Financial Integration in Emerging Market Economies

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Abstract This paper analyzes the de-facto integration in some Emerging Market Economies based on behavior of deviations from Covered Interest Parities in the last 10 years. It tests for modified market efficiency conditions in the presence of real world frictions and arrives at a single measure of de-facto integration for some Emerging Market Economies in the post-globalization era. An Asymmetric Self Exciting Threshold Autoregressive model (SETAR) is used to estimate bands of speculative inaction. Market efficiency requires the thresholds to be no wider than the transaction costs and the deviations to follow a stationary process outside the chosen bands. The analysis reveals a much more efficient financial market than has been allowed for in previous studies. The estimates of thresholds for emerging markets follow the pattern expected, given information on de-jure restrictions. Based on the estimated model, the paper constructs an index of de-facto integration and we find that Phillipines and India are the highest ranked amongst emerging markets in terms of their financial integration, and that Malaysia and Thailand occupy the lowest spot.

I. Introduction

The last decade has seen a massive increase in financial flows across the world, opening up of financial markets in emerging markets and creation of markets for financial instruments that

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never existed before in these economies. Most emerging economies now have markets for forward transactions in their currencies and for complex financial instruments. This paper is concerned with analysing the efficiency of currency and short term capital markets in some EMEs. An assessment of efficiency of global financial markets and their ability to promote savings, investment and growth is important to inform debate over the regulation and control over capital flows, particularly in the wake of the recent emerging market crises and increasing concerns about fluidity of capital. A policy of instituting capital controls loses some of its gloss if markets are known to be efficient and seems more compelling if they are not. Moreover, financial integration has a profound impact on the efficacy of fiscal, monetary and exchange rate policies. For example, an increase in domestic interest rates will not prevent large capital outflows in the event of a crisis [as happened in Brazil and Russia in late 1990's] if it only results in higher expected depreciation and if Uncovered Interest Parity holds. At a time where design of domestic regulatory mechanisms is a key policy issue, a measure of market efficiency and integration is important. While an apprailsal of the financial globalization of Emerging markets would include a study of equity markets, the analysis of currency and short term capital markets is the first step. Covered Interest Parity and Uncovered Interest parity are the cornerstones of most exchange rate models. A test of these assumptions casts light on how well these models can be expected to explain actual exchange rate movements, and also what alternative assumptions might yield better models.

This paper analyzes the de-facto integration in some leading Emerging Market Economies based on behavior of deviations from Covered Interest Parity in the last 10 years. It is concerned with understanding what market efficiency means in the presence of real world frictions, testing for that efficiency and arriving at a single measure of de-facto integration for some [2] Emerging Market Economies (EMEs henceforth) in the post-globalization era. Our analysis leads us to a model with no-arbitrage bands, even in a world with risk-neutral agents. The idea that existence of transactions costs and capital controls leads to no-aribitrage bands within which speculative forces would not operate is not new, and a similar derivation of no-arbitrage bands in the presence of transactions costs is contained in Balke and Wohar (1998). We extend this to a world of

[2] Sample restricted by data availability

capital controls and derive the implications of different types of controls on the bandwidth and symmetry of the bands and derive testable implications of presence of such frictions. Asymmetric Self Exciting Threshold Autoregressive model (SETAR) is used to estimate bands of speculative inaction for EMEs and some developed market economies and the results are largely as predicted. Our estimated thresholds are non-trivial, asymmetric and are larger in the negative direction for countries known to have imposed controls on capital outflows (Malaysia, India). Also as expected, the thresholds are narrower and enclose a larger percentage of deviations in developed markets. What this means is that one need not appeal to large risk premia to explain the 'failiure' of interest parities in EMEs. Our analysis also allows us to understand why tests of UIP have failed even for developed market economies. The answer lies in failing to account for modification, in theory, of market efficiency conditions in the absence of costless and control-free arbitrage. Based on the estimated model, the paper constructs an index of de-facto integration and we find that Phillipines and India are the highest ranked amongst emerging markets in terms of their financial integration, and that Malaysia and Thailand occupy the lowest spot. These are consistent with the findings of Francis, Hasan and Hunter (2002) who estimate a non-linear model to explain the deviations from *Uncovered* Interest Parity for some EMEs. We also compare our Integration Index to two other indices of capital account openness. The correlation between our index and the de-jure index of Chinn (2006) is high, but that between our index and the quantitative measure of Lane and Milesi-Ferretti (2006) is low, indicating that price measures are important in assessing integration, that conditions on the ground - enforcement and incentives/opportunities - matter for arbitrage and simply an increase in global flows cannot be expected to do the honours.

Bulk of the research on financial integration has so far focused on industrialized countries, while emerging markets too have seen a substantial rise in openness to flows and level of flows (and have also begun to realize the demands openness makes on domestic macroeconomic management). Empirical literature on CIP has generally tended to validate the hypothesis for the industrial countries, within the limits of the transaction costs and limits to speed of adjustment due to imperfectly elastic supply of funds. Obstfeld and Taylor (2004) compute covered interest differentials with monthly data vis--vis the Pound Sterling for US and German markets for the period 1921-2003 and find that the differentials were large between 1920 and 1980, but shrank considerably after 1980. Significantly, these differences became lower post 1980 than they were at the peak of the Gold Standard. And have been falling since Frankel (1991) estimated a time trend in absolute value of covered interest differentials for 25 developed countries during the 1980's and found a statistically significant negative trend for 10 of those 25 countries. Other studies that have estimated the differential in (6) and tested for presence of profitable opportunities outside of the 'transfer points' include Frenkel and Levich (1975), Clinton (1988), Taylor (1989), Peel and Taylor (2002) and Obstfeld and Taylor (2004). These transfer points have been estimated variously through data on triangular arbitrage, bid-ask spreads and brokerage fees and endogenously through a Threshold Autoregressive (TAR) model in Peel and Taylor (2002) and Obstfeld and Taylor (2004). Popper (1993) Popper (1993) and Vieria (2003) provide evidence that CIP more or less holds even at longer maturities (more than one year). Deviations were found to be linked to out-of-line fiscal policies.Balke and Wohar (1998)[3] study covered interest differentials between US dollar and UK pound for the period 1974-93 using TAR model, but instead of estimating constant thresholds, they compute time-varying thresholds from those implied by the modified CIP conditions from the data and then compute the AR coefficients for each regime econometrically. In this paper, we stick to estimating constant bands because as we discuss below, capital controls and other frictions not entirely captured by the bid-ask spreads also influence the thresholds. In the Emerging markets economies which are the subject out our analysis, such restrictions have played a particularly important role. Branson and Taylor (2004) is a study of covered interest parity between US and Russia, which finds large bands around the equality using the TAR technique, but these bands are not symmetric. The lower bound is close to zero and the upper bound, which involves borrowing in US dollars and lending in Rubles to be large, about 1 per cent. In our work below, we explain where the asymmetry may derive from. The bulk of literature on financial integration in EMEs had been confined to testing uncovered interest parity due to lack of conventional forward contracts and market data. With the developement of such markets in many of these economies since the late 1990's there is now enough data to explore the issue of covered arbitrage in these economies, which is what we do here - and compare the working of these markets in EMEs to some developed

[3]My Thanks to Menzie Chinn for this reference

countries.

Section II is an overview of the modified CIP conditions, Section III describes the data and presents the summary statistics for CIP deviations Section IV presents the results and Section V concludes.

II. CIP in the Presence of Frictions

In a fully integrated world with perfectly competitive profit maximizing agents and no transactions costs, the following Covered Interest Parity (CIP) condition would hold in equilibrium:

$$\delta_t = P\left(\frac{F_{t+k} - S_t}{S_t}\right) - (i_{t+k} - i^*_{t+k}) = 0 \tag{1}$$

where δ_t is the covered interest differential, i_{t+k} and i^*_{t+k} are respectively returns on comparable domestic and foreign assets between time t and t+k, expressed as per cent per annum. S_t is the domestic currency price of foreign currency, F_{t+k} is the forward rate or the k^{th} period domestic currency price of foreign exchange delivered in that period. P is a scaling factor, used to annualize the first term (for example, if the forward rates are of maturity 1 month, then $P = 1200$). Since all the variables in the above equation are known a priori, any deviation from this parity in our model world represents pure profits and therefore cannot exist in equilibrium.

However, in a world with oligopolistic players in financial markets, underdeveloped money markets, exchange or capital controls or risk of such controls, differential taxation, limited supply of capital, sovereign immunities, transaction costs and other inconveniences, forward rate may differ from current spot rate by more than the interest differential, even with efficient and risk neutral markets. The arbitrage conditions are then modified in the manner discussed below. We start with a discussion of transactions costs, encapsulated in a positive bid-ask spreads on exchange rates, and then move on to a discussion of capital controls.

