the parameter estimates. An additional time trend variable was added before estimation. The final estimated form for the import demand equation using the 3SLS method was given by: [*]

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[1]Pyndick and Rubinfeld, 1991, 163-164.

[2]Umo and Fakiyesi, 1995, 7-8.

[3]Khan, 1974, 678-693.

[4]Faini et al. 1992, 282.

[*] Notice that the lagged import term is missing from the equation but this is how it was reported!

$$M_t = -1101.02 - 451.6(PM/PD)_t + 0.27\ GDP_t + 0.66\ DC_t + 15.42T_t$$
$$(-3.44) \quad (3.19) \qquad (-4.42) \quad (6.25) \quad (3.29) \qquad (III.9)$$

where: M_t is the value of imports,

DC_t is the value of domestic credit,

T_t is a time trend variable.

All coefficients were significant and with the appropriate signs. The author interprets the highly significant domestic credit coefficient to be a reflection of the strong influence of the government on imports during the period of estimation. As expected, there is an inverse relation between the exchange rate and the level of imports. None of the elasticities were calculated and so there is no indication of the degree of response of import values to exchange rate variations. The performance of the import demand function in short-term forecasting was "quite good", the author claimed.

The most recent of our reviewed studies is a masters thesis which analyzes the effect of devaluation on both the trade balance and the inflation rate for the period 1976-1992, (Diab, 1995).

What is new about this study is that the author explicitly incorporates the three exchange rates, the two official rates and the black market rate, into the demand specification for aggregate imports. It is assumed that v_1 of imports are financed by the central bank rate(E_{01})and v_2 are financed by the commercial banks rate(E_{02}). What remains of imports will be financed at the black market rate (E_b). The estimated import demand function took the following form:

$$\text{Log } M_t = -2.67 - 0.54 \log q_{Mt} - 0.03 \log RER_t + 1.01 \log Y_t$$
$$(-1.47)\ (-3.02)\qquad (-1.32)\qquad (2.91)$$

$$- 0.13 \log R_{t-1}$$
$$(-2.85) \qquad \text{(III.10)}$$

$$RER_t = PM/PD \qquad \text{(III.11)}$$

$$PM = P^*M\{[v_1/(v_1 + v_2)]E_{01} + [v_2/(v_1 + v_2)]E_{02}\} \qquad \text{(III.12)}$$

$$q_{Mt} = E_b/\{[v_1/(v_1 + v_2)]E_{01} + [v_2/(v_1 + v_2)]E_{02}\} \qquad \text{(III.13)}$$

where: P^*M is the US wholesale price index,

Y_t is national income in constant prices,

q_{Mt} is the relative increase of the black market rate over the official rate,

R_{t-1} is the official international reserve level.

Here the purchasing power parity definition of the real exchange rate is used. The US wholesale price index is taken to represent the world inflation rate. Although this is a common practice in most studies, since the US has the highest share in Egyptian imports, it would be more accurate if a weighted average of the wholesale price indices or consumer price indices for the five or six major trading partners with the highest shares in imports is taken to represent the world inflation rate. It might also have been better to separate the real exchange rate into two variables, the official rate as one and the black market rate as the other, to investigate how the response of imports changes with the degree of overvaluation of the home currency. However, the relatively small sample size with so many explanatory variables would have constrained the author to do so. It would have been certainly better to push the starting date a bit further back especially since no particular reason for starting the series in 1976 was specified.

The capacity to import is also explicitly incorporated in the specification via the inclusion of the official level of foreign reserves, lagged one period. The dollar value of imports, in nominal terms, is used as the dependent variable, while real national income is used as the activity variable. Thus, the same point made about elasticity estimates in the Central Bank study applies here. This casts some doubt on the accuracy of the results obtained from studies which use a mixture of nominal and real values of variables in their specification.

The results obtained here are in line with the previous studies. Income elasticity of demand has the highest value of 1.01 as compared to a -0.3 price elasticity of demand. This is exactly the same value obtained in the study be the Central Bank of Egypt. Imports were found to respond very weakly and negatively to changes in the international reserve level with an elasticity of -0.03.

Goodness of fit is very high with the explanatory variables explaining 97% of the change in imports. Although this value is as high as the one in Saleh's study, the present specification is certainly more meaningful. The Durbin-Watson statistic is quite acceptable with a value of 2.14.

A rise of 1% in q_{Mt}, the ratio of the black market exchange rate to a weighted average of the official rates, is estimated to decrease imports by 0.54% . The real exchange rate is significant only at the 80% confidence level, while all the other variables are significant at the 98% confidence level.

The author attributes the low price elasticity of demand to the high intermediate and capital commodity content of imports, which are essential components in import substitution industries. Thus devaluation is seen as ineffective in rationalizing imports. Moreover, after estimating an export demand equation, the Marshall-Lerner condition was not satisfied since the sum of the price elasticities of import and export demand, in absolute value, did not exceed unity as the condition requires. The violation of this condition in both the short run and the long run was attributed to the structural rigidity of the foreign sector and so it was concluded that devaluation is not an effective policy for reducing the trade deficit.

The Annual Conferences for Egyptian Economists for 1991 and 1992 contributes to our review with three studies. Two were presented as part of the conference on Egypt's economic policies in the nineties and the third was presented the following year in the conference on liberalization policies.

In the first of these studies (Ghars El-Din, 1990), the author estimates an import demand function in the traditional log-linear form to obtain estimates of price and income elasticities and examine the Marshall-Lerner condition. The estimated equation, using 1970-1978 as the sample period, was given by:

$$\log M_t = -5.21 - \underset{(-1.95)}{0.23} \log(PM/PD)_t + \underset{(2.79)}{0.89} \log GDP_t \qquad \text{(III.14)}$$

This equation describes the behavior of manufactured imports only, as part of a simplified model of the Egyptian manufacturing sector. It should be noted that the value of imports is taken in constant prices while GDP is left in nominal values. |Again, a mixture of nominal and real values is used. The author's choice of the US wholesale price index as a proxy for the price of imports (PM) is questionable and so is the use of the Egyptian import price index as a proxy for the price of domestic substitutes (PD), which is inconsistent with other studies. Also, the very small sample period reduces the efficiency of estimation. Price and income elasticities are reported to be -0.23 and 0.89, respectively, with income and relative prices explaining 90% of the variations in manufactured imports. In his analysis the author argues that, in rationing imports, lowering the income elasticity of demand would be more effective than raising the price elasticity. This is more easily said than done.

The second study (El-Mehdy, 1990) divides imports into fuel and raw materials as one group, intermediate commodities, capital commodities and consumer commodities. The study is concerned with analyzing the balance of payments in the nineties depending on the structural changes that occurred during the period 1970-1989. Despite the presence of these structural changes, no dummy variables are included in the specifications. Bivariate demand equations were specified in linear form with only one activity variable. This reminds us of Saleh's specification except that here income is used as the activity variable for consumer imports, instead of aggregate consumption. Also in this study there is the additional import group fuel and raw materials.

Each equation, in linear form, is estimated using ordinary least squares to obtain the marginal propensities to import for each group. The marginal propensity to import proved to be the lowest for consumer goods(6%) and the highest for capital goods(35%), with intermediate imports in between(10%). The marginal propensity to import capital commodities was measured with respect to aggregate investment, while for the other two groups it was measured with respect to national income. So their values are not directly comparable with each other.

The reported R^2 values were quite high, ranging from 0.88 to 0.92. Still they are not as high as those reached by Saleh. No elasticity estimates were given and the reported data were insufficient for us to calculate them independently.

The author lays blame on the import substitution policy undertaken by Egypt, starting from the beginning of the fifties up to the mid-seventies, for the large increase in intermediate and capital imports. He concludes his study with a presentation of three alternate scenarios for predicting the balance of payments behavior during the nineties. This is done depending on the forecasted growth rates of the main components, imports and exports of both commodities and services, and transfers. The first scenario assumes no change in current policies. The second assumes more inward orientation, and the third assumes more outward orientation. The author analyzed the first two scenarios to result in a continuation of the balance of payments deficit and other structural imbalances. The third scenario, assuming a complete liberalization of the exchange rate, would lead to home currency devaluation and improve the balance of payments, despite low import price elasticities.

