IMPORT DEMAND UNDER A FOREIGN EXCHANGE CONSTRAINT

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Abstract.
This paper develops a forward-looking model for import demand under a foreign exchange con­
straint, in which import growth is an increasing function of contemporaneous and expected future
export growth. Unlike existing models which stress the role of foreign exchange reserves and
contemporaneous export earnings for countries that have limited access to foreign borrowing,
this one stresses the importance of the expected time path of future export earnings. The im­

plications of the model are tested and confirmed with data from three East Asian developing
countries for which relevant time series are available at quarterly intervals.

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1 Introduction

Countries that have limited access to foreign borrowing ought to take into account the expected time path of future export earnings in deciding how much to import today. And they ought to do so even when the foreign exchange constraint, the product of the limited access to foreign borrowing, does not bind; i.e., even when the sum of current export earnings, foreign exchange reserves and the amount that can be borrowed in the international financial markets exceeds current desired imports. Otherwise, they would expose themselves to the perils of fluctuations in export earnings, and in particular to the need to curtail imports, even of basic goods, at some point in the future at which their foreign exchange reserves and limited access to foreign borrowing could not compensate for a fall in these earnings.

Yet, most of the existing models of import demand largely overlook the expected time path of future export earnings. Consequently, they are not likely to take sufficiently into account the impact of the constraint, nor to be correctly specified. Reminiscent of the consumption literature, these models typically consider one of two polar cases. In the first, with notable examples the intertemporal models of import demand, only the long term budget constraint matters. That is, the present value of the stream of future imports must be less than or equal to the present value of the stream of future exports plus the country’s current net foreign assets (Hemphill [1974], Winters [1987]). In this case, imports are completely decoupled from the expected time path of future export earnings.

In the second polar case, imports are tied to the contemporaneous availability of foreign exchange, implicitly assuming that the foreign exchange constraint binds every period. Building upon the ideas of Khan (1974), models falling into this case augment typical import-demand equations with the stock of real reserves (Khan and Knight [1987]), contemporaneous foreign exchange receipts and the stock of foreign exchange reserves (Moran [1988]), or with contemporaneous export receipts (Mazarei [1995]). Parenthetically, the aforementioned equations usually consider relative prices and some contemporaneous measure of economic activity — the latter proxied by real GDP and GNP — as main determinants of import demand (see, among others, Bahmani-Oskooee [1986], Khan [1974], Khan and Knight [1987], and Reinhart [1995]).

This paper, in turn, develops a model of import demand under a foreign exchange constraint that formalizes the ideas outlined in the introductory paragraph. Specifically, the paper develops an error-correction model for (log) imports in which import growth (log-change) is increasing in contemporaneous and expected future export growth. (Imports and exports appear to be stationary in log-differences.) The two building blocks are a function for desired (log) imports that is increasing in (log) contemporaneous and expected future export earnings; and a typical
partial adjustment mechanism that is driven by country-specific import restrictions, as well as by the inertia in adjusting trade flows similar to that assumed in the J-curve literature. The first building block additionally includes reserves, the proxy for the foreign exchange constraint considered before, and other variables suggested by the existing studies.

Two implications of the model are particularly useful in checking the consistency of the results and their robustness to alternative interpretations. First, across countries, the coefficients of the export-growth terms should be decreasing in the maximum amount that can be borrowed in addition to existing debt. (These coefficients are increasing in the coefficients of contemporaneous and future export earnings in the function for desired imports.) A high amount effectively reduces the importance of the expected time path of future export earnings as more imports can be financed—if need arises—by foreign borrowing at any point in time. Second, the coefficient of the error-correction term, which is equal to the speed of adjustment, should be lower (in absolute value) for countries with more severe import restrictions. Such restrictions, as Faini et al. (1988) note, diminish the responsiveness of imports to price and income incentives.

Developing countries are likely to be subject to a foreign exchange constraint and, thus, natural candidates for the empirical analysis. From the East Asian ones, only Indonesia, Korea, the Philippines and Thailand have appropriate series at quarterly intervals. Korea, however, whose error-correction term is non-stationary, is not included in the sample. Latin American countries, whose import decisions were greatly distorted during the previous decade by the “debt crisis”, were not considered.

The econometric results for the three sample countries are largely consistent with the model. Specifically, for all of them import growth is increasing in contemporaneous and future export growth and decreasing in the error-correction term. In addition, the relative across-countries magnitude of the estimated coefficients is as expected. Notably, the Philippines, which—as indicated by historical data—probably had the lowest access to foreign borrowing and the most severe import restrictions during the sample period, has the highest coefficients for the export-growth terms and the lowest for the error-correction term (in absolute value). Also, Thailand, which probably had the highest access to foreign borrowing, has the lowest coefficients for the export-growth terms.

The results are also robust to the alternative interpretation that the significance of the contemporaneous and future export-growth terms is due to imports of intermediate goods that are re-exported after further processing. Had this interpretation been true, Thailand, which had the highest share of imports of intermediate goods, should have the highest coefficients for these terms. The opposite, however, is true.
The remainder of the paper is organized as follows. Section 2 develops the error-correction model and explores the implications of the external financing constraint and of import restrictions. Section 3 describes the data and presents the econometric results, while Section 4 discusses briefly their implications for import dynamics. Finally, three appendix tables provide information that can be used to check the consistency of the results with the model and their robustness to alternative interpretations.

