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Import Demand in Developing Countries

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As a less restrictive trade regime is associated with greater responsiveness to economic incentives, econometric evidence that does not allow for the impact of import controls cannot be used reliably to assess the effect of a devaluation on the trade balance.

"Measured income elasticities in developing countries are generally higher than 1 -- and relative prices, although mostly inelastic, significantly affect demand for imports. When a lack of foreign exchange or, more generally, a restrictive trade regime effectively constrains import flows, the measured impact of price and activity variables becomes less pronounced. To recover structural elasticities in such a case, one can develop a direct modeling of quantitative restrictions (which is arduous) or use the experience of a structurally similar country (which is quicker). In general, a less restrictive trade regime is associated with greater responsiveness to economic incentives.

Econometric evidence that does not allow for the impact of import controls cannot be used reliably to assess the effect of a devaluation on the trade balance. Indeed, devaluation combined with trade liberalization (a common feature of many adjustment programs) will have a more pronounced effect on import demand than available evidence would suggest.

The authors compare three approaches to modeling and estimating import demand--which is arduous when trade controls are pervasive:

Option 1: Trade import equations work well when import controls are relatively stable over time, but it is difficult to determine if this is the case. Without *a priori* information, and short of using all misspecification tests, one could perhaps rely on a comparison between estimated elasticity and the "norm" computed in this study. If the difference between the two values is deemed too high, consider:

Option 2: This takes into account the impact of foreign exchange availability. If it seems clear that the country has foreign exchange constraints, the traditional specifications should be bypassed, but incorporating this constraint into the import demand equation is difficult for several reasons. At a minimum, the authors recommend using the broadest possible instrument list, including indicators of world demand, competitors' prices in export markets, exogenous capital flows, and international reserves.

Option 3: The direct incorporation of quantitative restrictions is the main method of recovering structural (notional) demand parameters and assessing, for example, the impact of removing import restrictions. Unfortunately, a good indicator of quantitative restrictions is not usually available and, even if it exists, interpreting its behavior may be difficult.

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- * This paper summarizes ongoing work at the Trade Policy Division on import behavior in developing countries. While providing new evidence, the paper draws on two main sources; Pritchett (1987) and Bertola and Faini (1987). We are very grateful to Bela Balassa, Mario Blejer, Enzo Grilli, Jaime de Melo, Vinod Thomas, and Jim Tybout for their very valuable comments. Abdel Senhadji-Semlali provided skilled research assistance at various stages and Karla Cabana skillfully typed the manuscript.

Introduction

Understanding how import flows react to changing economic conditions is essential to the design of a successful structural adjustment program. There is widespread agreement that imports generally react more swiftly than exports to substantive trade liberalization, resulting in short-run current account imbalances and a need for temporary financing. This is, incidentally, one of the main justifications used by international organizations for supplementing structural adjustment packages with external loans. Being able to predict import flows more accurately can help policymakers assess 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.

Unfortunately, several factors make predicting import flows in developing countries difficult. In particular, quantitative restrictions can be singled out because they drive a wedge between actual and desired imports, making the estimation of notional, i.e. unconstrained,¹ demand parameters problematic. Other complications include the pervasive presence of high and variable tariffs, which make observed border prices an unreliable indicator of import costs. Similarly, developing countries marked dependence on foreign capital goods makes aggregate estimation sometimes misleading (Khan 1975; de Melo and Vogt 1986 because the marginal propensity to import is highly dependent on the composition of income. These issues have been addressed to some extent in the empirical literature on trade focusing on developing countries. Also, the modeling of the

impact of quantitative restrictions has been given considerable attention. Khan (1974), by positing that import restrictions vary over time in a serially correlated way, models their effect by assuming an autoregressive process in the error term. Others [Dutta 1964, Turnovsky 1968 and more recently, Chu et al. 1983, Pritchett 1988 and Moran 1988] have used indicators of foreign exchange availability as a proxy for the government's inclination to impose import controls. An important shortcoming of this approach is that, with some noticeable exceptions (e.g. Chu et al. 1983), it does not allow for the recovery of the structural demand parameters.

This paper presents new and relatively comprehensive evidence about import behavior in developing countries, updating and generalizing the evidence presented in Khan (1974). We focus on the impact of import controls and, because of data limitations, overlook the effect of tariffs and the aggregation problem (although in section 4 the issue is touched upon). Even in this more restricted framework, two tasks appear particularly worth pursuing: (1) the identification of "stable" parameters in the description of import behavior and (2) an analysis of the structural and policy determinants of the parameters themselves.

In pursuing these objectives, we have relied on three different but complementary approaches. First, traditional import demand functions relating import flows to relative price and domestic output were estimated for a set of 50 countries. The resulting parameters were then retained for a subsequent cross-country comparison of the pattern of income and price elasticities. This approach allows us to move closer to establishing a "standard" elasticity for countries with similar characteristics. The second approach relied on incorporating the foreign exchange constraint directly in the import demand equation. This approach was applied to

countries for which a statistically satisfactory import demand equation could not be identified using the first approach. Finally, the third line of attack relied on direct measures of import controls. The value of the structural import parameters was recovered from a behavioral equation relating the share of imports not subject to controls to price, output, and rationing measures (the latter to allow for any spillover effect). Given the large amount of data required to construct an adequate indicator of quantitative restrictions, the equation was estimated for only one country.

