Estimating the Determinants of Capital Flows to Emerging Market Economies: A maximum-likelihood disequilibrium approach
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Abstract

This paper studies the determinants of capital flows defined as external bond and syndicated loan issuance to 10 emerging economies (EMEs) since 1992. We follow Mody and Taylor (2004) by estimating an explicit disequilibrium system of demand and supply of capital flows using maximum likelihood techniques. We use the estimated supply and demand determinants to calculate time-varying probability of international supply-side rationing. We extend Mody and Taylor's paper by estimating a pooled and fixed-effects panel of 10 countries (instead of 4 separately) on a longer time period (1992:1 to 2004:12 instead of 1990:1 to 2000:6). On the supply side, credit ratings and EME spreads have a positive and significant effect on capital flows in all of the countries studied. On the demand side, domestic equity indices have a positive effect on capital flows, while reserves over imports and EME spreads have a negative one. The signs and magnitude of the coefficients in the fixed-effect model are in line with individual country results; with strong country-specific effects in the demand equation. Finally, we calculate the probability of capital crunch for Brazil.

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1. Introduction

The analysis of capital flows to emerging market economies (EMEs), both from a short and a long-run perspective has captured the interest of academic economists and policy makers for several decades.[1] The resurgence of capital flows to EMEs in the first half of the 1990s, led to a period of high volatility, with periods of seeming exuberance interrupted by periods of financial crises that affected large emerging economies such as Mexico, Russia, Brazil and several East Asian countries. Interesting surveys of these episodes include Calvo, Leiderman and Reinhart (1996), Taylor and Sarno (1997), International Monetary Fund (2000) and Roubini and Sester (2004).

The volatile nature of emerging capital markets reflects the fact that significant flows to emerging markets can rapidly change in magnitude or even stop suddenly in the wake of information available about a debtor country's default risk.[2] Given that a collapse in capital flows can be costly to EMEs it is important to identify the determinants of capital flows in order to increase our understanding of how to avoid or minimise such costs. Traditionally, capital flows have been analysed in terms of so called 'push and pull' factors as in Agenor (1998), Mody, Taylor and Kim (2001) and Ferrucci, Herzberg, Soussa and Taylor (2004). Push factors refer to global determinants of flows from the world financial markets to EMEs, while pull factors refer to country specific elements that reflect domestic fundamentals and investment opportunities. Although the 'push-pull' approach is a useful framework to understand flows to EMEs, few studies have implemented a standard supply and demand analysis to study the behaviour of capital flows over time.

Chart 1 shows the volatile behaviour of capital flows to EMEs as well as a measure of the cost of capital they faced (the EMBI/EMBIG spread[3]) since 1992. The combined observation of capital flows and the cost of capital reflects the interaction of the supply of capital from the rest of the world to EMEs and the demand for capital of EMEs. For creditors supplying capital, the interest rate associated with these flows reflects expected returns, defined as the sum of a risk free rate in US dollars plus a (credit) risk premium. For debtors demanding capital, it represents the cost of funds. But the outcomes observed in Chart 1 might not reflect an efficient competitive equilibrium resulting from the interaction of supply and demand. The supply of flows, for instance could be rationed as a