2 A Forward-Looking Model of Import Demand

Equation (1) formalizes the idea that desired imports at time \( t \), \( im_t^D \), should be increasing in contemporaneous and expected future exports, \( ex_t \) and \( E_t ex_{t+k} \) \( (k \geq 1) \). Equation (1) also includes the real interest rate, \( rer_t \), while other variables that could affect import demand are subsumed into the vector \( z_t \). Among the latter are foreign exchange reserves carried over from the previous period, \( RES_{t-1} \), and contemporaneous income. \( E \) is the usual expectations operator, \( u_t \) the error term, while small and capital letters denote respectively logs and levels.

\[
im_t^D = \delta + \alpha_0 ex_t + \alpha_1 E_t ex_{t+1} + \alpha_2 E_t ex_{t+2} + \ldots + \alpha_p E_t ex_{t+p} + \zeta rer_t + \phi z_t + u_t \tag{1}
\]

Equation (1) encompasses the existing models of import demand under a foreign exchange constraint. As noted earlier, these models augment typical import-demand equations, which include some measure of economic activity —subsumed into \( z_t \)— and the relative price of imports —captured by \( rer_t \), with reserves (Khan [1974], Khan and Knight [1988], Moran [1988]), and contemporaneous foreign exchange (Moran [1988]) or export receipts (Mazarei [1995]). Khan and Knight (1988), for example, justify the inclusion of the stock of real reserves arguing that the capacity of many developing countries to import is constrained by their limited reserves. This argument, however, implicitly assumes that these countries are always up against their borrowing limit in the international financial markets and, hence, the foreign exchange constraint binds every period. A similar assumption is implicit in the models that attempt to capture the effect of the constraint with contemporaneous foreign exchange or export receipts. In econometric terms, the existing models impose the restriction \( \alpha_k = 0 \) for \( k > 0 \).

Equation (1) also encompasses the intertemporal models of import demand which postulate that only the long-term budget constraint binds. The latter effectively assume that, as long as the long-term budget constraint is satisfied, developing countries can borrow as much as they wish to ride a temporary decline in export earnings or in anticipation of higher future earnings.
As a consequence, the intertemporal models decouple import demand from the expected time path of export earnings. In any event, their determinants of import demand are included in the $z_t$ vector of equation (1).

The inequality below shows the foreign exchange constraint. It states that actual imports at $t$, $IM_t$, cannot exceed the sum of contemporaneous exports receipts, $EX_t$, reserves carried over from the previous period, $RES_{t-1}$, and the maximum amount that can be borrowed in the international financial markets in addition to existing debt, $U_t$. This constraint, which is stricter than the long-term budget constraint assumed in intertemporal models of import demand, drives the significance of the expected time path of future export earnings and thus justifies the inclusion of $xt+k$ $(k \geq 0)$ in equation (1). (See below for details.)

$$ IM_t \leq EX_t + RES_{t-1} + U_t $$ (2)

$U_t$ derives from the sovereign credit ceiling often used in the literature. This ceiling, as in Adda and Eaton’s (1997) typical specification, is expressed as a floor on the borrowing country’s net external assets, with a lower floor corresponding to a higher ceiling. $U_t$, therefore, is equal to the ceiling minus existing debt. Nevertheless, both $U_t$ and the ceiling express the idea that lenders impose limits on how much countries can borrow at a particular period. The theoretical reasons for this behavior by lenders is beyond the scope of this paper, but interested readers can refer to Adda and Eaton (1997). It should be noted, however, that this credit rationing imposed on a country by the international financial markets is different from the import restrictions national governments often impose for balance of payments considerations. Such restrictions include import surcharges, advance import deposits and restrictions on current transactions.

An important implication of the forward-looking nature of import demand postulated in equation (1) is that the foreign exchange constraint can affect $IM_t^P$ even when it does not bind contemporaneously; i.e., even when (2) holds as a strict inequality, $IM_t < EX_t + RES_{t-1} + U_t$. The reason is that the possibility of a binding constraint in the future, i.e., $IM_{t+k} = EX_{t+k} + RES_{t+k-1} + U_{t+k}$ for some $k \geq 1$, will affect current desired imports. To illustrate this, a decline in $EX_{t+k}$ $(k \geq 1)$ increases the probability that (2) will hold as an equality and, hence, the constraint will bind at $t+k$. As a consequence, it may induce lower desired imports and higher reserves at $t$. The higher reserves will be used to reduce the aforementioned probability and the associated risk of a forced curtailment of imports even of basic goods.