The first four sections of this paper discuss the three approaches outlined above in more detail. A finding that recurs throughout these sections is that import restrictions in general significantly diminish the responsiveness of import demand to price and income incentives. The last section offers some conclusions.

1. The Traditional Approach

A traditional import demand function relating real imports (M) to real income (Y) and the ratio of import prices (P_M) to domestic prices (P_D) was estimated for 50 countries:

$$\ln M(t) = b_0 + b_1 \ln Y(t) + b_2 \ln [P_M(t)/P_D(t)] + V_1(t) \quad (1)$$

where $V_1(t)$ is an error term with the standard properties. This function was then tested to determine whether it was historically stable, generated serially uncorrelated residuals, and had predictive power. The resulting estimates of income and price elasticities are reported only for countries that passed the tests of misspecification. The most striking feature of the specification testing is that although only a few tests were undertaken, and despite the inclusion of a general dynamic form and the potential lack of power of the tests, import regressions for almost half

(44 percent) of the countries could be rejected as misspecified. This does not bode well for ad hoc country-oriented estimation and highlights the importance of the kind of cross-country study undertaken in this paper.

Some groups of countries appear more likely not to have a stable, well-behaved import relationship. Of the import regressions estimated for 14 Sub-Saharan African countries, only 4 could be accepted. Although most of the OPEC countries were not among the original 50 countries because of lack of data, there is a notable, and not surprising, tendency for oil exporters to have unstable import functions.²

In cases in which foreign exchange availability or, more generally, time-varying government controls cause unstable estimates, the model will need to be extended to account for these constraints. But, for countries for which a satisfactory import equation could be estimated, it can be argued that import controls were relatively constant over time; as a result, we were able to recover stable parameters describing import behavior. These are "constrained" elasticities, however, measuring the responsiveness of imports that are, to some extent controlled. "True" (or notional) import elasticities, that is, elasticities that would prevail in the absence of controls, as we discuss later, are higher.

It is nonetheless of some interest to consider the pattern of estimated parameters (see Table 1). Income elasticities were usually precisely estimated and generally higher than one. The mean for the 28 country sample of income elasticities was 1.33. Only two countries had income elasticities significantly less than one, whereas 12 of the 28 countries (43 percent) had income elasticities significantly greater than one. We stress that these are "secular" elasticities, i.e. they implicitly assume that changes in trend output have the same impact on imports as

Table 1. Import Demand Elasticity Estimates for 28 Countries

Region/Country	Price Elasticity		Income Elasticity	
Latin American and Caribbean				
Argentina	-2.1	(.67) ^{a/}	2.56	(.63) ^{a/}
Bolivia	-.44	(.21) ^{a/}	1.11	(.102) ^{a/}
Brazil	-1.1	(2.1)	.63	(.88)
Chile	-.32	(.12) ^{a/}	2.21	(.16) ^{a/}
Colombia	-.52	(.35)	1.25	(.08) ^{a/}
Paraguay	-.56	(.45)	1.42	(.36) ^{a/}
Peru	-.40	(.20) ^{a/}	1.66	(.17) ^{a/}
Uruguay	-.35	(.17) ^{a/}	2.12	(.15) ^{a/}
Honduras	1.2	(1.2)	1.08	(.29) ^{a/}
Jamaica	-.18	(.16)	1.12	(.24) ^{a/}
Asia				
Bangladesh	-.36	(.12) ^{a/}	1.52	(.17) ^{a/}
India	.74	(.55)	1.05	(.39) ^{a/}
Indonesia	-1.5	(1.1)	1.02	(.92)
Korea	-.22	(.54)	1.50	(.16) ^{a/}
Malaysia	-2.3	(1.7)	1.67	(.37) ^{a/}
Pakistan	-.48	(.08) ^{a/}	.76	(.135) ^{a/}
Philippines	-.56	(.34) ^{b/}	1.2	(.2) ^{a/}
Thailand	-.67	(.23) ^{a/}	1.25	(.086) ^{a/}
Middle East and North Africa				
Israel	-.66	(.22) ^{a/}	1.43	(.05) ^{a/}
Morocco	-.42	(.43)	1.38	(.24) ^{a/}
Syria	.43	(.38)	1.44	(.07) ^{a/}
Tunisia	-.25	(2.08)	1.43	(.39) ^{a/}
Sub-Saharan Africa				
C.A.F.	-1.87	(.26) ^{a/}	.57	(.10) ^{a/}
Gabon	-1.33	(.587) ^{a/}	1.53	(.057) ^{a/}
Kenya	-1.48	(.34) ^{a/}	1.37	(.26) ^{a/}
Zambia	-1.14	(.123) ^{a/}	.78	(.28) ^{a/}
Southern Europe				
Greece	.013	(.34)	1.37	(.07) ^{a/}
Yugoslavia	-.74	(.85)	.86	(.43) ^{a/}

^{a/} Significant at 5 percent level.

^{b/} Significant at 10 percent level.

Source: Pritchett (1987).

cyclical fluctuations of production do. The income elasticity of imports will be significantly higher in the short run; as the evidence in the studies by Khan and Ross (1975) and Clavijo and Faini (1988) indicates. Thus the assumption of a unit income elasticity, which is often made in the context of short and medium-run projections, proves to be inadequate.