The third study, presented at the 16th Annual Conference for Egyptian Economists (El-Saka, 1991), focused on measuring the ability of the Egyptian economy to absorb and adjust to a price, exchange rate and interest rate liberalization shock. For this purpose a structural macro econometric model was built for the period 1950-1990. The model is composed of eleven behavioral equations for consumption, investment, public expenditure, public revenue, exports, imports, currency substitution (dollarization), money demand, the price level, subsidies and the exchange rate. The whole model is built on a partial adjustment disequilibrium mechanism. The import demand equation for the period 1950-1990, took the form:

$$\log M_t = i_0 + i_1.(\log NER_t + \log PM_t - \log PD_t) + i_2.\log Y_t + \log U_t \quad (III.15)$$

where: $\log [(NER_t .PM_t)/PD_t]$ is the real exchange rate.

Although dummy variables were used to account for wars in other equations, they were not used in the import equation. The author did not report which actual variables he used to represent M_t, PM_t, PD_t and Y_t, and whether they were in nominal or in real values. It is clear that he adopted the purchasing power parity definition of the real exchange rate. The income elasticity of demand for imports, i_2, was found to be 1.74 compared to a 0.44 income elasticity of demand for exports with respect to the world income level. This means that the growth in GDP will exert pressure on the trade deficit. On the other hand, the price elasticity of demand for imports was found to be less than its export counterpart*. In the end it was estimated that the average speed of adjustment of the balance of trade would reach approximately four time periods(years).

In this same conference, an important paper on effective protection was presented and cannot be passed without mentioning (El-Said, 1991). Defining the effective protection rate for a particular activity to be the relative rise (fall) in domestic value added over international market value added due to the presence of a particular nominal protective structure, the author compares pre-1986 with post-1986 effective protection rates for selected industrial and agricultural importables. A couple of findings are worth noting. First, the entire sample of agricultural importables was found to suffer from negative effective protection in varying degrees and it appears that effective protection under the new foreign trade policies is improving for traditional staple crops in particular, such as wheat and rice, although they have remained negative after the 1986 tariff revisions. This amounts to a hidden taxation on these activities.

All the manufactured importables in the sample were found to be effectively protected by the tariff structure alone. But when the rest of the liberalization measures are added, this turns into an effective taxation (negative effective protection), except in the cases of the cotton spinning and tomato processing industries.

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* The price elasticity of demand for exports was reported to be 0.72 while the price elasticity of demand for imports was not reported at all.

This study bears some resemblance to another influential joint piece of work between Kheir El-Din and El-Dersh(1991). However the latter gives a more general overview and detailed analysis of the components of foreign trade policy since 1986, including the tariff revisions, exchange-rate reform, elimination of non-tariff barriers and improvement of export incentives. Non-tariff barriers in particular were discussed in length up to the finest details. Effective protection was analyzed in a similar way to that in the above study with the addition of calculating rank correlation coefficients of effective protection rates with nominal rates and the production coverage of non-tariff barriers as a whole and import bans, respectively, before and after the new Executive Regulations for the Administration of Imports and Exports (ERAIE) were applied in 1991. The only high and significant correlation coefficients were with nominal protection rates, with a value of 0.51, and with import bans before the ERAIE, with a value of 0.84. Effective rates were found to be higher than their nominal counterparts except for the tobacco processing and cotton ginning industries. Also, a comparison was made between effective protection rates in 1991, after they had been considerably reduced by the recent liberalization measures, and their counterparts in 1959, prior to the central planning era, for selected industrial activities. They were found to be significantly higher than in 1959 for most of the activities. We should note that effective protection rates in this study are measured with respect to the tariff structure alone, to avoid the inaccuracies that are expected to arise when non-tariff barriers are taken into account.

The last and oldest of our reviewed studies is a master's thesis estimating an econometric model of import and export demand for the economy, for the period 1959-1976 (Fahmy, 1979). Focusing on the import demand part of the model, it appears that the specification of the import demand function and the estimation methods are no different from those employed in the recent studies.

Egypt was taken as a representative of developing countries to examine the validity of the assumption that the demand for imports of a developing country is determined by non-market forces. In other words, by what degree does it respond to price changes. This hypothesis was tested separately for each of the consumer, intermediate and capital commodity imports, using simultaneous equation estimation procedures to allow for the endogeneity of the price variable. For each import category, an import supply and demand equation was specified in log-linear form. For import demand, the ratio of import prices to domestic prices was used as the price variable and real per capita GDP was used as an activity variable for consumer imports, while investment was used as an activity variable for imports of intermediate and capital goods. Quantity of imports, as the dependent variable, was also used in per capita form. This has the advantage of incorporating the effect of population growth on import demand. Disequilibrium behavior was incorporated in the model through a partial adjustment framework, as is popular with most studies up to the most recent ones. Relative import prices, the world price level and world income were specified as determinants of import supply. It was reported that 2SLS and IV methods produced estimates quite close to each other.

With the data series ranging from 1959-1976, the three import demand equations were given by:

$$\log Mc_t = 10.2 + 1.58 \log (PM/PD)_t - 3.698 \log Y_t + 1.29 \log M_{t-1} \quad \text{(III.16)}$$

$$\log Mm_t = -2.61 - 1.52 \log (PM/PD)_t + 0.94 \log Y_t - 0.55 \log M_{t-1} \quad \text{(III.17)}$$

$$\log Mi_t = 9.15 - 2.17 \log (PM/PD)_t + 0.27 \log Y_t + 0.4 \log M_{t-1} \quad \text{(III.18)}$$

Autocorrelation was detected and the correlation coefficient was roughly calculated to be very close to unity. The presence of autocorrelation was seen to reflect the omission of quantitative restrictions from the specification, as relevant variables for the estimation of import demand in a developing country.[1] They were also seen to reflect the presence of bilateral trade agreements between Egypt and the U.S.S.R, at the time, which were unaccounted for in the specification.

For consumer imports, only the lagged value of imports proved significant as an explanatory variable and as seen from the equation, price and income elasticities also had the wrong signs. No explanation was given for this and no attempt was made to improve the specification. Conversely for intermediate imports, only price and income elasticities were significant and had the right sign. Price and income elasticities for

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[1]Khan, 1974, 678-693.

this group were estimated to be -1.5 and 1, respectively. Imports of capital goods had an even higher price elasticity of -2, while the income elasticity was only 0.3 and not significant. Thus the hypothesis that relative prices do not influence the import flows of a developing country could not be rejected only for consumer imports. The author did not calculate the long run elasticities, but built his analysis only on the short run elasticities. If we calculate these independently; the price and income elasticities of demand would be, respectively, -5.45 and 12.75 for consumer imports, -0.98 and 0.61 for intermediate imports and-3.6 and 0.5 for capital imports. We notice that the long run elasticities for consumer imports change to the right signs although their values are too high to be relied upon. For intermediate imports, the long run elasticities are lower than their short-run counterparts which is opposite of what theory tells us. For imports of capital goods, the long run elasticities of demand seem consistent with the short run estimates. It was expected that the author would have included a dummy variable to account for the change in regime, from the planned to the open-door policy.

The above studies use traditional estimation techniques to analyze import demand, from simple ordinary least squares to more complicated 3SLS and LIML methods. The choice between single equation and simultaneous equation estimation techniques was mainly based upon whether the price variable is regarded as endogenous or exogenous. Specifications in log-linear form were generally preferred to those in linear form. All studies which have accounted for disequilibrium behavior used the partial adjustment mechanism since it is the easiest to work with, as opposed to other, less restrictive, dynamic specifications.