The above argument can be shown rigorously using an explicit intertemporal optimization framework. With a caveat though: There are a lot of conceptual difficulties related to the utility function for total imports (for a pertinent discussion, see Faini et al. [1988, pp. 11-12]). Assuming
for simplicity—but without loss of generality—that the (constant) interest rate is equal to the
time discount rate, and abstracting from relative prices and income, the first-order condition
(f.o.c.) is \( u'(IM_{t+k}) = E_{t+k}u'(IM_{t+k+1}) + \lambda_{t+k} \), where \( u(.) \) is the time-separable utility function,
\( u'(.) \) denotes the marginal utility, and \( \lambda_{t+k} \) is the Lagrange multiplier associated with the foreign
exchange constraint—inequality (2)—at period \( t + k \). If the constraint binds at \( t + k \), \( \lambda_{t+k} > 0 \); if
it does not, \( \lambda_{t+k} = 0 \). In the first case, marginal utility at \( t + k \) would be higher and \( IM_{t+k} \) lower
than in the case the constraint (2) did not bind (or [2] did not exist and only the long-term budget
constraint applied).

If, as of \( t + k - 1 \), the constraint is expected to bind at \( t + k \) for some states of nature (exports
are stochastic), expected marginal utility \( E_{t+k-1}u'(M_{t+k}) \) will be higher than if the constraint is
not expected to bind. In response, an optimizing agent, say, a social planner, will reduce imports
at \( t + k - 1 \) even when the constraint does not bind at \( t + k - 1 \). To see it, the corresponding f.o.c.
when \( \lambda_{t+k-1} = 0 \), \( u'(M_{t+k-1}) = E_{t+k-1}u'(M_{t+k}) \), implies that as \( E_{t+k-1}u'(M_{t+k}) \) increases,
so does \( u'(M_{t+k-1}) \), which, in turn, implies that \( M_{t+k-1} \) decreases. Iterating backwards, the
probability of a binding constraint at some \( t + k \) \((k \geq 1) \) will lead to lower imports at \( t \).

The f.o.c. \( u'(IM_{t+k}) = E_{t+k}u'(IM_{t+k+1}) + \lambda_{t+k} \) also helps illustrate the importance of the
expected time path of future export earnings. A decrease in \( EX_{t+k} \) increases the severity of the
binding constraint and the value of \( \lambda_{t+k} \) and thus leads to lower \( IM_{t+k} \). Iterating backwards, the
decrease in \( E_t EX_{t+k} \) decreases optimal—desired, in the terminology of equation (1)—imports at
\( t \). Most important, this will hold even when the decrease in \( E_t EX_{t+k} \) \((k \geq 1) \) is coupled with an
increase in some \( E_t EX_{t+k+j} \) \((j > 0) \) which would leave the present value of the expected stream
of future export earnings unchanged. In contrast, when only the long-term budget constraint
binds, the above changes in \( E_t EX_{t+k} \) and \( E_t EX_{t+k+j} \) would not affect \( IM_t^D \).

Lagged reserves are expected to have a positive coefficient in equation (1), as an increase in
\( RES_{t-1} \) will be allocated between contemporaneous and future imports. Reserves are essentially
the analog of precautionary savings in the consumption literature. Further, the real exchange
rate at \( t, rer_t \), should have a negative coefficient. An increase in \( rer_t \), denoting in this framework
a real depreciation, would make foreign goods more expensive and, as a result, discourage
imports.

Across countries, the relative magnitude of the \( \alpha_k \) \((k \geq 0) \) coefficients should be inversely
related to \( U_t \). As \( U_t \) increases, a country can borrow more, if it so desires. Thus, the possibility
of a binding constraint at any point in the future decreases. And along with it decreases the
significance of the expected time path of export earnings. At the extreme, for a country that
faces only its long-term budget constraint the expected time path of exports will not matter and
its imports can be completely decoupled from it \( (\alpha_k = 0, \text{ for all } k \geq 0) \). Such a country can borrow to ride a temporary decline in export earnings or in anticipation of higher future earnings, using these earnings as collateral. This is reminiscent of the argument by Hemphill (1974) and Winters (1987) that ultimately long-run imports must be equal to long-run receipts.

To complete the model, actual imports, \( im_t \), are assumed to follow the partial adjustment mechanism described by equation (3). This typical mechanism, which is similar to that in Khan and Knight (1988) and Moran (1988), postulates that the actual change in (log) imports, \( \Delta im_t = im_t - im_{t-1} \), is proportional to the difference between current desired and lagged actual (log) imports, \( im_t^D - im_{t-1} \). \( \beta \) measures the speed of adjustment, \( 0 < \beta < 1 \), while \( \epsilon_t \) is an i.i.d. error term. The adjustment mechanism can be justified by the import restrictions countries facing a foreign exchange constraint often impose (Faini et al. [1988]), as well as by the time lags typically assumed in the J-curve literature. Provided the lags related to the J-curve are sufficiently similar across countries, the countries with low restrictions should have a higher \( \beta \).

\[
im_t - im_{t-1} = \beta(im_t^D - im_{t-1}) + \epsilon_t
\]

(3)

Substituting equation (1) into (3) yields the error-correction model for (log) imports shown in equation (4). The corresponding error-correction term, \( ECM_{t-1} \), is shown in equation (5).

\[
\Delta im_t = \psi + \sum_{i=0}^{p} \psi_i \Delta ex_{t+i} + \pi \Delta rer_t - \beta ECM_{t-1} + \gamma z_t + \eta_t
\]