II.1. Transactions Costs and CIP

When bid-ask spreads exist, the ask rate for a currency in terms of say US Dollars (denoted USD henceforth) is the number of USD the investor would have to give up in order to get one unit of the foreign currency from the dealer. The bid rate for a currency is the number of units of USD the investor gets when she sells one unit of the currency to a foreign exchange dealer, and it is equal precisely to the inverse of the ask rate for USD in terms of that currency. This last identity is used often in the succeeding analysis. We denote by F_b the one-period forward bid rate for a foreign currency, expressed as USD per unit of that currency, by F_a the forward ask rate for that currency, also expressed as USD per foreign currency unit. Spot rates are similarly expressed in terms of USD per foreign currency unit and subscripted accordingly. The spread on forward rate and spot rates are defined respectively, as:

$$\zeta_F = F_a - F_b \tag{2}$$

$$\zeta_S = S_a - S_b \tag{3}$$

Suppose the transactions involve the US Dollar and the Chilean Peso, denoted CHP. The US is assumed to be the 'home' country and i is the US interest rate of one period maturity, i^* is the foreign interest rate of the same maturity. When an investor buys CHP spot with USD, she can do so at the spot ask price for CHP (which is equal precisely to the inverse of spot bid price for USD in terms of CHP) and can sell them forward at the forward bid price for CHP. A covered arbitrage that involves borrowing in USD to invest in CHP, in a world where this difference between bid and ask prices exists, will be profitable if and only if[4]:

$$\frac{(1+i^*)F_b}{S_a} > (1+i) \tag{4}$$

[4]Suppose the investor borrows 1 USD today. She can buy $\frac{1}{S_a} = S_b^c$ CHP with the one USD spot. (S_b^c = bid rate for USD in terms of CHP and is expressed as CHP per USD). At the end of the period, the investor would have $\frac{(1+i^*)}{S_a}$ CHP and have to pay $(1+i)$ back in USD. The sale of $\frac{(1+i^*)}{S_a}$ CHP forward today would yield $F_b\frac{(1+i^*)}{S_a}$ USD tomorrow, resulting in the equation that follows

i.e. if

$$\delta_p = \frac{F_b - S_a}{S_a} - (i - i^*) > 0 \tag{5}$$

An outflow from CHP and into USD similarly is profitable if the following holds:

$$\frac{(1+i)S_b}{F_a} > (1+i^*) \tag{6}$$

or,

$$\delta_n = \frac{F_a - S_b}{S_b} - (i - i^*) < 0 \tag{7}$$

Since $\delta_p \neq \delta_n$, Covered Interest Parity now gets complicated. It requires that the following hold:

$$\delta_p \leq 0 \qquad and \qquad \delta_n \geq 0 \tag{8}$$

Note here that since ask rates are always greater than the corresponsing bid rates (otherwise the dealer would make a loss), $\delta_p \leq \delta_n$ always. The equality holds only when the bid and ask rates are equal, in the frictionless world. When bid rates differ from ask rates, δ_n and δ_p cannot both be equal to zero at once. If $\delta_p \leq 0$ holds, there is a (positive) range over which δ_n can vary, without violating the modified Covered Interest Parity condition, and it is given by $[0, (\delta_n - \delta_p)]$ or equivalently, by $[0, (\frac{F_a}{S_b} - \frac{F_b}{S_a})]$. Similarly, when $\delta_n \geq 0$, there is a negative range over which δ_p can vary, without violating the modified CIP. If we had data only on δ_n, there would be a range given by $[\kappa_n, 0] = [(\frac{F_b}{S_a} - \frac{F_a}{S_b}), 0]$ within which arbitrage wouldn't take place. If we were to measure only δ_p, this no-arbitrage band would be given by $[0, (\frac{F_a}{S_b} - \frac{F_b}{S_a})]$.

As it happens, we are measuring the average of the bid and ask rates in the spot and forward markets to arrive at our measure of CIP. Our computed forward and spot rates are:

$$F = \frac{F_b + F_a}{2} = F_b + \frac{\zeta_F}{2} = F_a - \frac{\zeta_F}{2} \tag{9}$$

$$S = \frac{S_b + S_a}{2} = S_b + \frac{\zeta_S}{2} = S_a - \frac{\zeta_S}{2} \tag{10}$$

And the computed CIP differential:

$$\frac{F - S}{S} - (i - i^*) = \frac{F_b + \frac{\zeta_F}{2} - S_a + \frac{\zeta_S}{2}}{S_a - \frac{\zeta_S}{2}} - (i - i^*) \tag{11}$$

$$= \left(\frac{F_b - S_a}{S_a}\right)\left(1 + \frac{\zeta_S}{2S_a}\right) + \frac{\zeta_F + \zeta_S}{2S_a - \zeta_S} - (i - i^*) \tag{12}$$

[Using $\frac{1}{1+x} \approx 1 - x$ for small x]

$$\Rightarrow \hat{\delta} = \left(\frac{F_b - S_a}{S_a}\right) - (i - i^*) + \left(\frac{F_b - S_a}{S_a}\right)\frac{\zeta_S}{2S_a} + \frac{\zeta_F + \zeta_S}{2S_a - \zeta_S} \tag{13}$$

$$\Rightarrow \hat{\delta} = \delta_p + C_1 \tag{14}$$

where

$$C_1 = \left(\frac{F_b - S_a}{S_a}\right)\frac{\zeta_S}{2S_a} + \frac{\zeta_F + \zeta_S}{2S_a - \zeta_S}$$

Similarly,

$$\frac{F - S}{S} - (i - i^*) = \frac{F_a - \frac{\zeta_F}{2} - S_b - \frac{\zeta_S}{2}}{S_b + \frac{\zeta_S}{2}} - (i - i^*) \tag{15}$$

$$= \left(\frac{F_a - S_b}{S_b}\right)\left(1 - \frac{\zeta_S}{2S_b}\right) - \frac{\zeta_F + \zeta_S}{2S_b + \zeta_S} - (i - i^*) \tag{16}$$

$$\Rightarrow \hat{\delta} = \delta_n - C_2 \tag{17}$$

where

$$C_2 = \left(\frac{F_a - S_b}{S_b}\right)\frac{\zeta_S}{2S_b} + \frac{\zeta_F + \zeta_S}{2S_b + \zeta_S}$$

When δ_p is less than zero, so that arbitrage out of CHP is not profitable, it may seem profitable to the observer because $\hat{\delta}$ may be positive, and the same holds for arbitrage out of CHP. C_1 and C_2 are not easily signed, and vary not just with the spreads but also with the forward and spot rates themselves. The assumption that our model is making is that C_1 and C_2 are bounded, and it is these bounds that constitute our thresholds. It is also possible, with some furthur algebra, to say something about the symmetry of these bounds, or the lack of it. Lets compare C_1 and C_2 term by term. The second terms of both are equal, because the denominators of both equal $2S$, from equation 10. From the first terms, using again the fact of ask rates being greater than bid rates, we arrive at:

$$\frac{\zeta_S}{2S_b} > \frac{\zeta_S}{2S_a}$$

$$\text{and} \quad \frac{F_a - S_b}{S_b} > \frac{F_b - S_a}{S_a}$$

$$\Rightarrow C_2(1) > C_1(1)$$

So that, $C_2 > C_1$, implying an asymmetry in the thresholds, even with symmetric costs to or controls on arbitrage. For any given δ, this would imply a larger negative threshold in absolute value than the positive one, if C_1 is positive. This would occur if one of the following is true:

1. $F_b > S_a$ i.e. the foreign currency (CHP here) is expected to appreciate. Note that since the ask rates are higher than bid rates, this doesn't hold if exchange rate is expected to remain constant. In our sample, most countries' currencies have seen a secular appreciation against the dollar, so one would expect the negative threshold to be larger than the positive one, although this result should be applied cautiously...we are talking here about forward rates of maturities 3 months or less, so short term considerations come into play. Moreover, the result only talks about expected appreciation incorporated in forward rates, not actual ex-post appreciation, which is what one observes in the sample.

2. $F_b < S_a$ but $\frac{\zeta_F+\zeta_S}{S_a+S_b} > \left(\frac{S_a-F_b}{S_a}\right)\frac{\zeta_S}{2S_a}$, which is to say that any expected depreciation incorporated in the forward rate is not too large[5].

II.2. CIP in the presence of capital controls.