In those specifications which have not accounted for the presence of quantitative restrictions, the stability of the elasticity estimates is strongly doubted, especially when these restrictions vary over time. The reason for our doubt is that, in one cross country study, the traditional import demand specification for Egypt, estimated by OLS, failed both subsample and postsample tests of stability for the period, 1961-1985.[1] Thus it is suggested that we test for the stability of the parameter estimates before calculating elasticities, and if they are found to be unstable the specification needs to be extended to account for quantitative restrictions in one way or another. However, none of the reviewed studies ignoring the presence of the foreign exchange constraint have reported any stability tests for their estimates or even mentioned this point.

All reviewed studies had some weak point(s) or other in their specification. Most of them made the mistake of using nominal values of the import and activity variables. Only three out of nine studies accounted for quantitative restrictions, each using a different proxy. There is no conflict between the results obtained from the different studies starting from 1979 to 1995, with the exception of the last study. They all agree on the weak response of import demand to price changes compared to the stronger response to real changes in the economy, represented by the activity variables. The exceptions were for capital and intermediate imports. This may be attributed to the fact that this study uses a more historical time series and so we may speculate that capital and intermediate

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[1]Faini et al, 1992, 282-292.

imports were more responsive to their own price changes during the sixties and the first half of the seventies as compared to the second half of the seventies, the eighties and the early nineties. None of the studies bothered to calculate confidence intervals for their elasticity estimates. Studies which incorporated devaluation in the analysis concluded that it was ineffective in rationalizing imports with the exception of El-Mehdy's study which concluded that the effectiveness of devaluation is conditional upon the complete liberalization of the economy. As for its effectiveness on the trade balance as a whole, we comment that it is not as straightforward to analyze. Evidence from LDC's shows that the relation between the trade balance and devaluation follows a "J curve" path over the short run.[1] But, apparently, Egypt does not follow this same path. In one cross country study performrned over the period 1973-1995, Egypt, among others, was found to follow an "N curve" path showing that the trade balance improves immediately after the devaluation with respect to the real exchange rate, deteriorates for a while then starts improving again. This is in the short run. In the long run the relation was normally found to be positive.[2] This is not quite substantiated by the conclusions drawn from the studies reported here on Egypt because, apart from not taking the real effective exchange rate into account, they contain serious economic and econometric defects.

We finally note that most of the reviewed studies analyzed import demand relations for forecasting purposes. This is probably because being able to predict import flows more accurately can help policy makers assess

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[1]Himarios, 1989, 143-168.

[2]Oskooee et al, 1992, 641-652.

more confidently the overall sustainability of an adjustment program, determine the appropriate speed of the trade liberalization process, and avoid the possibility of unexpected foreign exchange constraints jeopardizing the adjustment effort.[1]

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[1]Faini et al, 1992, 282.

Chapter IV

THE MACRO ECONOMETRIC IMPORT MODEL

A. Assumptions of the Model

The model is built in an imperfect substitutes framework which is seen most suited to the composition of total commodity imports and to the capital imports group. Within this framework we apply the Hemphill model (1974) to investigate the import demand relation, by explicitly including an indicator of import capacity in the linear, log-linear, and per capita forms of the relation. Import capacity is assumed to vary inversely with quantitative restrictions imposed on imports, so by including it in the specifications we implicitly account for the presence of quantitative restrictions on commodity imports.

We will be working under the basic assumption of an infinite elasticity of supply for both total commodity and capital imports. This implies exogenous import prices and makes estimation using single equation methods possible. This assumption is derived from the more general small country assumption which is seen applicable to the Egyptian economy which is considered a price taker in the international market for commodity imports. Also, there is no one dominant source for our commodity imports, which would reduce the supply elasticity for imports.

The use of the log-linear form in estimation implicitly assumes that all elasticity estimates are constant, while the use of the linear form implicitly assumes that price elasticities are decreasing and that income or activity elasticities approach unity.[1]

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[1] Boylan et al., op.cit., 561.

The estimation period is from 1974 to 1995, corresponding to the liberalization period of the foreign trade sector. Annual observations are used, with all real variables in constant 1987 prices and price variables in index form, also to the base 1987. The observations for 1994 and 1995 are not available for some series and hence are constructed, keeping in mind the consistency of the series.

B. Empirical Estimation

i. Integration Analysis

Before undergoing the cointegration analysis it is necessary to closely examine the stationarity of all the variables which are possible candidates in our model. Results of the unit root tests are summarized in table (IV.1). We apply the Dickey-Fuller test statistic and, if autocorrelation is detected, the augmented Dickey-Fuller statistic as well. Our test equation includes a drift term to start with which is eliminated when insignificant. The calculated statistics are compared to the Mackinnon (1991) critical values.

Aggregate commodity imports are accepted as an I(1) process at the 5% significance level . Non-stationarity could only be corrected for by differencing , even after augmentation. Differencing took care of the autocorrelation. Likewise for capital imports. GDP in both its original and per capita form is accepted as an I(1) process at the 5% level. Augmenting was not necessary. GDP growth, however, is found to be stationary at the 5% level without any treatment. The import capacity variable, in per capita form is accepted as a stationary process, after accounting for serial correlation and at the 10% significance level. A logarithmic transformation allows us to accept stationarity of the series at the 5% level. The WSP series shows signs of autocorrelation which disappeared through first differencing. The series could only be accepted as an I(2) process . Likewise for the WWSPCM series. Although AMPI is accepted as an I(1) process and WSP is I(2), PR is found to be I(1). The CMPI series showed signs of autocorrelation which was still present after differencing. The series is accepted as I(2) in its original form and I(1) in its logarithmic form. PRC is I(1), like PR, although both CMPI and WWSPCM are accepted as I(2). This may reflect the cointegration of the two series. A possible explanation for the higher integration order of WSP and WWSPCM is that these indices are constructed such that they incorporate import prices. This serves as an additional source of external non-stationarity. Both PR and PRC are I(1) in logarithmic form. While the RCER becomes stationary through a logarithmic transformation at the 10% level, the RWER becomes stationary only through first order differencing. GFCF is accepted as I(1) at the 5% level in its original form and becomes stationary through a logarithmic transformation at the 10% level. GFCFG is originally stationary at the 10% level.

To sum, stationarity was induced by a stochastic detrending of the series in levels in most cases and through logarithmic transformations in a few others. Deterministic trends were rarely present. Most series accepted as I(1) processes at the conventional significance levels of the Mackinnon critical values and at higher significance levels by comparison to simulated critical values by Blangiewicz and Charemza (1990), were also accepted as random walk processes. There is no fear of over differencing, since all series did not require differencing more than once, except for WSP and WWSPCM, and the test statistics showed no signs of overdifferencing.

These test results are in line with those of other empirical studies in both developed and developing countries. The non-stationarity of the series during the study period could be accounted for by the adverse change in external conditions in the mid-eighties which, spread all over the economy, and the price, interest rate and trade liberalization starting in 1991.

