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Abstract.

This paper develops a forward-looking model for import demand under a foreign exchange constraint, 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 implications 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 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.

$$im_t^D = \delta + \alpha_0 ex_t + \alpha_1 E_t ex_{t+1} + \alpha_2 E_t ex_{t+2} + ... + \alpha_p E_t ex_{t+p} + \zeta rer_t + \phi z_t + u_t \qquad (1)$$

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 ex_{t+k} $(k \geq 0)$ in equation (1). (See below for details.)

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

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^D 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 $E_t EX_{t+k}$ $(k \geq 1)$ 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 λ_{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 λ_{t+k} and thus leads to lower IM_{t+k}. Iterating backwards, the decrease in E_tEX_{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_tEX_{t+k} $(k \geq 1)$ is coupled with an increase in some E_tEX_{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_tEX_{t+k} and E_tEX_{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 α_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 ($\alpha_k = 0$, 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, $im_t^D - im_{t-1}$. β measures the speed of adjustment, $0 < \beta < 1$, while ϵ_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 β.

$$im_t - im_{t-1} = \beta(im_t^D - im_{t-1}) + \epsilon_t \tag{3}$$

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).

$$\Delta im_t = \psi + \sum_{i=0}^{p} \psi_i \Delta ex_{t+i} + \pi \Delta rer_t - \beta ECM_{t-1} + \gamma z_t + \eta_t \tag{4}$$

$$ECM_{t-1} = im_{t-1} - \lambda_0 - \lambda_1 ex_{t-1} - \lambda_2 rer_{t-1} \tag{5}$$

Δ is the usual difference operator. The terms ψ_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 β and all α_k ($k \geq 0$) are positive, all ψ_k ($k \geq 0$) should be positive as well. The coefficients of rer_t and ECM_{t-1}, π 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 ψ_k ($k \geq 0$), which are increasing in the α_n's ($n \geq k$) and β, should be decreasing in U_t –as the α_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 expected. 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, EX_t, 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, IM_t, 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 EX_t and IM_t 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 *00rf* 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

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

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 $e_t/e_{i,t}$ 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., $w_{i,t}^n = \frac{w_{i,t}}{\sum_{i=1}^{7} w_{i,t}}$; $w_{i,t}$ 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, Δrer_t exhibits very little autocorrelation. The same applies to Δex_t, with the exception of Thailand. Also, the correlation coefficients of Δim_t with leads of Δex_t and Δrer_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 Δex_t and Δrer_t with Δim_{t+k} $(k = 0, 4)$ are not shown; these coefficients are not needed because Δim_t is not instrumented. As for Δim_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 β– 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 β than the other two countries. The latter should have approximately equal β'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 α_k's), and Thailand the highest U_t (and the lowest α_k's).

Finally, to check the robustness of the results to the alternative interpretation that the significance of Δex_{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 α_k and ψ_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 Δex_{t+k} $(k \geq 0)$ is due to re-exporting, Thailand should have higher ψ_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 α_k $(k \geq 0)$ coefficients and Thailand the lowest. In addition, the Philippines should have the lowest β, while the other two countries should have similar ones. Provided that the cross-country differences are bigger for the α_k's than the β's, and keeping in mind that the ψ_k coefficients are increasing in both β and α_k, the Philippines should have the highest ψ_k's and Thailand the lowest. Lastly, if the significance of $E_t\Delta ex_{t+k}$ $(k \geq 0)$ is driven by re-exports, Thailand should have the highest ψ_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, ex_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 Δex_{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 Δex_{t+k} for $k \geq 2$ is not expected to bias significantly the coefficients of Δex_{t+k} $(k = 0, 1)$ and Δrer_t because the first series exhibits very little auto-correlation as well as little correlation with the second (see, Johnston, 1984, p.260). Nevertheless, Δex_{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, ω was set equal to reserves over imports, $\frac{RES_{t-1}}{IM_{t-1}}$, and to "real" reserve growth, $\Delta res_{t-1} = log(RES_{t-1}/CPI^{us}_{t-1}) - log(RES_{t-2}/CPI^{us}_{t-2})$. Both measures are lagged because the reserves reported in the IFS (line *1l.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 η_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 Δex_{t+k} $(k = 0, 1)$ and Δrer_t. If, however, ρ_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 ψ_0, ψ_1, π, β and γ; the R^2 and $D.W.$ statistics; the instruments used; and the adjusted R^2's of the projection of Δex_{t+k} $(k = 0, 1)$ and Δrer_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 $\bar{R}^2$ of Δex_t from 0.272 to -0.120, and of Δex_{t+1} and Δrer_t to about half that reported in Table 2. For Thailand, reducing the instrument lags from six to four does not affect perceptibly the $\bar{R}^2$ of Δex_t and Δex_{t+1}, but reduces substantially that of Δrer_t (from 0.033 to -0.054).