The analysis above assumes that all distortions and costs are fully reflected in the bid-ask spreads. In practice, this is not true. Countries tax foreign investments and earning at different rates, may impose taxes or reserve requirements on foreign capital flows for the explicit purpose of encouraging or discouraging such flows, or may impose outright limits on transaction volumes, among other measures. For example, Brazil increased tax payable by foreigners on fixed interest investments in Brazil from 5 per cent to 9 per cent between October 1994 and March 1995. Chile imposed a stamp tax of 1.2 per cent per year on foreign loans, applicable on all credits in their first year, except trade loans in 1991. In this section, we look at the implications of capital controls for the CIP relationship, and how this relates it to our model.

[5]This depreciation can be quite substantial without being too large. Note that the above can be rearranged to get $\frac{2\zeta_F}{\zeta_S} + 1 > \frac{S_b-F_b}{S_a}$. Since $\zeta_F > \zeta_S$, the LHS is greater than 3.

II.2.1. Tax on Inflows

Suppose there exists a tax τ on foreign inflows into Chile (the analysis is analogous to a tax on outflows). Now, a foreigner investing in Chile can make a profit iff:

$$\begin{aligned}(1-\tau)(1+i^*)\frac{F_b}{S_a} &> (1+i)\\ \Rightarrow \frac{F_b}{S_a} &> 1+i-i^*+\tau\\ \Rightarrow \frac{F_b-S_a}{S_a}-(i-i^*) &> \tau \end{aligned} \tag{18}$$

which in terms of computed δ is,

$$\hat{\delta}=\frac{F-S}{S}-(i-i^*)=\delta_p+C_1>\tau \tag{19}$$

With a tax on inflows only, the condition for profitable outflows remains unchanged. Covered Interest Parity then requires:

$$\delta_p \leq \tau \text{ and } \delta_n \geq 0 \tag{20}$$

$$i.e.:\; -C_2 \leq \hat{\delta} \leq \tau + C_1 \tag{21}$$

thus increasing the positive threshold. A tax on outflows would push downwards the negative threshold.

II.2.2. Reserve Requirements

Suppose, as in Chile between 1994 and 1998, there exists a requirement to keep as unremunerated reserves, u per cent of every USD of inflow into the country. This amount is paid back at time h, which let's assume is greater than or equal to 1, the maturity period of our short term speculative investment. Assume also that the return from investment is repatriated at the time the investmenet matures and that interest rates are constant throughout (not realistic, but dropping this assumption will only reinforce our results). At time 0, the choice being faced is between investing a USD for h periods at the interest rate i or to invest $\frac{1-u}{S_a}$ at interest rate i^* for one period and re-invest this in USD for $h-1$ periods at interest rate i. Now, a profitable speculative inflow into Chile requires that the following condition hold[6]:

$$(1-u)(1+i^*)(1+i)^{h-1}\frac{F_b}{S_a} + u \geq (1+i)^h \tag{22}$$

$$\Rightarrow \frac{F_b - S_a}{S_a} - (i - i^*) \geq \frac{1 + i - u(1+i)^{1-h}}{(1-u)(1+i^*)} - 1 - i + i^* \tag{23}$$

the right hand side of which can be verified to be positive and to increase with the reserve requirement, u and the period that reserves are held, h. The last can be interpreted to mean that the burden of a fixed length reserve requirement is greater, the shorter the period of investment. A quantitative restriction on capital inflows therefore, pushes up the positive threshold. Similarly, a quantitative restriction on capital outflows can be shown to push down the negative threshold.

One can summarize the testable implications derived from the above discussion as follows:

1. The no-arbitrage band $[\kappa_n, \kappa_p]$ is larger than the largest spread.

2. The thresholds are likely to be asymmetric around zero, with larger negative thresholds for currencies that are expected to appreciate or not to depreciate too much.

3. Taxes and quantitative controls on capital inflows increase the positive threshold, and controls or taxes on outflows increase the absolute value of the negative threshold.

   The impact of limited supply of capital is not derived, but is likely to be towards reducing the speed with which the differentials revert back to the band. In the absence of market rationality, the differentials could follow a non-stationary process even outside the bands.

II.3. Empirical Model

In what follows, we estimate these no-arbitrage bands using an Asymmetric Self-Exciting Threshold Autoregressive model (SETAR) - self-exciting because the thresholds are lags of δ itself, and asymmetric because the negative threshold is allowed to differ from the positive

[6] This is in terms of USD at time h.

threshold. It takes the form:

$$\delta_t = \rho_i \delta_{t-1} + \epsilon_{it} \qquad \text{for} \quad \kappa_n < \delta_{t-1} < \kappa_p \tag{24}$$

$$\delta_t - \kappa_n = \rho_n(\delta_{t-1} - \kappa_n) + \epsilon_{nt} \quad \text{for} \quad \delta_{t-1} \leq \kappa_n \tag{25}$$

$$\delta_t - \kappa_p = \rho_p(\delta_{t-1} - \kappa_p) + \epsilon_{pt} \quad \text{for} \quad \delta_{t-1} \geq \kappa_p \tag{26}$$

where $\epsilon_{jt} \sim N(0, \sigma_j^2)$, $\;j = i, n, p$ and κ_n and κ_p are the negative and positive thresholds respectively. Note that this model implies that speculative activity will push the deviations to the edges of the band, rather than its center. The AR(1) process within the band is allowed to be a random walk, but the hypothesis of efficient arbitrage states that the AR(1) process outside the bands be stationary. If the thresholds were known, the model could be estimated by ordinary least squares applied separately to the inner regime and outer regime observations. But since the thresholds aren't known, we do a grid search over possible threshold combinations. If every value of δ_t occurring in the sample was taken as a likely threshold value, the possible combinations could be extremely large. Moreover, one needs to allow sufficient number of observations in the outer regimes to make estimation possible. Therefore, all the percentiles between the 5^{th} and 95^{th} percentiles are taken and separated into sets of negative thresholds candidates and positive threshold candidates. The model then choses the combination of negative and positive threshold values that maximize the likelihood function:

$$\begin{aligned}\mathscr{L} = &-\frac{1}{2} \sum_{\delta_{t-1} \in (\kappa_1, \kappa_2)} [\ln \sigma_i^2 + \frac{\epsilon_{it}^2}{\sigma_i^2}] \\ &-\frac{1}{2} \sum_{\delta_{t-1} \geq \kappa_p} [\ln \sigma_p^2 + \frac{\epsilon_{pt}^2}{\sigma_p^2}] \\ &-\frac{1}{2} \sum_{\delta_{t-1} \leq \kappa_n} [\ln \sigma_n^2 + \frac{\epsilon_{nt}^2}{\sigma_n^2}]\end{aligned} \tag{27}$$

In the estimation exercises below, we considered only 'non-crisis' periods, with crisis periods being identified as six months before and after a crisis month identified by Kaminsky and Reinhart (1999) criteria. An argument can be made that the crisis periods involve imminent defaults or threats thereof which need to be taken into account in deriving the relevant parity conditions, something that we have not done yet.

II.4. Integration Index

To construct the Integration Index, we first normalize each of the various indicators of openess derived from our model, viz. the threshold bandwidth, the percentage of observations lying in outer regimes, the median positive and (absolute value of) negative deviation outside threshold and the third quartile of continuous runs outside thresholds. Observations on each of the five variables are normalized by subtracting from them their inter-country mean and dividing by the standard deviation. This is done for both maturities, one and three months. For Malaysia, Thailand and Mexico, for which data on one of the maturities is not available, we use the available maturity's data to approximate for the missing maturity model[7]. The normalized observations are then averaged for each country and the negative of the resulting number taken to arrive at our Integration Index[8]. Note that this index is centered at zero and gives only an ordinal ranking. We compare this index with two other available indices of financial integration/openess. The first one is constructed by Chinn-Ito[9] and is a de-jure measure of openess constructed using Principal Component Analysis. The second is a quantitative measure of de-facto integration constructed as the ratio of total foreign assets and liabilities to GDP using data constructed by Lane and Milesi-Ferretti (2006). Each of these indices is available yearly, upto 2004. We average these for each of our countries over our sample period (1995-2004 for all the developed countries and shorter for EMEs) to arrive at a single number which we then compare with our index.

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[7]The analysis was repeated after dropping these three countries and the ranking of the rest of the countries are identical relative to each other in the smaller sample.

[8]Note that each of our variables are defined so that a larger value (say of number of observations outside threshold) would mean lower integration, so that a simple average of the normalized values would be a larger number the less integrated the country is.