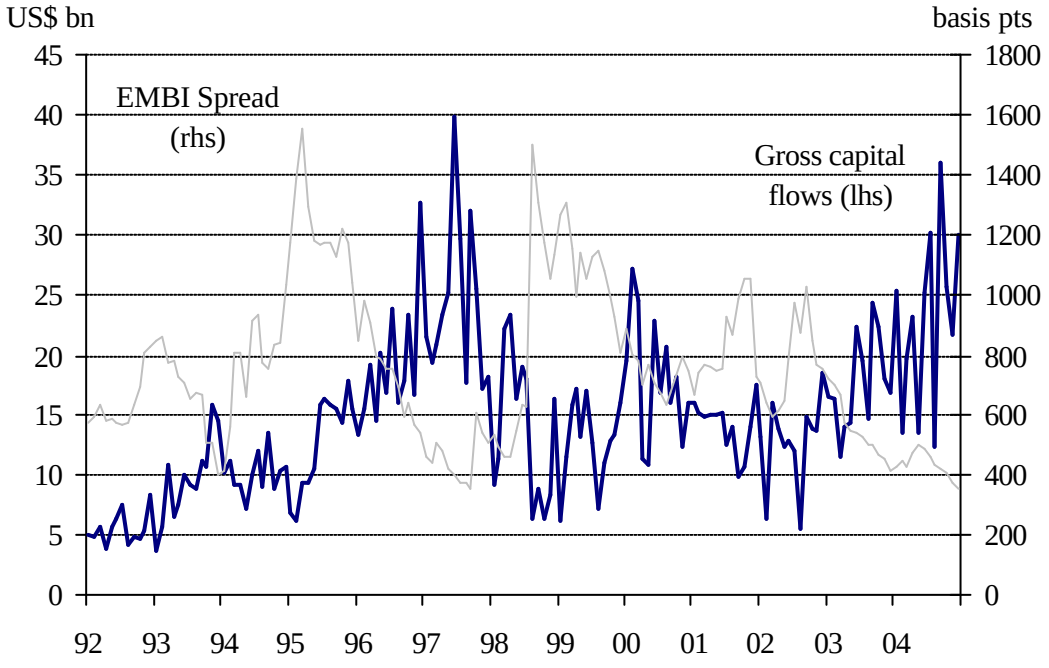
[1] See for example, Eichengreen (2003) and Reinhart and Rogoff (2004) for recent discussions, and Lucas (1990) for a seminal one.
[2] See Calvo and Reinhart (1999) for a discussion of sudden stops and Eichengreen and Mody (1998) for a description of the increasing, but volatile pattern of flows in the 1990s.
[3] The spreads series corresponds to the EMBI spread from 1992 to 1997. From 1998 to 2004 we spliced the EMBIG on the EMBI spread using the EMBIG's growth rate.

country might be willing to acquire capital that is unavailable from creditor countries at the current cost of capital. Similarly, the demand for flows could be dwarfed by excess supply in times of over-optimism about debtor countries given the cost of capital.

Previous work by Mody and Taylor (2004) has estimated the determinants of supply and demand for international capital flows to emerging markets taking into account an explicit disequilibrium approach. They conducted the study for four different countries separately for the period of 1990:1 – 2000:6. Their estimation was carried out using maximum likelihood techniques which allowed them to calculate the probability that the market for flows has been supply (or demand) constrained at different points in time.

This paper extends Mody and Taylor (2004) by estimating a panel of ten countries on a longer sample period (to 2004:12). The panel estimation involves both a pooled as well as a fixed-effects estimation. The latter allows us to distinguish the effect of aggregate shocks to EMEs from country-specific ones, which we can then compare with domestic fundamentals in order to identify periods of crunches or exuberance for all EMEs.

Chart 1: Gross capital flows to EMEs and EMBI/EMBIG spread*



*Sum of flows to 10 selected countries: Brazil, Colombia, Hungary, India, Korea, Malaysia, Mexico, South Africa, Thailand and Turkey
Sources: Dealogic's Bond and Loanware, JPM.

The theoretical appeal of the disequilibrium approach is that there are reasons to believe that capital flows might be relatively unresponsive to movements in interest rates. One reason why the cost of credit to EMEs at any given point in time might not clear markets is due to credit rationing as explained in the seminal work of Stiglitz and Weiss (1981). Their main idea is that interest rates might not always clear credit markets because lenders may have incomplete information about borrower's creditworthiness or their level of risk aversion. Under these circumstances they will try to avoid high-risk borrowers even if they are willing to pay very high interest rates. In some instances, therefore, the supply for credit might be below the demand and there will be a credit crunch.

There are different ways in which credit rationing is reflected in international financial markets. Mody and Taylor discuss three manifestations of rationing, all of which result from asymmetric information. In all three cases, asymmetric information leads to a risk premium that opens up a wedge between the competitive interest rate and the observed one. That wedge, however, can be present permanently (as implied by Stiglitz and Weiss); sporadically and then disappear (as in a 'sudden stop' a la Calvo and Reinhart (1999); or it might fluctuate with the cycle (as in the financial accelerator model of Bernanke, Gertler and Gilchrist (1999).