Insert Table 2 Here

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, Δrer_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, β is inversely related to the severity of import restrictions, while ψ_0 and ψ_1 are inversely related to the presumed U_t. In greater detail, β is lowest ($\beta = 0.284$) for the Philippines, the country that had the most severe restrictions. The β's of the other two countries, 0.372 for Indonesia and 0.364 for Thailand, are virtually the same. Also, ψ_0 decreases from the Philippines to Indonesia to Thailand, despite that the first country has the lowest β. The Philippines also has the highest ψ_1. Indonesia's slightly lower ψ_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 ψ_0 and ψ_1 indicates that the significance of Δex_{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 ψ_0 and ψ_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 $\bar{R}^2$ of Δrer_t (from 0.080 to 0.117) and marginally that of Δex_t and Δex_{t+1}. Yet, Δrer_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 Δex_t and ECM_{t-1} virtually unchanged and increases slightly that of Δex_{t+1} (from 0.187 to 0.211).

Lastly, both functions of reserves, $\frac{RES_{t-1}}{IM_{t-1}}$ and Δres_{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 Δim_t and Δex_{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 ψ_k $(k \geq 0)$ and β 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 ψ_k $(k \geq 0)$ should be higher (lower) during periods of low (high) access to foreign borrowing, and β 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.

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TABLE 1.
Correlation Coefficients

Country		Δex_{t+k}					Δrer_{t+k}					Δim_{t+k}				
		$k=0$	$k=1$	$k=2$	$k=3$	$k=4$	$k=0$	$k=1$	$k=2$	$k=3$	$k=4$	$k=0$	$k=1$	$k=2$	$k=3$	$k=4$
Indonesia	Δex_t	1.00	0.03	-0.18	-0.02	0.21	0.12	-0.16	-0.37	-0.26	-0.05					
	Δrer_t	0.12	0.10	-0.09	0.16	0.21	1.00	0.17	0.04	0.03	0.10					
	Δim_t	0.32	-0.02	-0.08	0.02	0.13	-0.37	0.18	-0.27	-0.01	-0.25	1.00	-0.28	0.11	-0.08	0.28
Philippines	Δex_t	1.00	-0.15	-0.05	-0.11	0.11	0.05	-0.04	0.03	-0.17	0.02					
	Δrer_t	0.05	-0.19	0.04	-0.15	0.11	1.00	0.15	0.07	-0.11	0.03					
	Δim_t	0.36	0.18	-0.11	-0.03	0.27	0.11	-0.04	-0.08	-0.08	-0.06	1.00	-0.03	-0.22	0.24	0.39
Thailand	Δex_t	1.00	-0.02	-0.54	0.05	0.55	0.06	-0.12	-0.12	0.04	0.05					
	Δrer_t	0.06	0.14	0.06	-0.06	0.11	1.00	0.18	0.05	0.04	0.18					
	Δim_t	0.14	0.04	0.12	0.25	0.04	-0.07	-0.22	0.09	-0.19	-0.06	1.00	-0.03	0.37	0.09	0.09

Notes:

1. Δ: 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 *78abd* 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

$$\Delta im_t = \psi + \psi_0 \Delta ex_t + \psi_1 \Delta ex_{t+1} + \pi \Delta rer_t + \beta ECM_{t-1} + \gamma z_t + \eta_t$$
$$\eta_t = \rho_1 \eta_{t-1} + u_t$$

Country	ψ_0	ψ_1	π	β	γ	R^2	$D.W.$	Instruments	First stage $\bar{R}^2$ of Δex_t	First stage $\bar{R}^2$ of Δex_{t+1}	First stage $\bar{R}^2$ of Δrer_t
Indonesia	0.463 (5.86)***	0.177 (1.82)*	-0.399 (-2.21)**	-0.372 (-3.22)***		0.495	1.75	$\Delta ex_{t-k}, \Delta im_{t-k},$ $\Delta rer_{t-k}, k = 1,8$ ECM_{t-1}	0.272	0.278	0.423
Philippines	0.688 (2.99)***	0.514 (3.20)***		-0.284 (-3.10)***	0.235 (2.37)**	0.242	1.72	$\Delta ex_{t-k}, \Delta im_{t-k},$ $\Delta rer_{t-k}, k = 1,4$ ECM_{t-1}	0.136	0.127	0.080
Thailand	0.273 (2.04)**	0.187 (1.69)*		-0.364 (-4.24)***		0.229	1.88	$\Delta ex_{t-k}, \Delta im_{t-k},$ $\Delta rer_{t-k}, k = 1,6$ ECM_{t-1}	0.406	0.468	0.033

Notes:

1. Sample Periods (dictated by data availability):
   - Indonesia: 1981:1-1995:4
   - Philippines: 1977:1-1995:4
   - Thailand: 1976:1-1995:4.
2. All equations and instrument sets include a *constant*.
3. The first stage $\bar{R}^2$ refers to the adjusted R^2 of the projection of Δex_t, Δex_{t+1} and Δrer_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 ρ_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 ROBUSTERRORS option in RATS.
6. For the Philippines, z_t corresponds to Δim_{t-4}. Δim_{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 ρ_i were insignificant.