[9]Chinn (2006)

III. The Data

Data used is of daily frequency, and is sourced from Datastream (for forward rates and for interest and exchange rates of developed markets (excluding Hong Kong)), Global Financial Database (for interest rates and exchange rates of emerging market economies and Hong Kong) and the online database of Federal Reserve Bank of St Louis (for Euro-dollar deposit rates). Data from IMF's International Financial Statistics was used for generating index of currency market turbulence, to identify crisis periods. Only countries for which at least 5 years of data was avaliable were used in the analysis. The period of analysis is from the late 1990's to 2006 for most countries, except for Hungry, whose daily data series stops in 2002 and Poland, whose data begins in 2002. For developed economies and Singapore, longer data series were available but were truncated to post-1995 period, to facilitate comparison with other EMEs. Interbank interest rates of one and three month terms are used. The US is treated as the home country in each equation. For countries that had one or more crisis during the sample period, the estimates have been reported for the full sample as well as non-crisis periods. However only models estimated using non-crisis periods were used for constructing the Integration Index.

Tables 1 and 2 give the summary statistics on CIP differentials for both 1- and 3-month maturity instruments. The mean deviations for both maturities are significantly different from zero, except for Malaysia (1-month), Hungary (3-month), Hong Kong (3-month) and South Africa (3-month). This is consistent with CIP in a less than perfect world, as seen above and in Cheung et. al. (2003). Also, the mean, variance and range of deviations do not move in the same direction, so that a more formal evaluation of the parity condition is needed. For example, although Hong Kong doesn't have the smallest means, it does have low variances and range of deviations.

IV. The Results

Tables 3 to 9 summarize the estimates of the TAR models for each of the countries in the sample. The developed countries, as expected, have narrower thresholds than EMEs as well as fewer observations that lie outside of the thresholds, smaller average and median deviations[10] outside thresholds and smaller continuous runs outside threhsolds. Among EMEs, Hungary and Mexico have the narrowest bands (3-month differentials), while Thailand has the widest (6.08, 1-month). Poland (both 1- and 3-month) and Singapore (3-month parity) are also quite narrow. Most EMEs have bands that are higly asymmetric about zero, with larger negative thresholds than positive ones. The model therefore, is able to capture the higher costs to borrowing in local currencies and lending in dollars imposed by capital controls. Although we discussed only two types of capital controls in Section II.2 above, this prediction of enlarged bands when capital controls are imposed is true more generally. Given that even the most well-implemented capital restrictions rarely involve a complete moratorium on foreign lending (long or short term), they only serve to make such transactions more expensive and harder (but not impossible) to undertake. These can thus be transalted into an effective tax, akin to the tax discussed in Section II.2.1, which any CIP differential must additionally cover, to be profitable.

Often, the controls seek to (and are successful in[11]) changing the composition of capital flows to longer maturities and therefore impose a higher effective tax on shorter term transactions, while reducting the supply of speculative capital. This reduction in the supply of capital means that the differentials would take longer to converge to the band edge. To see whether this happens in our sample, we compute the half lives[12] where possible, of deviations outside the band. Half lives of positive coefficients less than 0.5 are less than one day[13] - which means all developed markets (except Norway) and most EME coefficients, except one or more

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[10]Note that the average and median deviations outside thresholds are measured from the relevant threshold value, not from zero.

[11]Magud et. al. (2005)

[12]Half Life $= -log(2)/log(\rho)$ where ρ is the AR coefficient in the relevant regime.

[13]Results available on request

coefficients in India, Philippines, Malaysia and Thailand. For coefficients that are negative, half lives aren't defined. But one can look at continuous runs (number of successive days for which the differential was outside the same threshold) shown in columns (7) and (8) of Table 7. The median consecutive run for all countries is less than 2 (it being 2 only for Malaysia (1-month) and Japan (3-month)) and the highest third quartile is 14 (Malaysia again). This suggests that most deviations, when they do occur tend to be corrected within a business week. All countries, however, have seen at least one run that lasted a considerable period of time, the longest being Malaysia's, with a continuous run of over a year [14] of positive 1-month differentials. The longest continuous runs are, on average higher for EMEs than for developed markets and are longer for negative deviations than for positive deviations, confirming our expectations, as controls on outflows are more common in EMEs than on inflows.

Tables 8 and 9 give the estimated Threshold models. All the AR(1) coefficients of outer regimes are significantly less than 1 (in absolute value) at 1 per cent level of significance[15], indicating market efficiency. Our Index of financial integration is presented in Table 7. What is immediately clear is that all the developed countries, with the exception of Japan, rabk higher than all the EMEs in our sample, with the market for UK pound showing most efficient arbitrage with the US Dollar. Japan is the lowest ranked developed country in our sample, and I think the reason is not that arbitrageurs aren't doing their job in this market - the exact size of carry trade in yen is unknown but widely believed to be 'large' - but that differentials in Japan continue to persist because of the undiminishing supply of savings from the Japanese. Among the EMEs, Philippines and India show remarkably high degree of openness while Malaysia is unsurprisingly bottom ranked. Our index is highly correlated with the de-jure index of integration developed by Chinn-Ito but has a low correlation with the de-facto index based on Lane and Milesi-Ferretti data on total foreign assets and liabilities, thus underscoring the importance of using both quantitative and price measures in evaluating financial integration.

[14] The days here are 'business days', so that a continuous run of 369 business days would mean about two calender years!! Note also that the data for Malaysia starts on 1 Sept 1999.

[15] Results not shown here, but available upon request

V. Conclusions and Furthur Work

The research presented here reveals a much more efficient global financial market than has been allowed for in previous studies. Although all the emerging economies in our sample seem less integrated than the developed economies, in none of them are deviations from CIP such as to reject efficient arbitrage. The estimated coefficients on outer regimes are all significantly less than one in absolute value. Most estimated thresholds are asymmetric, with countries known to have controls on outflows showing lower negative thresholds. Among the EMEs, Philippines and India show remarkably high degree of openness while Thailand and Malaysia are bottom ranked.

In future work I hope to be able to relate the estimated thresholds to actual bid-ask spreads, explore the implications of limited supply of arbitrage funds and of financial repression on the arbitrage conditions and on bid-ask spreads. I also hope to include considerations of non-neutrality towards risk and to test whether a modified uncovered parity holds, and to what extent have the deviations from it corrected by globalization. Another interesting issue one would want to address is how and whether volatility impacts our thresholds. The entire sample period can be split into periods in which most countries experienced higher volatility and those that were more tranquil the world over. Did we see some countries better withstanding such periods (in terms of thresholds that were not significantly different between the two periods?). Did the more volatile periods see a flight to quality (which would be reflected in larger bands for better quality assets and vice versa)?

Table 1. Summary Statistics: CIP Deviations with 1-Month Interbank Interest Rates

Country	N	Mean	Std. Error	Variance	CV	Min	Max
Emerging Markets							
Hungary	1293	-1.027	0.108	15.160	-3.790	-17.269	21.077
India	1900	-1.088	0.045	3.827	-1.797	-12.809	8.069
Malaysia	1809	-0.084*	0.044	3.567	-22.485	-11.422	3.640
Philippines	1851	-1.872	0.058	6.270	-1.338	-47.564	32.383
Poland	1203	-1.440	0.105	13.164	-2.519	-14.006	22.122
Singapore	2605	-0.354	0.049	6.236	-7.055	-11.368	13.338
South Africa	2413	-2.588	0.111	29.691	-2.105	-32.513	39.515
Thailand	1995	-2.556	0.073	10.663	-1.278	-37.978	14.729
Developed Markets							
Australia	3051	0.134	0.025	1.843	10.111	-16.704	17.255
Canada	3051	0.108	0.016	0.771	8.119	-10.964	7.753
Denmark	3051	0.070	0.028	2.447	22.386	-25.597	15.102
Euro Area	2021	0.061	0.029	1.655	21.027	-11.504	20.429
Hong Kong	2910	-0.062	0.012	0.434	-10.663	-10.021	2.363
Japan	3051	0.340	0.046	6.503	7.510	-37.603	52.376
Norway	2772	0.231	0.052	7.623	11.931	-24.090	96.644
Sweden	3051	0.111	0.027	2.160	13.267	-24.081	20.695
Switzerland	3051	0.223	0.021	1.366	7 5.245	-12.460	10.832
United Kingdom	3051	0.049	0.016	0.817	18.603	-17.095	10.145

Note. — USA is assumed to be home country, for which Eurodollar rates of corresponding maturity are used. Data used is of daily frequency and is sourced from Datastream, GFD and Federal Reserve of St Louis Database. The deviations are on a per cent per annum basis. Only non-crisis period observations are used. For developed markets and Singapore, full available data (extending back to the 1980's) is used. N is the number of observations, Std. Error the standard error of the mean, CV the coefficient of variation, Min the minimum value and Max the maximum observed differential.

*Not significantly different from zero.