The income elasticity estimates for developing countries reported here are quite close to estimates for developed countries. In their survey Goldstein and Khan (1985) report the results of a number of studies that estimate import activity elasticities for 14 developed countries. The cross-country averages of the estimates from the four studies with broadest coverage ranged from 1.22 to 1.63. The central tendency of the previous estimates for developing countries is also above one. The modal value of Bahmani-Oskooee's³ (1986) six-country estimates is 1.16.

Price elasticities were generally less precisely estimated. The average price elasticity of $-.57$, while a non-negligible price responsiveness, is less than one. Only 14 of the 28 countries had long-run price elasticities significantly different than zero (even at the 10 percent significance level). Only 2 countries had estimated price elasticities significantly greater than one, whereas 9 of the 28 countries have price elasticities significantly less than one. Most countries had price elasticities in the zero to one range, indicating that although price responsiveness is not entirely absent, it is not large, perhaps, as noticed earlier, because of the existence of controls. Some regional patterns of price elasticity are striking. For example, six of the eight South American countries in this study are reported to have price elasticities in the narrow range of 0.3 to 0.6. All of the four Sub-Saharan African

countries have price elasticities greater than one. The pervasive controls on imports that were imposed in Latin American countries to foster industrialization may explain the low estimated elasticity for those countries. Conversely, in the Sub-Saharan countries a pure foreign exchange constraint may be binding as quantities adjust to price changes in order to keep constant the total expenditure in foreign currency.

A comparison of the literature on price elasticities reveals much less consensus on price than on income elasticities. In their 1985 review article, Goldstein and Khan summarize several studies of aggregate import price elasticities.⁴ The reported cross-country average elasticity varies widely across studies. In Goldstein, et al., (1980), the average price elasticity for the eight countries reported is .57.⁵ A paper by Geraci and Prewé (1980) on five developed countries finds an average import price elasticity of .734. Other studies find average price elasticities around one.⁶ Although this paper's price elasticity estimates for developed countries are lower than the average,⁷ they are well within the bounds of prior estimates. Evidence for developing countries is more limited. Khan (1974) reports price elasticity estimates for 15 developing countries⁸ that average (excluding Turkey) .948.⁹ Bahmani-Oskooee (1986) uses quarterly data to estimate long-run price elasticities for seven developing countries with an average (excluding South Africa) of .395. This study confirms the consensus that the estimated historical long-run price responsiveness in developing countries is less than one.¹⁰

2. Cross-Country Patterns

Previous studies have shown that countries of similar size and income levels also display other economic similarities. Both the sectoral composition of production (Chenery and Syrquin, 1975) and trade patterns (McCarthy, Taylor, and Alikhani 1984) have been shown to be systematically related to per capita income and population. The estimates of import demand elasticities for 28 countries developed in this study are used to investigate import responsiveness and its relation to three country characteristics: per capita income,¹¹ population, and openness of trade as measured by the share of imports plus exports in gross national product (GNP).

This type of study has two purposes: (1) to establish a standard elasticity for countries with similar characteristics; and (2) to give an indication, using the openness variable, of the direction and magnitude of changes in import responsiveness as a country becomes more open at given income and population.

The empirical relationships are established by cross-country regressions of income and price elasticities on per capita income in thousand US\$ (Y), its square (YSQ), share of trade in output (TRD), and population (POP). The results for price elasticities (Ep) are as follows:¹²

$$|E_p| = .65 - .54 Y + 8.54 \times 10^{-5} YSQ + .79 TRD - .002 POP \quad (2)$$

$$(3.32) \quad (2.74) \quad (1.9) \quad (2.58) \quad (1.61)$$

$$R^2 = .79 \quad SER = 1.49$$

Perhaps not surprisingly, we find that the price elasticity of import demand increases significantly with a higher trade share for a given per capita income and population size. Although it is not clear to what extent trade openness is a policy variable rather than a structural characteristic, this result suggests that liberalization may raise price elasticities as the share of trade increases for a given population size and relatively stable per capita income. The estimated quadratic pattern of price elasticities with respect to per capita income is primarily due to the extraordinary high estimated price elasticities of the Sub-Saharan African countries (see Table 1) at the low end and to a gradual increase of elasticities through the rest of the range of incomes. With respect to income elasticities (E_y), we find that:

$$E_y = .72 + 7.5 Y - 1.33 \times 10^{-4} Y^2 + .004 POP - .0004 TRD \quad (3)$$

(3.09) (3.47) (3.16) (.31) (.018)

Income elasticities of imports increase with income up to about \$2,800 per capita and then decrease. To explain this pattern, we can refer to a modified Engel's law: at very low income levels, imports may consist of food and necessary intermediates, which have less than unity elasticity, whereas at higher income levels more sophisticated investment goods and intermediate inputs are imported, that is, goods with higher income elasticities. Alternatively, it may be argued that at low levels of per capita income, high income-elasticity goods are neither produced nor consumed. At middle levels of per capita income, high income-elasticity goods are imported, that is they are consumed, but are not produced domestically. Finally, as an economy matures, the match between the production structure and the consumption structure improves. With the

increasing production of high income-elasticity goods, the overall income elasticity of import demand declines. More research on the sectoral composition of imports is needed to test these tentative hypotheses.¹³

This cross-country type of study allows us to move closer to establishing a standard elasticity for countries with similar economic characteristics. At the same time, the openness variable gives an indication of the direction and magnitude of changes in import responsiveness as a country becomes more open at a given per capita income and population, as might be brought about by a more liberal trade policy. Although we cannot directly observe the impact of government policy on import responsiveness for any given country, we should be able, by looking at values across countries, to observe the impact of different policies on observed elasticities.