Table (IV.1): Unit Root Test Results

Variable	Dickey-Fuller Statistic	Variable	Dickey-Fuller statistic
AMC	-1.04	PCMCAP	-2.99 (10%)
Δ AMC	-3.36 (1%)	LPCMCAP	-3.09 (5%)
LAMC	-1.47	AMPI	0.37
Δ LAMC	-4.11 (1%)	Δ AMPI	-2.21 (5%)
PCAMC	-1.91	LAMPI	-0.33
Δ PCAMC	-3.89 (1%)	Δ LAMPI	-2.59 (5%)
LPCAMC	-1.91	WSP	-0.55
Δ LPCAMC	-4.12 (1%)	Δ WSP	-1.71
CMC	-2.22	Δ^2 WSP	-6.42 (1%)
Δ CMC	-3.29 (5%)	LWSP	-1.88
LCMC	-2.40	Δ LWSP	-3.1 (5%)
Δ LCMC	-3.51 (5%)	CMPI	0.82
GDP	-0.07	Δ CMPI	-2.59
Δ GDP	-4.27 (1%)	Δ^2 CMPI	-4.88 (1%)
LGDP	-1.77	LCMPI	-2.22
ΔLGDP	-3.45 (5%)	Δ LCMPI	-2.93 (10%)

Table (IV.1): (continued)

Variable	Dickey-Fuller Statistic	Variable	Dickey-Fuller Statistic
PCGDP	-1.44	WWSPCM	-1.72
Δ PCGDP	-3.79 (5%)	Δ WWSPCM	-1.91
LPCGDP	-1.76	Δ^2 WWSPCM	-4.82 (1%)
Δ LPCGDP	-3.58 (5%)	LWWSPCM	-1.22
GDPG	-3.45 (5%)	Δ LWWSPCM	-2.7 (10%)
GFCF	-1.85	PR	-1.66
Δ GFCF	-3.5 (5%)	Δ PR	-3.96 (1%)
LGFCF	-2.69 (10%)	LPR	-1.62
GFCFG	-3.21 (5%)	Δ LPR	-3.83 (1%)
PLGFCFG	-3.08 (5%)	PRC	-1.35
MCAP	-1.39	Δ PRC	-3.77 (5%)
Δ MCAP	-3.96 (1%)	LPRC	-1.41
LMCAP	-3.18 (5%)	Δ LPRC	-3.85 (5%)

Table (IV.1) (concluded)

Variable	Dickey-Fuller Statistic
RWER	-2.28
Δ RWER	-5.27 (1%)
LRWER	-2.47
Δ LRWER	-5.32 (1%)
RCER	-2.64
Δ RCER	-6.68 (1%)
LRCER	-2.75 (10%)
POP	-1.28
Δ POP	-4.01 (1%)

Notes:

- The significance levels at which the statistics are rejected are in parenthesis.
- The symbol Δ denotes first differences and Δ^2 denotes second differences of the specified variable.

ii. **Cointegration Analysis**

With almost all variables not exceeding first order integration, the possibility of establishing a cointegrating relation for import demand behavior is high. A number of relations are specified and tested for using the Engle-Granger and Johansen procedures.

The "standard" specification is taken as a starting point for each of total commodity and capital imports.

Aggregate Commodity Imports

On average, commodity imports comprised 73.4% of total imports of goods and services during the estimation period, with a low of 51% in 1979 and a high of 97% in 1987. The standard relation which specifies imports in terms of gross income, domestic prices and import prices, could not be accepted as cointegrating at all. Specifically the domestic price variable was used in first differences of the levels and in log form, as I(1) transformations of the series, but was not significant in any of the specified relations. This may be because the wholesale price index is not an adequate representative of domestic prices because it includes import prices and prices of non-tradables. PR was also found insignificant in most specified relations.

Out of five relations accepted by the Engle-Granger procedure, only two found support from the Johansen procedure, one of which produced completely different estimates. Both relations are in per capita form. It was thought best to incorporate the population variable in this way.

Relation 1

The following long-run cointegrating relation was obtained by the Engle-Granger procedure:

$$LPCAMC_t = -1.45 + 1.58LPCGDP_t + 0.344LPCMCAP_{t-1}$$
$$(-2.17)\ (6.16)\qquad (2.81)$$

$$0.156LAMPI_t - 0.732LPCGDP_{t-1} \qquad \text{(IV.1)}$$
$$(-3.94)\qquad (-3.03)$$

(t-statistics are in parenthesis)

$R^2 = 0.91$ $\bar{R}^2 = 0.89$ $DW = 1.63$ F-statistic = 41.44

There was no support by the data for the partial adjustment mechanism so often used in traditional studies. All variables in the relation are I(1) except for LMCAP, which is I(0). The data appears to fit the specification reasonably well. Although the goodness of fit and adjusted goodness of fit coefficients are not as high as those obtained in traditional studies, they are more reliable. If RWER or PR are used as price variables instead of AMPI they are not significant and worsen the regression results as a whole. If we solve for the equilibrium relation, we obtain:

$$LPCAMC^* = -1.45 + 0.847LPCGDP^* + 0.344LPCMCAP^*$$
$$- 0.156LAMPI^* \qquad \text{(IV.2)}$$

Re-estimating this relation for the pre-ERSAP period, 1974-91, does not change results significantly, which gives us confidence in the stability of the parameter estimates and implies that the recent import-liberalization measures have not changed the response of imports to its major determinants.

The error-correction mechanism as obtained from the above equilibrium relation was found to be significant at the 10% significance level by comparison to the Mackinnon critical values. Incorporating this error-correction term into the short-run dynamics of the relation, we obtain the following relation, re-parameterized in first differences:

$$\Delta LPCAMC = \underset{(7.74)}{1.58}\ \Delta LPCGDP_t + \underset{(2.53)}{0.33}\ \Delta LPCMCAP_{t-1} - \underset{(-2.12)}{0.22}\ \Delta LAMPI_t - \underset{(-4.36)}{0.85}\ ECMPC3_{t-1} \qquad (IV.3)$$

$R^2 = 0.82 \quad \bar{R}^2 = 0.79 \quad DW = 1.72 \quad F = 24.23$

and for the 1974-91 period, the same relation is estimated to be:

$$\Delta LPCAMC = \underset{(8.38)}{1.55}\ \Delta LPCGDP_t + \underset{(2.68)}{0.35}\ \Delta LPCMCAP_{t-1} - \underset{(-2.29)}{0.22}\ \Delta LAMPI_t - \underset{(-4.06)}{0.92}\ ECMPC3_{t-1} \qquad (IV.4)$$

$R^2 = 0.85 \quad \bar{R}^2 = 0.81 \quad DW = 1.95 \quad F = 22.26$

where; ECMPC3 is the residual obtained from the above equilibrium relation.

As in the long-run relation, there are only minor discrepencies in the parameter estimates in the two periods, with a higher feedback coefficient in the second case.

We re-estimate this same model by the Johansen procedure in a partial system equation framework by taking AMPI as exogenous to the system. Since the λ-max and trace statistics are not clear-cut and critical values are said to be only approximated in the case of small-samples and in the presence of exogenous variables, it is safer to experiment with one and two cointegrating vectors. Both one and two cointegrating vectors may be accepted at the 99% of the trace statistic. Whether we choose one or two vectors, the first vector is the most preferred from an economic point of view and it is the most consistent with the Engle-Granger estimates, where we obtain similar elasticity estimates in the long-run, but completely different estimates in the short-run. Whereas the DW statistic lies in the inconclusive range in both the long-run and short-run relations of the Engle-Granger procedure, the LM statistic for first order serial correlation under Johansen accepts no serial correlation with a probability of 100%. The estimated feedback coefficient is also very close under both procedures. It is very high, implying that imports return to their estimated equilibrium state very rapidly. The differences in the short-run estimates could be attributed to the difference in the lag structure of the short-run relations in both cases. As we know, the Johansen procedure imposes an identical lag structure on all the variables present in the relation, whereas under the Engle-Granger procedure we do not impose an identical lag structure on all the variables. It could be additionally attributed to the bias produced by the single equation framework. The short-run elasticities obtained under the Johansen procedure appear to be more consistent with their long-run counterparts. With regard to the long-run estimates, the import price elasticity is the lowest and the activity elasticity is the highest, but it does not reach unity. These estimates are lower than those obtained under the recent studies but they bear the same relation to each other. Results of the Johansen procedure are summarized in tables (IV.2) and (IV.4), and long-run and short run elasticity estimates are summarized in tables (IV.5). and (IV.6), respectively.