Table 2. Summary Statistics: CIP Deviations with 3-Month Interbank Interest Rates

Country	N	Mean	Std. Error	Variance	CV	Min	Max
Emerging Markets							
Hungary	1301	-0.032*	0.038	1.842	-42.245	-5.723	6.974
India	1920	0.445	0.030	1.749	2.972	-9.047	5.711
Mexico	1380	-0.479	0.063	5.510	-4.904	-21.857	9.591
Philippines	1878	-0.203	0.022	0.881	-4.621	-12.190	11.546
Poland	1203	-0.468	0.035	1.448	-2.570	-4.672	7.427
Singapore	2611	-0.171	0.017	0.747	-5.046	-5.281	4.398
South Africa	3132	0.016*	0.042	5.483	147.250	-11.804	41.590
Developed Markets							
Australia	3051	0.138	0.013	0.523	5.235	-20.255	11.902
Canada	3051	0.074	0.006	0.099	4.244	-3.581	5.579
Denmark	3051	0.093	0.010	0.284	5.715	-8.559	5.174
Euro Area	2021	0.055	0.012	0.268	9.482	-8.960	6.936
Hong Kong	2910	0.005*	0.009	0.218	97.805	-4.185	17.561
Japan	3051	0.204	0.008	0.203	2.205	-6.098	12.925
Norway	2772	0.162	0.019	0.958	6.057	-7.927	32.817
Sweden	3051	0.144	0.010	0.307	3.837	-7.981	6.922
Switzerland	3051	-0.068	0.009	0.226	-6.934	-5.942	7.120
United Kingdom	3051	0.091	0.005	0.092	3.334	-3.209	3.585

Note. — USA is assumed to be home country, for which Eurodollar rates of corresponding maturity are used. Data used is of daily frequency and is sourced from Datastream, GFD and Federal Reserve of St Louis Database. The deviations are on a per cent per annum basis. Only non-crisis period observations are used. For developed markets and Singapore, full available data (extending back to the 1980's) is used. N is the number of observations, Std. Error the standard error of the mean, CV the coefficient of variation, Min the minimum value and Max the maximum observed differential.

*Not significantly different from zero.

Table 3. Deviations From CIP: 1-Month Interbank Interest Rates, Entire Sample

Country	Threshold Estimates		Data Range	
	Negative	Positive	Begin Date	End Date
Emerging Markets				
Hungary	-1.16	0.01	28 Oct 97	03 Oct 02
India	-1.85	0.12	02 Dec 98	29 Dec 06
Philippines	-3.94	0.50	03 Jan 97	03 Oct 05
Poland	-0.80	0.05	12 Feb 02	11 Jan 07
Malaysia	-3.62	1.68	02 Jan 97	11 Jan 07
Singapore	-4.69	0.04	01 Jan 95	11 Jan 07
South Africa	-2.40	0.20	02 Apr 97	29 Dec 06
Thailand	-7.66	0.97	02 Jan 97	29 Dec 06
Developed Markets				
Australia	-0.37	0.73	01 Jan 95	25 Jan 07
Canada	-0.13	0.33	01 Jan 95	25 Jan 07
Denmark	-0.20	0.10	01 Jan 95	25 Jan 07
Euro Area	-0.04	0.16	05 Jan 99	25 Jan 07
Hong Kong	-0.60	0.19	01 Jan 95	11 Jan 07
Japan	-0.78	0.29	01 Jan 95	25 Jan 07
Norway	-0.52	0.87	01 Jan 95	25 Jan 07
Sweden	-0.15	0.35	01 Jan 95	25 Jan 07
Switzerland	-0.007	0.49	01 Jan 95	25 Jan 07
United Kingdom	-0.11	0.22	01 Jan 95	25 Jan 07

Note. — USA is assumed to be home country, for which Eurodollar rates of corresponding maturity are used. Data used is of daily frequency and is sourced from Datastream, GFD and Federal Reserve of St Louis Database. The deviations are on a per cent per annum basis.

Table 4. Deviations From CIP: 1-Month Interbank Interest Rates, Non-Crisis Periods

Country	Threshold Estimates		Crisis Period	
	Negative	Positive	Begin Date	End Date
Emerging Markets				
Philippines	-3.56	0.21	01 Jun 97	30 Jun 98
Malaysia	-3.42	1.65	01 Jan 97	31 Aug 99
Singapore	-0.91	0.02	01 Jun 97	30 Nov 98
Thailand	-6.06	0.02	01 Jan 97	31 Jul 98
Developed Markets				
Norway	-0.38	0.39	01 Jun 97	30 Jun 98

Note. — USA is assumed to be home country, for which Eurodollar rates of corresponding maturity are used. Data used is of daily frequency and is sourced from Datastream, GFD and Fed Reserve of St Louis Database. The deviations are on a per cent per annum basis

Table 5. Deviations From CIP: 3-Month Interbank Interest Rates, Entire Sample

Country	Threshold Estimates		Data Range	
	Negative	Positive	Begin Date	End Date
Emerging Markets				
Hungary	-0.05	0.01	28 Oct 97	03 Oct 02
India	-0.97	1.52	02 Dec 98	29 Dec 06
Mexico	-0.12	0.003	18 Jul 01	29 Dec 06
Philippines	-1.45	1.75	03 Jan 97	03 Oct 05
Poland	-0.21	0.001	12 Feb 02	11 Jan 07
Singapore	-1.88	0.02	01 Jan 95	11 Jan 07
South Africa	-0.41	1.72	02 Apr 97	17 Jan 07
Developed Markets				
Australia	-0.09	0.26	01 Jan 95	25 Jan 07
Canada	-0.05	0.20	01 Jan 95	25 Jan 07
Denmark	-0.01	0.10	01 Jan 95	25 Jan 07
Euro Area	-0.12	0.09	05 Jan 99	25 Jan 07
Hong Kong	-0.31	0.29	01 Jan 95	11 Jan 07
Japan	-0.08	0.10	01 Jan 95	25 Jan 07
Norway	-0.03	0.62	01 Jan 95	25 Jan 07
Sweden	-0.01	0.28	01 Jan 95	25 Jan 07
Switzerland	-0.17	0.15	01 Jan 95	25 Jan 07
United Kingdom	-0.04	0.21	01 Jan 95	25 Jan 07

Note. — USA is assumed to be home country, for which Eurodollar rates of corresponding maturity are used. Data used is of daily frequency and is sourced from Datastream, GFD and Federal Reserve of St Louis Database. The deviations are on a per cent per annum basis.

Table 6. Deviations From CIP: 3-Month Interbank Interest Rates, Non-Crisis Periods

Country	Threshold Estimates		Crisis Period	
	Negative	Positive	Begin Date	End Date
Emerging Markets				
Philippines	-1.23	0.75	03 Jan 97	30 Jun 98
Singapore	-0.26	0.0002	01 Jun 97	30 Nov 98
Developed Markets				
Norway	-0.10	0.35	01 Jun 97	30 Jun 98

Note. — USA is assumed to be home country, for which Eurodollar rates of corresponding maturity are used. Data used is of daily frequency and is sourced from Datastream, GFD and Fed Reserve of St Louis Database. The deviations are on a per cent per annum basis

Crisis periods refer to 6 month windows around Crisis months identified using Kaminsky and Reinhart(1999) criteria

Table 7. Measures of Financial Openness, Non-Crisis Periods

Country	Percent Obs. in Outer Regimes	Average Deviation Negative	Average Deviation Positive	Median Deviation Negative	Median Deviation Positive	Longest Run Negative	Longest Run Positive	Median Run	3^{rd} Quartile
				1-Month CIP					
Emerging Markets									
Hungary	85	-2.97	2.52	-2.27	1.72	10	7	1	2
India	49	-1.19	1.63	-0.80	1.05	69	52	1	2
Malaysia	32	-0.19	0.23	-0.07	0.28	95	369	2	14
Philippines	21	-1.70	2.02	-0.97	0.65	16	9	1	1
Poland	90	-2.78	2.64	-2.25	1.77	13	5	1	3
Singapore	89	-1.81	1.86	-1.60	1.68	12	12	1	3
South Africa	71	-4.35	3.11	-3.13	1.81	17	7	1	2
Thailand	22	-3.40	0.87	-1.78	0.61	15	10	1	2
Developed Markets									
Australia	12	-1.79	2.39	-0.54	0.99	5	5	1	1
Canada	12	-1.79	1.30	-0.98	0.54	7	7	1	1
Denmark	52	-3.31	0.38	-1.49	0.09	4	58	1	3
Euro Area	28	-0.93	1.13	-0.06	0.10	19	10	1	2
Hong Kong	41	-0.56	0.25	-0.15	0.19	10	29	1	3
Japan	38	-3.88	1.26	-2.01	0.25	3	25	1	2
Norway	14	-2.76	2.63	-1.40	0.34	4	20	1	1
Sweden	13	-2.41	1.87	-1.55	0.30	4	4	1	1
Switzerland	24	-0.99	1.04	-0.11	0.19	26	19	1	2
United Kingdom	15	-1.00	1.18	-0.16	0.11	10	18	1	1