APPENDIX.

TABLE A-1.

Import Restrictions

Year	Indonesia Current Payments	Indonesia Import Surcharges	Indonesia Advance Deposits	Philippines Current Payments	Philippines Import Surcharges	Philippines Advance Deposits	Thailand Current Payments	Thailand Import Surcharges	Thailand Advance Deposits
1977		•	•	•		•		•	
1978	•	•	•	•		•		•	
1979		•	•	•		•		•	
1980		•	•	•		•		•	
1981		•	•	•		•		•	
1982		•		•		•		•	
1983				•		•		•	
1984				•	•	•		•	
1985				•	•	•		•	
1986					•	•		•	
1987		•		•	•	•		•	
1988		•		•	•	•		•	
1989		•		•	•	•		•	
1990		•		•	•	•		•	
1991		•		•	•	•		•	
1992		•		•	•	•		•	
1993		•		•				•	
1994		•		•				•	
1995		•		•				•	

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:
   (a) "Current Payments": restrictions on payments for current transactions.
   (b) "Import Surcharges": cost-related restriction.
   (c) "Advance Deposits": advance import deposits.

APPENDIX (continued).

TABLE A-2.

Selected Debt Statistics

	Indonesia			Philippines			Thailand		
Year	Total Debt % of GNP	Interest Arrears ,000 US$	Principal Arrears ,000 US$	Total Debt % of GNP	Interest Arrears ,000 US$	Principal Arrears ,000 US$	Total Debt % of GNP	Interest Arrears ,000 US$	Principal Arrears ,000 US$
1977	34.6	0.0	0.0	41.9	0.0	100.0	17.0	0.0	0.0
1978	33.9	0.0	0.0	47.8	0.0	200.0	21.1	0.0	0.0
1979	35.3	0.0	0.0	48.3	0.0	500.0	24.6	0.0	0.0
1980	28.0	0.0	0.0	53.7	0.0	500.0	25.9	0.0	0.0
1981	25.5	0.0	0.0	58.5	0.0	500.0	31.6	0.0	0.0
1982	27.9	0.0	0.0	66.2	0.0	700.0	34.0	0.0	0.0
1983	36.9	0.0	0.0	74.0	14700.0	68200.0	35.0	0.0	0.0
1984	38.8	0.0	0.0	80.0	54000.0	388500.0	36.3	0.0	0.0
1985	44.4	0.0	8800.0	89.1	64200.0	761600.0	45.9	0.0	0.0
1986	56.5	0.0	500.0	96.5	2600.0	12900.0	43.8	0.0	0.0
1987	73.0	300.0	500.0	91.5	3800.0	660800.0	40.9	0.0	0.0
1988	63.9	0.0	500.0	77.3	38600.0	155200.0	35.8	0.0	0.0
1989	61.3	0.0	0.0	68.2	500.0	2600.0	32.9	0.0	0.0
1990	64.0	0.0	0.0	68.7	46600.0	167100.0	33.2	0.0	0.0
1991	64.9	0.0	0.0	70.5	89200.0	214300.0	39.0	0.0	0.0
1992	66.2	0.0	0.0	60.7	300.0	6400.0	38.3	0.0	0.0
1993	58.7	0.0	0.0	64.9	0.0	0.0	34.9	0.0	0.0
1994	57.2	0.0	0.0	60.8	0.0	0.0	34.4	0.0	0.0
1995	56.9	0.0	0.0	51.5	0.0	0.0	34.9	0.0	0.0

Source: *Global Development Finance – 1997* database (World Bank).

APPENDIX (continued).

TABLE A-3.

Imports of Intermediate Goods
(% of Total Imports)

Year	**Indonesia**	**Philippines**	**Thailand**
1977	50.9	68.6	72.1
1978	51.7	64.9	69.6
1979	57.8	63.5	72.0
1980	60.0	66.2	68.5
1981	58.1	65.4	71.9
1982	58.4	64.7	73.2
1983	60.7	65.2	68.8
1984	64.5	62.0	68.0
1985	66.8	64.3	68.8
1986	67.3	63.2	64.8
1987	65.7	55.6	66.6
1988	66.0	59.8	65.2
1989	66.5	61.2	66.9
1990	59.7	59.1	64.6
1991	55.4	73.5	63.9
1992	56.5	56.7	61.6
1993	62.0	53.1	60.6
1994	65.6	50.1	62.4
1995	65.3	49.8	62.7

Notes:

1. Source: International Trade Statistics Yearbook, various issues, (United Nations).
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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