<u>Relation 2</u>

The second long-run cointegrating relation obtained in per capita form is:

$$PCAMC_t = \underset{(-0.88)}{-26.75} + \underset{(8.94)}{0.31PCGDP_t} + \underset{(3.99)}{0.62PCMCAP_t} - \underset{(-4.05)}{0.38AMPI_t}$$

$$\underset{(-2.18)}{-1.01RWER} \qquad \text{(IV.5)}$$

R^2=0.87 $\quad \bar{R}^2$=0.84 $\quad$ DW=1.7 $\quad$ F=29

Only the constant term is insignificant in this relation. For the first time two price variables are found significant in determining import demand behavior. If AMPI is deleted, regression results worsen and the relation is no longer cointegrated. Since there are no lagged explanatory or dependent variables in this relation, it is also the long-run equilibrium relation from which we derive the error-correction term, ECMPC1. This term is found to be stationary at the 5% significance level and so we accept cointegration at this level. Incorporating ECMPC1 into the short-run dynamics of the relation, we obtain:

$$\Delta PCAMC_t = \underset{(6.88)}{0.43\Delta PCGDP_t} + \underset{(2.23)}{0.34\Delta PCMCAP_t} - \underset{(-2.34)}{0.57\Delta AMPI_t}$$

$$- 0.77\Delta RWER_t - 0.89ECMPC1_{t-1} \quad (IV.6)$$
$$(-1.97) \qquad (-4.29)$$

R^2=0.79 $\bar{R}^2$=0.74 DW=1.6 F=15.1

It is noticed that the same variables found significant in the long-run are also found significant in the short-run. The feedback coefficient is extremely high here, as in the previous relation. Estimates of the long-run and short-run elasticity estimates at midpoints are summarized in tables (IV.5) and (IV.6), respectively. The long-run estimates as obtained here are much higher than their counterparts in the previous relation with the exception of the AMPI elasticity, which is very close in both cases. The short-run elasticity values are also found to be much higher than their long-run values, again contradicting theory. From this procedure the RWER appears to be more effective than AMPI as a price variable, in determining import demand. To check on these results, we re-estimate this model by the Johansen procedure. From the beginning only AMPI is taken as exogenous to the system, as in the previous relation. Estimation results are summarized in tables (IV.3) and (IV.4). Again because the critical values are approximated, we consider both one and two cointegrating vectors. We reject the hypothesis of one cointegrating vector because the parameter estimates differ widely from those obtained under the Engle-Granger procedure and so it is likely that there exists more than one cointegrating vector. We accept the hypothesis of two cointegrating vectors at the 90% level of the λ-max statistic and the 95% level of the trace statistic. The LM statistic for first order serial correlation is accepted with a probability of 87%. By choosing two cointegrating vectors and considering only the first vector, being the more economically reasonable, we obtain completely different results for most of the long-run estimates. They are found to be equal for AMPI, the only exogenous variable in the system, and much lower for the remaining variables. These estimates are reasonably close to those obtained under relation 1. Short-run elasticities with respect to AMPI are also equal under the Johansen technique for both relations. PCGDP elasticities are quite close but there is a major difference in the PCMCAP short-run elasticity. Although it doesn't show in the Engle-Granger estimates, the feedback coefficient seems to have been affected by the inclusion of the RWER, which led to a slowing down of the adjustment process. It appears that the short-run parameter estimates are more sensitive to changes in the estimation procedure than their long-run counterparts.

<u>Capital Commodity Imports</u>

Capital imports comprise 20-25% of total commodity imports, of which over 50% are machines and transportation equipment, on average. The most acceptable long-run Equilibrium cointegrating relation for capital imports is in the log-linear form and it is obtained from the following estimated equation:

$$LCMC_t = \underset{(-0.85)}{-1.77} + \underset{(1.9)}{0.53}\, LMCAP_{t-1} + \underset{(2.38)}{0.74} LGFCF_t - \underset{(-2.02)}{0.53} LCMPI_t$$

$$+ \underset{(3.5)}{0.538} LCMC_{t-1} + \underset{(1.98)}{0.48}\, LCMPI_{t-1} - \underset{(-1.89)}{0.65} LGFCF_{t-1} \qquad (IV.8)$$

$R^2 = 0.88$ $\bar{R}^2 = 0.83$ DW=2.12 F=17

Solving for the long-run equilibrium relation, we obtain:

$$LCMC^* = -1.77 + 0.2\ LGFCF^* + 1.14LMCAP^* - 0.1LCMPI^* \tag{IV.9}$$

From this Equilibrium relation, the error-correction term is found to be stationary at the 5% level and thus we accept the cointegration of this relation at that level. After incorporating the error correction term into the short-run dynamics of the relation for Capital Imports, we obtain the following result:

$$\underset{}{\Delta LCMC_t} = \underset{(-4.57)}{-1.28} + \underset{(3.24)}{0.81\Delta LGFCF_t} - \underset{(-4.2)}{0.72\Delta LCMPI_t} \underset{(-5.96)}{-0.69ECMC_{t-1}} \tag{IV.10}$$

R^2=0.76 $\bar{R}^2$=0.72 DW=1.88 F=17.13

No autocorrelation is detected through the DW statistic of the short-run equation. The stock-adjustment model is supported by the data in the long-run only, and import capacity is found insignificant in both current and lagged values in the short-run. In the long-run, capital imports are found to respond to import capacity with a lag. The elasticity estimates found here are larger than their long-run counterparts, which cannot be explained by theory.

Re-estimating this relation using the Johansen procedure and taking the capital imports price index as exogenous to the system, we can only accept the presence of two cointegrating vectors at the 99% level of the trace statistic. The first cointegrating vector produces the wrong signs for the parameter estimates so we consider the second vector only. Results are summarized in tables (IV.7) and (IV.8). They imply that the Engle-Granger single equation method is inappropriate for the modeling of import demand behavior of capital imports. Long-run and short-run elasticity estimates are very different from those obtained above. The long-run elasticity of capital imports with respect to import capacity is the highest of all and is higher than the Engle-Granger estimates. The GFCF and CMPI elasticties are also higher than their Engle-Granger counterparts. Results are summarized in tables (IV.9) and (IV.10). The feedback coefficient is also much lower under Johansen's procedure. Short-run estimates are more consistent with their long-run counterparts, as compared to the Engle-Granger estimates. Under Johansen's procedure MCAP remains significant in the short-run.

Table (IV.2) Results of the Johansen Procedure for Relation (1) of Aggregate Commodity Imports

k=1			
Eigenvalues			
	0.7437	0.4206	0.2562

Cointegrating Vectors (β)			
LPCAMC	-7.581	-5.246	-2.119
LAMPI	0.92	-1.96	-0.862
LPCGDP	-5.811	6.977	5.772
LPCMCAP	-1.786	7.425	-1.920

Testing The Number of Cointegrating Relations (r)						
Statistic			Critical Values (Johansen & Nielson, 1993)			
λ-max	trace		λ-max	trace		
		H_0	90%	90%	95%	99%
			Quantiles			
28.59	46.27	r ≤ 0	13.39	26.7	29.38	31.76
11.46	17.68	r ≤ 1	10.6	13.31	15.34	19.69
6.22	6.22	r ≤ 2	2.71	2.71	3.84	6.64

Table(IV.2) concluded

The Normalized Long-run Cointegrating Vector (r=1)			
LPCAMC	LAMPI	LPCGDP	LPCMCAP
1.0	0.121	-0.767	-0.236

The Normalized Long-run Cointegrating Vector (r=2)			
LPCAMC	LAMPI	LPCGDP	LPCMCAP
1.0	0.121	-0.767	-0.236
1.0	0.374	-1.33	-1.41

The Normalized Feedback Coefficient (α)	
r=1	r=2
-0.841 (-3.756)	-0.841 (-3.835)
	-0.143 (-0.944)

Table (IV.3) Results of the Johansen Procedure for Relation (2) of Aggregate Commodity Imports

k=1			
Eigenvalues			
0.7116	0.4421	0.3602	0.2416

Cointegrating Vectors (β)				
PCAMC	0.039	0.021	-0.007	-0.0116
PCGDP	-0.009	-0.008	0.002	0.011
AMPI	0.008	0.007	-0.008	0.013
PCMCAP	-0.012	-0.041	-0.014	-0.004
RWER	0.017	0.077	0.056	-0.037