Table 7—Continued

Country	Percent Obs. in Outer Regimes	Average Deviation Negative	Average Deviation Positive	Median Deviation Negative	Median Deviation Positive	Longest Run Negative	Longest Run Positive	Median Run	3^{rd} Quartile
				3-Month CIP					
Emerging Markets									
Hungary	98	-1.07	0.96	-0.83	0.74	13	24	1	2
India	21	-0.50	1.45	-0.33	1.35	15	170	1	2
Mexico	96	-1.05	1.13	-0.84	0.79	12	11	1	2
Philippines	10	-0.93	1.30	-0.46	0.47	13	17	1	1
Poland	93	-0.94	0.87	-0.77	0.61	13	5	1	3
Singapore	90	-0.68	0.62	-0.61	0.56	16	12	1	3
South Africa	55	-1.55	1.42	-1.21	0.83	35	5	1	3
Developed Markets									
Australia	22	-1.10	0.29	-0.49	0.05	3	46	1	2
Canada	11	-0.56	0.50	-0.26	0.19	4	3	1	1
Denmark	51	-0.92	0.17	-0.40	0.05	4	76	1	3
Euro Area	24	-0.98	0.32	-0.61	0.04	4	19	1	2
Hong Kong	10	-0.48	0.39	-0.17	0.06	17	9	1	2
Japan	83	-0.88	0.18	-0.48	0.10	3	214	2	5
Norway	10	-1.12	1.62	-0.65	0.77	5	6	1	1
Sweden	10	-0.95	1.13	-0.58	0.68	4	4	1	1
Switzerland	22	-0.36	0.62	-0.07	0.16	32	15	1	2
United Kingdom	10	-0.51	0.52	-0.24	0.15	5	4	1	1

Note. — USA is assumed to be home country, for which Eurodollar rates of corresponding maturity are used. Data used is of daily frequency and is sourced from Datastream, GFD and Fed Reserve of St Louis Database. The deviations are on a per cent per annum basis
Crisis periods excluded refer to 6 month windows around Crisis months identified using Kaminsky and Reinhart(1999) criteria

Table 7. Integration Index

Country	Integration Index	Ranking	Chinn-Ito Measure	LMF Measure
United Kingdom	1.02	1	2.62	5.96
Canada	0.90	2	2.62	2.07
Switzerland	0.86	3	2.62	8.55
Euro	0.78	4		
Australia	0.75	5	1.66	1.79
Hong Kong	0.71	6	2.62	11.93
Sweden	0.65	7	2.54	3.79
Norway	0.59	8	2.35	2.29
Denmark	0.43	9	2.62	3.04
Philippines	0.36	10	0.20	1.43
Japan	0.24	11	2.49	1.14
India	0.01	12	-0.95	0.47
Mexico	-0.03	13	0.72	0.79
Singapore	-0.20	14	2.42	8.04
Hungary	-0.26	15	1.08	1.50
Poland	-0.32	16	0.20	1.03
South Africa	-0.56	17	-1.09	1.25
Thailand	-0.65	18	-0.05	1.43
Malaysia	-1.31	19	-0.01	2.05
Correlation			0.73	0.40

Note. — See text for details on calculation of the Integration Index and of the Chinn-Ito and Lane and Milesi-Ferretti (LMF) Indices. The values in the 'Correlation' row are the correlation of our index with the index in the respective column.

Table 8. Estimated Threshold (ASETAR) Models

1-Month CIP	
AUSTRALIA	**CANADA**
$\delta_t = 0.33 * \delta_{t-1} + \epsilon_{it}$ for $-0.37 < \delta_{t-1} < 0.73$ (0.07) $\delta_t + 0.37 = -0.10(\delta_{t-1} + 0.37) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.37$ (0.05) $\delta_t - 0.73 = -0.12(\delta_{t-1} - 0.73) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.73$ (0.06) $\sigma^2_{it} = 1.19$, $\sigma^2_{nt} = 6.23$, $\sigma^2_{pt} = 7.76$ $R^2 = 0.02$, Log-Likelihood = -4911.3	$\delta_t = 0.97 * \delta_{t-1} + \epsilon_{it}$ for $-0.13 < \delta_{t-1} < 0.33$ (0.10) $\delta_t + 0.13 = -0.12(\delta_{t-1} + 0.13) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.13$ (0.06) $\delta_t - 0.33 = -0.13(\delta_{t-1} - 0.33) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.33$ (0.05) $\sigma^2_{it} = 0.45$, $\sigma^2_{nt} = 4.01$, $\sigma^2_{pt} = 2.70$ $R^2 = 0.03$, Log-Likelihood = -3449.25
DENMARK	**EURO AREA**
$\delta_t = 0.37 * \delta_{t-1} + \epsilon_{it}$ for $-0.2 < \delta_{t-1} < 0.10$ (0.35) $\delta_t + 0.2 = 0.11(\delta_{t-1} + 0.2) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.20$ (0.04) $\delta_t - 0.10 = -0.02(\delta_{t-1} - 0.10) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.10$ (0.04) $\sigma^2_{it} = 0.72$, $\sigma^2_{nt} = 8.16$, $\sigma^2_{pt} = 3.56$ $R^2 = 0.01$	$\delta_t = 0.76 * \delta_{t-1} + \epsilon_{it}$ for $-0.04 < \delta_{t-1} < 0.16$ (0.33) $\delta_t + 0.04 = 0.04(\delta_{t-1} + 0.04) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.04$ (0.05) $\delta_t - 0.16 = 0.10(\delta_{t-1} - 0.16) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.16$ (0.05) $\sigma^2_{it} = 0.81$, $\sigma^2_{nt} = 2.90$, $\sigma^2_{pt} = 4.77$ $R^2 = 0.01$
HONG KONG	**HUNGARY**
$\delta_t = 0.84 * \delta_{t-1} + \epsilon_{it}$ for $-0.60 < \delta_{t-1} < 0.19$ (0.03) $\delta_t + 0.60 = 0.45(\delta_{t-1} + 0.60) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.60$ (0.05) $\delta_t - 0.19 = -0.08(\delta_{t-1} - 0.19) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.19$ (0.06) $\sigma^2_{it} = 0.10$, $\sigma^2_{nt} = 1.53$, $\sigma^2_{pt} = 0.29$ $R^2 = 0.36$	$\delta_t = 1.25 * \delta_{t-1} + \epsilon_{it}$ for $-1.16 < \delta_{t-1} < 0.01$ (0.41) $\delta_t + 1.16 = -0.02(\delta_{t-1} + 1.16) + \epsilon_{nt}$ for $\delta_{t-1} \leq -1.16$ (0.04) $\delta_t - 0.01 = -0.22(\delta_{t-1} - 0.01) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.01$ (0.05) $\sigma^2_{it} = 11.53$, $\sigma^2_{nt} = 16.68$, $\sigma^2_{pt} = 15.22$ $R^2 = 0.05$