As in Mody and Taylor (2004), who in turn follow Maddala (1983) and Kiefer (1980), we estimate the disequilibrium supply and demand system using maximum likelihood techniques. The estimated supply and demand equations can then be used to estimate the probability that supply is less than demand at any given point in time, in other words, the probability of a capital crunch. Using this methodology we estimate the supply and demand functions country by country for Brazil, Colombia, Hungary, India, Korea, Malaysia, Mexico, South Africa, Thailand and Turkey. We extend Mody and Taylor's analysis by estimating the system as a panel for countries both assuming a common intercept and by allowing for fixed-effects. Potentially, this would allow us to isolate credit crunches that have affected the EMEs as a whole, as opposed to country specific crunches.

Our preliminary results suggest that the supply of flows to EMEs is positively related with EME spreads (a measure of expected return), credit ratings, and the ratio of reserves to short term debt. On the demand side, domestic equity indices have a positive effect on capital flows, while the ratio of reserves over imports and EME spreads (a measure of the cost of capital to borrowers) have a negative one. We also estimate the system as a panel with and without fixed effects. It is reassuring to find that the signs and magnitude of the coefficients are broadly in line with the country-by-

country results. Moreover, we find evidence of strong country-specific effects in the demand for capital, but not in the supply for it. Finally, we present the probability of a capital crunch for Brazil.

The rest of the paper is organised as follows. Section 2 discusses the theoretical causes of a capital crunch. Section 3 presents the empirical model and the econometric technique used to estimate it. Section 4 describes the data, while section 5 reports and discusses the results. Finally, section 6 concludes.

2. Theoretical background

If interest rates do not clear credit markets at any given point in time, then the observed quantity reflects excess supply or demand for credit. When the market is constrained by the supply of credit it is said to be experiencing rationing (Stiglitz and Weiss (1981)). Conversely, when the market is constrained by demand it is said to have excess supply, which in the case of capital markets, could be associated with times of exuberance.

The basic idea behind rationing is that interest rates might not always clear credit markets because lenders will try to avoid borrowers who are willing to pay very high interest rates for project financing assuming these are too risky. Hence, it is the asymmetry of information about the creditworthiness of the borrowers that is at the root of credit rationing.

There are three ways in which asymmetric information may lead to credit rationing. In all three cases, asymmetric information leads to a risk premium that opens up a wedge between the competitive interest rate and the observed one. That wedge, however, can be present permanently (as implied by Stiglitz and Weiss); sporadically and then disappear (as in a 'sudden stop' à la Calvo and Reinhart (1999)); or it might fluctuate with the cycle (as in the financial accelerator model of Bernanke, Gertler and Gilchrist (1999)).

In the context of capital flows, Stiglitz and Wiess (1981) show why interest rates might not adjust to clear credit markets, thus providing an explanation for why some countries are permanently rationed at any point in time. But investors can actually reassess the probability of default of debtors at any point in time, and more often than not around financial crisis. This assessment could reflect either a

change in fundamentals or contagion effects, and regardless of which occurs in practice, a sudden stop (Calvo Reinhart (1999)) or collapse in credit (Mankiw (1986)) may follow.

Finally, credit rationing could evolve at business cycle frequencies as a result of asymmetric information. Because creditors have imperfect information about borrowers, they charge a premium which will vary according to the value of the borrower's collateral. In bad times the value of a firm's collateral falls, the premium charged for its borrowed capital rises, and hence credit falls, thus reinforcing the downturn. This procyclical feature of credit cycles is usually referred to as the financial accelerator mechanism described in Bernanke, Gertler and Gilchrist (1999).

3. Methodology: empirical model and econometric technique

In this paper we assume that it is the short side of the market that determines the amount of capital that flows to emerging economies. In a capital crunch, for example, the demand for capital inflows exceeds the supply, which in turn reflects the short side of the market. The fact that the short side of the market is what one observes as capital flows can be characterised by the condition:

$$C_t = \min(C_t^d, C_t^s) \tag{1}$$

where C_t^d is the demand for capital at time *t*, C_t^s is the supply of capital at time *t* and C_t is the actual amount of capital inflow.