TAble(IV.3) concluded

Testing The Number of Cointegrating Relations (r)						
Statistic		Critical Values (Johansen & Nielson, 1993)				
λ-max	trace		λ-max	trace		
		H_0	90%	90%	95%	99%
			Quantiles			
26.11	53.55	r ≤ 0	17.15	43.84	47.208	50.186
12.25	27.44	r ≤ 1	13.39	26.7	29.38	31.76
9.38	15.18	r ≤ 2	10.6	13.31	15.34	19.69
5.81	5.81	r ≤ 3	2.71	2.71	3.84	6.64

The Normalized Long-run Cointegrating Vectors (r=2)				
PCAMC	PCGDP	PCMCAP	AMPI	RWER
1.0	-0.237	-0.295	0.202	0.428
1.0	-0.354	-1.914	3.578	0.334

The Normalized Feedback Coefficients (α)			
r=2	-0.586 (-2.316)	r=1	
	0.207 (-1.497)		-0.586 (-2.02)

Table (IV.4) The Short-Run Coefficients for Aggregate Commodity Imports from the Johansen Procedure

Relation (1), r=1:

Γ_1 =

	LPCAMC	LPCGDP	LPCMCAP	LAMPI
ΔLPCAMC	-0.841	0.644	0.198	-0.102
ΔLPCGDP	-0.018	0.014	0.004	-0.002
ΔLPCMCAP	-0.149	0.114	0.035	-0.018

Relation (1), r=2:

Γ_1 =

	LPCAMC	LPCGDP	LPCMCAP	LAMPI
ΔLPCAMC	-0.984	0.835	0.401	-0.156
ΔLPCGDP	-0.073	0.088	0.083	-0.023
ΔLPCMCAP	0.261	-0.431	-0.545	0.135

Table (IV.4) The Short-Run Coefficients for Aggregate Commodity Imports from the Johansen Procedure (concluded)

Relation (2), r=1

$$\Gamma_1 = \begin{array}{c} \Delta PCAMC \\ \Delta PCGDP \\ \Delta RWER \\ \Delta PCMCAP \end{array} \overset{\begin{array}{ccccc} PCAMC & PCGDP & PCMCAP & AMPI & RWER \end{array}}{\begin{bmatrix} -0.586 & 0.139 & 0.173 & -0.118 & -0.251 \\ -0.553 & -0.131 & -0.163 & 0.112 & 0.237 \\ 0.081 & -0.019 & -0.024 & 0.035 & -0.036 \\ 0.178 & 0.042 & 0.053 & -0.076 & 0.057 \end{bmatrix}}$$

Relation (2), r=2

$$\Gamma_1 = \begin{array}{c} \Delta PCAMC \\ \Delta PCGDP \\ \Delta RWER \\ \Delta PCMCAP \end{array} \overset{\begin{array}{ccccc} PCAMC & PCGDP & PCMCAP & AMPI & RWER \end{array}}{\begin{bmatrix} -0.793 & 0.212 & 0.57 & -0.188 & -0.993 \\ 0.171 & 0.004 & 0.566 & -0.016 & -1.127 \\ 0.05 & -0.008 & 0.035 & -0.075 & 0.006 \\ 0.099 & -0.056 & -0.479 & 0.917 & 0.057 \end{bmatrix}}$$

Table (IV.5) The Long-Run Elasticities for Aggregate Commodity Imports

Relation	Variable	Model used Engle-Granger	Johansen (r=1, r=2)	
			r_1	r_2
(1)	PCGDP	0.847	0.77	1.33
	PCMCAP	0.34	0.24	1.42
	AMPI	-0.156	-0.121	-0.37
			r_1	r_2
(2)	PCGDP	1.19	0.91	1.36
	PCMCAP	0.62	0.29	1.9
	AMPI	-0.18	-0.18	-0.16
	RWER	-0.43	-0.1	-1.53

Table (IV.6) The Short-Run Elasticities for Aggregate Commodity Imports

		Model used		
Relation	**Variable**	**Engle-Granger**	**Johansen (r=1, r=2)**	
			r=1	r=2
	PCGDP	1.58	0.64	0.84
(1)	**PCMCAP**	0.332	0.20	0.4
	AMPI	-0.216	-0.10	-0.16
			r=1	r=2
	PCGDP	1.5	0.48	0.73
(2)	**PCMCAP**	0.15	0.08	0.1
	AMPI	-0.68	-0.14	-0.16
	RWER	-0.14	-0.05	-0.06

Table (IV.7) Results of the Johansen Procedure for Capital Imports

k=1		
Eigenvalues		
0.7014	0.5689	0.2521

Cointegrating Vectors (β)			
LCMC	1.137	3.788	-0.176
LGFCF	0.382	-1.687	-0.7
LCMPI	-0.015	0.85	-1.35
LMCAP	1.77	-6.702	5.421

Testing for the Number of Cointegrating Relations (r)						
Statistic			Critical Values (Johansen & Nielson, 1993)			
λ-max	trace		λ-max	trace		
		H_0	90%	90%	95%	99%
			Quantiles			
25.38	49.15	$r \leq 0$	13.39	26.7	29.38	31.76
17.67	23.77	$r \leq 1$	10.6	13.31	15.34	19.69
6.10	6.10	$r \leq 2$	2.71	2.71	3.84	6.64

Table (IV.7) concluded

The Normalized Long-run Cointegrating Vectors (r=2)			
CMC	GFCF	MCAP	CMPI
1.0	0.336	1.563	-0.013
1.0	-0.445	-1.769	0.224

The Normalized Feedback Coefficients (α)
r_1: -0.177 (-4.893)
r_2: -0.345 (-2.866)

Table (IV.8) The Short-Run Coefficients for Capital Commodity Imports from the Johansen Procedure

r=2

$$\Gamma_1 = \begin{matrix} \\ \Delta LCMC \\ \Delta LGFCF \\ \Delta LMCAP \end{matrix} \begin{matrix} LCMC & LGFCF & LMCAP & LCMPI \\ \end{matrix} \begin{bmatrix} -0.521 & 0.094 & 0.334 & -0.075 \\ 0.026 & -0.098 & -0.415 & 0.032 \\ 0.067 & -0.071 & -0.292 & 0.027 \end{bmatrix}$$

Table (IV.9) The Long-Run Elasticities for Capital Imports

	Model used	
Variable	**Engle-Granger**	**Johansen (r=2)**
GFCF	0.2	0.445
MCAP	1.14	1.769
CMPI	-0.1	-0.224

Table (IV.10) The Short-Run Elasticities for Capital Imports

Variable	Model used	
	Engle-Granger	Johansen (r=2)
GFCF	0.68	0.094
MCAP	---	0.334
CMPI	-0.87	-0.075

C. Results of the Analysis

The main results of the previous empirical analysis are summarized in the following points:

1. Traditional methodology is not suitable for modeling import demand due to the non-stationarity of most of the variable series involved, which produce spurious regressions when combined together in the absence of cointegration.
2. The acceptance of cointegration of aggregate commodity imports in the per capita form alone without domestic prices, implies that the standard specification is not justified by the data and that population is an important determinant of import demand behavior.
3. The small country assumption of exogenous import prices is supported by the data.
4. Imposing unjustified assumptions on the exogeneity of important explanatory variables changes estimation results widely and is likely to lead to the wrong conclusions.
5. Long-run and short-run elasticities are within the expected ranges. The activity elasticity is lower for capital imports than for aggregate imports in both the long-run and the short-run. The import capacity elasticity is much higher for capital imports. The price elasticities are the closest for the two commodity groups.
6. The difference in the Engle-Granger and Johansen estimates implies that the endo-exogeneous division of variables is imperfect in the Engle-Granger model.
7. A multi-equation model is more suited to modeling import demand behavior in Egypt and, although the Engle-Granger procedure gives us

economic intuition on parameter estimates, the Johansen procedure accounts for the endogeneity of the variables and thus produces more reliable estimates. The elasticities of those variables which are not exogenous to the model are highly biased in the long and short-run. There is no predicted direction for the bias. However, when the choice of a cointegrating vector is not clear, we are guided by the Engle-Granger estimates.