Table 8—Continued

1-Month CIP	
INDIA	**JAPAN**
$\delta_t = 1.08 * \delta_{t-1} + \epsilon_{it}$ for $-1.85 < \delta_{t-1} < 0.12$	$\delta_t = 0.48 * \delta_{t-1} + \epsilon_{it}$ for $-0.78 < \delta_{t-1} < 0.29$
(0.03)	(0.18)
$\delta_t + 1.85 = 0.50(\delta_{t-1} + 1.85) + \epsilon_{nt}$ for $\delta_{t-1} \leq -1.85$	$\delta_t + 0.78 = 0.10(\delta_{t-1} + 0.78) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.78$
(0.04)	(0.05)
$\delta_t - 0.12 = 0.81(\delta_{t-1} - 0.12) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.12$	$\delta_t - 0.29 = 0.18(\delta_{t-1} - 0.29) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.29$
(0.04)	(0.03)
$\sigma^2_{it} = 0.87, \quad \sigma^2_{nt} = 2.41, \quad \sigma^2_{pt} = 2.61$	$\sigma^2_{it} = 1.89, \quad \sigma^2_{nt} = 21.53, \quad \sigma^2_{pt} = 12.55$
$R^2 = 0.67$	$R^2 = 0.04$
MALAYSIA	**NORWAY**
$\delta_t = 0.91 * \delta_{t-1} + \epsilon_{it}$ for $-3.42 < \delta_{t-1} < 1.65$	$\delta_t = 0.82 * \delta_{t-1} + \epsilon_{it}$ for $-0.38 < \delta_{t-1} < 0.39$
(0.014)	(0.13)
$\delta_t + 3.42 = -0.413(\delta_{t-1} + 3.42) + \epsilon_{nt}$ for $\delta_{t-1} \leq -3.42$	$\delta_t + 0.38 = -0.20(\delta_{t-1} + 0.38) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.38$
(0.036)	(0.05)
$\delta_t - 1.65 = 0.657(\delta_{t-1} - 1.65) + \epsilon_{pt}$ for $\delta_{t-1} \geq 1.65$	$\delta_t - 0.39 = 0.62(\delta_{t-1} - 0.39) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.39$
(0.056)	(0.05)
$\sigma^2_{it} = 0.50, \quad \sigma^2_{nt} = 0.09, \quad \sigma^2_{pt} = 0.09$	$\sigma^2_{it} = 1.53, \quad \sigma^2_{nt} = 6.75, \quad \sigma^2_{pt} = 38.57$
$R^2 = 0.85$	$R^2 = 0.34$
PHILIPPINES	**POLAND**
$\delta_t = 0.922 * \delta_{t-1} + \epsilon_{it}$ for $-3.56 < \delta_{t-1} < 0.21$	$\delta_t = 3.13 * \delta_{t-1} + \epsilon_{it}$ for $-0.80 < \delta_{t-1} < 0.05$
(0.02)	(0.511)
$\delta_t + 3.56 = 0.117(\delta_{t-1} + 3.56) + \epsilon_{nt}$ for $\delta_{t-1} \leq -3.56$	$\delta_t + 0.8 = 0.163(\delta_{t-1} + 0.8) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.8$
(0.068)	(0.038)
$\delta_t - 0.21 = 0.563(\delta_{t-1} - 0.21) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.21$	$\delta_t - 0.05 = -0.137(\delta_{t-1} - 0.05) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.05$
(0.077)	(0.055)
$\sigma^2_{it} = 2.00, \quad \sigma^2_{nt} = 15.57, \quad \sigma^2_{pt} = 18.59$	$\sigma^2_{it} = 7.9, \quad \sigma^2_{nt} = 13.57, \quad \sigma^2_{pt} = 15.71$
$R^2 = 0.51$	$R^2 = 0.09$

Table 8—Continued

1-Month CIP	
SINGAPORE	**SOUTH AFRICA**
$\delta_t = \underset{(0.238)}{0.42} * \delta_{t-1} + \epsilon_{it}$ for $-0.91 < \delta_{t-1} < 0.02$	$\delta_t = \underset{(0.123)}{0.126} * \delta_{t-1} + \epsilon_{it}$ for $-2.4 < \delta_{t-1} < 0.2$
$\delta_t + 0.91 = \underset{(0.035)}{-0.09}(\delta_{t-1} + 0.91) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.91$	$\delta_t + 2.40 = \underset{(0.03)}{0.194}(\delta_{t-1} + 2.40) + \epsilon_{nt}$ for $\delta_{t-1} \leq -2.40$
$\delta_t - 0.02 = \underset{(0.031)}{-0.01}(\delta_{t-1} - 0.02) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.02$	$\delta_t - 0.20 = \underset{(0.042)}{-0.358}(\delta_{t-1} - 0.20) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.2$
$\sigma^2_{it} = 4.72,\ \sigma^2_{nt} = 6.75,\ \sigma^2_{pt} = 5.97$ $R^2 = 0.04$	$\sigma^2_{it} = 17.53,\ \sigma^2_{nt} = 37.08,\ \sigma^2_{pt} = 28.63$ $R^2 = 0.18$
SWEDEN	**SWITZERLAND**
$\delta_t = \underset{(0.238)}{1.02} * \delta_{t-1} + \epsilon_{it}$ for $-0.15 < \delta_{t-1} < 0.35$	$\delta_t = \underset{(0.08)}{0.894} * \delta_{t-1} + \epsilon_{it}$ for $-0.007 < \delta_{t-1} < 0.49$
$\delta_t + 0.15 = \underset{(0.048)}{-0.153}(\delta_{t-1} + 0.15) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.15$	$\delta_t + 0.007 = \underset{(0.034)}{-0.13}(\delta_{t-1} + 0.007) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.007$
$\delta_t - 0.35 = \underset{(0.069)}{-0.06}(\delta_{t-1} - 0.35) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.35$	$\delta_t - 0.49 = \underset{(0.045)}{-0.089}(\delta_{t-1} - 0.49) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.49$
$\sigma^2_{it} = 0.84,\ \sigma^2_{nt} = 7.22,\ \sigma^2_{pt} = 13.77$ $R^2 = 0.03$	$\sigma^2_{it} = 0.85,\ \sigma^2_{nt} = 2.41,\ \sigma^2_{pt} = 3.45$ $R^2 = 0.05$
THAILAND	**UNITED KINGDOM**
$\delta_t = \underset{(0.017)}{0.901} * \delta_{t-1} + \epsilon_{it}$ for $-6.06 < \delta_{t-1} < 0.02$	$\delta_t = \underset{(0.163)}{0.73} * \delta_{t-1} + \epsilon_{it}$ for $-0.11 < \delta_{t-1} < 0.22$
$\delta_t + 6.06 = 0.656(\delta_{t-1} + 6.06) + \epsilon_{nt}$ for $\delta_{t-1} \leq -6.06$	$\delta_t + 0.11 = -0.10(\delta_{t-1} + 0.11) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.11$

Table 8—Continued

1-Month CIP	
(0.061)	(0.035)
$\delta_t - 0.02 = -0.527(\delta_{t-1} - 0.02) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.02$	$\delta_t - 0.22 = -0.06(\delta_{t-1} - 0.22) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.22$
(0.085)	(0.062)
$\sigma^2_{it} = 3.19$, $\sigma^2_{nt} = 22.98$, $\sigma^2_{pt} = 3.72$	$\sigma^2_{it} = 0.48$, $\sigma^2_{nt} = 1.46$, $\sigma^2_{pt} = 4.23$
$R^2 = 750.25$	$R^2 = 0.01$

Note. — Standard Errors in Parenthesis. Data excludes crisis periods, where applicable. Note that the R^2 reported is for regression through the origin and is computed as $\hat{Y}'\hat{Y}/Y'Y$ where $\hat{Y}$ is the vector of predicted values from the model.

Table 9. Estimated Threshold (ASETAR) Models

3-Month CIP	
AUSTRALIA	**CANADA**
$\delta_t = \underset{(0.05)}{0.97} * \delta_{t-1} + \epsilon_{it}$ for $-0.09 < \delta_{t-1} < 0.26$ $\delta_t + 0.09 = \underset{(0.07)}{-0.01}(\delta_{t-1} + 0.09) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.09$ $\delta_t - 0.26 = \underset{(0.05)}{-0.07}(\delta_{t-1} - 0.26) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.26$ $\sigma^2_{it} = 0.16, \quad \sigma^2_{nt} = 4.62, \quad \sigma^2_{pt} = 0.99$ $R^2 = 0.05$	$\delta_t = \underset{(0.06)}{1.01} * \delta_{t-1} + \epsilon_{it}$ for $-0.05 < \delta_{t-1} < 0.20$ $\delta_t + 0.05 = \underset{(0.06)}{-0.16}(\delta_{t-1} + 0.05) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.05$ $\delta_t - 0.20 = \underset{(0.05)}{-0.14}(\delta_{t-1} - 0.20) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.20$ $\sigma^2_{it} = 0.07, \quad \sigma^2_{nt} = 0.37, \quad \sigma^2_{pt} = 0.31$ $R^2 = 0.31$
DENMARK	**EURO AREA**
$\delta_t = \underset{(0.012)}{0.97} * \delta_{t-1} + \epsilon_{it}$ for $-0.014 < \delta_{t-1} < 0.10$ $\delta_t + 0.014 = \underset{(0.041)}{0.097}(\delta_{t-1} + 0.014) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.014$ $\delta_t - 0.10 = \underset{(0.036)}{-0.005}(\delta_{t-1} - 0.10) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.10$ $\sigma^2_{it} = 0.09, \quad \sigma^2_{nt} = 0.84, \quad \sigma^2_{pt} = 0.42$ $R^2 = 0.03$	$\delta_t = \underset{(0.17)}{1.02} * \delta_{t-1} + \epsilon_{it}$ for $-0.12 < \delta_{t-1} < 0.09$ $\delta_t + 0.12 = \underset{(0.05)}{-0.11}(\delta_{t-1} + 0.12) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.12$ $\delta_t - 0.09 = \underset{(0.056)}{0.063}(\delta_{t-1} - 0.09) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.09$ $\sigma^2_{it} = 0.11, \quad \sigma^2_{nt} = 0.52, \quad \sigma^2_{pt} = 0.82$ $R^2 = 0.02$
HONG KONG	**HUNGARY**
$\delta_t = \underset{(0.03)}{0.58} * \delta_{t-1} + \epsilon_{it}$ for $-0.31 < \delta_{t-1} < 0.29$ $\delta_t + 0.31 = \underset{(0.06)}{0.45}(\delta_{t-1} + 0.31) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.31$ $\delta_t - 0.29 = \underset{(0.09)}{0.09}(\delta_{t-1} - 0.29) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.29$ $\sigma^2_{it} = 0.03, \quad \sigma^2_{nt} = 0.47, \quad \sigma^2_{pt} = 2.75$ $R^2 = 0.15$	$\delta_t = \underset{(9.79)}{25.23} * \delta_{t-1} + \epsilon_{it}$ for $-0.05 < \delta_{t-1} < 0.01$ $\delta_t + 0.05 = \underset{(0.04)}{0.03}(\delta_{t-1} + 0.05) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.05$ $\delta_t - 0.01 = \underset{(0.04)}{0.04}(\delta_{t-1} - 0.01) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.01$ $\sigma^2_{it} = 1.06, \quad \sigma^2_{nt} = 2.01, \quad \sigma^2_{pt} = 1.7$ $R^2 = 0.01$