The supply and demand for capital flows are in turn functions of a set of variables that determine C_t^d and C_t^s. These functions take the form:

$$C_t^d = b' X_t^d + u_t^d \tag{2}$$

$$C_t^s = g' X_t^s + u_t^s \tag{3}$$

where X_t^d and X_t^s are the vectors of determinants of supply and demand. Some elements of these vectors can be shared by both equations, but exclusion restrictions imply that at least one variable

has to be unique to one equation. u_t^d and u_t^s are white noise disturbances while ß and ? are parameter vectors. The problem is to estimate the parameter vectors in the system (1)-(3), and to calculate the probability of a capital crunch at any point in time. A capital crunch, in turn, occurs when

$$C_t = \min(C_t^d, C_t^s) = C_t^s. \tag{4}$$

Previous studies that estimate disequilibrium models have inferred whether the observed quantity in the market belongs to the supply or demand schedules by looking at the behaviour of price changes (Fair and Jaffe (1972) and Maddala (1983)). Positive price changes, for instance could indicate that the observed quantity belongs to the demand schedule, while falling prices (negative changes) indicate that observations belong to the supply. In the context of international capital flows, one could potentially use auction-cover ratios as a measure of excess demand. These data, however, is difficult to gather as it differs for each specific bond and syndicated loan issuance.

Given that credit rationing implies a departure from a perfectly competitive supply and demand equilibrium, we take an agnostic view about whether actual flows are part of the supply or demand functions and estimate the disequilibrium model with no sample separation developed by Kiefer (1980) and Maddala (1983).[4] This model allows one to calculate the probability of being in the supply or demand given the observed capital flow at any given point in time.

In particular, denote the probability of a capital crunch at any point in time by $?_t$. Hence the probability that any given observation belongs to the supply curve given that we observe the quantity of capital flows, C_t, is:

$$q_t = \Pr(C_t^s < C_t^d \mid C_t). \tag{5}$$

If u_t^d and u_t^s are assumed to be independently and normally distributed, the likelihood that an observation belongs to the demand is:

$$L_t^d = (1/s^s)j[(C_t - g'X_t^s)/s^s][1-\Phi[(C_t - b'X_t^d)/s^d] \tag{6}$$

[4] These methods were initially introduced by Fair and Jaffe (1972), Maddala and Nelson (1974), Amemiya (1974), and were later refined by Kiefer (1980) and Maddala (1983).

Likewise, the likelihood that an observation belongs to the supply is:

$$L_t^s = (1/s^{\,d})\, j\,[(C_t - b'X_t^d)/s^{\,d}][1-\Phi[(C_t - g'X_t^s)/s^{\,s}] \quad (7)$$

The likelihood of either occurring is therefore:

$$L_t = L_t^d + L_t^s \quad (8)$$

Hence the likelihood function may be written as (Keifer (1980) and Maddala (1983)):

$$LF_t = \prod_{t=1}^{T} L_t \quad (9)$$

where f and F are the standard normal density and distribution functions, respectively. Intuitively, this form of the likelihood function weights the standard normal distributions that apply to each regime (supply or demand in this case) by the probability of being on the supply or demand given the data. The model can be estimated by maximum likelihood techniques that search for the parameter values that maximise the likelihood function in (9). We implement the estimation procedure using a standard optimisation routine in Matlab.

It follows that the probability of a capital crunch at any point in time, $?_t$, as defined in (5), is:

$$q_t = L_t^s / L_t$$

which is the likelihood of being in the supply curve normalised by the total likelihood.

Estimating the system of demand and supply in disequilibrium has some advantages but also poses some challenges. The main advantage is that it allows one to identify demand and supply equations by assessing the probability of being in each regime, while assuming that the market does not clear. Otherwise, as in any equilibrium demand and supply system, the price variable is said to be endogenous as it is correlated with the error term in either the supply or the demand schedules. The main caveat is that the linear supply and demand functions are a simple representation of the possibly more complex supply of capital schedule in a context of credit rationing and asymmetric

information. Finally, our maximum likelihood estimation assumes that disturbances to demand and supply are normally distributed, which may not be case in practice.

4. Data

The capital flows data for this paper comprises a group of 10 emerging market economies; Brazil, Colombia, Hungary, India, Korea, Malaysia, Mexico, South Africa, Thailand and Turkey.[5] Our dataset sums monthly bond and syndicated loan flows for each country in the period 1992:1 – 2004:12 into a capital flows variable. These series, representing *gross* flows, are provided by Dealogic Bond- and Loanware. Equity flows are not included in our capital flows variable.[6]

Our dataset is a larger panel than that of Mody and Taylor. The choice of right-hand side variables, however, falls prey to the problem of availability and quality of monthly data – preventing an even larger cross-section of EMEs. For consistency, where possible we have relied on country-specific data from international financial institutions such as the IMF and World Bank, while using market data on spreads and interest rates. Only after exhausting these sources have we relied on national sources.