8. Capital imports are mainly determined by their previous levels in the long-run.

9. The speed of adjustment of capital imports to their long-run estimated equilibrium state is slower than that of the aggregate commodity group.

Chapter V
CONCLUSION

A. Economic Analysis and Policy Implications

Most of the recently performed traditional empirical studies fit the diagnosis for spurious regression, with suspiciously high goodness of fit coefficients accompanied by positive serial correlation, which implies the non-cointegration of their estimated relations. Thus our results are not comparable with those results of the reviewed studies.

With respect to the previous empirical findings of the Johansen procedure, we arrive at one major conclusion. Devaluation only becomes a determinant of import demand if it raises the real exchange rate and even then it exerts a limited effect on the demand for aggregate commodity imports in the long-run and an even more limited effect in the short-run. With respect to capital imports it is not found to be effective at all. However, the inclusion of the real exchange rate is found to slow down the adjustment process of imports in the short-run back to their long-run equilibrium state. This result confirms our previous experience with devaluations and is to be expected, considering the structure of Egyptian commodity imports. It may also be attributed to the import liberalization that accompanied the devaluation-cum-unification of the Pound in 1991, which reduced its net effect. The results we obtain are also justified by the witnessed upward trend in the import bill, despite devaluation. The net effect of devaluation on the trade balance would require an investigation of export demand behavior in the same previous way.

The consistency of the empirical findings with economic reality supports the use of cointegration and error-correction mechanisms in modeling the demand for aggregate and disaggregate commodity imports, but only in a multi-equation framework to allow for the endogeneity of the activity variable, import capacity and the real exchange rate.

Thus it is confirmed by the data that devaluation is an inappropriate policy tool for curtailing imports as it was originally intended for. This provides some empirical support for the government's firm rejection of any further devaluation. The analysis also concludes that the rise in GDP growth rates and foreign exchange inflows will exert further pressure on commodity imports, given the relatively high GDP and import capacity elasticities, while the rise in import prices will be less effective in reducing imports. Thus the net effect is likely to be a considerable rise in the import bill, and more competition for the import substitution industries.

B. Limitations of the Analysis and Directions for Future Research

Our estimates are subject to some degree of small sample bias which is reduced under the Johansen technique. The use of an appropriate domestic price variable would have allowed us to investigate further cointegrating relations. We have depended on simulated critical values alone, which are said to be model dependent. It would have been better to depend on customized testing for the unit-root and cointegration tests.

Restrictions on the elasticity estimates could have been relaxed by introducing curvilinearity into the relations through dummy variables, or otherwise, which may also have improved the specifications.

The analysis could have been extended to investigate the possibility of a cointegrated export demand relation, after which we may obtain further inference on the effectiveness of devaluation through an examination of the Marshall-Lerner condition for international demand elasticities, and compare the obtained results with those obtained under the traditional methodology.

Applying a higher degree of disaggregation is likely to be more intuitive and highlight inter-commodity differences in the behavior of import demand. If the import behavior of all commodity groups comprising aggregate imports are modeled, they may be used to deduce the aggregate parameter estimates based on more specific information, which is likely to give more efficient results.

For forecasting purposes, it is recommended to extend the analysis by applying Bayesian analysis and using shrinkage modeling techniques.

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Appendix A

SOURCES OF DATA AND VARIABLE DEFINITIONS

The main sources of data are:

1. CAPMAS Annual Bulletin of Foreign Trade Indices, published and unpublished data, various issues.
2. CAPMAS Foreign Trade Monthly Bulletin, various issues.
3. CAPMAS Statistical Yearbook, various issues.
4. Central Bank of Egypt Annual Report, 1995
5. IMF, BOPS, various issues.
6. IMF, DOTS, various issues.
7. IMF, IFS, various issues.
8. OECD Monthly Statistics of Foreign Trade, December1996.
9. The World Bank, World Tables, 1995.

Definition of Variables used in Chapter (IV)

AMC: Aggregate commodity imports in constant 1987 prices. (sources 1and 2)

AMPI: Price index for aggregate commodity imports. (source 1 and constructed for the years, 1994 and 1995, using source 8)

CMC: Imports of Capital commodities in constant 1987 prices. (sources 1and 2)

CMPI87: Price index for capital imports. (source 1and constructed for the years, 1994,1995 using source 8)

GDP: Gross Domestic Product at factor cost in constant 1987 prices. (sources 3and 9)

GDPG: Growth rate of GDP.

PLGDP: Growth rate of GDP, calculated as the percentage of the difference of log(GDP)

GFCF: Gross Fixed Capital Formation in constant 1987 prices. (source 7)

GFCFG: Growth rate of GFCF.

PLGFCF: Growth rate of GFCF, calculated as the percentage of the difference of log(GFCF)

NWER: A weighted average of the three nominal exchange rates, in index form. (Diab, 1995 and source 6)

RWER: A weighted average of the three real exchange rates, in index form. (sources 6 and 7)

RCER: The real commercial exchange rate, in index form. (Diab, 1995, sources 6 and 7)

WSP: The average annual wholesale price index. (source 3)

WWSPCM: A weighted average of the average annual wholesale price index for machines and transportation equipment, weighted by their respective shares in capital imports. (sources 2 and 6)

PR: Relative price index of total commodity imports, calculated as the ratio of AMPI to WSP.

PRC: Relative price index of capital imports, calculated as the ratio of CMPI to WWSPCM.

MCAP: Import capacity in constant 1987 prices.
(sources 4 and 6)

POP: Midyear estimates of total population in millions.
(source 7)

NOTES:

- All activity variables are in Millions of L.E
- For indices which were originally in a different base year, the following transformation was used;

Index in year (t) to the base 1987 = (Index in year (t) to any base/Index in year 1987 to the same base)*100.

- The above variable names preceded by "L" means they are in log form and preceded by "PC" means they are in per capita form.

Appendix B

CALCULATION OF THE REAL WEIGHTED EXCHANGE RATE

Table (B.1): Calculation of the Weighted Foreign Price Level

	US			Germany			Italy			France		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
1974	0.36	43.4	15.8	0.14	63.9	8.7	0.08	18.5	1.6	0.33	32.6	10.8
1975	0.37	47.4	17.5	0.16	67.7	10.9	0.11	21.6	2.5	0.21	36.5	7.5
1976	0.31	53.3	16.6	0.22	70.6	15.5	0.15	25.3	3.8	0.17	39.9	4.6
1977	0.3	57.4	17.6	0.2	73.2	14.7	0.17	30	5	0.19	43.6	5.2
1978	0.3	63.9	19.1	0.2	75.2	15.1	0.14	33.5	4.6	0.13	47.6	6.4
1979	0.26	72.5	20.6	0.19	78.3	15.1	0.12	38.5	4.7	0.2	52.7	10.7
1980	0.34	80	27.3	0.17	82.6	13.8	0.12	46.7	5.6	0.18	59.8	10.8
1981	0.38	84.9	32.1	0.2	87.7	17.1	0.14	55.9	7.9	0.18	67.8	12.3
1982	0.36	87.6	31.5	0.19	92.4	17.3	0.14	65	9.3	0.14	75.8	10.8
1983	0.32	91.4	29.4	0.2	95.4	20.2	0.16	74.6	11.9	0.14	83.1	11.6
1984	0.23	94.7	22.6	0.21	97.8	20.9	0.18	82.6	14.8	0.16	89.2	14.5