3. The Impact of Foreign Exchange Availability

The finding that in about 40 percent of developing countries the relationship between income and relative prices is unstable strongly suggests that there are other factors influencing import determination in such countries. Quantitative restrictions can be singled out as one of these factors. Whereas the pervasive presence of quantitative restrictions in developing countries is often motivated by the desire to foster domestic industrialization, the considerable variability of quantitative restrictions can be attributed mostly to balance of payment considerations. The latter, following Hemphill (1974) and Winters (1985), can in turn be related to the availability of foreign exchange. Thus, for example, a decrease in foreign exchange receipts may lead the government to tighten import controls and reduce import flows.¹⁴

As a cursory review of the literature suggests, there are basically two ways to allow for this factor. Both approaches recognize that the government in most developing countries largely controls the allocation of foreign exchange and that the supply of imports is really the supply of foreign exchange made available to purchase imports. In the first approach (Hemphill 1974; Chu et al. 1983; and Moran 1988), it is assumed that the policymaker fully controls the supply of foreign exchange and attempts to optimize a cost function that includes among its arguments the deviation of imports and reserves from their long-run equilibrium levels and the discrepancy between actual and notional imports, that is, the amount of rationing. Based on these assumptions, it is possible to relate the actual flow of imports to foreign exchange receipts, reserve levels, relative prices, and activity levels. Empirically, it is found that the inclusion of these foreign exchange indicators leads to much less precise estimates of both activity and price elasticities whose coefficients are often not statistically different from zero. This finding can be taken either as an indication that the inclusion of "irrelevant" variables (i.e., the foreign exchange availability indicators) leads to a loss of efficiency in the estimates and precludes precise estimation of price and activity parameters or that import responsiveness is much more limited for foreign exchange constrained countries.

This approach has both strengths and shortcomings. From a practical point of view, it allows us to assess, albeit indirectly, the impact of import controls based on a wide variety of indicators. However, with this approach, it is not possible to easily recover the true elasticities of demand and to assess the impact of changes in the trade

regime. More important, the whole approach relies on the possibility of specifying a stable government objective function--which is not a practicable hypothesis when faced with the need to make judgements concerning a major structural adjustment programs. Finally, as Moran (1988) and Chu et al. (1983) point out, there are some econometric problems within this approach. Because foreign exchange receipts are in general not exogenous, the resulting estimates may be inconsistent.

The second approach (Pritchett 1988; Moran 1988) aims at providing a simple way to recover the structural demand parameters. It relies on the specification of an import supply equation (describing the availability of foreign exchange) as well as on a standard demand equation (see equation 1).

$\ln M(t) = a_0 + a_1 \ln F(t) + a_2 \ln R(t-1) + a_3 [\ln P_m(t) - \ln P_m^w(t)] + V_2(t)$ (4)
where M denotes imports, F and R denote real foreign exchange receipts and reserve levels respectively, and P_m and P_m^w denote the domestic and the border prices of imports, respectively. A higher value of the import premium (P_m/P_m^w) may induce the government to supply more foreign exchange. Otherwise $a_3 = 0$.

In this model the domestic price of imports, P_m , will shift to equate supply and demand for foreign exchange. Prices will then be endogenous. To recover consistent estimates of the demand parameters, a two-stage least-squares procedure can be used with foreign exchange indicators $F(t)$ and $R(t-1)$ and other exogenous variables (P_D, Y) as instruments. This approach is at first blush more promising. It allows for the recovery of all structural parameters, while taking into account the impact of foreign exchange availability. Empirically, both price and

income elasticities turn out to be considerably higher than the corresponding price and income elasticities obtained by ordinary least-squares estimation. There are, however, some important flaws. First, where foreign exchange is scarce and imports are to some extent rationed, economic agents will react to price, income, and controls. It is not reasonable under these circumstances to suppose that consumers will act according to their notional demand. More crucially, as noted earlier, in this set-up the domestic price of imports is endogenous and generally differs from the border price. If, as is generally the case, we observe only the border price variable, we will be faced with the problem of an error on the variable. Moreover, this error will be correlated with all the exogenous variables which are therefore no longer appropriate instruments.¹⁵

To address these issues, we considered the set of countries discussed in Section 1 for which it was not possible to identify a statistically satisfactory equation.¹⁶ We then estimated an import demand equation using the second approach described above (i.e., taking indicators of foreign exchange availability as instruments) and tested throughout for the adequacy of the instrument set by means of a Sargan (1964) test.¹⁷ The results of the test (see Table A-1 in the appendix) highlight the dangers of relying on a single approach without testing for its possible limitations. For 8 out of 12 countries the test is highly significant, indicating a correlation between instruments and errors and showing coefficient estimates to be unreliable. At least two possibilities, both mentioned earlier, can account for this result. One possibility is simply that foreign exchange receipts are not exogenous.¹⁸ The other possibility is that we do not observe the correct price variable (i.e., the domestic

Table 2. Long-run Import Demand Elasticities^{a/}
(Two-stage, Least-squares estimates)