(4)

\[
ECM_{t-1} = im_{t-1} - \lambda_0 - \lambda_1 ex_{t-1} - \lambda_2 rer_{t-1}
\]

(5)

\( \Delta \) is the usual difference operator. The terms \( \psi_k \) for \( 0 \leq k < p \) are given by the recursive formula \( \psi_k = \psi_{k+1} + \beta \alpha_k \), with the boundary condition \( \psi_p = \beta \alpha_p \). Given that \( \beta \) and all \( \alpha_k \) (\( k \geq 0 \)) are positive, all \( \psi_k \) (\( k \geq 0 \)) should be positive as well. The coefficients of \( rer_t \) and \( ECM_{t-1} \), \( \pi \) and \( -\beta \), are negative. Moreover, for the same country it should be \( \psi_j > \psi_k \) for \( j < k \); i.e., less distant export-growth terms should have bigger coefficients. Across countries, the coefficients \( \psi_k \) (\( k \geq 0 \)), which are increasing in the \( \alpha_n \)'s (\( n \geq k \)) and \( \beta \), should be decreasing in \( U_t \) —as the \( \alpha_n \)'s are.

Equations (4) and (5) can be used to test the model. Note, however, that there is no need to convert exports, imports and reserves to "real", as long as they are expressed in a common international currency. This implication derives from equation (1) which, essentially, states that, in deciding how much to import, a country has to take into account existing savings in foreign currency (reserves) plus foreign exchange receipts from exports — both current and future ex-
pected. For consistency, though, with the existing studies, "real" figures are used. Nevertheless, the results are virtually the same with nominal ones.

3 Empirical Analysis

3.1 Data & Preliminary Results

Most series are collected from the International Financial Statistics (IFS) database. Exports, $E_{Xt}$, correspond to total export receipts net of factor payments, in millions of U.S. dollars; i.e., to the sum of exports of goods and services, plus income and transfer receipts, minus income and transfer payments; lines 78aad, 78add, 78agd, 78ajd, 78ahd and 78akd in the Balance of Payments block of IFS. Imports, $I_{Mt}$, correspond to the sum—in millions of U.S. dollars—of imports of goods and services; lines 78abd and 78aed in the same IFS block. To convert $E_{Xt}$ and $I_{Mt}$ to "real", both series are divided with the U.S. consumer price index (CPI); line 11164 in the IFS. The unit value of imports and exports, two alternative price indices for such a conversion, could not be used for the lack of data in the IFS. Specifically, both indices end in 1991 for the Philippines, while the first is not reported for Indonesia.

The real exchange rate, $RER_t$, is calculated as the weighted average of the country's bilateral real exchange rates—normalized to 100 in 1976:Q1—with the G-7 countries. For these rates, the consumer price index (CPI) (line 64 in IFS) and the quarterly averages of the bilateral nominal exchange rates (line OOrf in IFS) are used. The weights correspond to the average of the export and import share of the sample countries with each G-7 country, and are calculated with data from the "Direction of Trade Statistics" database of the International Monetary Fund. Another measure of the real exchange rate, the ratio of the unit values of exports and imports, could not be used for the lack of data in the IFS. In mathematical terms, the real exchange rate for a sample country is given by

$$RER_t = \sum_{i=1}^{7} w_{i,t} \left[ \frac{P_{i,t} e_{t}}{P_{t} e_{i,t}} \right] \left[ \frac{P_{i,76:1} e_{76:1}}{P_{76:1} e_{i,76:1}} \right]$$

$P_t$ and $e_t$ stand for the sample country's CPI and nominal exchange rate vis-à-vis the U.S. dollar; and $P_{i,t}$ and $e_{i,t}$ for the same series for the $i$ country from the G-7 group (for the U.S., $e_{i,t} = 1$). The ratio $e_{i,t} / e_{i,t}$ is equal to the nominal exchange rate of the sample country with the $i$ country. The second fraction in the square brackets normalizes the bilateral real exchange rates to 100 at the first quarter of 1976, the first period in the sample. Lastly, $w_{i,t}^{n}$ is the average trade
share with the \( i \) country. Following a standard practice, the shares are normalized so that they sup to one; i.e., \( w_{i,t}^n = \frac{w_{i,t}}{\sum_{i=1}^{n} w_{i,t}} \); \( w_{i,t} \) are the raw shares.

The sample includes Indonesia, the Philippines and Thailand. Standard unit-root tests indicate that their \( im_{t}, ex_{t} \) and \( rer_{t} \) are stationary in first differences. Their error-correction terms are stationary too. (The critical values for the unit-root tests were taken from Charemza and Deadman [1992]). Together with Korea, these are the only East Asian countries for which appropriate series are available at quarterly intervals. But Korea, whose error-correction term is non-stationary, is not included in the sample. Moreover, Korea is not included in the 1997 version of the Global Development Finance database, from which some data on external debt are retrieved (see below). Also, Latin American countries, whose import decisions were greatly distorted during the previous decade by the “debt crisis”, were not considered. Lastly, the sample period is dictated by data availability. It extends from 1981:1 to 1995:4 for Indonesia, 1977:1 to 1995:4 for the Philippines, and 1976:1 to 1995:4 for Thailand.