Table 9—Continued

3-Month CIP	
INDIA	**JAPAN**
$\delta_t = 0.85 * \delta_{t-1} + \epsilon_{it}$ for $-0.97 < \delta_{t-1} < 1.52$ (0.02) $\delta_t + 0.97 = 0.20(\delta_{t-1} + 0.97) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.97$ (0.09) $\delta_t - 1.52 = 0.95(\delta_{t-1} - 1.52) + \epsilon_{pt}$ for $\delta_{t-1} \geq 1.52$ (0.02) $\sigma^2_{it} = 0.19, \sigma^2_{nt} = 0.67, \sigma^2_{pt} = 0.31$ $R^2 = 0.86$	$\delta_t = 1.73 * \delta_{t-1} + \epsilon_{it}$ for $-0.08 < \delta_{t-1} < 0.10$ (0.41) $\delta_t + 0.08 = -0.04(\delta_{t-1} + 0.08) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.08$ (0.08) $\delta_t - 0.10 = 0.20(\delta_{t-1} - 0.10) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.10$ (0.017) $\sigma^2_{it} = 0.42, \sigma^2_{nt} = 1.12, \sigma^2_{pt} = 0.13$ $R^2 = 0.09$
MEXICO	**NORWAY**
$\delta_t = 2.19 * \delta_{t-1} + \epsilon_{it}$ for $-0.12 < \delta_{t-1} < 0.003$ (2.41) $\delta_t + 0.12 = 0.06(\delta_{t-1} + 0.12) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.12$ (0.04) $\delta_t - 0.003 = -0.17(\delta_{t-1} - 0.003) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.003$ (0.04) $\sigma^2_{it} = 1.37, \sigma^2_{nt} = 2.20, \sigma^2_{pt} = 2.33$ $R^2 = 0.02$	$\delta_t = 0.88 * \delta_{t-1} + \epsilon_{it}$ for $-0.097 < \delta_{t-1} < 0.35$ (0.07) $\delta_t + 0.10 = -0.04(\delta_{t-1} + 0.10) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.10$ (0.06) $\delta_t - 0.35 = 0.63(\delta_{t-1} - 0.35) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.35$ (0.06) $\sigma^2_{it} = 0.25, \sigma^2_{nt} = 1.37, \sigma^2_{pt} = 7.21$ $R^2 =?$
PHILIPPINES	**POLAND**
$\delta_t = 0.56 * \delta_{t-1} + \epsilon_{it}$ for $-1.23 < \delta_{t-1} < 0.75$ (0.03) $\delta_t + 1.23 = -0.18(\delta_{t-1} + 1.23) + \epsilon_{nt}$ for $\delta_{t-1} \leq -1.23$ (0.07) $\delta_t - 0.75 = 0.57(\delta_{t-1} - 0.75) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.75$ (0.10) $\sigma^2_{it} = 0.39, \sigma^2_{nt} = 1.19, \sigma^2_{pt} = 5.52$ $R^2 = 0.33$	$\delta_t = 4.37 * \delta_{t-1} + \epsilon_{it}$ for $-0.21 < \delta_{t-1} < 0.001$ (0.75) $\delta_t + 0.21 = 0.20(\delta_{t-1} + 0.21) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.21$ (0.04) $\delta_t - 0.001 = -0.14(\delta_{t-1} - 0.001) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.001$ (0.05) $\sigma^2_{it} = 0.70, \sigma^2_{nt} = 1.51, \sigma^2_{pt} = 1.65$ $R^2 = 0.09$

Table 9—Continued

3-Month CIP	
SINGAPORE	**SOUTH AFRICA**
$\delta_t = \underset{(0.30)}{0.46} * \delta_{t-1} + \epsilon_{it}$ for $-0.26 < \delta_{t-1} < 0.0002$ $\delta_t + 0.26 = \underset{(0.03)}{0.08}(\delta_{t-1} + 0.26) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.26$ $\delta_t - 0.0002 = \underset{(0.03)}{-0.04}(\delta_{t-1} - 0.0002) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.0002$ $\sigma^2_{it} = 0.55, \quad \sigma^2_{nt} = 0.81, \quad \sigma^2_{pt} = 0.70$ $R^2 = 0.06$	$\delta_t = \underset{(0.0653)}{-0.039} * \delta_{t-1} + \epsilon_{it}$ for $-0.41 < \delta_{t-1} < 1.72$ $\delta_t + 0.41 = \underset{(0.029)}{0.278}(\delta_{t-1} + 0.41) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.41$ $\delta_t - 1.72 = \underset{(0.103)}{-0.712}(\delta_{t-1} - 1.72) + \epsilon_{pt}$ for $\delta_{t-1} \geq 1.72$ $\sigma^2_{it} = 1.99, \quad \sigma^2_{nt} = 4.28, \quad \sigma^2_{pt} = 8.01$ $R^2 = 0.14$
SWEDEN	**SWITZERLAND**
$\delta_t = \underset{(0.06)}{0.99} * \delta_{t-1} + \epsilon_{it}$ for $-0.01 < \delta_{t-1} < 0.28$ $\delta_t + 0.01 = \underset{(0.05)}{0.10}(\delta_{t-1} + 0.01) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.01$ $\delta_t - 0.28 = \underset{(0.07)}{-0.03}(\delta_{t-1} - 0.28) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.28$ $\sigma^2_{it} = 0.18, \quad \sigma^2_{nt} = 0.91, \quad \sigma^2_{pt} = 1.96$ $R^2 = 0.07$	$\delta_t = \underset{(0.08)}{0.77} * \delta_{t-1} + \epsilon_{it}$ for $-0.17 < \delta_{t-1} < 0.15$ $\delta_t + 0.17 = \underset{(0.04)}{0.004}(\delta_{t-1} + 0.17) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.17$ $\delta_t - 0.15 = \underset{(0.06)}{-0.05}(\delta_{t-1} - 0.15) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.15$ $\sigma^2_{it} = 0.1, \quad \sigma^2_{nt} = 0.54, \quad \sigma^2_{pt} = 0.92$ $R^2 = 0.04$
UNITED KINGDOM	
$\delta_t = \underset{(0.05)}{0.88} * \delta_{t-1} + \epsilon_{it}$ for $-0.04 < \delta_{t-1} < 0.21$ $\delta_t + 0.04 = -0.14(\delta_{t-1} + 0.04) + \epsilon_{nt}$ for $\delta_{t-1} \leq -0.04$ (0.04)	

Table 9—Continued

3-Month CIP	
$\delta_t - 0.21 = -0.09(\delta_{t-1} - 0.21) + \epsilon_{pt}$ for $\delta_{t-1} \geq 0.21$ (0.06) $\sigma^2_{it} = 0.07, \quad \sigma^2_{nt} = 0.21, \quad \sigma^2_{pt} = 0.40$ $R^2 = ?$	

Note. — Standard Errors in Parenthesis. Data excludes crisis periods, where applicable. Note that the R^2 reported is for regression through the origin and is computed as $\hat{Y}'\hat{Y}/Y'Y$ where $\hat{Y}$ is the vector of predicted values from the model.

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