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Currency Crises in Emerging Markets: Capital Flows and Herding Behaviour

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Tuomas Komulainen

Currency crises in emerging markets: Capital flows and herding behaviour

Abstract

This study shows that due to herding behaviour and possible capital outflows, emerging market countries are vulnerable to multiple equilibria situations and currency crises. It uses a model by Jeanne (1997), where currency crises can be formed by multiple equilibria and self-fulfilling expectations. We determine the country fundamentals according to balance of payments approach. In this study we introduce capital flows, which depend from crisis probability, into the model. The capital flows are further assumed to follow herding behaviour, which produces a reason and mechanism for the large capital outflows witnessed during the recent crises. The range of country fundamentals, where self-fulfilling crises are possible, is now larger than without capital flows and herding behaviour. Consequently, the country fundamentals have to be better, if the country wants to stay totally out of crises. The model further points out lender interdependence as one shortcoming in the current structure of international capital markets. An empirical application of the model to the Mexican and Asian crises shows that when the possible capital outflows are included, the fundamentals of most emerging market countries were inside the range of multiple equilibria in 1994 and 1996, and so self-fulfilling crises were possible.

1 Introduction

Currency crises are often painful for citizens but interesting for economists, and hence they have inspired numerous academic and non-academic studies.[1] Theoretical work on currency or balance of payments crises has generally progressed most rapidly in the wake of actual crises, and the resulting analyses have changed in line with the economic circumstances and problems of the period in question. The currency crises of the last three decades can be divided into four waves: 1) The collapse of the Bretton Woods system set off the first wave in 1976. 2) The debt crisis in Latin America started the second wave in 1982. 3) The third was the EMS crisis of 1992. 4) And the most recent one started in Asia in 1997.[2] Again, the recent wave of crises inspired a new wave of academic research. The new theories should be more closely attuned to the current economic environment and thus better able to explain the recent crises of 1997-1999.

The Asian crisis surfaced when the Thai authorities allowed the baht to float and depreciate in July 1997. Shortly thereafter, four other Asian countries (Philippines, Malaysia, Indonesia and Korea) were forced to float their currencies. This wave of crises triggered financial and economic problems in other Asian countries as well as in Russia and Latin America. Later in August 1998, depreciation of the Russian rouble triggered currency crises in Latin America and financial problems even in some developed countries, eg in Hong Kong and the United States. During 1997-1999 altogether at least ten emerging market countries experienced currency crisis and several others felt some pressure. This study introduces two extensions to a currency crisis model - capital flows and herding behaviour - in order to better explain and characterize the recent crises.

Several studies have found the liberalization of financial sectors and capital accounts, and the capital flows which followed, as important factors in the recent crises in emerging markets.[3] After liberalization, developing, newly industrialized and transition countries became magnets for massive capital flows. [4] During 1984-1989 the yearly net capital inflow to these emerging markets was only USD 15 billion, but in 1990-1996 the yearly net capital inflow to emerging markets was USD 150 billion. In 1996 alone, the net capital inflow was USD 260 billion.[5] This 16-fold increase represented a huge expansion of investment possibilities for poor countries and created a new market segment for investors - the emerging markets.

However, increased capital mobility also meant increased financial instability. In the Asian crisis, the five countries involved (South Korea, Indonesia, Thailand, Malaysia and Philippines) clearly exemplify the instability of capital flows. In 1996 capital inflows to these countries amounted to almost USD 100 billion, but in 1997 there was instead a capital outflow of USD 12 billion. This turnaround was equivalent to more than 10% of the GDP of these countries (Grenville 1998). [6] Similar large capital outflows or sudden stop of capital flows occurred in almost all the countries hit by the recent crises. Empirical evidence also shows that the contagion effect in the Asian crisis was spread mainly through financial linkages (Kaminsky – Reinhart 2000). Accordingly, we introduce capital flows and the possibility of sudden capital outflow as extensions to a currency crisis model.

During the recent crises western banks simultaneously withdrew from emerging markets, which caused the large and sudden capital outflows. In the Latin American crisis U.S. investors and in the Asian crisis Japanese banks pulled out of these markets. Consequently, the emerging market countries totally lost their access to the bond markets (Calvo - Reinhart 1999, Kaminsky - Reinhart 1999). This herding behaviour by western banks is another phenomenon that might have been present in these crises. [7]

Financial literature gives several reasons for herding behaviour (see eg Devenow – Welch 1996 and Scharfstein – Stein 1992). For example, gathering and processing information on the fundamentals in the newly established or emerging markets is difficult and expensive, whereas learning about other investors' decisions is cheap. Thus herding behaviour might be especially common in the emerging markets. Although there are fairly many theoretical studies on herding behaviour, due to the practical problems involved, only a few empirical studies have been done on herding behaviour - and these have produced contradictory results. There is some empirical evidence on herding behaviour in emerging market countries, much of it related to crisis situations.[8] Herding behaviour is our second additional element in respect of the recent crises in emerging markets.

The currency crises of the 1990s showed that a crisis can occur partly because of self-fulfilling expectations. In the 'second generation' models, the crisis expectations create multiple equilibria, and a currency crisis is modelled as a jump from one equilibrium to another. This study uses as the basic currency model Jeanne's (1997) model, in which the conditions for multiple equilibria and self-fulfilling crises are derived.[9] These conditions

are based on fundamentals. We follow Masson (1999) and employ a balance of payments approach in determining the fundamentals. This approach might be well suited to the recent crises in emerging markets.[10]

We incorporate in our model capital flows, which depend on crisis probabilities. If the exchange rate peg is not credible, capital outflows will weaken country fundamentals and may create a multiple equilibria situation. [11] We further determine the capital flows by means of Basu's (1991) loan pushing model, which introduces herding behaviour into our model. This shows that if there is herding behaviour in the international capital markets, the credit supply curve becomes discontinuous. A slightly lower expected return in the borrowing country could lead to a sharp decline in loan supply and to capital outflows. This provides one explanation for the sudden capital outflows witnessed during the recent crises.

Masson (1999) also provides an enlightening empirical application of his model to the Mexican and Asian crises. However, in his results the fundamentals of several crisis countries were not within the range for multiple equilibria or were not worse than the critical level. We also test our model in respect of several emerging market countries just before the Mexican and Asian crises, taking into account the possible capital outflows.

Chapter 2 provides a survey of the literature relating to our study. In chapter 3 we first present the currency crisis model of Masson (1999) which work as a benchmark to our results. Further in chapter 3 we present the contribution of this study, ie the addition of capital flows and herding behaviour, and give the empirical application of our model. Chapter 4 presents concluding remarks and possible extensions.

2 Related literature

2.1 Currency crisis theories

Currency crisis theories go back to the Salant and Henderson (1978) model of speculative attack on the gold market, which Krugman (1979) applied to the foreign exchange market. In the model the government runs a budget deficit which is financed through additional money creation. The private sector will exchange this additional money creation for foreign currency and so reserves are steadily lost until reserves reach the threshold level. At that time

the demand for money falls, reserves fall to zero and a currency crisis occurs. This speculative attack is driven by the natural outcome of investors' maximization and forward looking behaviour.

The first generation speculative attack models share the basic assumption of weak country fundamentals, which are known to be unsustainable in the context of a fixed exchange rate regime. This then establishes a unique relationship between fundamentals and timing of the crisis. The strength of the models is that a sudden speculative attack and loss of reserves occur even though all the behavioural functions are continuous and the fundamentals develop predictably.[12]

The limitations of first generation theories became evident at latest after the EMS crisis in 1992-1993 since these models allowed only for an exchange rate peg, which either is or is not sustainable under the given fundamentals. The second generation models take into account the possibility of self-fulfilling crises (eg Obstfeld 1986, 1994, 1996 or Jeanne 1997). An increase in devaluation expectations makes it more costly for the authorities to maintain an exchange rate peg. These costs rise eg as higher interest rates lead to unemployment.[13] The government weighs the costs of defending the exchange rate against the benefits.[14] Investors anticipate the government's calculation and can raise the costs of defence (interest rates, unemployment) even further, and the crisis can become self-fulfilling.

These second generation models introduce the possibility of multiple equilibria: one in which there are no attacks, no change in fundamentals and indefinite maintenance of the peg and another in which investors expect an attack. The new fundamentals in the second equilibrium are validated after the investors' expected change in the exchange rate actually occurs. The currency crisis is then modelled as a sudden jump from one equilibrium to another. And the timing of crisis is no longer uniquely determined.

There are several factors that can create a situation of multiple equilibria and may cause a self-fulfilling currency crisis. In Obstfeld (1994) market participants expect the currency to be devalued at a given rate and set nominal interest rates at the to a higher level. Because of high unemployment or a large debt burden, the higher interest rates make the peg too costly for the government to keep.[15] In Obstfeld (1994) another source of multiple equilibria is the government's expected desire to offset a negative output shock. Authorities' behaviour as regards problems in the banking sector is another factor that can create a situation of multiple equilibria.[16] As the central bank

defends the peg, interest rates rise, which may cause losses to the banking sector.[17]

Jeanne (1997) derived fundamentals-based conditions for the existence of multiple equilibria. This narrowed the gap between first and second generation theories and enabled empirical testing of whether a currency crisis can be partly caused by self-fulfilling expectations.[18] In his model the private sector weighs the costs and benefits to the authorities and calculates whether it is optimal for the authorities to devalue. If the private sector expect it, devaluation becomes evident. Depending on the fundamentals, In Jeanne's model unemployment, there will be three cases: If the unemployment is low and so fundamentals are good enough, the country is in a good equilibrium where the private sector does not expect devaluation and the government does not devalue. If the unemployment is high and fundamentals bad enough, the country is in a bad equilibrium where the government's devaluation is perfectly anticipated by the private sector. Between these values there is a grey area where the government can either devalue or not, and we have the possibility for multiple equilibria. Whether or not devaluation occurs is determined by the markets' self-fulfilling mood.

Problematic is that the variety of fundamentals that influence the policymaker's decision can be quite large. These include 'hard' observable fundamentals, eg unemployment or trade balance, but also 'soft' fundamentals, such as the beliefs of foreign exchange market participants. For example, a sudden shift in market sentiment regarding the government's willingness to tolerate unemployment may trigger a currency crisis, which would not happen with a different set investors' expectations. Critical becomes how the fundamentals are chosen into the model.

2.2 Theories on currency crises in emerging markets

In emerging market countries authorities' willingness to decrease unemployment was not a key aspect of recent crises. Consequently, in a multiple equilibria model Masson (1999) used a balance of payments approach to determine the country fundamentals. The cost-benefit calculation is determined by expected value of foreign reserves, and his model does not include a direct escape clause for the government. The source of multiple equilibria is the higher debt service costs for the government due to depreciation expectations. He also tests his model with recent crises in emerging markets

and finds that the fundamentals of some crisis countries were inside the multiple equilibria region. We will use Masson's (1999) model as a basic currency crisis model and compare our results with his results.

The recent crises in emerging markets have also inspired new theories, where the liberalisation of the financial system and the weaknesses in the banking sector are the reason for the crises. Diaz-Alejandro (1985) cited liberalization of financial markets and bad banking supervision as reasons for the banking and currency crises in Latin America. In addition, the public expects governments to intervene and save most depositors when financial intermediaries run into trouble, whether or not deposits are explicitly insured. The model by Calvo and Vegh (1993, 1999) points out that a non-credible stabilization programme can be a reason why a consumption boom is followed by an drop in output and finally a currency crisis.[19] Similarly Kamim and Wood (1997) pointed out the boom and bust cycle of capital flows after the liberalisation as the reason for currency crises. [20]

Following the Diamond-Dybvig model, [21] Chang and Velasco (1998, 1999, 2001) placed the illiquidity of the financial system at the centre of their currency crisis model. They assume that banks take liquid deposits and invest part of the proceeds in illiquid domestic assets. Hence even small capital outflows from the deposits can create self-fulfilling banking and currency crises.[22] Rodrik and Velasco (1999) show both theoretically and empirically how the short-term borrowing and capital flows were important reasons for the recent crises in emerging markets. [23] In our model capital outflows are the reason for self-fulfilling currency crisis.

Corsetti et al (1999) use a model close to the first generation theories and formalize the moral hazard and government bailout story. In the model foreign investors are willing to lend to domestic agents at the international interest rate, because the agents have an implicit bailout guarantee from the government. This causes over-borrowing and over-investment by domestic agents. The expected bailout costs are seen as government liabilities, and in the end the crisis is caused by the government's budget deficit. Clearly problems in the banking sector and the importance of capital flows are new aspects in the theoretical literature.

During the 1990s the foreign influence causing or increasing the likelihood of crises has increased and initiated eg the discussion of new financial architecture. [24] The foreign influence can be divided into two parts: the spillover and contagion effects.[25] The spillover effect focuses on trade link-

ages and on the loss of price competitiveness caused by depreciation of the competitor's currency (Gerlach and Smets 1994). [26] The contagion term refers to the change in market sentiment, where a crisis one country causes an increase in cross-market correlation (Claessens and Forbes 2001).