Following a standard practice in models with unobserved expectations, \( E_t \Delta ex_{t+k} (k \geq 0) \) and \( E_t \Delta rer_{t} \) are instrumented with lagged variables. Table 1, however, which exhibits several correlation coefficients of interest, indicates that finding good instruments is not a trivial task. Briefly, \( \Delta rer_{t} \) exhibits very little autocorrelation. The same applies to \( \Delta ex_{t} \), with the exception of Thailand. Also, the correlation coefficients of \( \Delta im_{t} \) with leads of \( \Delta ex_{t} \) and \( \Delta rer_{t} \) are very small. On the positive side, none of the three series exhibits strong seasonality, as indicated by their relatively fourth-order autocorrelation coefficients. By the way, to avoid cluttering the table, the correlation coefficients of \( \Delta ex_{t} \) and \( \Delta rer_{t} \) with \( \Delta im_{t+k} (k = 0, 4) \) are not shown; these coefficients are not needed because \( \Delta im_{t} \) is not instrumented. As for \( \Delta im_{t} \)'s autocorrelation coefficients, they are shown to evaluate the magnitude of seasonality.

Insert Table 1 Here

Furthermore, three tables in the appendix provide information that can help check the consistency of the results with the model and their robustness to alternative interpretations. Table A-1 shows qualitative information on import restrictions that can be used to compare the speed of adjustment —coefficient \( \beta \)— across the sample countries. Although hard to quantify, it seems that the Philippines had the most severe restrictions during the sample period. In particular, it had restrictions on payments for current transactions for every year except 1986. It also imposed import surcharges from 1984 through 1992 and required advance deposits until 1992. Indonesia's and Thailand's restrictions appear about the same and less severe than those of the Philippines. Thus, provided the lagged import adjustment related to J-curve factors is sufficiently
similar across the three countries, the lagged adjustment postulated in equation (3) should be slower for the Philippines relative to the other two countries. In econometric terms, the Philippines should have a lower $\beta$ than the other two countries. The latter should have approximately equal $\beta$'s.

Table A-2 reports three statistics that can be used to gauge the relative magnitude of $U_t$ across the sample countries: total external debt as percent of GNP, plus interest and principal arrears in thousands of U.S. dollars. For almost every single year during the period 1977 to 1995, the Philippines had the highest debt-to-GNP ratio and Thailand the lowest. The Philippines also had both interest and principal arrears for most of the previous decade, Indonesia had some arrears from 1985 to 1988, while Thailand had none. Provided that high existing debt and past debt-servicing difficulties affect adversely a country’s access to foreign borrowing, the figures in Table A-2 suggest that the Philippines had the lowest $U_t$ (and the highest $\alpha_k$'s), and Thailand the highest $U_t$ (and the lowest $\alpha_k$'s).

Finally, to check the robustness of the results to the alternative interpretation that the significance of $\Delta e x_{t+k}$ ($k \geq 0$) may be due to imports of intermediate goods that are re-exported after further processing, Table A-3 reports the share of intermediate goods in total imports. The working hypothesis is that a higher share is associated with higher re-exports and, hence, higher $\alpha_k$ and $\psi_k$ ($k \geq 0$) coefficients. (This hypothesis is made out of necessity, because data on re-exports are not readily available for the sample countries.) Table A-3 shows that Indonesia and the Philippines had approximately the same average share, 61.0 versus 61.4 percent, which is below Thailand’s 67 percent. Thailand, also, had a higher share than the Philippines for every year except 1991. (For the second country, 1991 appears to be an outlier. Specifically, its share jumped from 59.1 in 1990 to 73.5 percent in 1991, and subsequently fell to the normal below 60.0 percent.) Thus, if the significance of $\Delta e x_{t+k}$ ($k \geq 0$) is due to re-exporting, Thailand should have higher $\psi_k$ ($k \geq 0$) coefficients than the Philippines. The comparison with Indonesia is not as straightforward because this country had a higher share than the other two for several years. This, however, is not a major hindrance for the interpretation of the results.

To summarize the expectations, the Philippines is expected to have the highest $\alpha_k$ ($k \geq 0$) coefficients and Thailand the lowest. In addition, the Philippines should have the lowest $\beta$, while the other two countries should have similar ones. Provided that the cross-country differences are bigger for the $\alpha_k$'s than the $\beta$'s, and keeping in mind that the $\psi_k$ coefficients are increasing in both $\beta$ and $\alpha_k$, the Philippines should have the highest $\psi_k$'s and Thailand the lowest. Lastly, if the significance of $E_t \Delta e x_{t+k}$ ($k \geq 0$) is driven by re-exports, Thailand should have the highest $\psi_k$'s.
3.2 Main Results