The choice of right-hand side variables differs slightly from the traditional 'push-pull' factors approach. In principle, the estimation of a joint demand and supply system implies that both push factors (usually associated with the external environment) and pull factors (assumed to be domestic attractors) could be part of both the supply and demand functions. In practice, the supply function could contain both, but the demand equation usually includes only pull factors.

On the supply side, we experimented with global push factors such as short and long term US interest rates (yields on 1-year Treasury bills and 10-year government bonds, respectively), US high yield spreads (yields on Moody's Baa-rated companies less those on Aaa-rated companies), a measure of industrialised countries economic activity (US IP), and a measure of expected returns (emerging markets bond yields (EMBI/EMBIG) over US risk free rate). Among the country specific factors that affect the supply of funds are credit ratings, domestic short term interest rates, the ratio of reserves to short term debt and stock market returns.

[5] These countries were chosen because they have the most reliable data covering the longest period possible.

On the demand side, we experimented with indicators of economic activity such as the level and change of consumer prices, the level of the domestic stock market, the level and growth rate of domestic IP, and the reserves to imports ratio. We also used the ratio of domestic credit to GDP, and cost of capital measures such as domestic short term interest rates, the domestic stock market index and EMBI/EMBIG spreads (aggregate).

Tables 1 and 2 show the expected priors for the signs of the supply and demand schedules, as well as the reasons supporting the intuition for the signs.

Table 1: Supply variables

Variable	Expected sign	Rationale
US 12-month Treasury bill	-	Indicates borrowing costs for EMEs, leading to higher probability of default. Also an indicator of global liquidity.
US 10-year bonds	-	Also indicator of borrowing costs.
US IP	+ or -	Higher US growth might imply more funds available for investment abroad. But might also mean greater investment opportunities domestically.
US high yield	-	Higher spreads reflect lower risk appetite and expectations of US slowdown.
EME spreads	+ or -	Can be a measure of both country risk (-) and/or expected return (+).
Domestic short term interest rates	+	Increase leads to higher expected returns.
Credit ratings	+	Increase suggests improved fundamentals
Change in domestic stock market index	+	Increase suggests improved fundamentals
Reserves / Short term debt	+	Higher ratio implies higher ability to meet short run obligations, with lower credit risk.
Bilateral exchange rate volatility	-	Measure of currency risk and financial instability in debtor country
VIX index of equity implied volatility	-	Proxy for global market risk aversion, with higher index value indicating higher risk aversion.
Exports / GDP	+	Measure of openness plus ability to service debt.
Fiscal balance	+	Measure of fiscal fragility.
Public sector debt / GDP	-	Measure of fiscal fragility.

[6] Bondware does report initial public offerings and additional share offerings, but otherwise does not cover cross-border equity flows.

Table 2: Demand variables

Variable	Expected sign	Rationale
Domestic stock market index	+	Signals stronger economic activity, with higher need for investment capital.
Domestic IP	+	Indicator of domestic economic activity.
EME spreads	-	Higher cost of capital reduces demand for capital
Reserves / Imports	-	More available reserves to cover imports lowers need for international capital
Consumer price index	+ or -	Indicator of domestic economic activity, with sign dependent on what causes output gap to narrow.
External debt service/Exports	+	Higher debt repayments relative to export inflows increases need for alternative external financing.

Some of the variables do not have a clear expected sign, in which case we have labelled then '+ or -'. EME spreads for example could be positively related to flows as they could reflect higher expected returns. But they could also have a negative sign as they could capture default risk. Although our dataset includes all of these variables only those that are statistically significant at the 5% level are included in our preferred the model. We also allowed for dynamic effects by including current values as well as lags of these variables. The dataset was constructed using monthly data covering the period 1992:1 – 2004:12.