Some progress in explaining recent crises and the contagion effect has been made using models that contain financial diversification and the use of leverage by investors. These models are founded on basic portfolio theory, where a representative investor weighs the risks and returns in different countries. Schinasi and Smith (2000) study the effects of different portfolio management rules and margin calls. They find that diversification, together with leveraged investors, creates conditions for the contagion effect. In the model by Calvo (1998) the contagion effect is caused by margin calls by informed investors, who are then mimicked by uninformed investors.[27] Calvo and Mendoza (2000) discuss optimal diversification as the number of possible investment countries grows. They show that costly information gathering might not be profitable when the number of countries grows. This might cause herding behaviour and contagion of currency crises. [28]

Herding behaviour can be one reason for the large capital flows and contagion effect. Keynes (1936) already compares investors to beauty-contest judges who vote on the basis of the expected popularity of contestants with other judges rather than on the basis of absolute beauty. Later studies have found many theoretical reasons for this herding behaviour (Schafstein - Stein 1990, Banerjee 1992, Trueman 1994 and Devenow - Welch 1996).[29] Rational herding behaviour is usually modelled as being due to 1) payoff externalities, 2) principal-agent problems or 3) information externalities (Devenow and Welch 1996). Krugman (1997) gives two reasons for the herding behaviour in Asian crises. First, there is a bandwagon effect driven by investors' awareness or expectations that other investors have private information. Secondly, much of the money invested in emerging markets is managed by agents rather than directly by principals. These agents are compensated in accord with comparisons with other money managers, and so herding behaviour is quite rational.

All these reasons might well be sufficient for herding behaviour and create conditions for large capital inflow periods, which followed by substantial capital outflows. We study the effect of herding behaviour and use it as a reason for the large capital outflows in our currency crisis model.

2.3 Empirical studies on the Asian crisis

Empirical literature on currency crises have emerged recently and extensive surveys and examples can be find in Kaminsky et al (1998), Hawkins - Klau (2000) and Kajanoja (2001).[30] We concentrate here on studies made specifically on the recent crises in emerging markets. Kaminsky and Reinhart (1999a) uses non-parametric approach to evaluate the usefulness of a number of different variables in signalling a pending or potential crisis. Threshold values are chosen for each indicator so as to strike a balance between the risk of many false signals and the risk of missing the crisis altogether. They studied 76 currency crises and 26 banking crises in 1970-1995, and found that financial liberalization, real interest differentials, and current account deficits are accurate indicators of currency crises. In addition, a banking crisis usually starts before the balance of payments crisis. And 71% of these banking crises were preceded by financial liberalization. Similarly, Mahar and Williamson (1998), who studied liberalization in 34 countries, found that only three countries were able to liberalize without a crisis.[31]

Several studies have pointed out moral hazard and corporate governance problems as reasons for the Asian crisis. Corsetti et al (1998a) discuss the economic developments leading to these crises. They stress the moral hazard problem entailed in a long tradition of public guarantees, which leads to over-lending by domestic banks and current account deficits. But they also point out the over-lending syndrome by international banks, which neglected the standards for sound risk assessments. Johnson et al (1999) construct a model where managerial agency problems and weak minority shareholder rights render emerging market countries vulnerable to sudden loss of investor confidence. They study the practice of investor protection in 25 emerging market countries during the 1997-1999 crises and find that in countries with poor protection of minority shareholder rights the collapse of stock markets and depreciation of currencies was more severe.

There are several studies on the contagion effect during the Asian crisis. Baig – Goldfajn (1999) found clear evidence of contagion during the Asian crisis. They find that cross-country correlations of sovereign bond prices increased substantially during the crises period, which is evidence of contagion in the international debt markets. In addition, they argue that there was an element of financial panic at the onset of the Asian crisis.[32] Similarly, Kaminsky and Reinhart (1999b) found that particularly Japanese banks drastically curtailed their lending to all other Asian countries after the devalua-

tion of Thai baht. Baig and Goldfajn (2000) study the contagion from Russia to Brazil in late 1998. They examined cross-country correlations of stock indices, spreads on sovereign bonds and capital flows and conclude that, after the Russian crisis, panicking foreign investors triggered contagious currency crises in other emerging market countries.[33] Clearly the main channels of contagion during the crises of 1997-1999 were located in financial sectors rather than in foreign trade.[34]

The stylised facts and empirical studies point out some key reasons for the recent crises in emerging markets. After the liberalization moral hazard and ineffective supervision enabled the private sector in emerging markets to use large amount of short-term borrowing. The lenders in developed countries were few and most likely without sufficient information. All this rendered the borrowing countries very vulnerable to herding behaviour, contagion through financial linkages and sudden stop of capital flows. We incorporate the possibility of capital outflows and herding behaviour into the currency crisis model.

3 A currency crisis model with multiple equilibria

The purpose of the currency crisis model presented in this chapter is to provide one explanation of why emerging market countries have been so vulnerable to currency crises during the last decade. We use a second generation model by Jeanne (1997) in which multiple equilibria are possible. Following Masson (1999), we use a balance of payments approach to specify the country fundamentals that are critical to crisis probability. This approach might be suitable for the recent crises in emerging markets. The model derives the conditions for multiple equilibria and self-fulfilling crises. In this study the model and results by Masson (1999) will be used as a benchmark.

We add capital flows and herding behaviour to the currency crisis model. Capital flows, which depend from the crisis probability, enable multiple equilibria. If a fixed exchange rate system is not credible, capital outflows will weaken country fundamentals. Next, we derive the reason and mecha-

nisms for these capital outflows. We introduce investors' herding behaviour via Basu's (1991) loan pushing theory. At the end of the chapter the model's implications are discussed and empirical applications to the Asian and Mexican crises are provided.

3.1 The basic model

Following Jeanne (1997), we assume that an fixed exchange rate system is abandoned if the net benefits from maintaining the peg becomes negative ($B < 0$). The net benefits term includes both the gross benefits and the cost of the peg. The term is broken down into two terms, gross benefits (b_t) and credibility costs ($\alpha\pi_{t-1}$)

$$B_t = b_t - \alpha\pi_{t-1}. \qquad (1)$$

The gross benefit term (b_t) includes country fundamentals based on perfect credibility of the peg. It is determined by macroeconomic variables such as unemployment, trade deficit, capital flows etc. The second term($\alpha\pi_{t-1}$): implies that, for given macroeconomic fundamentals, lower credibility (ie higher probability of crisis, π_{t-1}) increases the cost and reduces the net benefit of the peg. There are various reasons why lower credibility reduces the benefit and reduces the possibilities of maintaining the exchange rate peg. For example, lower credibility boosts inflation expectations, real wages and unemployment, and so authorities are less willing to defend the exchange rate (as in sec 2.2.)[35]

The term π_{t-1}in equation (1) is the probability, as evaluated by the private sector at time t-1, that the country authorities will devalue by choice or be forced to do so at time t. It is also the probability that a currency crisis will occur at time t. The model assumes rational expectations. The devaluation probability evaluated at time t must equal the probability that the peg's net benefit will be negative at time t+1:

$$\pi_t = \text{prob}_t [B_{t+1} < 0] \qquad (2)$$

In Jeanne (1997), equation (2) also includes a parameter indicating the strength of the government's commitment to the exchange rate peg. Nowadays with

free and sometimes large capital movements, governments and central banks in emerging market countries usually do not have enough resources to defend a peg, even though they would like to do so. And so more relevant issues are the current fundamentals and what investors expect them to be in the future. In addition, how investors expect other investors or capital flows to behave are important for crisis probability. Consequently, we do not include a parameter about the government's toughness in our model.

The model further assumes that innovations to the variable b_t are independently and identically distributed. Denoting $\phi_t = E_t b_{t+1}$, we write

$$\varepsilon_t = b_t - \phi_{t-1} \qquad (3)$$

which is normally distributed with mean zero and variance σ^2. The ε_t defined in equation (3) has a density function, f ( ), that is continuous, symmetric [$f(\varepsilon) = f(-\varepsilon)$]strictly increasing in $(-\infty, 0)$ and strictly decreasing in $(0, \infty)$.

Using equations (1) and (3), equation (2) can be rewritten as

$$\pi_t = prob_t [\varepsilon_{t+1} < \alpha\pi_t - \phi_t] \qquad (4)$$

We denote the cumulative distribution function of ε by F( ). Using the notation for innovations in equation (3), we express equation (4) in terms of the cumulative distribution function, F( ):

$$\pi_t = F [\alpha\pi_t - \phi_t] \qquad (5)$$

which is the key equation in Jeanne's currency crisis model. Since both the RHS and LHS of the equation depend positively on π_t, there may be multiple solutions. The possibility of multiple solutions means that the given level of expected future fundamentals, ϕ_t, may be consistent with several devaluation probabilities at time t. A self-fulfilling currency crisis is then a jump from one devaluation probability to another.

Following Masson (1999) we determine the fundamentals according to a simple balance of payments approach. The cost-benefit calculus by the private sector is determined by the sufficiency of foreign reserves. The reason for the possibility of multiple equilibria in Masson's model is higher debt service costs when devaluation is expected. In many emerging market countries, increased private and government indebtedness worsened country fundamentals before the recent crises (Table 1).[36] This model and results work

also as a benchmark to our results when capital flows and herding behaviour are included.

Table 1: Indebtedness of emerging market countries, 1996-1997

Country	DEBT/GDP (96)	LPS/GDP (97)	STD/R (97)	STD/TOTAL (97)
Indonesia	47 %	55 %	1.6	24 %
Malaysia	39 %	90 %	0.6	39 %
Philippines	51 %	48 %	0.7	19 %
Thailand	50 %	97 %	1.1	46 %
Korea	21 %	62 %	3.0	67 %
Average	42 %	71 %	1.4	39 %

Source: Masson (1999), Karunaratne (1999), Goldstein (1998)
Note: LPS/GDP = Bank lending to private sector/GDP
STD/R = Short-term debt/ foreign reserves
STD/Total = Short-term debt / total debt

The model includes a home country, which is a emerging market country, and an external environment that determines the risk-free interest rate. The return on home country assets (ex ante and in natural log form) is

$$E_t \ln [(1+r_t)/(S_{t+1}/S_t)] \cong i_t - \pi_t \ln (S_{t+1}/ S_t) - (1- \pi_t) \ln 1 \quad (6)$$
$$= i_t - \pi_t \ln (1+\delta)$$
$$\cong i_t - \pi_t\delta$$

where S_t is today's spot exchange rate and S_{t+1} is its value in the next period in the event of devaluation (otherwise $S_{t+1} = S_t$) and i_t is the return on emerging market country assets denominated in domestic currency. Thus the investors' demand is compensated by an amount equal to the risk-free foreign return, r, plus the devaluation probability, π_t ,times the expected per-

centage devaluation, δ.[37]

The home country fundamentals are determined according to a simple balance of payments approach. The change in reserves is given by

$$R_{t+1} - R_t = T_{t+1} - (r + \pi_t \delta) D \qquad (7)$$

where T is the trade balance, D is the country's external indebtedness, and R denotes international reserves. A currency crisis occurs at t+1 if $R_{t+1} - \bar{R} < 0$. We denote by $\bar{R}$ the threshold level for reserves. The probability of crisis in period t+1, which is formed at time t, is

$$\pi_t = \Pr [T_{t+1} - (r + \pi_t \delta) D + R_t - \bar{R} < 0]. \qquad (8)$$

The gross benefits of the fixed exchange rate system (b_t) without the credibility problems is defined as

$$b_t = T_t - rD + R_{t-1} - \bar{R}, \qquad (9)$$

and its expected value is

$$\phi_t = E_t b_{t+1}. \qquad (10)$$

Thus, in the Masson model, the value ϕ_t in equation (5) depends negatively on the level of reserves and expected trade balance and positively on the stock of debt and foreign interest rates. The cost of the fixed exchange rate system due to credibility problems is

$$\alpha = \delta D. \qquad (11)$$

Now we can write the crisis probability in the format:

$$\pi_t = \Pr [T_{t+1} - r D + R_t - \bar{R} < \pi_t \delta D] = \Pr [b_{t+1} < \alpha \pi_t]. \qquad (12)$$

The source of uncertainty in Masson's model is a shock to the trade balance (T), and σ denotes the standard deviation of this shock. Expressing equation (12) in terms of the cumulative distribution function, F( ), we obtain a formulation similar to that in equation (5): $\pi_t = F[\alpha\pi_t - \phi_t]$.