Country	Income Elasticity	Price Elasticity
Mexico	1.29 (.09)	-1.12 (.15)
Libya	.64 (.24)	-1.21 (.05)
Nigeria	5.10 (4.67)	3.71 (5.40)
Senegal	2.43 (.36)	-.35 (.43)
Portugal	2.24 (1.10)	-1.58 (.94)
Ivory Coast	1.6 (.19)	-1.58 (.42)
Venezuela	3.34 (.59)	2.23 (1.03)

a/ Standard errors in parenthesis

price of imports), but only the border price. To address the first possibility we consider an enlarged model in which foreign exchange receipts are endogenous and depend on the performance of exports. The exogenous factors underlying export behavior can then be used as (possibly appropriate) instruments for estimating equation 1. Finally, the Sargan test can be used again to check whether this new set of instruments still correlates with the error term. We then find that of 12 countries, only 8 show no misspecification problems. The estimation results for these countries are summarized in Table 2 and presented in more detail in Table A-2 in the appendix. Overall results are not at variance with what was found in section 1. Income elasticities are well determined and generally higher than one, and prices play a significant though less important role.

Although we have used a fairly broad set of instruments, there are still five countries for which the Sargan test shows significant value. Therefore, a case can be made that at the root of the econometric troubles is the fact that instead of observing the domestic price of imports, we only observe their border values. Under such circumstances, it is easily shown that the reduced-form estimation of the demand for imports, while precluding the recovery of the structural parameters, is the only viable option. (See Table A-3 for full estimation results.)

Some care is now necessary in interpreting the coefficients. For instance, once again we find that income plays a major role in determining imports. However, we must allow for the fact that now income affects imports both directly (by raising import demand) and indirectly (by increasing export supply and foreign exchange availability). The reduced-form coefficient in Table A-3 captures both these effects and will not

provide an estimate of the notional income elasticity of demand.

Similarly, an increase in the price of domestic substitutes (P_D) has two contrasting effects insofar as it leads directly to higher imports (the demand curve for imports shifts to the right) but also discourages exports, reduces foreign exchange receipts, and shifts the supply schedule for imports to the left. The net effect on import quantities is ambiguous and is reflected empirically in the shifting sign and low significance of the reduced-form coefficient associated with P_D (Table A-3). Regarding other prices, import and export prices have almost without exception the expected negative and positive impact on imports. Finally, lagged reserves appear to positively affect import quantities. The effect, however, is statistically weak. The statistical properties of the equation are satisfactory, and indications of misspecification are much weaker here than when we applied ordinary least squared to equation 1.

In summary, considerable specification testing and common sense are required in order to find the most appropriate framework for determining import flow in a given country. Traditional import demand equations can provide the policymaker with valuable information on the price and activity responses of import flows. However, when considerations about the availability of foreign exchange become paramount, one of the approaches described above becomes more appropriate. However, limitations of these approaches and the resulting need for careful econometric practice should not be overlooked. Also, if the need arises to recover the structural elasticities (for instance when predicting the impact of import liberalization), the experience of similar countries is useful--perhaps the cross-country analysis described in section 2.

4. Modeling Non-Tariff Barriers Directly

The demand for imports comes mostly from private consumers and producers. Under a stringent balance of payments constraint, however, the government will restrict the availability of foreign exchange through price and especially nonprice mechanisms, moving demand for imported goods away from notional demand curves. Sometimes a direct measure of import controls is available, which can be incorporated in a model of rationed import demand. The key here is the recognition that in most developing countries not all imports are subject to controls, but even at the subcategory level, several foreign goods are freely importable into the country. By focusing the analysis on this subset of imports it is possible, with some additional assumptions, to recover estimates of structural parameters that can then be used to assess the impact of trade liberalization. More specifically, it is assumed that consumers and producers determine their optimal choice among three kinds of goods: free imports, restricted imports, and domestically produced commodities.

Border-relative import prices are constant. The crucial assumption is that the ratio of the marginal propensity to import rationed goods to the overall marginal propensity to import can be approximated by the import coverage ratio of non-tariff barriers (i.e., by the ratio of restricted imports to total imports). Higher values of this indicator signal a tightening of the import constraint.¹⁹ Although this is not necessarily always the case, it appears to be true in the context of our empirical application to Morocco. This model permits us to recover the total marginal propensity to import and, as a result, to simulate the impact of lifting non-tariff barriers. The model was applied to the demand for consumption, intermediate, and investment goods in Morocco from 1966 to

1985, using, respectively, a linear expenditure system, a Cobb-Douglas production function and a Cobb-Douglas allocation function. It was found that, for consumer goods, the marginal notional propensity to import was 9 percent versus a restricted value of 4.2 percent. For investment goods the activity elasticities were equal to one in the unrestricted case and .87 in the restricted case. For intermediate goods quantitative controls had no major impact. Notional price elasticities were also fairly well determined, ranging from around one for consumer goods, .68 for investment imports, and .31 for imported intermediate goods (see Table 3). Also, by using these notional parameters, it was possible to estimate the impact of a full repeal of import controls. Not surprisingly, the biggest impact was on consumer goods, for which steady state value of imports would have increased in 1985 by 66 percent had quantitative restrictions been abolished. The impact on investment imports would have been significant as well, increasing by 5 percent in the long-run. No sizeable effect was detected for intermediate imports because imports controls for this category were fairly loose.