5. Results

5.1 Supply and demand estimates

Tables 3, 4 and 5 summarise the results of the maximum likelihood estimation of the supply and demand system of capital flows. The variables shown represent the subset of variables which are statistically significant to the 5% level. Given that we used an optimisation tool to obtain the estimated coefficients, we need to specify initial values to run the algorithm. We use OLS estimates as our initial values. Although we know OLS will be biased due to endogeneity of prices and

quantities in a demand system, this is an informative guess for the maximum likelihood estimation algorithm. We are particularly careful when interpreting the results using OLS as initial values. In particular, in an equilibrium demand and supply system the price variable is said to be endogenous as it is correlated with the error term in either the supply or the demand schedules. Furthermore, in our application the supply of flows could be relatively insensitive to the cost of capital. In this case the estimated supply relationship could be capturing shocks to an inelastic supply that effectively is identifying the demand side of the model. In order to avoid this we constrain the sign of spreads in the supply to be positive. We then compare the maximised value of the likelihood function of the constrained model with the unconstrained one and report the results that deliver the highest value – the maximum likelihood estimates. Interestingly, for each individual country and for the pooled and fixed effects estimation we ended up ruling out the negative sign on spreads in the unrestricted model.

Table 3: Estimated supply and demand of capital flows – individual countries

	Constrained MLE							
	Brazil		**Mexico**		**Korea**		**Thailand**	
	F-O	M-T	F-O	M-T	F-O	M-T	F-O	M-T
Supply								
Ratings	0.14	0.20	0.23	0.14	0.13	0.15	0.67	0.13
Spread	1.31	1.27	0.82	1.20	1.66	1.21	0.30	1.58
FX/STdebt	-0.06	0.74	-0.42	0.45	0.93	0.44	-0.17	0.54
Constant	3.91	6.41	2.05	7.87	-3.12	3.25	-6.35	4.09
Demand								
Local equity	0.20	0.38	0.29	0.43	0.98	0.78	0.67	1.08
IP	-0.01	0.46	0.02	0.38	0.01	0.95	-0.02	0.89
FX/Imports	-0.02	-0.10	0.03	-0.12	-0.05	-0.21	-0.01	-0.23
Spreads	-1.40	-0.98	-0.58	-1.22	-0.47	-1.02	-0.23	-0.94
Constant	6.71	13.50	4.18	-5.04	2.40	-8.87	2.33	-0.63
stdev supply	0.17	1.31	0.21	1.11	0.00	1.25	1.53	1.16
stdev demand	0.46	1.41	0.60	0.76	0.47	1.20	0.25	1.13

Table 3 compares our supply and demand determinants with those in Mody and Taylor (2004). On the supply equation it is interesting to note that credit ratings are positive and significant in each of the four countries studied. Furthermore, the absolute size of the coefficients does not differ dramatically. As one would expect, credit ratings signal a lower probability of default which translates into higher flows. Spreads are also a positive and significant determinant of capital flows, as in Mody and Taylor. As in the case of ratings, the absolute magnitudes do not differ dramatically. A direct interpretation of this result is that flows respond positively to interest rates, given the higher

expected return channel. It is also possible, however, that the relatively inelastic supply curve that we are estimating (given the large positive relationship between spreads and flows) is masking a backward bending supply curve. This interpretation is not fully valid as we are controlling for borrower quality through credit ratings. Finally, the ratio of reserves over short-term debt is negative but significant for all four countries but Korea. This result is surprising as one would expect a positive sign for this variable as Mody and Taylor find. Higher reserves over short term debt signals improved liquidity conditions in EMEs and hence raises capital flows to EMEs.

On the demand side, local equity index levels are positive as in Mody and Taylor in all four countries. As expected, higher equity markets signal a stronger domestic economic activity and therefore increases the country's requirement of external capital to finance its growth. Industrial production, however, does not have a clear positive effect as in Mody and Taylor. In our model, this variable is close to zero in every case and negative for Brazil and Thailand. The ratio of foreign exchange reserves to imports is close to zero and negative in most cases (except for Mexico). Mody and Taylor find higher values with expected negative sign which signals that the country can finance itself with out the need of international financial markets. Finally, spreads have a negative sign as expected, which shows that the demand for capital declines with higher cost of capital.