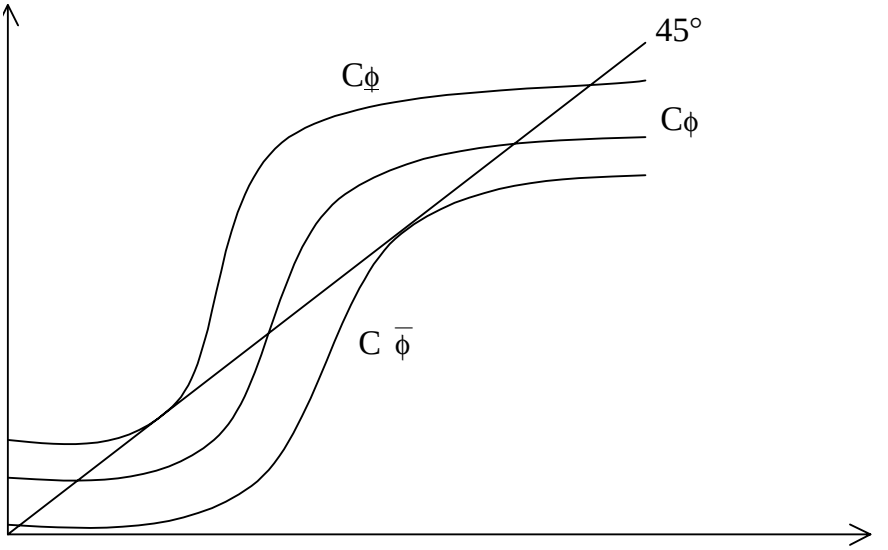


Figure 1. Cumulative distribution functions

Following Jeanne (1997) the first condition for multiple says that the slope of the cumulative distribution function must be steeper than the 45° line from the origin. This can be seen from figure 1, where the 45° line corresponds to the LHS of equation (5) and $C\phi$ to the RHS. The slope of the cumulative distribution function is equal to $f(d\pi - \phi)$, which should thus be greater than 1.[38] It is assumed that the slope of f ( ) reaches its maximum at f(0) (where $\alpha\pi = \phi$). The slope at this point is equal to α f (0). Accordingly, the first condition for multiple equilibria is

$$\alpha f(0) > 1. \qquad (13)$$

Masson (1999) assumes that ε_t is normally distributed with mean zero and variance σ^2 . Accordingly, the first conditions on the multiple equilibria can be written as[39]

$$z_1 = \frac{\alpha}{\sigma\sqrt{2\Pi}} > 1 \qquad (14)$$

where Π denotes the constant 3.141… Since $\alpha = \delta D$, the condition for multiple solution depends on the size of debt and extent of devaluation, relative to the standard deviation, σ, of shocks to the trade balance.

This range for multiple equilibria is defined by the two tangency points between F $[\alpha\pi_t - \phi_t]$ and the 45° line, ie cumulative distribution functions should be tangent to the 45° line at ($\bar{\pi}$, $\bar{\pi}$) and ($\underline{\pi}$, $\underline{\pi}$). The conditions for ϕ and π can be written as

$$\bar{\pi} = F\,[\alpha\,\bar{\pi} - \bar{\phi}\,] \qquad (15)$$

$$1 = \alpha\, f\,[\alpha\,\bar{\pi} - \bar{\phi}\,]\,. \qquad (16)$$

are possible.

The equation (15) states that the LHS of equation (5) is equal the RHS and the equation (16) comes from the tangency condition. From the latter, we obtain

$$f^{-1}\left(\frac{1}{\alpha}\right) = \alpha\bar{\pi} - \bar{\phi} \qquad (17)$$

where f^{-1} denotes the inverse function of f ( ) and takes positive values. Using equations (15) and (17), we obtain

$$\bar{\pi} = F\left(f^{-1}\left(\frac{1}{\alpha}\right)\right) \qquad (18)$$

which we put back into equation (17) and obtain the critical value $\bar{\phi}$ (above which, no crisis). By similar calculations, we obtain the other critical value, $\underline{\phi}$ (below which, a crisis is certain):

$$\bar{\phi} = -f^{-1}\left[\frac{1}{\alpha}\right] + \alpha F\left(f^{-1}\left(\frac{1}{\alpha}\right)\right)$$

$$> \phi_t >$$

$$\underline{\phi} = f^{-1}\left[\frac{1}{\alpha}\right] + \alpha F\left(-f^{-1}\left(\frac{1}{\alpha}\right)\right). \qquad (19)$$

If the fundamentals, ϕ_t, are inside these critical values[$\bar{\phi}$, $\underline{\phi}$], the country fundamentals are inside the grey area and multiple equilibria are possible. Note that if the fundamentals are even worse than $\underline{\phi}$ a currency crisis should be a certainty. Assuming $\varepsilon_t$is normally distributed the second condition can be written in the form [40]

$$\sigma w_1 + \alpha F(-w_1) < \phi_t < (-\sigma w_1) + \alpha F(w_1) \qquad (20)$$

where $w_1 = \sqrt{2 \ln z_1}$. Again, if the expected fundamentals, ϕt, are inside these limits, a self-fulfilling currency crisis is possible. The limits are symmetric and depend on the value of $\alpha = \delta D$ and σ.

Masson (1999) also derives conditions for reserves:

$$R^{min,\,max} = \phi_t^{min,\,max} - E(T_{t+1}) + rD + \bar{R}. \qquad (21)$$

If the reserves are sufficient, there should be little possibility of a crisis; if they are too small, crisis should be almost certain. Masson (1999) gives numerical examples to illustrate his model (see appendix 1, table 2). He assumes that the threshold level for reserves is zero, the expected value of the trade balance is 1.25% of GDP, the standard deviation of trade balance is 2% of GDP, the foreign interest rate is 5% and the expected devaluation is 25%. For example, if the external debt is 25% of GDP, an initial level of reserves between 2.91% and 3.34% of GDP permits a self-fulfilling currency crisis to occur. If the reserves are above these levels, a currency crisis is deemed unlikely. If they are lower the limits, a crisis should be certain.

This model can easily be used in empirical studies, and Masson (1999) reports applications to the crises in Mexico 1995 and Asia 1997. The data and the results are given in appendix 1, table 1. The results indicate that the fundamentals of several crisis countries where either below the critical level (where a crisis should be certain) or between the critical values for multiple equilibria (where a crisis may occur due to self-fulfilling expectations). For example, in 1994 Mexico's fundamentals were clearly lower than $\underline{\phi}$ so a crisis was certain. However, this model does not indicate some important crises, eg those in Brazil, Korea and Thailand.

Masson's (1999) model includes only the trade balance and interest pay-

ments, but not the capital account balance. However, capital flows and capital account reversals played a critical role during the recent crises (Calvo - Reinhart 1999). Consequently, the empirical results (given in appendix 1) could be improved if the behaviour of capital flows were added to the model. Masson (1999b) also notes that capital account turnarounds played critical roles in recent crises in emerging market countries. These issues will be tackled next.

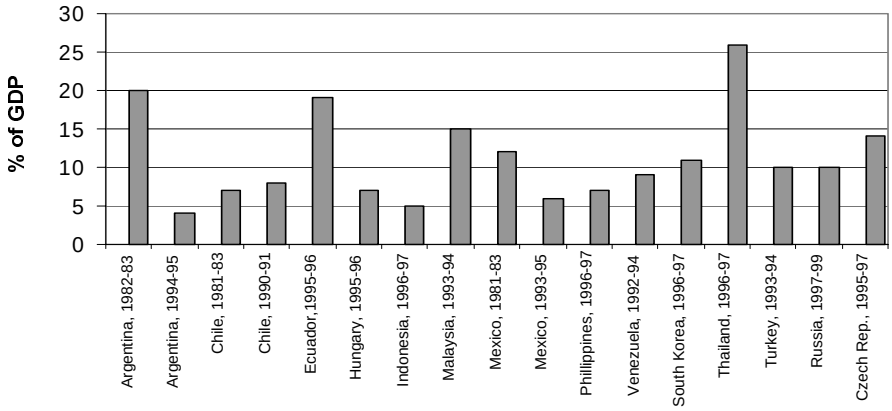
In any case, the model, the example, and the empirical application seem to illustrate quite nicely how vulnerable countries are to currency crises. In particular, the balance of payments approach and the reason for multiple equilibria (higher debt service costs) seem to be suitable for emerging market countries.

3.2 Capital flows

Like the studies cited in chapter 2 show liberalization and capital flows were important factors in the recent crises. And as figure 1 shows, the capital outflows (reversals) were very common and substantial during these crises. Moreover, during 1997-1999, currency crises spread mainly via financial linkages, as many international banks simultaneously withdrew from the emerging market countries. Here we introduce capital outflows as a reason for multiple equilibria and study the consequence of capital flows to the crisis vulnerability.

We assume in the model that capital flows depend on the country's crisis probability, since devaluation reduces investors' returns.[41] If there are depreciation expectations, capital will flow out of the country. These outflows are usually in equity and short-term corporate and government bonds, and they must be compensated from the reserves if the exchange rate peg is to be maintained.[42] Accordingly, the outflows weaken country fundamentals.

Large capital account reversals in EM countries



Source: Calvo -Reinhart (1999), Nabli (1999), CBR (1999)

Figure 2. Capital account reversals in emerging market countries

We denote the capital account as $S_t(\pi)$ and capital flows depend negatively on crisis probability, $S'(\pi) < 0$. Devaluation expectations for period t+1, which surface at time t, cause a capital outflow in period t+1. The higher debt service cost is still represented by a separate parameter, $\alpha = \delta D$.[43] The net benefit of the peg is thus

$$B_t = b_t - \alpha \pi_{t-1} + S_t(\pi_{t-1}). \quad (22)$$

The fundamentals covered by the parameter b_t, with full credibility of the peg, can thus be expressed as

$$b_t = T_t - rD + R_{t-1} - \bar{R}. \quad (23)$$

Denoting $\phi_t = E_t b_{t+1}$, the change in fundamentals takes a form similar to that in equation (3), ie $\varepsilon_t = b_t - \phi_{t-1}$.

With no currency crisis expectations $(\pi_t = 0)$, the change in reserves is the normal $T_{t+1} + rD$. But if $\pi_t > 0$, higher debt service costs and capital outflows will reduce the reserves. The change in reserves becomes [44]

$$R_{t+1} - R_t = T_{t+1} - (r + \pi_t\, \delta)\, D + S_{t+1}(\pi_t). \tag{24}$$

The probability of a crisis at time t +1 (formed at time t) is

$$\pi_t = \Pr\,[T_{t+1} - r\,D + R_t - \bar{R} < \pi_t\, \delta\, D - S_{t+1}(\pi_t)\,] \tag{25}$$

and the cumulative distribution function becomes

$$\pi_t = F\,[\alpha_1 \pi_t - S_{t+1}(\pi_t) - \phi_t]. \tag{26}$$

We observe that the crisis probability, π_t , now appears two times on the RHS of equation (26). We now derive the conditions for multiple equilibria, solving first the condition for the slope on the RHS of equation (26) and obtain

$$f\,(0)\,[\alpha - S'(\pi_t)] > 1 \tag{27}$$

or, if we assume that ε_t is normally distributed with $(0, \sigma^2)$,

$$z_2 = \frac{1}{\sigma\sqrt{2\pi}}\,[\alpha - S'(\pi_t)] > 1 \tag{28}$$

where $S'(\pi) < 0$. We further solve for the critical values of the fundamentals. and, via a calculation similar to that in section 3.1, we obtain and derive the following condition for the fundamentals ϕ_t:

$$\bar{\phi} = -f^{-1}\left[\frac{1}{\alpha - a}\right] + \alpha F\left[f^{-1}\left(\frac{1}{\alpha - a}\right)\right] - S\left[F\left[f^{-1}\left(\frac{1}{\alpha - a}\right)\right]\right]$$

$$> \phi_t > \tag{29}$$

$$\underline{\phi} = f^{-1}\left[\frac{1}{\alpha - b}\right] + \alpha F\left[-f^{-1}\left(\frac{1}{\alpha - b}\right)\right] - S\left[F\left[-f^{-1}\left(\frac{1}{\alpha - b}\right)\right]\right].$$

where we denote $S'(\bar{\pi}) = a$ and $S'(\underline{\pi}) = b$. Assuming ε_t is normally distributed and denoting $w_2 = \sqrt{2 \ln z_2}$ we can write this condition as

$$\sigma w_2 + \alpha F(-w_2) - S(F(-w_2)) < \phi_t < (-\sigma w_2) + \alpha F(w_2) - S(F(w_2)) . \quad (30)$$

Considering some of the results, first, we observe that c*apital flows, which depend of devaluation probability, enable multiple equilibria.* This means that free capital flows per se can explain self-fulfilling currency crises. Consequently, excess indebtedness of the government or a banking sector bail-out is not necessary requirement to currency crisis.