The paper follows Engle and Granger's two-step estimation approach (Engle and Granger [1987]). At the first step, \( im_t \) is regressed on a constant, \( \epsilon x_t \) and \( rer_t \). The lagged residuals of this regression correspond to \( ECM_{t-1} \), equation (5). At the second step, equation (4) is estimated. However, the difficulty of finding good instruments for \( \Delta ex_{t+k} \) \( (k \geq 0) \) restricts its terms to only two; i.e., \( k = 0, 1 \). Thus the equation to be estimated becomes as shown in (6). In it, the omission of \( \Delta ex_{t+k} \) for \( k \geq 2 \) is not expected to bias significantly the coefficients of \( \Delta ex_{t+k} \) \( (k = 0, 1) \) and \( \Delta rer_t \) because the first series exhibits very little auto-correlation as well as little correlation with the second (see, Johnston, 1984, p.260). Nevertheless, \( \Delta ex_{t+2} \) was not significant when included in the estimated equation.

\[
\Delta im_t = \psi + \psi_0 \Delta ex_t + \psi_1 \Delta ex_{t+1} + \pi \Delta rer_t + \beta ECM_{t-1} + \omega (RES_{t-1}) + \gamma z_t + \eta_t \tag{6}
\]

In equation (6), reserves appear as a general function, \( \omega (RES_{t-1}) \), to allow for maximum flexibility. Specifically, \( \omega \) was set equal to reserves over imports, \( \frac{RES_{t-1}}{IMP_{t-1}} \), and to "real" reserve growth, \( \Delta res_{t-1} = log(RES_{t-1}/CPI_{t-1}^{us}) - log(RES_{t-2}/CPI_{t-2}^{us}) \). Both measures are lagged because the reserves reported in the IFS (line 11.d) correspond to end-of-period figures. They are also tested for stationarity. Further, income is subsumed into the \( z_t \) vector. For the lack of quarterly GNP data, income is proxied with (end-of-quarter) domestic credit; line 32 of the Monetary Survey section of the IFS for Indonesia and the Philippines, and line 52 for Thailand. Two proxies are used: domestic credit converted to U.S. dollars with the end-of-quarter nominal exchange rate (line 00ae in IFS), and domestic credit converted to "real" with the consumer price index. In equation (6), \( z_t \) corresponds to the growth rate at \( t \) of the income proxy.

But instrumenting variables dated \( t + 1 \) with instruments dated \( t - 1 \) may induce an AR(1) term in \( \eta_t \). Thus, and in line with Carroll et al. (1994), equation (6) is estimated with non-linear instrumental-variable least squares (IV-NLLS) in which the error term is assumed to follow the process \( \eta_t = \rho_1 \eta_{t-1} + u_t \). IV-NLLS negates the need to lag the instruments two periods, a practice that would exacerbate the already-difficult task of finding good instruments for \( \Delta ex_{t+k} \) \( (k = 0, 1) \) and \( \Delta rer_t \). If, however, \( \rho_1 \) is insignificant, the more efficient results with instrumental-variable ordinary least squares (IV-OLS) are reported.

Table 2 summarizes the empirical evidence. Starting from the left, it shows the name of the country; the estimated coefficients \( \psi_0, \psi_1, \pi, \beta \) and \( \gamma \); the \( R^2 \) and D.W. statistics; the instruments used; and the adjusted \( R^2 \)'s of the projection of \( \Delta ex_{t+k} \) \( (k = 0, 1) \) and \( \Delta rer_t \) on the instrument sets. The extensive sets reflect the aforementioned difficulty of finding good predictors.
for the instrumented variables. To give an idea of this difficulty, reducing the lags for Indonesia's instruments from eight to six reduces the $R^2$ of $\Delta ex_t$ from 0.272 to -0.120, and of $\Delta ex_{t+1}$ and $\Delta rer_t$ to about half that reported in Table 2. For Thailand, reducing the instrument lags from six to four does not affect perceptibly the $R^2$ of $\Delta ex_t$ and $\Delta ex_{t+1}$, but reduces substantially that of $\Delta rer_t$ (from 0.033 to -0.054).

The evidence is largely consistent with expectations. To begin with, both contemporaneous and future export growth affect positively and significantly import growth for all three countries. In addition, the inequality $\psi_0 > \psi_1$ holds for all. (It is statistically significant though for Indonesia only.) Further, the error-correction term is significant and has the correct sign. But the (%) change of real exchange rate, $\Delta rer_t$, is not significant for the Philippines and Thailand. Nevertheless, the real exchange rate affects their import growth through the error-correction term.

Even more interesting, the relative magnitude of the estimated coefficients across the sample countries is largely as expected, too: Briefly, $\beta$ is inversely related to the severity of import restrictions, while $\psi_0$ and $\psi_1$ are inversely related to the presumed $U_t$. In greater detail, $\beta$ is lowest ($\beta = 0.284$) for the Philippines, the country that had the most severe restrictions. The $\beta$'s of the other two countries, 0.372 for Indonesia and 0.364 for Thailand, are virtually the same. Also, $\psi_0$ decreases from the Philippines to Indonesia to Thailand, despite that the first country has the lowest $\beta$. The Philippines also has the highest $\psi_1$. Indonesia's slightly lower $\psi_1$ than Thailand's, 0.177 versus 0.187, is not consistent with the model. But the difference is too small to reject the model on this evidence only.