Table (B.1) Continued

	US			Germany			Italy			France		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
1985	0.28	95.3	26.6	0.21	99.9	20.5	0.16	90.2	14.7	0.15	94.4	14.2
1986	0.33	96.4	31.8	0.19	99.7	19.2	0.14	95.5	13.1	0.16	96.8	15
1987	0.36	100	36	0.18	100	18	0.13	100	13	0.15	100	15
1988	0.38	104	42.6	0.18	101.3	18.5	0.13	105.1	13.7	0.15	102.7	15.4
1989	0.35	109.1	38.4	0.19	104.1	20.2	0.12	111.7	12.9	0.18	106.3	19
1990	0.29	114.9	33.3	0.23	106.8	24.1	0.13	118.9	15.9	0.19	109.9	21.2
1991	0.33	119.8	39.5	0.21	110.6	23.7	0.14	126.4	17.6	0.14	113.4	16.1
1992	0.36	123.4	45	0.22	115	24.8	0.14	132.9	18.1	0.1	116.2	12.1
1993	0.37	127.1	46.5	0.17	119.7	20.6	0.16	138.9	22.2	0.14	118.6	16.2
1994	0.36	130.3	46.9	0.2	123.3	25.1	0.14	144.5	19.8	0.13	120.5	15.9
1995	0.36	134	48.2	0.18	125.4	22.9	0.15	152	22.1	0.14	122.6	17.4

Table (B.1) Continued

	Japan			UK				Japan			UK		
	(1)	(2)	(3)	(1)	(2)	(3)		(1)	(2)	(3)	(1)	(2)	(3)
1974	0.02	56.3	1.4	0.06	27	1.7	**1985**	0.11	99.3	11	0.0	92.8	8.5
1975	0.06	62.8	4	0.09	33.5	2.9	**1986**	0.09	99.9	9.4	0.0	96	8.7
1976	0.09	68.8	6.5	0.11	39.1	4.2	**1987**	0.09	100	9	0.0	100	9
1977	0.1	74.4	7.2	0.11	45.3	5	**1988**	0.08	100.7	7.9	0.0	104.8	8.9
1978	0.09	77.5	7.1	0.13	49	6.7	**1989**	0.08	103	7.9	0.0	113	11.1
1979	0.09	80.4	7.4	0.13	55.6	7.3	**1990**	0.08	106.2	8.1	0.0	123.8	10.1

Table (B.1) Concluded

	Japan			UK				Japan			UK		
	(1)	(2)	(3)	(1)	(2)	(3)		(1)	(2)	(3)	(1)	(2)	(3)
1980	0.08	86.6	7.2	0.11	65.6	7.1	**1991**	0.08	109.7	9.1	0.09	131.1	12.2
1981	0.01	90.9	0.7	0.09	73.4	6.9	**1992**	0.09	111.6	10	0.09	135.9	12.3
1982	0.09	93.4	8	0.08	79.7	6.6	**1993**	0.1	113	11.2	0.07	138	9.2
1983	0.1	95.2	9.4	0.079	83.4	6	**1994**	0.09	113.7	10.2	0.08	141.5	11
1984	0.13	97.3	12.9	0.07	87.5	6.4	**1995**	0.1	113.6	11.1	0.07	146.3	10.7

<u>Source:</u>

(1) IMF, DOTS; 1980, 1987, 1989, 1995, and 1996.

(2) Calculated from IMF, IFS; 1995 and 1996.

(3) Calculated from this table as (1)*(2).

Table (B.2) Calculation of the Real Weighted Exchange Rate

Year	Nominal Weighted Exchange rate(1)	Real Weighted Exchange rate (RWER) (2)	RWER in index form (1987=100) (3)
1974	0.4128[a]	0.9521	60.3
1975	0.4174	0.9848.	62.4
1976	0.4449	1.0847	68.7
1977	0.4791	1.1058	70
1978	0.5071	1.1376	72
1979	0.7045	1.6009	101.4
1980	0.7056[b]	1.4475	91.97
1981	0.7602	1.5145	1.4799
1982	0.7861	1.4799	1.382
1983	0.8051	1.382	87.5
1984	0.8169	1.2498	79.2
1985	1.1185	1.5825	100.2
1986	1.2456	1.448	91.7
1987	1.579	1.579	100
1988	2.105	1.9118	121.1
1989	2.3439	1.8	114
1990	2.6098	1.7644	111.7

[a] The black market exchange rate is not available for this year, so this figure is calculated as an average of the commercial and official rates only.

[b] Based on the 1981 weights.

Table (B.2) Calculation of the Real Weighted Exchange Rate (concluded)

Year	Nominal Weighted Exchange rate(1)[a]	Real Weighted Exchange rate (RWER) (2)	RWER in index form (1987=100) (3)
1991	3.2279	1.9109	121
1992	3.322	1.7899	113.4
1993	3.335[b]	1.6592	105.1
1994	3.354	1.572	105.1
1995	3.353	1.510	95.6

Notes:

(1) Calculated from Diab (1995), tables 1 and 6.

(2) Calculated as; the nominal weighted exchange rate *(weighted foreign CPI (table B.1)/(CPI of Egypt)

[a] The Average annual rates.

[b] For 1993-1995, the average annual nominal exchange rates are taken from the EIU Country Profile, 1996-97.

Appendix C

KEY STATISTICAL INDICATORS AND SUMMARY OF DEVALUATION EPISODES DURING THE STUDY PERIOD

Table (C.1) Calculated Real Average Annual Growth Rates

	GDP	GFCF	AMC	CMC	MCAP
1974-84	11.5	16.3	13.3	19.7	6.6
1985-90	3.5	4.7	-1.6	-9.4	0.4
1991-95	2	-1.2	6.2	6.5	-4.1
1974-95	7.3	6.6	4.9	3.5	2

Table (C.2) Composition of Imports (% shares)

	Fuel	Raw Materials	Consumption Goods	Capital Goods	Intermediate Goods
1970	8.3	13.5	17.3	23.3	37.6
1974	2.6	32	17.6	13.5	34.3
1978	1.1	11.6	23.8	32.6	30.9
1981	2.2	14.4	26	25.7	31.7
1986	3	10.4	21.5	23.9	41.2
1995	1	14.2	18.6	22.4	44

Table (C.3) Share of Commodity Imports in GDP

1974	23.6	**1985**	28
1975	34.5	**1986**	26.7
1976	32.2	**1987**	23.3
1977	36	**1988**	24.2
1978	39.2	**1989**	22.4
1979	29.6	**1990**	21.7
1980	29.8	**1991**	21.5
1981	39	**1992**	20.6
1982	35.5	**1993**	21
1983	33.7	**1994**	23.4
1984	32.7	**1995**	26.4

Table (C.4) Summary of Devaluation Episodes During The Study Period, 1974-1995.

1979	Unification of the exchange rate and devaluation by shifting a significant part of transactions from the official rate (0.39 L.E/US$) to the higher commercial rate created in 1973 (0.7 L.E/US $).
1981	Return to the multiple exchange rate system (a) The fixed central bank pool rate (0.7 L.E/US $) (b) The commercial banks pool. This fluctuated around 0.84L.E/US $ (c) The accounting exchange rate for charging accounts and payment agreements with the non IMF members. This was fixed at 0.39L.E/US $. (d) Transactions outside banks through the black market rate (floating).
1985	A 60% devaluation of the authorized banks exchange rate which accounts for 50% of transactions.
1987	Devaluation of more than 60% with the establishment of the free banking market rate to replace the authorized banks pool rate. The free banking rate was opened in May at 2.165 L.E/US $ which represented a 37% devaluation on the previous rate.
1989	Devaluation of the central banking rate in August ,by 63.6% , from 0.7 L.E/US $ to 1.1 L.E/US $.
1990	Further devaluation by 55% in July on central banking rate to 2L.E/US $. This accounted for 15% of transactions.
1991	Replacement of the prevailing system by a dual exchange rate system in February (primary and free market rate) as a transitional phase. The free market rate fluctuated around 3.3 L.E/US $. Unification of the two markets in October 1991, by pegging the Egyptian pound to the US dollar .Thus ending a long history of multiple exchange rates and fragmentation of the exchange market.

Source: Abdel-Khalek (1987, 1995), and Khier El-Din(1992)