We now compare the conditions obtained here for self-fulfilling crisis to our benchmark case without capital flows obtained in chapter 3. Looking at equations (28) and (14), we see that, due to capital outflow expectations, it is likely that more countries will meet the first condition for a self-fulfilling crisis. This is because $S'(\pi)$ is negative and z_2 is larger than z_1. We also see that the value of $S'(\pi_t)$ (change in capital flows) becomes critical for the crisis probability.[45]

We also compare the condition on the limits of fundamentals (equations 30 and 20). We assume that at $\bar{\pi}$ there is a capital outflow and hence the S term is negative at the $\bar{\phi}$ limit. We observe that the $\bar{\phi}$ limit is now larger when possible capital flows are included in the model. This is because in equation (30) the second term dominates the first one and the S ( ) term is negative.[46] C*ompared to the situation without capital flows, country fundamentals must be better if the country is to completely avoid crisis.*

The change in the $\underline{\phi}$ limit is ambiguous. We cannot be sure how our alteration affects it. The reason is that it is difficult to say anything about the sign of the S ( ) function at $\underline{\pi}$ in the lower limit, $\underline{\phi}$.

In any case, since we obtained the new limits $[\bar{\phi}, \underline{\phi}]$, the model improves the basis for empirical work. There might be more countries that could meet the conditions for a self-fulfilling crisis. For example, in the empirical results of Masson (1999; see appendix 1), even more countries might meet the conditions for self-fulfilling crises.

Some caveats are in order. We have not considered where the capital inflows are invested in the economy and how this might change the country fundamentals.[47] Thus we are not able to say that currency crises are actually more common in the real word due to the liberalization of capital accounts. Only if country fundamentals - trade balance, country indebtedness etc - are the same as before, will the country fall more readily into a self-fulfilling crisis.

We have not yet studied the mechanism whereby capital outflows occur

in crisis situations or why capital flows should create a multiple equilibria situation. Moreover, the size of possible capital outflows, [S( )], is now critical. This determines how good the fundamentals ($\bar{\phi}$) must be so as to enable the country to totally avoid a crisis. To study these questions, we will now examine international capital markets and introduce herding behaviour into our model. Herding may well be extreme behaviour on the part of investors, but it gives a reason for the large capital outflows, and enlighten us the way capital flows can behave in crisis situations.

3.3 Herding behaviour

We assume that investors follow herding behaviour, which determines the capital flows in our emerging market country. This behaviour gives us the $S_t(\pi)$ function that was used earlier and provides the reason and mechanism for capital outflows in our currency crisis model. We use a loan pushing model by Basu (1991) to introduce the herding behaviour. Although there are many theoretical models on herding behaviour, and herding has been found to be behind the recent crises in emerging markets (Masson 1999b), it has not previously been made a formal part of a currency crisis model. The model also formalises the empirical results that the sudden and simultaneous withdraws by Japanese lenders induced the crises in Asia.

In chapter 2 we cited several arguments why herding behaviour might be present in the international capital markets and especially in emerging markets. One further reason is the costliness and inadequacy of information from emerging markets. In many countries, liberalization of financial sectors and capital accounts was implemented without adequate supervisory bodies and information.[48] Governments and enterprises were not able to inform investors adequately. The research departments of commercial and investment banks were not yet operating on an adequate level. Databases on clients' creditworthiness were missing, and so investors and lenders were unable to measure clients' risks accurately (Cavallo 1999). Instead, they might have been looking at what other investors were doing. In addition, some cooperative practices, eg syndicated bond issues, can give rise to herding behaviour.[49]

In the loan pushing model, investors base their strategies on what they see other investors doing, and are themselves not searching for information. An excess supply of credit is viewed as a positive sign by investors. For

example, an oversubscription of a bond issue can be regarded as a sign of creditworthiness and lead to a larger amount of lending to the country.

The loan pushing theory is further based on the assumption that lenders or banks are supplying more credit to the borrowing country than the latter would voluntarily take at the prevailing interest rate.[50] The notion that countries are pushed to take more loans than they are 'willing' to take might not be accurate. It may be closer to the truth to say that local banks and enterprises are willing to take these loans but that it is not appropriate for the country as a whole to take them, and maybe for the lenders to grant them.

The borrower announces (L, i), where L is the amount the borrower wants to borrow and i is the interest rate he is willing to pay. Assume further that each lender supplies either one unit of credit or nothing. Let w^e be the expected excess supply of credit and r_j the lowest rate at which the lender j is willing to lend to the borrower. The r_j can be treated as being inversely related to excess supply, w^e:

$$r_j = r_j (w^e). \tag{31}$$

We have now the expected excess supply (w^e) and the interest rate (i) that the borrower is willing to pay. We assume that the total supply of credit (S) to the country is determined as

$$S = S (w^e, i) = \#\{j \varepsilon H \mid r_j (w^e) \leq i \} \tag{32}$$

where $\partial S / \partial w^e \geq 0, \partial S / \partial i \geq 0$ and # A denotes the number of elements in the set A. Consequently, investors regard the excess supply (w^e) as a sign of the country's creditworthiness.

The borrower announces (L, i_t) and the lenders than supply the amount of credit based on rational expectations:

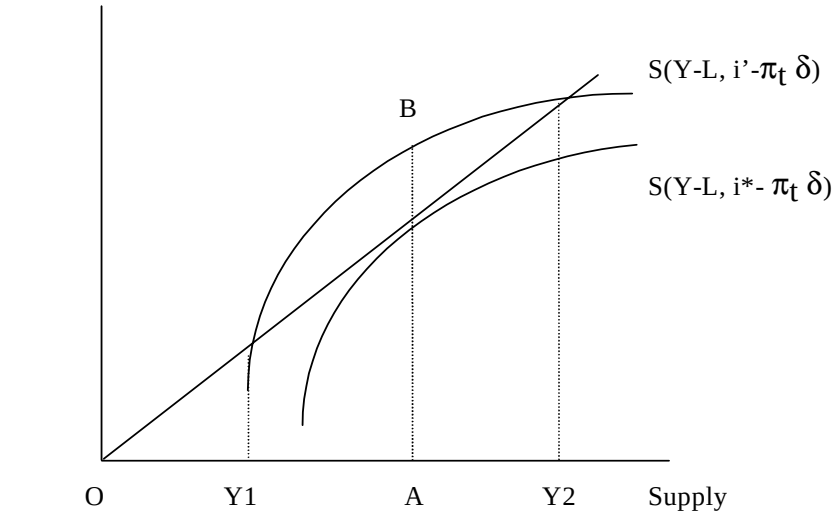
$$Y=S(Y^e–L, i_t) \tag{33}$$

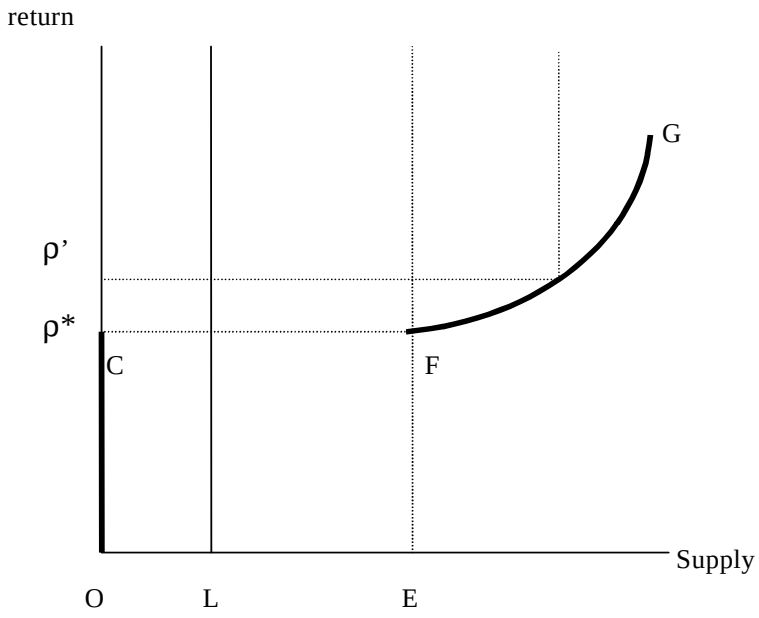
where Y^e is the expected supply of funds, L is the demand for credit and i is the interest rate the borrower is willing to pay. Lenders will end up supplying Y units of credit only if this amount satisfies equation (33). And they choose the largest supply which satisfies equation (33). We write the lender's return $\rho_t = i_t - \pi_t \delta$. We further denote the supply of credit, which assumes rational expectations, into the form

$$S = S\,(Y^e - L,\ i_t - \pi_t\ \delta). \qquad (34)$$

Figure 3 shows the interdependence of lending and the supply of credit. If the expected supply is OA, the interest i' and the return ρ', the supply of credit is given by S (Y^e - L, i'-π_t δ) and the amount supplied is given by AB. But because B lies above the 45° line, the expected supply, OA, is not consistent with rational expectations. The equilibria that are consistent with rational expectations are 0, Y1 and Y2. The lender chooses the largest of these, ie Y2. Now if the interest rate is lowered to i* and the return to ρ^*, the supply of credit consistent with rational expectations is OA, which will also be the actual amount supplied.

The thick line in the lower panel of figure 3 shows the relationship between the interest rate and the amount of credit supplied under rational expectations. The aggregate supply of credit is now discontinuous and in figure 3 is determined according to OC and FG.





Source: Basu (1997)

Figure 3. Supply of credit

In the model, the borrowing country chooses and announces (L, i_t) so as to achieve maximum utility. The solution and the equilibrium in the credit market can easily occur when there is an excess supply of credit to the country, ie $S(Y^e - L, i_t - \pi_t \delta) > L$. As in figure 3, one class of solutions consists of those where the demand for credit is OL, the expected return ρ^*, and the amount supplied OE. Here, despite excess supply, the borrower cannot lower the interest rate, because this would totally eliminate the supply of credit to the country. The equilibrium is fragile, as figure 3 illustrates. Small disturbances or news can lead to a total cessation of lending to the country.

According to the loan pushing model, the supply of credit, S_{t+1}, depends positively on the expected supply, Y^e, and return variable $\rho_t = i_t - \pi_t \delta$. We can formally express the supply of new loans as

$$S_{t+1} = \begin{cases} 0, & \text{if } i_t - \pi_t \delta < \rho^* \text{ or } Y^e < \bar{Y} \\ S_{t+1}(Y^e - L, i_t - \pi_t \delta) & \text{if } i_t - \pi_t \delta \geq \rho^* \text{ and } Y^e \geq \bar{Y} \end{cases}. \qquad (35)$$

If the expectation variable, Y^e, and the return variable, $i_t - \pi_t \delta$, exceed their threshold levels, $\bar{Y}$ and ρ^*, the country receives foreign loans. If not, no new loans are supplied. Accordingly, the supply of credit function becomes discontinuous at the threshold levels. The model presents an extreme case of herding behaviour, since a small decrease in return will cause the supply of credit to drop to zero. The strength of the model is that this discontinuity and the reversal of capital flows are explained endogenously.[51] even though all the primitive behavioural functions in the model are continuous.

Next we combine the loan pushing model and the currency crisis model examined above. We aim to introduce a mechanism and reason for the large capital outflows in our currency crisis model. We also offer an explanation as to why international banks suddenly withdrew from many emerging market countries during the Asian crisis.

We assume that the loan pushing model determines the capital flows and the country's capital account balance, S_{t+1}.[52] Capital flows , S_{t+1}, depend on the behaviour of other investors ($Y^e - L$) and the return term ($i_t - \pi_t \delta$), which are evaluated at the first period t. We assume further that in the period t the threshold values are exceeded and capital inflow (at least in the amount OE) occur.

In the next period, t+1, capital inflow continue, if the expectation variable, Y^e, and the return variable, $i_t - \pi_t \delta$, exceed their threshold levels, $\bar{Y}$ and ρ^*.