These results suggest a few policy implications. First, the results show that lifting quantitative restrictions will not only affect the level of imports but may also lead to a significant increase in the sensitivity of imports to activity levels. Under the plausible condition that controlled imports and domestic goods are net substitutes, the elimination of controls will increase the price responsiveness of imports as well. Second, our empirical results suggest that for Morocco the reduction of tariff barriers has only limited effect on import demand, while the elimination of quantitative restrictions, especially on consumption goods, will lead to an upsurge of imports. Whether this can be

Table 3: IMPORT DEMAND FUNCTIONS UNDER RATIONING
Estimates for Morocco

	Notional Marginal Propensity to Imports	Committed Quantities of:	
		Domestic Goods	Imported Goods
Consumption Goods	.0897	9213	333.1
[Linear Expenditure System]	(.030)	(1985.1)	(94.27)
Investment Share of Domestically Produced Capital Goods (β) ^{1/}			
Investment Goods		.32	
(Cobb-Douglas Allocation Function)		(.10)	
	Labor Share in Gross Output (α) ^{2/}	Share of Imported Inputs in Gross Output (δ) ^{2/}	Rate of Technical Progress
Intermediate Goods	.31	.08	.03
(Cobb-Douglas Allocation Function)	(.21)	(n.a.)	(.008)

Standard Errors in Parenthesis

Source: Bertola and Faini (1987)

1/ Notional Price Elasticity: $1-\beta$

2/ Notional Price Elasticity: $\frac{\alpha}{\alpha+\gamma}$

generalized to other countries remains to be seen. Common sense and the experience of some countries (like Turkey) would suggest that consumption good imports may indeed react swiftly to trade liberalization.

5. Conclusions

The modeling and estimation of import demand in a context in which trade controls are pervasive is arduous. Yet for the purpose of policy simulation and a firm understanding of how imports react to changing economic conditions, solid empirical work is indispensable to this effect. We have pursued three approaches, all of which have strengths and shortcomings. Traditional import equations work well when import controls are relatively stable over time (first option). But it is fairly difficult to determine a priori whether this is indeed the case. In the absence of a priori information and short of using the full set of misspecification tests, one could perhaps rely on a comparison between the estimated elasticity and the "norm" computed in this study.

If the difference between the two values is deemed to be too high, an approach that allows for the impact of foreign exchange availability should be used (second option). Of course, if there are strong a priori reasons to believe that the country has foreign exchange constraints, the traditional specification should be immediately bypassed. Still, it must not be forgotten that the incorporation of the foreign exchange constraint in the import demand equation is beset by several difficulties. In fact, both endogeneity and error-in-variable problems make instrumental variable estimation of the structural import demand equation problematic. At a minimum, we recommend the use of the broadest possible instrument list, including indicators of world demand, competitors' prices in export markets as well as exogeneous capital flows and international reserves.²⁰

Finally (the third option), the direct incorporation of quantitative restrictions is the main method of recovering structural (i.e., notional) demand parameters and assessing, for example, the impact of removing import restrictions. However, this approach also suffers from many shortcomings. A good indicator of quantitative restrictions is not usually available, and even if this indicator exists, interpreting its behavior may be difficult.²¹

Although these caveats should be borne in mind when analyzing our results, our study has been able to convey some useful facts on both the modeling and the behavior of import flows in developing countries. In sum, we have shown that "measured" income elasticities in developing countries are generally higher than one and relative prices, although they are mostly inelastic, significantly affect demand for imports. When the lack of foreign exchange or, more generally, a restrictive trade regime effectively constrains import flows, the measured impact of price and activity variables becomes less pronounced. To recover structural elasticities in such a case, one can develop a direct modeling of quantitative restrictions which is arduous, or one can use the experience of a structurally similar country which is quicker. In general, a less restrictive trade regime is associated with higher responsiveness of imports to economic incentives. We conclude that the econometric evidence that does not allow for the impact of import controls cannot be used reliably to assess the effect of a devaluation on the trade balance. Indeed, if devaluation is combined with a liberalization of the trade regime (a common feature of many adjustment programs), its effect on import demand will be more pronounced than the available evidence would suggest.

APPENDIX

This appendix provides further detail on the modeling results presented in section 3. In Table A-1 column A presents the results of the Sargan test when equation 1 is estimated using an instrumental variable procedure with real total foreign exchange receipts (F) and lagged real reserves (R) as instruments. Columns B and C of the Table present the results for the same test, but allow for the possible endogeneity of F. Underlying the results in column B is the implicit assumption that export demand is infinitely elastic. Then only supply matters, and the instruments set should include the right-hand side variable of the export supply equation, that is, income (Y), export prices (P_x), and domestic goods prices (P_D). If, however, export demand is less than infinitely elastic (i.e., the small country assumption does not hold), then P_x is endogenous and should be replaced in the instrument list by world demand (WD) and the foreign competitor's price (P^W). More formally, we assume that export supply can be represented as

$$\ln X(t) = c_0 + c_1 \ln Y(t) + c_2 \ln [P_x(t)/P_D(t)] \quad (1)$$

and export demand is equal to

$$\ln X(t) = d_0 + d_1 \ln WD + d_2 \ln (P_x/P_x^W) \quad (2)$$

with possibly $d_2 \rightarrow -\infty$.

Table 2-A presents the estimation results using the appropriate instrument set. We find that income is a major determinant of import demand. The long-run income elasticity is around one for Mexico, Libya, and the Ivory Coast; it increases to about two for Portugal and Senegal and climbs to extraordinary values for Venezuela and especially for Nigeria. Relative prices play a significant role in affecting import demand in

Mexico, Libya, the Ivory Coast, and Portugal. For Nigeria and Senegal the effect is not significant. For Venezuela the coefficient is significant with the wrong sign.