Moreover, the relative across-countries magnitude of $\psi_0$ and $\psi_1$ indicates that the significance of $\Delta ex_{t+k}$ ($k = 1, 2$) is not likely due to re-exporting. Had this interpretation been true, Thailand, which had a higher share of imports of intermediate goods than the Philippines for almost every single year, should have higher $\psi_0$ and $\psi_1$. The opposite, however, holds.

The above results and the corresponding conclusions are robust to the instrument set used. Specifically, although the parameter estimates are somewhat sensitive to the instrument set, their significance and relative across-countries ranking is not. To give an example, including four lags of the ratio $\log(RES_t/IM_t)$ in the Philippines' instrument set increases substantially the first-stage $R^2$ of $\Delta rer_t$ (from 0.080 to 0.117) and marginally that of $\Delta ex_t$ and $\Delta ex_{t+1}$. Yet, $\Delta rer_t$ remains insignificant, while the coefficients of the other variables remain virtually the same. The same happens when the number of instrument lags is increased from four to six. For Thailand, reducing the number of lags from six to four leaves the coefficients of $\Delta ex_t$ and $ECM_{t-1}$ virtually
unchanged and increases slightly that of $\Delta ex_{t+1}$ (from 0.187 to 0.211).

Lastly, both functions of reserves, $\frac{RES_{t-1}}{TM_{t-1}}$ and $\Delta res_{t-1}$, and both proxies of income were insignificant for all countries and all instrument sets. Worth also pointing out, the results are qualitatively the same when exports and imports are not divided by the U.S. CPI. This indicates that the correlation between $\Delta im_t$ and $\Delta ex_{t+k}$ ($k = 0, 1$) is driven by the value of exports and not by the U.S. CPI. This, in turn, provides further support for the paper's forward-looking model.

4 Discussion

To summarize, the empirical results indicate that the expected time path of future export earnings does affect import demand, and more so for countries that have low access to foreign borrowing. Also, the speed of import adjustment is lower for countries with more severe import restrictions. These findings are consistent with the paper's forward-looking model of import demand under a foreign exchange constraint. As such, they have important policy implications. Notably, a real depreciation may not succeed in reducing imports. If exports are sufficiently price elastic, the resultant upward revision of expected future export earnings may dominate the effect of the depreciation.

In addition, as access to foreign borrowing and import restrictions vary over time, so should the coefficients $\psi_k$ ($k \geq 0$) and $\beta$ and, along with them, the short-run dynamics of imports. (The short-run dynamics is captured by the error-correction model, equation [4], and the long-run dynamics by the error-correction term, equation [5]). Briefly, the coefficients $\psi_k$ ($k \geq 0$) should be higher (lower) during periods of low (high) access to foreign borrowing, and $\beta$ lower (higher) during periods of more (less) severe import restrictions. This implication is not affected by the possibility that import restrictions evolve endogenously in response to balance of payments considerations (Faini et al. [1988]; see, also, Bartolini and Drazen [1997] for a related theoretical discussion.). It is instructive, though, to note that the sample country with the lowest access to foreign borrowing, the Philippines, had the most severe restrictions. In any event, exploring the presumed time variability of the above coefficients is a worthwhile research endeavor, though beyond the scope of this paper.

Lastly, econometric specifications of import demand that do not take into account the expected time path of future export earnings are likely to be misspecified. Hence, another worthwhile research endeavor is to explore whether the paper's intuition can help improve econometric specifications of import demand by developing countries.
REFERENCES


### TABLE 1.
Correlation Coefficients

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<tr>
<th>Country</th>
<th>$\Delta ex_{t+k}$</th>
<th>$\Delta rer_{t+k}$</th>
<th>$\Delta im_{t+k}$</th>
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<td>$k = 0$</td>
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<td>$\Delta ex_t$</td>
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<td>0.12</td>
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<td>$\Delta im_t$</td>
<td>0.32</td>
<td>-0.02</td>
</tr>
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<td>$\Delta im_t$</td>
<td>0.36</td>
<td>0.18</td>
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<td>$\Delta ex_t$</td>
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<td>$\Delta rer_t$</td>
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<td></td>
<td>$\Delta im_t$</td>
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<td>0.04</td>
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</table>

**Notes:**
1. $\Delta$: first-difference operator.
2. Variable Definitions & Sources:
   - $ex_t = \log(EX_t/CPI_t^{us})$.
     $EX_t$ corresponds to total export receipts net of factor payments, in millions of U.S. dollars; i.e., to the sum of exports of goods and services, plus income and transfer receipts, minus income and transfer payments; lines 78aad, 78add, 78agd, 78ajd, 78ahd and 78akd in the Balance of Payments block of the "International Financial Statistics" (IFS). Exports are converted to "real" with the U.S. Consumer Price Index (CPI), $CPI_t^{us}$, line 11164 in IFS.
   - $im_t = \log(IM_t/CPI_t^{us})$.
     $IM_t$ corresponds to the sum—in millions of U.S. dollars—of imports of goods and services; lines 78ab and 78aed in the Balance of Payments block of the IFS. Imports are also converted to "real" with the U.S. CPI.
   - $rer_t = \log(RER_t)$.
     $RER_t$ is the CPI-based real effective exchange rate. $RER_t$ is calculated as the weighted-average of the country's bilateral real exchange rates with the G-7 countries. For these rates, which are normalized to 100 at the first quarter of 1976, the consumer price index (CPI) (line 64 in IFS) and the quarterly averages of the bilateral nominal exchange rates (line 00rf in IFS) are used. The weights are equal to the average of the export and import share of the sample countries with each G-7 country; they are calculated with data retrieved from the International Monetary Fund's "Direction of Trade Statistics" database.
### Table 2.
#### Main Results