Capital outflows in the amount of OE occur if the threshold values are not exceeded.[53] The change in reserves now becomes

$$R_{t+1} - R_t = T_{t+1} - (r + \pi_t \delta) D + S_{t+1} (Y^e - L, i_t - \pi_t \delta) \quad (36)$$

where i_t corresponds to the return on domestic (domestic-currency-denominated) bonds announced at time t.[54] The probability of a crisis at time t+1, formed at time t, becomes

$$\pi_t = \Pr [T_{t+1} - (r + \pi_t \delta) D + S_{t+1} (Y^e - L, i_t - \pi_t \delta) + R_t - \bar{R} < 0]. \quad (37)$$

Since we are interested in the $i_t - \pi_t \delta$ term, we write the cumulative distribution function in the form

$$\pi_t = F [\alpha_1 \pi_t - S_{t+1} (i_t - \pi_t \delta) - \phi_t] \quad (38)$$

We again have multiple equilibria, one with positive investor expectations ($\pi_t = 0$) and another with currency crisis expectations ($\pi_t > 0$). In the first case, a lending boom to the country occurs and there is a capital inflow ($S_{t+1} \geq OE$). In the second (bad) equilibrium, no new loans are supplied and a capital outflow occurs ($S_{t+1} = -OE$). A small decrease in the expected return in the emerging market country (in $i - \pi_t \delta$) may move the country to the bad equilibrium, where capital outflows occur. This change in the capital account must be financed by a current account surplus or change in reserves. If these are not sufficiently large, currency crisis expectations will be realized, ie a crisis will occur.[55]

Next we again derive the conditions for a self-fulfilling crisis, and compare them to our benchmark case without capital flows and herding behaviour. We assume that in the first period, t, the return exceeds the threshold level, ie $i - \pi_t \delta \geq \rho^*$, and that $Y^e - L \geq \bar{Y}$. The country attracts foreign investment, and the capital inflow in period t is denoted OE (as in figure 3). We consider the situation for two cases: 1) $i - \pi_t \delta \geq \rho^*$ and 2) $i - \pi_t \delta < \rho^*$. In the first case ($i - \pi_t \delta \geq \rho^*$) the country continues to have a capital inflow [$S(i - \pi_t \delta) \geq OE$)], and $S(\bar{\pi}) = a$ and $S'(\bar{\pi}) = b$, both < 0. The condition for the country fundamentals ϕ is now

$$\bar{\phi} = -f^{-1}\left[\frac{1}{\alpha - a}\right] + \alpha^* F\left[f^{-1}\left(\frac{1}{\alpha - a}\right)\right] - S\left[F\left[f^{-1}\left(\frac{1}{\alpha - a}\right)\right]\right] \quad (39)$$

$$> \phi_t >$$

$$\underline{\phi} = f^{-1}\left[\frac{1}{\alpha - b}\right] + \alpha^* F\left[-f^{-1}\left(\frac{1}{\alpha - b}\right)\right] - S\left[F\left[-f^{-1}\left(\frac{1}{\alpha - b}\right)\right]\right].$$

In the second case (i - π_t δ < ρ) there are no new capital flows to the country, and a capital outflow occurs. We denote S'($\underline{\pi}$) and S'(π) = – OE. The condition for country fundamentals f is now

$$\overline{\phi} = -f^{-1}\left[\frac{1}{\alpha + OE}\right] + \alpha^* F\left[f^{-1}\left(\frac{1}{\alpha + OE}\right)\right] - S\left[F\left[f^{-1}\left(\frac{1}{\alpha + OE}\right)\right]\right]$$

$$> \phi_t >$$

$$\underline{\phi} = f^{-1}\left[\frac{1}{\alpha + OE}\right] + \alpha^* F\left[-f^{-1}\left(\frac{1}{\alpha + OE}\right)\right] - S\left[F\left[-f^{-1}\left(\frac{1}{\alpha + OE}\right)\right]\right]. \quad (40)$$

We must choose the lower limit, $\underline{\phi}$, from the first case (equation 39) and the upper limit, $\overline{\phi}$, from the second case (equation 40).[56] These will be the limits for the country fundamentals $[\overline{\phi}\ \underline{\phi}]$, and the condition for a self-fulfilling crisis.

We now assume that e_t is normally distributed and denote $w_3 = \sqrt{2 \ln z_3}$ and $w_4 = \sqrt{2 \ln z_4}$, where

$$z_3 = \frac{1}{\sigma\sqrt{2\pi}}[\alpha + a] \quad (41)$$

and

$$z_4 = \frac{1}{\sigma\sqrt{2\pi}}[\alpha + OE]. \quad (42)$$

Equation (41) now gives us the condition for the slope of F ( ). In addition, we are now able to write the limits for the fundamentals as

$$\alpha F(-w_3) + \sigma w_3 - S(F(-w_3)) < \phi_t < \alpha F(w_4) - \sigma w_4 - S(F(w_4)). \quad (43)$$

We compare this condition for a self-fulfilling crisis to the benchmark case without herding behaviour and capital flows. Again, $\underline{\phi}$ is now larger and the fundamentals must be better if the country is to totally avoid a crisis. We assume further that the possible capital inflow (at least OE) is at least as large as the variance in fundamentals, σ.[57] The lower limit, $\underline{\phi}$, is now smaller. Thus countries with relatively bad fundamentals can avoid crises. And since the range for fundamentals [$\underline{\phi}$ $\bar{\phi}$] widens as compared to equation (20), self-fulfilling crises are now more common if herding behaviour and capital flows are included in the model.

Using this framework we can also study the boom-bust cycle of capital flows. After liberalization or in the first period, t, the return exceeds the threshold level, $i - \pi_t - \delta \geq \rho^*$, and $Y^e - L \geq \bar{Y}$ The country attracts capital inflows and the capital account surplus is at least OE (as in figure 4). We may further assume that either the trade balance or the debt payments term is in deficit. In the next period, t+1, the return term may again exceed the threshold level, $i - \pi_t - \delta \geq \rho^*$, in which case the country continues to receive capital inflows. However, there is also a clear possibility that $i - \pi_t - \delta \geq \rho^*$ and that there will be a large negative change in capital flows. This requires that the trade balance move into surplus or/and that the currency be devalued. Thus, in the second period after the liberalization, there is a risk of a large, negative outcome due to a change in capital flows. And the investors take this into account.

In the model with herding behaviour, changes in expectations about the loan supply (Y^e) also affect crisis vulnerability. These expectations are affected by many variables, eg interest rates in developed markets and the worldwide savings rate.[58] Even a lower subscription of a bond issue (a lower $Y^e - L$) could change these expectations. A negative change in these variables may cause Y^e to drop below the threshold level, $\bar{Y}$, and cause currency crises in emerging market countries.

To summarize, the loan pushing model shows that 1) *herding behaviour creates a mechanism for the large capital outflows experienced in emerging market countries in recent years*. The fragile equilibrium in the debt market renders the borrowing country vulnerable to capital outflows and currency crisis. The country may receive large capital inflows, which can suddenly reverse direction. Moreover, this capital account reversal can be quite large relative to the size of the country. In the model the amount of loans demanded is less than the supply (OE > L). 2) *In the currency crisis model the range of*

self-fulfilling crises becomes larger than without capital flows and herding behaviour. Countries with quite good fundamentals may fall into crises while countries with relatively bad fundamentals avoid crises.[59] 3) *The supply of loans, S_{t+1}, depends on several factors, some of which are exogenous to the authorities in the borrowing country*. In the model even a smaller than expected subscription to a bond issue can cause capital outflows and a currency crisis in the country. 4) *The model directs our attention to the current situation in the international loan markets, where the different lenders are often interdependent.* Institutional aspects, eg the current practice of syndicate loan issues or the lack of an institution to provide accurate information, might be important reasons for herding behaviour and factors behind the recent crises.

3.4 An application to the crises in emerging markets

We apply our model for several emerging market countries just before the crises in Mexico (1995) and Asia (1997). We use equation (43), where normal distribution of e_t is assumed, and fundamentals determined according to b_t. Our calculations are done for yearend, 1994 and 1996. The calculation method is similar to that in Masson (1999) and hence we are able to examine any change or improvement that results from the inclusion of capital flows.[60]

The data on trade balance, reserves and debt are from Masson (1999), and those on capital flows are from the IFS. We determine Smin as capital outflows under currency crisis expectations, and Smax as capital inflows in the absence of such expectations.[61] For Smax, we use 1994 or 1996 capital inflows, which are expected to continue if currency crisis expectations do not materialize. For possible capital outflows, Smin, we use the portfolio liabilities from balance of payment data in 1994 or 1996, which are expected to become capital outflows if currency crisis expectations materialize.[62] In addition, direct investments are assumed to fall to zero. These assumptions would seem to reflect the loan pushing theory by Basu (1991).

The results of our calculations are presented in appendix 2. In the table there, variable D denotes debt, R reserves, T trade balance, and S capital account balance. All figures are in per cent of GDP. S( )' denotes the, possibly negative, capital account reversal between 1994 and 1995 or between 1996 and 1997. Smax is the capital inflow when currency crisis expectations do not materialize and Smin the capital outflow when they materialize.[63] The variable z_t is calculated according to equation (42) and should be greater The

than one to enable multiple equilibria and self-fulfilling crises. The variable ϕ_t denotes country fundamentals in the given year and $[\phi_{max}, \phi_{min}]$ is the range for multiple equilibria.

The main observation is that in almost all the countries the fundamentals were inside the range of multiple equilibria and hence self-fulfilling currency crises were possible. Only for Chile, Columbia and Malaysia, in both years, and in South Africa and Korea in 1994, were the fundamentals better than the ϕ_{max} limit, indicating that currency crisis should not occur. The fundamentals for Mexico in 1994 and Turkey in 1994 were below the ϕ_{min} limit, indicating that crisis should be certain. In all other countries the fundamentals were inside the range of multiple equilibria. This lends some support to the conclusion that a self-fulfilling currency crisis can be a common phenomenon in emerging market countries. Compared to the results in Masson (1999), the fundamentals of several crisis countries (Brazil, Indonesia and Korea in 1996, Turkey in 1996, and Thailand in 1996) are now inside the range of multiple equilibria, indicating the possibility of self-fulfilling crisis.

4 Conclusion and discussion

The currency crises in 1997-1999 were in many countries preceded by the liberalization of capital accounts and financial sectors. This enabled large capital inflows but also increased the indebtedness of many emerging market countries. The financial sectors in these countries were often undeveloped and poorly supervised, which resulted in weak investor-rights protection, insufficient information and moral hazard problems. This led to excessive borrowing and investments in these economies. Recent empirical studies have found that the crises were finally induced by the sudden decrease in foreign financing by international banks.

This study used a currency crisis model by Jeanne (1997), which derives conditions that enable a self-fulfilling crisis. These conditions for multiple equilibria and self-fulfilling crises are based on country fundamentals. Following Masson (1999), we employed a balance of payments approach to determine these country fundamentals. In his model, higher debt service costs are the reason for multiple equilibria. The model indicates the range of country fundamentals that enable self-fulfilling crises. The model is well suited to

the recent crises in emerging markets, and we use the model and the results by Masson (1999) as a benchmark case.

In this study we extended the model by introducing capital flows, which depend on crisis probability. In the model currency crises may occur without excess indebtedness of the government and without banking sector bailout. If the exchange rate peg is not credible, capital outflows weaken country fundamentals and may introduce multiple equilibria. Compared to the benchmark case without capital flows, the country fundamentals must be now better if the country is to totally avoid a crisis. However, the manner in which capital inflows may improve country fundamentals was not studied.

We also employed herding behaviour by the lenders as the causal mechanism for the large capital account reversals that marked recent crises. This was accomplished via Basu's (1991) loan pushing model, where herding behaviour causes a discontinuous supply of credit to the country. The fragility of the credit market equilibrium renders the country vulnerable to sudden changes in capital flows. Even a smaller-than-expected subscription for a bond issue or lower expected returns in emerging market countries can cause a total cessation of foreign financing and a currency crisis. The range of country fundamentals for which multiple equilibria and self-fulfilling crises are possible is wider when capital flows and herding behaviour are included in the model. The model further indicates that lender interdependence, as exemplified by syndicated loan issues, is a shortcoming of the present structure of international loan markets.

We apply our model for several emerging market countries just before the crises in Mexico (1995) and Asia (1997). The main observation is that in almost all of these countries the fundamentals were inside the range of multiple equilibria and hence self-fulfilling crises were possible. This somewhat contradicts the findings of Masson (1999). The results here also indicate that although country fundamentals are important and country authorities may be attending to them, a currency crisis can still occur in an environment of free capital flows and herding behaviour.

The model in this study could be improved in various ways. First, the manner in which capital inflows affect country fundamentals could be studied within the context of the model. A natural extension would be to include a banking sector. Second, the reasons for herding behaviour could be formalized, which might introduce microeconomic explanations for the sharp shifts in investor expectations and capital flows. The contagion effect could also be formalized in the model. A foreign crisis can shift sentiment, since it would

lower the expected return in emerging markets. A foreign crisis can cause large capital outflows and currency crises in all the emerging market countries whose fundamentals are inside the grey area, where self-fulfilling crisis is possible.

References

Alba, P. ; Bhattacharya, A. ; Clessen, S. ; Ghosh, S. and Hernandez, L. (1998) Volatility and Contagion in a Financially-Integrated World: Lessons from East Asia's Recent Experience. Paper presented in PAFTAD 24 Conference May, 1998.

Asani, S. and Sandeep, P. (1998) Stock Market Crises in Developed and Emerging Markets. Unpublished Paper. J.P. Morgan and The Federal Reserve Bank of New York.

Bacchetta, P. (1992) Liberalisation of Capital Movements and of the Domestic Financial System. Economica 59. 465-74.

Bacchetta, P. and van Wincoop, E. (1998) Capital Flows to Emerging Markets: Liberalisation, Overshooting, and Volatility. NBER Working Paper 6530.

Baig, T. and Goldfajn, I. (1999) Financial market contagion in the Asian crisis. IMF Staff Papers, Vol. 46, No 2 (June 1999).