Table 4: Estimated supply of capital flows – 10 countries

Supply: Constrained MLE				
	Pooled		**Fixed effects**	
	coeff's	**se**	**coeff's**	**se**
Ratings	0.12	0.04	0.09	0.03
Spread	1.80	0.26	0.79	0.99
FX/STdebt	-0.14	0.05	0.03	0.04
Constant	-1.95	0.50	-0.10	2.67
Bra			0.00	0.00
Col			-0.01	0.01
Hun			2.05	0.37
Ind			-0.32	0.22
Kor			-0.04	0.24
Mal			0.04	0.29
Mex			0.85	0.33
SAf			0.53	0.31
Tha			1.62	0.31
Std. Dev. supply	2.47	0.20	1.85	0.15
Function value	1744.2		1473.1	

Table 4 shows the results of the supply equation for the pooled regression including 10 countries. Unlike the previous country-by-country regressions these results pool ten countries together and

assume by construction that the coefficients are the same for the asset class as a whole. In the case of fixed effects we allow the intercepts to differ across countries. The results show that spreads and rating are positive as in the country by country study, but with fixed effects the coefficient on spreads becomes insignificant. Note, however, that most country dummies are not significant either, so there are no country specific effects on the supply of capital to EMEs.

Table 5 shows the results for the demand equation for the pooled estimation of 10 countries. Compared with the supply, the demand side delivers results that are closer to the individual country results and to the OLS estimates in Appendix A. The local equity index is positive, while industrial production and reserves over imports is close to zero as in the country-by-country study. Spreads are negative as expected and, unlike the supply schedule, country dummies are significant in almost every case. This result is interesting as it could mean that countries differ significantly in their appetite for tapping markets to finance their needs.

Table 5: Estimated demand for capital flows – 10 countries

Demand: Constrained MLE

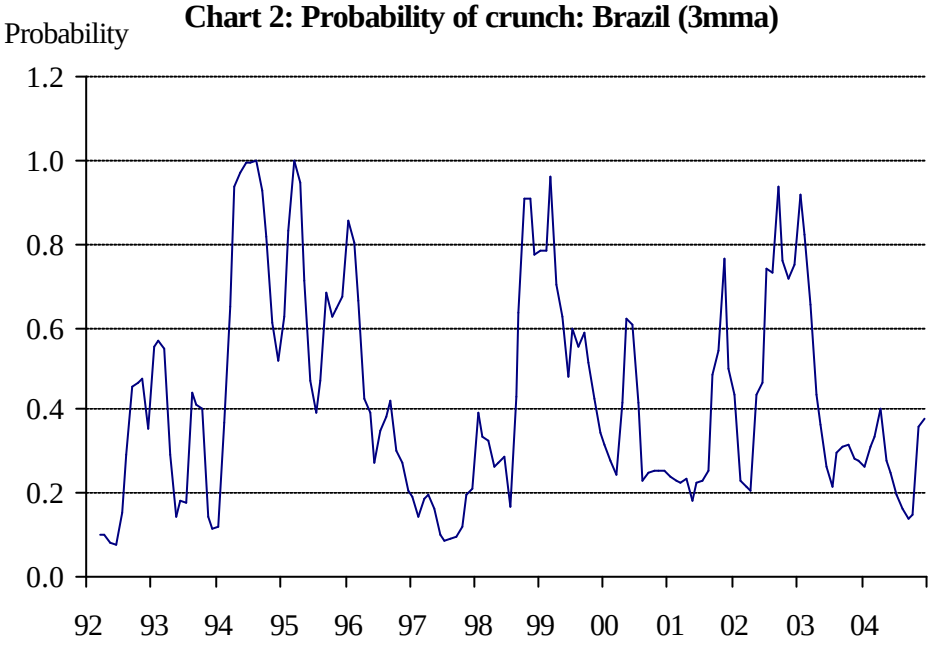
	Pooled		**Fixed effects**	
	coeff's	**se**	**coeff's**	**se**
Local equity	0.24	0.03	0.28	0.02
IP	0.00	0.00	0.00	0.00
FX/Imports	0.00	0.01	0.01	0.01
Spreads	-0.95	0.09	-0.62	0.26
Constant	5.11	0.25	4.14	0.76
Bra			0.00	0.00
Col			-0.01	0.00
Hun			0.23	0.05
Ind			-0.29	0.06
Kor			-0.35	0.05
Mal			-0.36	0.06
Mex			0.27	0.05
Saf			-0.13	0.05
Tha			0.33	0.05
Std. Dev. demand	0.42	0.01	0.34	0.02
Function value	1744.2		1473.1	

Annex A reports the result of estimating a supply and demand equation separately using OLS. As we have explained before this is conceptually and econometrically inadequate, but the results are useful as a starting point. The results differ mostly for the supply equation, while those of the demand are relatively similar.