\[ \Delta m_t = \psi + \psi_0 \Delta e x_t + \psi_1 \Delta e x_{t+1} + \pi \Delta r e r_t + \beta E C M_{t-1} + \gamma z_t + \eta_t \]

\[ \eta_t = \rho_1 \eta_{t-1} + u_t \]

<table>
<thead>
<tr>
<th>Country</th>
<th>( \psi_0 )</th>
<th>( \psi_1 )</th>
<th>( \pi )</th>
<th>( \beta )</th>
<th>( \gamma )</th>
<th>( R^2 )</th>
<th>D.W.</th>
<th>Instruments</th>
<th>First stage ( R^2 ) of ( \Delta e x_t )</th>
<th>( \Delta e x_{t+1} )</th>
<th>( \Delta r e r_t )</th>
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<tr>
<td>Indonesia</td>
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<td>0.495</td>
<td>1.75</td>
<td>( \Delta e x_{t-k}, \Delta m_{t-k}, \Delta r e r_{t-k}, k = 1, 8 ) ECM_{t-1}</td>
<td>0.272</td>
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<td>0.688</td>
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<td>0.242</td>
<td>0.245</td>
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<td>( \Delta e x_{t-k}, \Delta m_{t-k}, \Delta r e r_{t-k}, k = 1, 4 ) ECM_{t-1}</td>
<td>0.136</td>
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<td>0.080</td>
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<td>Thailand</td>
<td>0.273</td>
<td>0.187</td>
<td>-0.364</td>
<td>(-4.24)**</td>
<td></td>
<td>0.229</td>
<td>1.88</td>
<td>( \Delta e x_{t-k}, \Delta m_{t-k}, \Delta r e r_{t-k}, k = 1, 6 ) ECM_{t-1}</td>
<td>0.406</td>
<td>0.468</td>
<td>0.033</td>
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</table>

**Notes:**

1. Sample Periods (dictated by data availability):

2. All equations and instrument sets include a constant.

3. The first stage \( R^2 \) refers to the adjusted \( R^2 \) of the projection of \( \Delta e x_t \), \( \Delta e x_{t+1} \) and \( \Delta r e r_t \) on the instruments. For other variable definitions & sources, see Table 1 and the main text.

4. Estimation Method: Instrumental-Variable Ordinary Least Squares (IV-OLS) because \( \rho_1 \) is insignificant for all countries. The estimated coefficients are virtually the same with Instrumental-Variable Non-Linear Least Squares.

5. The \( t \)-statistics are estimated with a heteroskedasticity-consistent variance/covariance matrix, using the ROBURSTERRORS option in RATS.

6. For the Philippines, \( z_t \) corresponds to \( \Delta m_{t-4} \). \( \Delta m_{t-4} \) proved more efficient at correcting fourth-order autocorrelation in the residuals than using the process \( \eta_t = \sum_{i=1}^{4} \rho_i \eta_{t-i} + u_t \). In this process, all \( \rho_i \) were insignificant.
### TABLE A-1.
Import Restrictions

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</table>

**Notes:**

1. Source: *Exchange Arrangements and Exchange Restrictions* (International Monetary Fund), various issues.
2. Following the conventions in the *Exchange Arrangements and Exchange Restrictions*, a bullet (•) denotes the existence of a restriction; a blank space its absence.
3. Variable Definitions:
   - **Current Payments**: restrictions on payments for current transactions.
   - **Import Surcharges**: cost-related restriction.
   - **Advance Deposits**: advance import deposits.
### APPENDIX (continued).

#### TABLE A-2.

Selected Debt Statistics

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<th>Year</th>
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<td>Principal Arrears</td>
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<td>,000 US$</td>
<td>% of GNP</td>
<td>,000 US$</td>
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Source: *Global Development Finance – 1997 database (World Bank).*
TABLE A-3.
Imports of Intermediate Goods
(% of Total Imports)

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Notes:


2. Following the Classification by Broad Economic Categories (1976), *intermediate goods* were calculated as the sum of categories
   (a) 111 Food and beverages, primary, mainly for industry
   (b) 121 Food and beverages, processed, mainly for industry
   (c) 2 Industrial supplies not elsewhere specified
   (d) 31 Fuels and lubricants, primary
   (e) 322 Fuels and lubricants, processed (other than motor spirit)
   (f) 42 Parts and accessories of capital goods (except transport equipment)
   (g) 35 Parts and accessories of transport equipment.
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