Baig, T. and Goldfajn, I. (2000) The Russian Default and the Contagion to Brazil. IMF Working Paper 00/160.

Banerjee, A.V. (1992) A Simple Model of Herding Behaviour. Quarterly Journal of Economics. Volume CVII, August 1992, Issue 3.

Banerjee, S. and Cadot, O. (1996) Syndicated lending under asymmetric creditor information. Journal of Development Economics Vol. 49.

Basu, K. (1991) The international debt problem, credit rationing and loan pushing: Theory and experience. Princeton Studies in international finance No. 70, October 1991.

Basu, K. (1997) Analytical development economics. The MIT Press. Cambridge.

Bayomi, T. and Eichengreen, B. (1993) European Monetary Unification. Journal of Economic Literature. Vol. XXXI.

Berg, A. and Patillo, C. (1999) Are Currency Crises Predictable? A Test. IMF Staff Papers, Vol. 46, No. 2 (June 1999).

Brown, S. - Goetzmann, N. and Park, J. (2000) Hedge Funds and the Asian Currency Crisis. The Journal of Portfolio Management. Vol. 26 number 4, Summer 2000.

Caballero, R. J. and Krishnamurthy, A. Emerging Market Crises: An Asset Market Perspective. Unpublished Paper, draft, February 4, 2000.

Calvo, G. (1996) Varieties of Capital-Market Crises. Forthcoming in Calvo, G. and King M. (ed.) The Debt Burden and its consequences for Monetary Policy. Published for the International Economic Association by Macmillan, August 1998.

Calvo, G. and Mendoza, E. G. (2000) Rational Herd Behaviour and the Globalization of Securities Markets. Journal of International Economics 51, 2000.

Calvo, G. - Leiderman L. and Reinhart C. (1993) Capital Inflows and Real Exchange Rate Appreciation in Latin America: The role of external factors. IMF Staff Papers Vol. 40, No 1 (March 1993).

Calvo, G. and Reinhart C. (1999) When Capital Inflows Come to a Sudden Stop: Consequences and Policy Options. Draft June 29,1999.

Calvo, G. and Vegh, C. (1993) Exchange-rate based stabilization under imperfect credibility. In: Open-Economy Macroeconomics. Ed. Frisch, H. and Worgotter, A.MacMillan Press, London.

Calvo, G. and Vegh, C. (1999) Inflation Stabilization and BOP Crises in Developing Countries. In: Handbook of Macroeconomics, Vol. 1C. Ed. Taylor, J. and Woodford, M.

Cavallo, D. (1999) Policymakers Roundtable. Journal of Banking and Finance 23 (1999).

Castrén, O. and Takalo, T. (2000) Capital Market Development, Corporate Governance and the Credibility of Exchange Rate Pegs. ECB Working Paper No. 34, October, 2000.

Chang, E. C.; Cheng, J. W. and Khorana, A. (2000) An examination of herding behaviour in equity markets: An international perspective. Journal of Banking & Finance 24 (2000).

Chang, R. and Velasco, A. (1998) Financial Crises in Emerging Markets: a Canonical Model. NBER Working Paper 6606.

Chang, R. and Velasco, A. (1999) Liquidity Crises in Emerging Markets: Theory and Policy. Federal Reserve Bank of Atlanta, WP 99-15.

Chang, R. and Velasco, A. (2001) A model of Financial Crises in Emerging Markets. The Quarterly Journal of Economics, May 2001.

Claessens, S. and Forbes, K. (2001) International Financial Contagion. The book is in the process of being published by Kluwer Academy Publishers.

Corsetti, G.; Pesenti, P. and Roubini, N. (1998a) What caused the Asian Currency and Financial Crisis? NBER Working Papers No. 6833.

Corsetti, G.; Pesenti, P. and Roubini, N. (1998b). Paper tigers? A model of the Asian crisis. NBER Working Papers No. 6783.

Corsetti, G.; Pesenti, P. and Roubini, N. (1999) Paper tigers? A model of the Asian crisis. European Economic Review 43 (1999). (Does not include the empirical part, like the version in the NBER WP series.)

Devenow, A. and I. Welch (1996) Rational herding in financial economics. European Economic Review 40:1996

Diamond, D.W. and Dybvid, P.H. (1983) Bank Runs, Deposit Insurance and Liquidity. Journal of Political Economy, 1983, vol. 91, No. 3.

Diaz-Alejandro, C.F. (1985) Good-bye financial repression, hello financial crash. In: Velasco, A. (ed.) Trade, Development and the World Economy: Selected essays of Diaz-Alejandro. Blackwell, Oxford 1998.

Dooley, M.; Fernandez-Arias, E. and Kletzer, K. (1996) Is the Debt Crisis History? Recent Private Capital Inflows to Developing Countries. The World Bank Economic Review Vol. 10 No 1, January 1996.

Dornbusch, R. ; Goldfajn, I. and Valdes, R. O. Currency Crises and Collapses. Brookings Papers on Economic Activity, 2: 1995.

Eichengreen, B. ; Rose, A. K. and Wyplosz, C. (1995) Exchange Rate Mayhem: The antecedents and aftermath of speculative attacks. Economic Policy, No. 21, October 1995.

Eichengreen, B. ; Rose, A. K. and Wyplosz, C. (1996) Contagious Currency Crises. CEPR Discussion Paper 1453.

Esquivel, G. and Larrain, F. (1998) Explaining Currency Crises. Unpublished Paper. Harvard University.

Fisher, S. (1999) On the Need for an International Lender of Last Resort. Journal of Economic Perspectives. Vol. 1, number 4, Fall 1999.

Flood, R. P. and Garber, P. (1984) Collapsing Exchange-Rate Regimes; Some liner examples. Journal of International Economics. Vol. 17/1984.

Flood, R.P. and Marion, N.P. (2001) Perspectives on the Recent Currency Crisis Literature. In: Money, Capital Mobility, and Trade. Ed: Calvo, G. - Dornbusch, R. and Obstfelf, M. The MIT Press. Cambridge, Massachusetts.

Fratzsher, M. (1999) What Causes Currency Crises: Sunspots, Contagion and Fundamentals? EUI Working Paper No. 99/39. European University Institute.

Gerlach, S. and Smets, F. (1994) Contagious Speculative Attacks. CEPR Discussion Paper No. 1055.

Glink, R. and Rose A. K. (1999) Contagion and Trade. Why are currency crises regional? Journal of International Money and Finance 18 (1999).

Godfajn, I. and Valdes, R.O. (1997) Capital Flows and the Twin Crisis: The Role of Liquidity. IMF Working Paper 97/87.

Godfajn, I. and Valdes, R.O. (1999) Liquidity crises and international financial architecture. Mimeo.

Grenville, S. (1998) The Asia Crisis, Capital Flows and the International Finance Architecture. Talk to Monash University Law School Foundation Melbourne May 1998.

Gultekin, M. N.; Gultekin, N.B. and Penati, A.(1989) Capital Controls and International Capital Market Segmentation: The Evidence from Japanese and American Stock Markets. The Journal of Finance Vol. XLIV. No 4. September.

Hawkins, J. and Klau, M. (2000) Measuring Potential Vulnerabilities in Emerging Market Economies. BIS Working Papers No 91, October 2000.

IMF (1998) World Economic Outlook 1998. May 1998. IMF.

IMF (1998) Thailand: Statistical Appendix, Staff country report No 98/119. International Monetary Fund, Washington, D.C.

s

IMF (2000) Russian Federation: Selected Issues. Staff Country Report No. 00/150. International Monetary Fund, Washington, D.C.

Jeanne, O. (1997) Are currency crises self-fulfilling? A test. Journal of International Economics. Vol. 43, No ¾ November.

Jeanne, O. (1999) Currency Crises: A Perspective on Recent Theoretical Developments. CEPR Discussing Paper No. 2170. June 1999.

Jeanne, O. and Masson, P. (1998) Currency Crises, Sunspots and Markov-switching regimes. CEPR Discussing Paper No. 1990.

Johnson, S.; Boone, P. ; Breach, A. and Friedman, E. (1999) Corporate Governance in the Asian Financial Crisis. Draft November 15, 1999.

Kajanoja, L. (2001) Essays on Currency Crises and Exchange Rate Expectations. Research Reports No. 88:2001, Department of Economics, University of Helsinki.

Kaminsky, G. L. ; Lizondo, S. and Reinhart, C.M. (1998) Leading Indicators of Currency Crises. IMF Staff Papers Vol. 45. No. 1 March.

Kaminsky, G. L. and Reinhart, C. M. (1998) Financial Crises in Asia and Latin America: Then and Now. American Economic Review, vol. 88, No2. AEA papers and proceedings, May 1998.

Kaminsky, G. L. and Reinhart, C. M. (1999a) The Twin Crises: The Causes of Banking and Balance of Payments Problems. American Economic Review, vol. 89, No 3, June.

Kaminsky, G. L. and Reinhart, C. M. (1999b) Bank Lending and Contagion: Evidence from the Asian Crisis. in T. Ito and A. Krueger, eds. Regional and Global Capital Flows: Macroeconomic Causes and Consequences, (Chicago: University of Chicago Press for the NBER, forthcoming 2000).

Kaminsky, G. L. and Reinhart, C. M. (2000) On Crises, Contagion, and Confusion. Journal of International Economics 51 (2000).

Kaminsky, G. L. and Schmukler, S. L. (1999) What triggers market jitters? A chronicle of the Asian crisis. Journal of International Money and Finance 18 (1999).

Kamin, S. B. (1999) The current international financial crisis: how much is new? Journal of International Money and Finance 18 (1999).

Kamin, S. B. and Wood, P.R. (1998) Capital Inflows, Financial Intermediation and Aggregate Demand: Empirical Evidence from Mexico and other Pacific Basin Countries. International Finance Discussion Papers 583. Board of Governors of The Federal Reserve System.

Karunaratne, N.D. (1999) The Asian Miracle and Crisis. Intereconomics, January/February 1999.

Keynes, J. M. (1936) The General Theory of Employment Interest and Money. MacMillan and Co. Limited, London. Book IV, Chapter 12.

Kindleberger, C. P. (1978) Manias, Panics and Crashes; A History of Financial Crisis. MacMillan. Worcester.

Knight, M. (1998) Developing Countries and the Globalization of Financial Markets. IMF Working Paper 98/105.

Krugman, P. (1979) A Model of Balance-of-Payments Crisis. Journal of Money, Credit, and Banking Vol. 11, No. 3. August.

Krugman, P. (1996) Are Currency Crisis Self-fulfilling? NBER Macroeconomics Annual 1996.

Krugman, P. (1997) Currency Crisis. Unpublished paper. MIT.

Krugman, P. (1998) What happened to Asia? Unpublished paper. MIT.

Krugman, P. (1999) Balance Sheets, The Transfer Problem, and Financial Crises. Draft, prepared to the festschrift volume in honour of Robert Flood.

Lakonishok, J. ; Shleifer A. and Vishny R. (1991) Do institutional investors destabilize stock prices? Evidence on herding and feedback trading. NBER WP No. 3846.

Mahar, M. and Williamson, J. (1998) A Survey of Financial Liberalisation. Essays in international Finance No 211, November 1998. International Finance Section, Princeton University.

Martinez, G.O. (1998) What Lessons Does the Mexican Crisis Hold for Recovery in Asia? Finance and Development. June 1998.

Masson, P. (1999) Contagion: Macroeconomic models with multiple equilibria. Journal of International Money and Finance 18 (1999).

Masson, P. (1999b) Multiple Equilibria, Contagion and the Emerging Market Crises. IMF Working Paper 99/164.

McKinnon, R.I. and Pill, H. (1998) International Overborrowing. A Decomposition of Credit and Currency Risks. Unpublished Paper. February 1998.

Morris, S. and Shin, H.S. (1998) Unique Equilibrium in a Model of Self-Fulfilling Currency Attacks. The American Economic Review. June 1998, Vol. 88, No. 3.

Nabli, M. (1999) Financial Integration, Vulnerabilities to Crisis, and EU Accession in Five Central European Countries. World Bank Technical Paper No. 439. The World Bank, Washington, D.C.

Obstfeld, M. (1986) Rational and Self-fulfilling Balance-of-Payments Crises. American Economic Review. March 1986. Vol. 76, No.1.

Obstfeld, M. (1994) The Logic of Currency Crisis. NBER Working Paper No. 4640.

Obstfeld, M. (1996a) Models of Currency Crisis with Self-fulfilling Features. European Economic Review 40:1996.

Obstfeld, M. (1996b) Comment. Are Currency Crisis Self-fulfilling? Krugman, P. In: NBER Macroeconomics Annual 1996.

Obstfeld, M. (1998) The Global Capital Market: Benefactor or Menace? NBER Working Paper 6559.

Van Rickenhem, C. and Weder, B. (1999) Sources of Contagion: Finance or Trade. IMF Working Paper 99/146.