Finally, in Table 3-A we present the reduced form estimation for these seven countries for which the Sargan test was always significant and no appropriate instrument set could be found. Assuming that the country is small and combining equations 1-3 leads to

$$\ln M(t) = \frac{1}{a_3 - b_2} \{ (b_1 a_3 - b_2 a_1 c_1) \ln Y(t) + b_2 (a_1 + a_3) \ln P^W(t) -$$

$$b_2 (a_1 + a_2 c_2) \ln P_x - b_2 a_2 \ln R(t-1) \}$$

where $b_2 < 0$. It is also assumed that $F = P_x X$ (i.e. only export revenues matter).

As mentioned in the text, it is not possible, unless someone is willing to estimate the full reduced form for all the endogenous variables (as performed in Chu et al. 1983), to recover the structural parameters of the import demand equation. Therefore, care must be used in interpreting the coefficients in Table A3. These results are still relatively encouraging. Income is always a major determinant (with the exception perhaps of Ecuador) of imports. Similarly, prices play a consistently significant role (the reasons underlying the shifting sign and the low significance of P_D are explained in the text). The statistical properties of the equation are also satisfactory. For all five countries the equation, as indicated by the Chow test, is stable and the hypothesis of serially uncorrelated can always be accepted at a 2.5 percent significance level. The Hendry test for stability reaches extraordinary values for Ghana and the Dominican Republic, but as noticed by Kiviet (1986), in the small sample its actual size may exceed its nominal size by a very large factor.

Table A-1 - Test of Correlation Between Instruments and Errors

	Instrument Set ^{a/}		
	A	B	C
Mexico	4.86	1.51	-
Costa Rica	9.69	10.60	12.71
Libya	2.69	-	-
Nigeria	5.03	4.93	-
Ghana	8.94	8.38	9.94
Ivory Coast	2.70	-	-
Ecuador	11.20	11.91	12.07
Venezuela	.08	-	-
Dominican Republic	9.85	9.6	9.39
Salvador	6.24	12.3	9.81
Senegal	14.83	2.37	-
Portugal	7.21	6.59	4.98

Critical Value $X^2(m)$.05	5.99	5.99	7.81

^{a/}Instrument Sets

- A: Y P_D F R(-1) M(-1)
 B: Y P_D P_x R(-1) M(-1)
 C: Y D_D P_x^w WD R(-1) M(-1)

Table A-2 - Dependent Variable: $\ln M(t)$

Country	$\ln Y(t)$	$\ln[P_M(t)/P_D(t)]$	$\ln M(t-1)$	$\bar{R}^2$	Instrument Set	Godfrey ⁺ Test (X^2_1)
Mexico	1.29 (.09)	-1.12 (.15)	---	.92	B	.07
Libya	.43 (.22)	-.81 (.18)	.33 (.14)	.98	A	1.47
Nigeria	1.07 (.36)	.78 (.48)	.79 (.20)	.89	B	.62
Senegal	1.12 (.46)	-.16 (.22)	.54 (.18)	.87	B	2.13
Portugal	1.10 (.31)	-.64 (.26)	.51 (.23)	.64	C	.39
Ivory Coast	.84 (.17)	-.95 (.18)	.40 (.13)	.98	A	2.04
Venezuela	3.34 (.59)	2.23 (1.03)	---	.80	A	.10

Note:

Y : income (GDP)
 P_M : import price
 P_D : domestic Price (GDP deflator)
 P_X : export price
 P_X^W : price of export competing goods
 R : foreign exchange reserves
 WD : world demand
 F : foreign exchange receipts

Instrument Sets:

A: $Y P_D F R(-1) [M(-1)]$
 B: $Y P_D P_X R(-1) [M(-1)]$
 C: $Y P_D P_X^W WD R(-1) [M(-1)]$

+ For serial correlation

Table A-3 - Dependent Variable: $\ln M(t)$

	$\ln Y(t)$	$\ln P_m(t)$	$\ln P_D(t)$	$\ln P_x(t)$	$\ln R(t-1)$	$\ln M(t-1)$	TESTS					
							$\bar{R}^2$	DW	Homog.	Chow	Stability	Serial Correlation
Costa Rica	1.50 (.93)	-.41 (.12)	.20 (.19)	.03 (.19)	.03 (.04)	-	.98	2.04	16.5 ⁺⁺	.06	1.34	-
Ghana	.42 (.33)	-.68 (.15)	-.18 (.07)	.71 (.16)	.05 (.04)	.31 (.16)	.93	2.62	5.32 ⁺	1.97	155.3 ⁺⁺	5.07 ⁺
Ecuador	.08 (.18)	.17 (.19)	-.69 [*]	.42 (.14)	.21 (.04)	.52 (.15)	.97	2.51	.68	1.96	13.02 ⁺	4.83 ⁺
Dominican Rep.	1.13 (.09)	-.47 (.31)	-.35 (.40)	.38 (.17)	.11 (.07)	-	.96	1.38	8.07 ⁺	2.67	211.5 ⁺⁺	-
Salvador	.68 (.18)	-.35 (.16)	η^*	.35 (.09)	.04 (.05)	.33 (.11)	.95	1.39	1.87	1.18	13.04 ⁺	1.53