5.2 Estimating the probability of a capital market crunch: the case of Brazil

Using the estimated coefficients for Brazil we calculate the probability of a capital crunch, $?_t$. Chart 2 plots the three month moving average of this probability for the period 1992:1 – 2004:12. The probability tracks well some period of international turmoil when Brazil was directly or indirectly involved. The probability reached more than 60% for the first time in 1994 with the Mexican crisis. It then declines steadily in 1996 missing the Asian crisis in 1997, but it increases again in 1998 and 1999 with the Russian and Brazilian crises. It falls again at the beginning of this century, but picks up with the Brazilian expectations crisis in late 2002. Since then the index has fallen markedly, in line with stronger fundamentals.

Chart 2: Probability of crunch: Brazil (3mma)



6. Conclusions

This paper estimates a disequilibrium demand and supply system of capital flows to EMEs. The aim of the disequilibrium setup is to explicitly acknowledge that interest rates might not clear credit markets in general, and international capital markets in particular. We estimate the model using maximum likelihood techniques which allow us to identify the determinants of both supply and demand, and also to estimate the probability of a capital crunch affecting EMEs at different points in

time. We view this as an important surveillance tool because it could help us to discriminate periods of country specific crunches from period of widespread crunches. The latter, in turn, could be related to periods of contagion in EMEs.

Our supply results show that credit ratings and EME spreads are positively related with capital flows. But further investigation should be undertaken in order to understand the true reason for the positive slope of EME spreads: higher expected returns or a backward bending supply curve. The demand equation is downward sloping and appears to be more stable across estimation techniques.

The estimates of the probability of a crunch for Brazil are encouraging. But further work remains to be done in order to estimate this probability for other countries and for the asset class as a whole. The panel estimation can also be refined in order to relax the homogeneity of coefficients imposed in the pooled and fixed effects regressions. Finally, the maximum likelihood technique could be adapted to capture a more flexible supply schedule which could help us unveil the true relationship between flows and spreads.

Annex A: OLS Results

Table 6: OLS estimates - Individual countries

	OLS			
	Brazil	**Mexico**	**Korea**	**Thailand**
Supply				
Ratings	0.21	-0.07	0.12	0.28
Spread	-1.41	-0.70	-0.17	0.00
FX/STdebt	-0.06	0.12	0.19	-0.04
Constant	5.41	5.68	1.26	-1.49
R-squared (adj.)	0.15	0.06	0.30	0.26
Demand				
Local equity	0.20	0.23	1.16	1.94
IP	-0.01	0.01	0.01	-0.02
FX/Imports	-0.02	0.01	-0.07	0.01
Spreads	-1.40	-0.47	-0.62	-0.11
Constant	6.71	3.88	2.56	-0.97
R-squared (adj.)	0.32	0.07	0.18	0.20

Table 7: OLS estimates of supply of flows - 10 countries

	Supply: OLS			
	Pooled		**Fixed effects**	
	coeff's	**se**	**coeff's**	**se**
Ratings	0.02	0.01	0.05	0.01
Spread	-0.69	0.16	-0.57	0.15
FX/STdebt	-0.07	0.01	-0.02	0.02
Constant	4.28	0.49	3.23	0.47
Bra			0.00	0.00
Col			0.00	0.00
Hun			0.94	0.10
Ind			-0.43	0.08
Kor			-0.23	0.08
Mal			0.01	0.10
Mex			0.65	0.09
SAf			0.22	0.10
Tha			0.95	0.08
R-squared (adj.)	0.03		0.22	

Table 8: OLS estimates of demand for flows - 10 countries

Demand: OLS				
	Pooled		Fixed effects	
	coeff's	se	coeff's	se
Local equity	0.18	0.05	0.26	0.05
IP	0.01	0.00	0.01	0.00
FX/Imports	0.01	0.01	0.03	0.01
Spreads	-0.56	0.17	-0.53	0.15
Constant	3.53	0.49	3.20	0.44
Bra			0.00	0.00
Col			-0.01	0.00
Hun			0.69	0.09
Ind			-0.59	0.09
Kor			-0.21	0.08
Mal			-0.22	0.08
Mex			0.76	0.08
Saf			0.31	0.08
Tha			0.86	0.08
R-squared (adj.)	0.02		0.23	

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