Rajan R. (1994) Why bank credit policies fluctuate: A theory and some evidence. Quarterly Journal of Economics 1994 issue 2 Vol. CIX.

Rodrik, D. and Velasco, A. (1999) Short-term Capital Flows. NBER Working Paper No. 7364.

Rogoff, K. (1999) International Institutions for Reducing Global Financial Instability. Journal of Economic Perspectives. Vol. 1, number 4, Fall 1999.

Sachs, J. (1984) Theoretical Issues in International Borrowing. Princeton Studies in International Finance No. 54, July 1984. International Finance Section, Department of Economics, Princeton University.

Sachs, J. ; Tornell and Velasco (1996) Financial Crises in Emerging Markets: The Lessons from 1995. Brookings Papers on Economic Activity 1996:1.

Salant, S. W. and Henderson, D.W. (1978) Market Anticipation of Government Policy and the Price of Gold. Journal of Political Economy 86, August.

Sargent, T. J. (1986) Rational Expectations and Inflation. Harper & Row. New York.

Scharfstein, D.S. - Stein, J. C. (1990) Herd Behaviour and Investment. The American Economic Review, volume 80, number 3, June 1990.

Stiglitz, J. (1998) Sound Finance and Sustainable Development in Asia. Keynote to the Asia Development Forum Manila March 1998.

Appendix 1

Table 1: Results by Masson (1999)

Country (σ)	Date	D_t	R_t	T_t	z_t	ϕ_t min	ϕ_t max	ϕ_t
Argentina (2,12)	1994	31.90	5.10	-2.5	1.51	3.38	4.62	1.93 U
	1996	34.40	6.10	-0.3	1.60	3.47	5.03	4.71 I
Brazil (1.69)	1994	28.00	6.60	1.10	1.65	2.80	4.20	6.04
	1996	28.00	7.80	-1.8	1.65	2.80	4.20	5.83
Chile (3.05)	1994	46.20	25.10	1.40	1.51	4.87	6.67	23.10
	1996	37.10	20.60	-2.2	1.21	4.37	4.90	18.03
Colombia (2.68)	1994	30.30	11.00	-3.1	1.13	3.68	3.90	6.40
	1996	32.60	11.00	-2.1	1.21	3.84	4.31	7.44
India (0.46)	1994	33.30	6.70	-0.7	7.22	1.11	7.22	3.50 I
	1996	27.20	5.80	-1.6	5.90	1.07	5.73	2.80 I
Indonesia (1.23)	1994	55.50	6.90	2.30	4.54	2.71	11.29	4.72 I
	1996	46.90	8.10	1.30	3.81	2.61	9.14	7.46 I
Korea (2.38)	1994	14.90	6.70	-0.7	0.62	-	-	5.43
	1996	21.20	7.00	-4.9	0.88	-	-	3.20
Malaysia (3.53)	1994	39.50	35.10	-1.6	1.12	4.85	5.15	31.97
	1996	38.60	27.00	0.70	1.46	4.77	4.98	26.30
Mexico (3.29)	1994	37.30	1.50	-4.9	1.13	4.50	4.75	-3.86 U
	1996	48.00	5.80	2.50	1.10	5.17	6.83	5.54 I
Philippines (2.76)	1994	57.90	9.40	-6.3	2.10	4.98	9.52	-0.72 U
	1996	51.10	12.00	-9.8	1.84	4.77	7.98	0.44 U
S. Africa (3.05)	1994	15.30	1.40	1.80	0.50	-	-	3.08
	1996	18.00	0.70	0.70	0.59	-	-	2.08
Thailand (2.47)	1994	46.20	20.90	-4.3	1.86	4.28	7.22	13.57
	1996	50.10	20.90	-5.7	2.02	4.40	8.10	13.47
Turkey (1.91)	1994	50.10	5.50	-6.3	2.61	3.68	8.82	-5.15 U
	1996	44.30	9.10	-10	2.30	3.55	7.45	-1.73 U

Source: Masson (1999)

Note: I = fundamentals are inside the range of multiple equilibria
U = fundamentals are under the range of multiple equilibria
In the rest of the countries fundamentals are better than the range of multiple equilibria

Table 2: An example

Debt (% of GDP)	ϕt min	ϕt max	R min	R max
25	**2.91**	**3.34**	**2.91**	**3.34**
50	**3.81**	**8.69**	**5.06**	**9.94**
75	**4.23**	**14.52**	**6.73**	**17.02**
100	**4.5**	**20.5**	**8.25**	**24.25**

Source: Masson (1999)

Appendix 2: Results with capital flows

		D	*R*	*T*	*S*	*S()'*	*Smax*	*Smin*	z_t	ϕt	ϕmax	ϕmin	
Argentina	1994	31.90	5.10	-2.50	4.33	8.17	4.33	-3.83	3.04	0.53	8.11	-0.63	
	1996	34.40	6.10	-0.30	6.18	10.74	6.18	-4.56	3.64	4.56	9.28	-2.31	
Brazil	1994	28.00	6.60	1.10	1.95	13.58	1.95	-11.64	4.86	5.88	15.37	1.32	
	1996	28.00	7.80	-1.80	4.41	7.22	4.41	-2.82	3.36	4.99	6.77	-1.36	
Chile	1994	46.20	25.10	1.40	9.99	12.37	9.99	-2.38	3.13	23.50	8.57	-4.63	B
	1996	37.10	20.60	-2.20	10.01	11.86	10.01	-1.85	2.76	17.06	6.06	-4.95	B
Columbia	1994	30.30	11.00	-3.10	4.35	6.19	4.35	-1.85	2.05	5.93	5.34	-0.26	B
	1996	32.60	11.00	-2.10	6.37	8.60	6.37	-2.24	2.49	7.73	6.04	-2.02	B
India	1994	33.30	6.70	-0.70	3.29	4.99	3.29	-1.71	11.55	3.84	8.90	-2.16	
	1996	27.20	5.80	-1.60	3.13	4.17	3.13	-1.04	9.52	3.22	6.75	-2.04	
Indonesia	1994	55.50	6.90	2.30	2.21	4.44	2.21	-2.23	5.94	5.59	13.38	0.52	
	1996	46.90	8.10	1.30	4.85	7.09	4.85	-2.24	6.10	7.71	11.29	-2.18	
Korea	1994	14.90	6.70	-0.70	2.61	4.73	2.61	-2.12	1.42	5.03	3.11	0.13	B
	1996	21.20	7.00	-4.00	4.82	9.16	4.82	-4.34	2.42	2.24	5.98	-1.17	
Malaysia	1994	39.50	35.10	-1.60	1.69	3.85	1.69	-2.16	1.55	30.93	7.01	3.34	B
	1996	38.60	27.00	0.70	9.45	9.72	9.45	-0.27	2.19	26.31	4.48	-4.01	B
Mexico	1994	37.30	1.50	-4.90	3.95	5.99	3.95	-2.05	1.86	-5.82	6.47	0.95	U
	1996	48.00	5.80	2.50	1.36	4.34	1.36	-2.98	1.98	6.57	9.68	3.94	
Philippine	1994	57.90	9.40	-6.30	7.38	8.68	7.38	-1.30	3.35	-0.66	10.61	-2.23	
	1996	51.10	12.00	-9.80	13.65	19.86	13.65	-6.21	4.72	0.36	13.62	-8.29	
Russia	1994	46.00	3.78	10.10	-7.56	0.17	1.09	-7.56	1.55	10.89	14.24	3.72	
	1996	52.00	3.97	5.82	-4.92	0.60	0.55	-4.92	1.81	7.92	12.86	4.51	
S. Africa	1994	15.30	1.40	1.80	0.81	2.96	0.81	-2.06	0.89	2.21	-	-	B
	1996	18.00	0.70	0.70	2.29	5.66	2.29	-1.61	1.33	0.75	4.56	1.03	
Thailand	1994	46.20	20.90	-4.30	8.49	16.31	8.48	-2.00	4.50	13.60	14.60	-3.73	
	1996	50.10	20.90	-5.70	10.83	20.00	10.83	-6.67	5.25	13.40	16.76	-5.91	
Turkey	1994	50.10	5.50	-6.30	-4.19	1.12	4.65	-5.32	2.85	-4.06	14.15	-0.96	U
	1996	44.30	9.10	-10.0	6.39	7.81	6.39	-1.42	3.95	-2.49	8.79	-2.69	

Source: Masson (1999), IMF (2000), IMF (1998), IFS.

Note: Except for Russia and Thailand, data for capital flows are from IFS.

For Russia: IMF (2000) Russian Federation: Selected Issues. Staff Country Report No. 00/15. For Thailand: IMF (1998) Statistical Appendix. Staff country report No 98/119.

B = fundamentals are better than the range of multiple equilibria

U = fundamentals are below the range of multiple equilibria

For the other countries the fundamentals are inside the range of multiple equilibria

Notes

[1] See eg Kindleberger (1978) and Diaz-Alejandro (1985) on the history of financial crises, and Jeanne (1999) and Kajanoja (2001) for recent surveys on currency crisis theories. This study was inspired by the crises in Asia and Russia in 1997-1998. The author is an economist at the Institute for Economies in Transition, Bank of Finland, and is currently visiting the Center for International Economics, University of Maryland. Email: komulainen@econ.bsos.umd.edu. All opinions expressed are those of the author and do not necessarily reflect the views of the Bank of Finland. The author is grateful to Fernando Broner, Pertti Haaparanta, Lauri Kajanoja, Iikka Korhonen, Maurice Obstfeld, Jukka Pirttilä and Jouko Vilmunen for their valuable comments. Remaining errors are mine. Financial support from the Yrjö Jahnsson Foundation and Wihuri Foundation is gratefully acknowledged.

[2] Esquivel and Larrain (1998) apply this classification scheme for currency crisis periods. Of course, other currency crises have also occurred, particularly in emerging market countries.

[3] See eg Calvo - Vegh 1993, Calvo et al 1993, Rodrik - Velasco 1999 and Calvo - Reinhart 1999. Mahar - Williamson (1998) studied liberalization in 34 countries and found that only three of them were able to liberalize their financial markets without subsequently suffering severe problems in the form of currency or banking crises.

[4] See Obstfeld (1998) for arguments in favour of free capital mobility and Mahar - Williamson (1998) for a good survey of financial market liberalization.

[5] Net capital flows include net direct investment, net portfolio investment, official and private borrowing, and other long- and short-term net investment flows (IMF 1998).

[6] And like other asset prices, the currencies fell dramatically. The Indonesian rupiah lost 80% of its value in less than a year and the Russian rouble plummeted 65% in a couple months. Similarly, daily collapses in the equity markets in some markets amounted to as much as 20-30% (see Kaminsky - Schmukler 1999). And like other asset prices, the currencies fell dramatically. The Indonesian rupiah lost 80% of its value in less than a year and the Russian rouble plummeted 65% in a couple months.

[7] After the liberalization, investors increased their investments in emerging market countries, partly because others were doing the same thing. And during the crises investors withdraw from many countries because others were doing it. This is a tentative argument; only a few empirical studies have been done on herding behaviour during the Asian crisis.

[8] Rajan (1994) found some herding behaviour in bank's credit policies, especially during banking crises in New England in 1986-1992. Lakonishok et al (1991) studied 769 pension funds between 1985 and 1989 and found only weak evidence of herding and somewhat stronger evidence of positive feedback trading in shares of smaller companies. Choe et al (1998) found clear evidence of herding behaviour just before the Korean crisis in 1997. Chang et al (2000) found no evidence of herding among developed markets but did find herding behaviour in two emerging markets (South Korea and Taiwan) which was more pronounced when volatility was higher.

[9] In 1996 an academic discussion emerged on whether a currency crisis can be caused by self-fulfilling expectations or solely by economic fundamentals (eg Krugman 1996, Obstfeld 1996b and Eichengreen et al 1996).

[10] In the model currency crises may occur without government's policy, like excess governments indebtedness or banking sector bailout.

[11] The source of multiple equilibria in Masson (1999) is the higher debt service costs due to depreciation expectations. In Jeanne (1997) multiple equilibria situations are caused by authorities' tendency to try to reduce unemployment. Since this is not so characteristic of recent crises in emerging markets, we model causation and fundamentals differently.

[12] See for a basic setup of first generation models in Calvo and Vegh (1999) or Flood and Marion (2001). For recent surveys on currency crises, see Jeanne (1999) or Kajanoja (2001).

[13] A second example of costs is a high debt stock denominated in domestic currency. This provides government with a justification for inflating the debt away by abandoning the peg. In addition, Obstfeld 1994 astutely notes that for countries with access to world capital markets, reserve adequacy per se is far less a concern than it was in the early 1970s, the crux of the matter being authorities' willingness to accept the costs.

[14] Reasons for defending a fixed exchange rate are for example: it serves as a guarantor of low inflation or it facilitates international trade and investment (see eg Obstfeld 1994 and Krugman 1998b).