Note: Y : income (GDP)
 P_m : import price
 P_D : domestic goods price (GDP deflator)
 P_x : export price
R : foreign exchange reserves
M : imports
* : constrained coefficient (based on the homogeneity test)
+ : null hypothesis rejected at 5 percent significance level
++ : null hypothesis rejected at 1 percent significance level

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FOOTNOTES

- 1/ It is well known (Neary and Roberts, 1980) that the price responsiveness of consumer demand will vary if some commodities happen to be rationed. Accordingly, it is useful to distinguish between notional price responsiveness, i.e., the consumer response to price change when no commodity is subject to ration and constrained price responsiveness.
- 2/ Libya, Nigeria, Algeria, Egypt, Ecuador, Venezuela, and Mexico all failed both tests (sub-sample and post-sample) of stability. Among oil exporters only Indonesia and Gabon were included.
- 3/ This study capriciously excludes a negative estimate for Israel.
- 4/ In the summary table of Goldstein and Khan wrong signed results are excluded, pushing the "average" elasticity bias upward. They are not excluded in the present paper. Excluding the four positive point estimates would raise the average estimated price elasticity to .771.
- 5/ One of nine estimates was positive.
- 6/ Table 4.1 in Goldstein and Khan (1985) summarizes the long-run price elasticities reported in the studies.

Author	Date	No. of Countries	No. of Positive	(Average of Negative)
Houthakker Mag	1969	13	3	.81
Adams et al.	1969	9	3	.715
Armington	1970	14	0	1.35
Samuelson	1973	14	7	.923
Taplin	1973	13	0	.791
Beenstock-Minford	1976	7	2	1.51
Gylfason	1978	10	3	1.24

- 7/ The lower price elasticity estimates could be explained by the sectoral composition of developing country imports. Fuels (SITC 3) and food (SITC 0 and 1), which are a larger component of developing country than of developed country imports, have on average much lower price elasticities than manufactures (SITC 5-9).
- 8/ Khan does test for auto-correlation and finds significant first-order auto-correlation in 6 of 15 (40 percent) regressions. This finding is similar to this paper's rejection of 43 percent (22 of 50), the import functions estimated.
- 9/ Including Turkey's estimate of 2.29 raises the average to 1.07.
- 10/ The double-log functional form used to estimate the elasticities imposes constant elasticity. Therefore, assuming after estimation that the elasticities vary across countries because of factors related to income violates the original maintained hypothesis. However, the cross-country variation in real per capita income far

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exceeds the within country variation. A step-function relation could be postulated that would allow constant elasticities within countries but a pattern across countries. A functional form that did not impose constant elasticities was also estimated but precisely the same pattern was detected using these estimates.

- 11/ The double-log functional form used to estimate the elasticities imposes constant elasticity. Therefore, assuming after estimation that the elasticities vary across countries in a way related to income violates the original maintained hypothesis. However, the cross-country variation in real per capita income far exceeds the within-country variation. A step function relation could be postulated that would allow constant elasticities within countries but a pattern across countries. Secondly, a functional form that did not impose constant elasticities was estimated and precisely the same pattern was detected using these estimates.
- 12/ These GLS results weighing each price elasticity observation by its estimated standard error to account for the differences in precision of estimation across countries. The OLS are, reassuringly similar.
- 13/ McCarthy, et al. (1985) provide some evidence on the relationship between sectoral composition of imports and per capita income, but they estimate only a linear term.
- 14/ There are, of course, other justification to the inclusion of foreign exchange availability indicators in an import demand equation. It could be argued, for instance, that reserve levels and foreign exchange receipts act as a proxy for present and future wealth, which in turn is likely to affect import demand. Alternatively, the fact that we observe the border and not the domestic price of imports may, under some conditions, lead to the inclusion of foreign exchange indicators in the import demand equation.
- 15/ This can be easily seen if we consider that when we only observe P_m^W and not P_m , the error term in the equation will include an expression in $P_m - P_m^W$ which is obviously correlated with all the exogenous variables. This effect, first noticed in Clavijo et al. (1988), is also mentioned in Moran (1988).
- 16/ Lack of sufficiently long series for the full set of foreign exchange indicators forced us to consider only a subset of 12 out of the initial 20 countries.
- 17/ The latter, under the null hypothesis of no correlation between errors and instruments, is distributed as $X^2(n)$ with n equal to the difference between the number of instruments and of right-hand side variables.

- 18/ We use the term "exogenous" a bit loosely here. By exogenous we only mean to imply that the right-hand-side variables are not correlated with the error term. Notice that we assume throughout that this is indeed the case for $R(t-1)$.
- 19/ There is no way to rigorously justify this assumption. We can only argue that if import regimes are made more stringent by shifting commodities into the restricted list, there will be a strong and positive correlation between the import coverage ratio of NTB and the non-tariff barriers ratio of the marginal propensity to import rationed goods to the overall marginal propensity to import. Indeed both indicators will increase when commodities are shifted into the restricted list.
- 20/ It would also be essential to inquire from national sources how import prices are computed. In general, import prices are based on border prices and therefore are an inadequate measure of true import costs to domestic agents.
- 21/ An increase in the coverage ratio of non-tariff barriers may indeed indicate that controls are more stringent (more goods are subject to quantitative restrictions) or that they have become more lenient (more restricted goods are allowed into the country). Although for Morocco the quantitative restriction indicator was clear, it is certainly not so in every developing country.

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