[15] Obstfeld (1994) leaves somewhat obscure the question of what triggers currency depreciation expectations. The trigger might be fundamentals. Obstfeld (1994) mentions eg the Danes' negative vote on the Maastricht Treaty as a trigger for the EMS crises.

[16] Political commitment might also be a reason for a self-fulfilling crisis (see Krugman 1997). The EMS crisis is the clearest example of this. Once Britain and Italy left the system, this raised expectations that it was easier for other governments to abandon the system as well.This expectation caused the capital outflows and the collapse (or

change) of the system, although the governments were actually unwilling to abandon the system.

[17] Banks' liabilities are usually of short-term maturity whereas their assets are of long term maturity. In many emerging market countries, devaluation itself causes problems for banks that have liabilities denominated in foreign currencies. Similarly, expectations that the central bank will act as lender of last resort by expanding the monetary base expose devaluation expectations (Obstfeld 1996a).

[18] See Jeanne - Masson (1998) and Kajanoja (2001) for empirical studies on the EMS crises. Some recent theoretical studies have found that if investors face a small amount of noise in the signals regarding country fundamentals and are uncertain whether the information is common knowledge, a multiplicity of equilibria and self-fulfilling crisis need not obtain (Morris and Shin 1998). They found that there is a critical state of fundamentals below which attack always occurs and above which attack never occurs. An important factor for the incidence of currency attack is the amount of noise and whether investors regard the information about country fundamentals as common knowledge.

[19] McKinnon and Pill 1998 stress also the failure to limit banks' exposure to foreign exchange risk, which increases the magnitude of lending and overinvestment. Bacchetta (1992) formalized the liberalization in an overlapping-generations model, where finitely living individuals optimize intertemporally in an open economy. Both a simultaneous liberalization (financial sector and capital account) and sequential liberalization programmes were studied. Bacchetta found that the likely outcome is an initial capital inflow, which is then followed by an outflow.

[20] Kamim and Wood 1997 write about the crises in Latin America, but generally the story is adequate also for the recent crises in Asia. He introduced the following series of events: stabilization and liberalization of financial markets improve the investment environment. Capital inflows and real appreciation of the currency lead to a widening of the current account deficit. The expansion of loanable funds leads to a rapid increase in consumption and investment. The increase in private indebtedness and emergence of nonperforming loans may cause a reversal of capital flows, which leads to a speculative attack against the currency. See Sachs et al 1996 for similar explanations of the Latin American crisis. See Calvo et al 1993 for the capital inflow problem in Latin America. The size of external debt and the large amount of short-term debt in crisis countries in Asia is cited in Corsetti et al 1998.

[21] A model by Diamond and Dybvig (1983) shows how the difference in maturity structures of bank assets and liabilities render banks vulnerable to runs. In this model, bank assets include an illiquid production technology, whereas bank liabilities are liquid, traditional demand deposit contracts. This creates a situation of multiple equilibria, one equilibrium being a run on banks. Diamond and Dygvid (1983) do not

study currency crises, although the logic of the bank run is similar to currency crisis theories. Also based on the Diamond-Dygvid model, Caballero and Krishnamurthy (2000) study the consequences of collateral constraints. They show that rising domestic interest rates and a collateral shortage amplify a crisis. Similarly, Castrén and Takalo (2000) show that credit constraints and poor corporate governance can create a mechanism that increases the probability of a currency crisis.

[22] Chang and Velasco 1998 stress that this illiquidity story is more suitable for emerging markets, because nonbanks play only a minor role in the debt and equity markets. Moreover, the access of emerging market banks to world capital is more limited. In case of illiquidity, banks cannot obtain emergency funds from the international private capital markets. This illiquidity may also affect government finances and hence the model is related to the first generation theories.

[23] Some studies have modelled the lending boom-bust cycle as a consequence of government guarantees, moral hazard or information costs (see eg Dooley 1997, Corsetti et al 1997 or Bacchetta - Wincoop 1998).

[24] See eg Krugman 1999, Fischer 1999 and Rogoff 1999 for discussions of the international financial architecture and Goldfajn - Valdes 1999 for theoretical work.

[25] The definition of contagion effect used here follows that in Masson 1998 and in Esquivel and Larrain 1998. However, the reasons for simultaneous currency crises, ie the spillover (trade) and contagion (sentiment) effects, are hard to determine and vary from one currency crisis to another. See Eichengreen et al (1996), Esquivel-Larrain (1998) and Claessens and Forbes (2001) for empirical evidence on the contagion effect before the Asian crisis. See Bajn-Goldfajn (1999) and Fratzcher (1999) for evidence of contagion in the Asian crisis.

[26] According to Alba et al 1998, competitive devaluation is not the reason for the Asian crisis. According to their calculations, a 10-20% devaluation by neighbouring countries increases the depreciation needed by the other countries only by a half to a full percentage point (Alba et al 1998).

[27] Banerjee and Cadot (1996) study the international debt crisis in a game theoretic model. In their model, well-informed traders are firstly able to find newcomers who refinance both the bad and good quality bonds.

[28] In Bacchetta and Wincoop (1998) investments are distributed into developed and emerging market economies. They study financial liberalization, which is introduced in the form of removal of a tax on investments in emerging market countries. An information cost is added. The result is a capital inflow-outflow spiral, and information costs may cause a contagion effect.

[29] Empirical research is still scarce, but usually herding behaviour has been found to be more common in respect of investments in smaller enterprises, emerging markets

and crisis situations (Lakonishok et al 1991, Choe et al 1998 and Chang et al 2000).

[30] Berg and Patillo (1999) evaluate three theories and models to predict the crises in Asia. They find that two models are no better than guesswork and that the third model explains 28% of the actual cross-country crisis rankings. The methods studied are from Kaminsky et al (1998), Frankel and Rose (1996) and Sachs et al (1996). The study by Kaminsky et al (1998) had some predicting power for the Asian crisis. Kaminsky and Reinhart (1998) conclude that the Asian crisis is similar to the post financial liberalization episodes in Latin America. An increasing volume of short-term capital inflows and booms in lending and asset prices characterized both crisis episodes. However, several studies have focused specifically on the Asian crisis, and these might better explain recent events.

[31] Mahar and Williamson (1998) however remark that not all of these crises were due to the liberalization, and in some countries banks had large nonperforming loan portfolio before liberalization got underway.

[32] Similarly, Patel and Sarkar (1998) studied nine stock market crises in 18 countries during 1970-1997. They found strong evidence of contagion within regions and that most of the countries within a region were hit by the crisis in question.

[33] They found no evidence that this contagion was caused by compensatory liquidation of assets by international institutional investors.

[34] See also Kaminsky - Reinhart (2000) and van Rijkeghem - Weder (1999). In contrast, Glick - Rose (1999) argue that currency crises tend to spread along regional lines because of trade links.

[35] Similarly, in the model by Jeanne (1997), the government has an interest in devaluing because it wants to reduce the unemployment rate. We will determine such costs differently later in this study.

[36] See Kamin (1999) on the importance of external debt, both of government and banks.

[37] Here the devaluation percentage is assumed to be given and is not endogenously determined in the model, in contrast to some other studies (see Flood and Garber 1984 for first generation models and Obstfeld 1984 for second generation models). This can be seen as a weakness of the model. In the empirical application of the model, the devaluation percentage, d, is assumed to be 25%.

[38] $f(\ )$ is the derivative of the cumulative distribution function, $F(\ )$.

[39] The normal distribution function has the value $1/\sigma\sqrt{2\pi}$ at $f(0)$.

[40] This comes from the tangency condition, $1 = \alpha f[\alpha\pi - \phi]$, and solving for ϕ min and $\bar{\phi}$ max.

[41] Using a different model, Sachs et al (1996) also note that capital flows depend on expected devaluation, which enables multiple equilibria.

[42] We can consider the capital account to consist of two terms, S = FDI + PF(p), where the first term is (exogenous) foreign direct investment and the second represents portfolio investment, which depends on the devaluation probability. For simplicity, we denote the capital account simply as S (p) and ignore FDI.

[43] Debt service costs, $(r + \pi_t \delta)$ D, are part of the current account and hence are expressed as a separate term. An alternative method could be to regard the possible capital flows as an increase or decrease in D.

[44] The S( ) term may be negative if devaluation expectations are sufficiently large.

[45] Or for the size of the capital outflow that the market expected in the event of a crisis.

[46] The second term dominates, because $F( ) \geq f^{-1}( )$ (see also equation 29 and the results in table 2 in appendix 1). In equation (30) the first and the second term will shift in opposite directions. At the $\bar{\phi}$ limit, the first term is smaller and the second term larger than in equation 20 (note that w2 > w1).

[47] Capital inflows probably improve country fundamentals, at least in the long run.

[48] Whether the country is illiquid or insolvent depends on lenders' beliefs. If they think the country is simply illiquid, they will continue to lend, which will prevent insolvency and justify their view. If they think the country is insolvent, the lenders will refuse to lend and the country will turn out to be insolvent (Basu 1991). These beliefs can be quite fragile, and changes in them may cause capital outflows and currency crises. Consequently, the structure of international credit markets and the process of forming beliefs affect countries' vulnerability to large changes in capital flows.

[49] Sachs (1984) points out that in a syndicated loan issue each participating bank tries to be a free rider, which leads to insufficient monitoring and supervision of the borrower. The model and results by Calvo - Mendoza (1998) provide some reasons why investors are not seeking for information about the country fundamentals.

[50] As Basu (1991) observes, the interest rate is not the only factor involved; for example, maturity and default provisions are also important.

[51] This even though the primitive behavioural functions, like equation (31) or (32), are continuous. The assumption that lenders can lend only one unit or nothing is not critical to this result. Critical is that there is some number of lenders or amount of excess supply which is expected.

[52] Of course in reality the capital account balance is affected by several other factors as well. In order to study herding behaviour, we restrict these variables and assume that the capital account balance is determined solely by the loan pushing model. In emerging market countries where information is expensive and difficult to receive and process, herding behaviour might be more prevalent. However, we should keep in mind that in the loan pushing model the discontinuous supply of credit is an extreme case of lender interdependence or herding behaviour.

[53] This amount is a result from the loan pushing model. Foreign investors sell their first period holdings.

[54] $i_t - \pi_t \delta = \rho$.

[55] The crisis and the devaluation of the currency might move the trade balance toward surplus. And when depreciation expectations cease, the capital outflow slows.

[56] If the fundamentals are better than the $\bar{\phi}$ limit, there should be no crisis. Thus the $\bar{\phi}$ limit must be from the second case. At the $\underline{\phi}$ limit a crisis should be certain; hence the limit is from the first case.

[57] This is quite reasonable assumption, given the large capital inflows to many emerging markets after the liberalizations, which was preceded by large capital outflows. These occurred although the changes in fundamentals were not very large.

[58] Unfortunately, we are not able here to study these effects more thoroughly. In any case, empirical results by Dooley et al (1996) show that interest rates in developed countries have been significant factors in explaining government bond prices in emerging market countries.

[59] Given our assumption about the size of capital flows and change in fundamentals (s). The intuition behind the result is that capital flows which do not depend from country fundamentals may 'punish' or 'save' countries. The result that capital flows widen the range for multiple equilibria is similar to the results received by Chang - Velasco (2001). Although they use a model which studies banking crises. In their model larger capital inflow, ceteris paribus, increase the vulnerability of a bank run.

[60] The time period over, which pt is calculated, surely is critical to the results. We use the same method than by Masson where both short-term and long-term debt is included. For capital flows we use the yearly flows from the balance of payments. An alternative method would be to use the crisis onset years for a particular country or use just monthly data.

[61] Smin denotes the S ( ) function at the $\bar{\phi}$ limit and Smax the S( ) function at the $\underline{\phi}$ limit in equation (43). In our calculation the interest rates in developed country or in emerging market country do not affect these capital flows. Although in the model and in reality this would be true.

[62] In many of the countries studied, the inflows of portfolio investment become massive capital outflows during the crisis year. For example in Mexico the actual outflows in 1995 fit our assumptions. For Russia and Thailand, the data are not from the IFC but rather from IMF (2000) and IMF (1998), respectively. We calculated Smin for Thailand somewhat differently as the sum of private sector loans, other portfolio investments, other short-term investments, and other capital (incl. non-residents' baht accounts).

[63] It is possible to view [Smax, Smin] as the range for possible capital flows during the next year.

[64] This means that although country fundamentals are important and country authorities keep them in relatively good condition, a currency crisis may occur in an environment of free capital flows.

[65] Clearly more sophisticated methods are needed to test whether the crises occurred due to self-fulfilling expectations. See eg Kajanoja 2001 and Jeanne - Masson 1998 who use models where the trigger value for the fundamentals follows a Markov process. They regress realignment expectations on macroeconomic variables, using both linear and regime switching models. Their conclusion is that regime switches may reflect self-fulfilling changes in expectations.

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