

“Partial Economic Reforms and Financial Crises: An Emerging Markets Perspective”

**Prof^a. Monica Baumgarten de Bolle
(CEP/London School of Economics)**

LOCAL

Fundação Getúlio Vargas
Praia de Botafogo, 190 - 10º andar - Auditório

DATA

06/01/2000 (5ª feira)

HORÁRIO

16:00h



Coordenação: Prof. Pedro Cavalcanti Gomes Ferreira
Email: ferreira@fgv.br - ☎ (021) 536-9250

Partial Economic Reforms and Financial Crises: An Emerging Markets Perspective

Monica Baumgarten de Bolle*
CEP[†] and London School of Economics

First Draft: April 1999

This Draft: May 1999
(Preliminary. Comments Welcome)

Abstract

The recent emerging market experiences have posed a challenge to the conventional wisdom that unsustainable fiscal deficits are the key to understanding financial crises in these countries. The health of the domestic banking system has emerged as the main driving force behind the perverse dynamics of partial reforms. The current paper shares this view and uses a model of contractual inefficiencies in the banking sector to understand the dynamics of these reforms. We find that the threat of a large exchange rate devaluation depends on the stock of international reserves relative to the stock of domestic credit that must be extended by the Central Bank in response to a large capital outflow. Moreover, if a country has a weak banking sector but high net reserve ratios, the capital flow reversal might only increase the vulnerability to a currency crisis without necessarily causing it. The results are in accordance with much of the empirical literature on the determinants of financial crises in emerging markets. Some aspects

*I thank Helene Rey for very helpful comments and dedicated supervision. I also thank Nobu Kiyotaki and participants at the CEP annual conference in Stoke Rochford. I gratefully acknowledge the Brazilian Government / CAPES for financial support.

[†]London School of Economics, Centre for Economic Performance, Houghton Street, London WC2A 2AE, United Kingdom. Tel: +44 171 9557080; Fax: +44 171 9557595; e-mail: M.B.De-Bolle@lse.ac.uk.



of the recent policy debate on the introduction of capital controls are also analysed

1 Introduction

Up until the Mexican crisis of 1994/1995, “partial economic reforms” were generally viewed as the failure of some emerging market governments to implement the necessary supporting policies to the “Washington Consensus”: opening trade, balancing the budget, privatisation, and inflation stabilisation. The conventional wisdom had been that financial crises in emerging markets were largely due to macroeconomic mismanagement in the form of unsustainable fiscal deficits.

The Mexican experience and the follow-up crises in Argentina (1995) and East Asia (1997) challenged this view to the extent that the affected countries had effectively implemented “complete” reforms in the above sense: these economies had achieved balanced budgets, low inflation, and controlled money growth. Nonetheless, they all suffered sudden capital flow reversals that were largely unanticipated.

The vast body of research begun in the aftermath of these crises has brought to light 3 broad views on the underlying causes of emerging market financial turmoil. Some economists argue that changes in international conditions are the key driving factor: abrupt changes in the international market may seriously affect the ability of debtor countries to repay existing loans. The Latin American debt crisis of the early 1980’s is an often cited example of how shifts in external conditions can set the stage for financial collapse¹. Others, such as Krugman (1998) and Dooley (1998), blame “crony capitalism” and the moral hazard issues linked to the existence of a lender of last resort both at the domestic and international levels. Finally, Kaminsky and Reinhart (1997), and Sachs, Tornell and Velasco (1995) focus on the inherent instability of financial markets as a possible explanation.

The current paper shares the latter view and attempts to show that structural reforms which lack the appropriate focus on the behaviour of the domestic banking system may be largely doomed to failure. In particular, we interpret such a “partial economic reform” as a sudden and unanticipated

¹Many observers have identified the rise in US interest rates and the fall in commodity prices at the time as important determinants of the debt crisis.

wealth shock which hits the economy shortly after its implementation². We use a model of contractual inefficiencies in the banking sector to understand the dynamics of these reforms, in the same spirit as Baumgarten de Bolle (1999). The main results are in accordance with much of the empirical literature on the determinants of emerging market financial crises, in particular Sachs, Tornell and Velasco (1995) and Kaminsky and Reinhart (1997).

We find that the ratio of short term debt to foreign reserves is a crucial indicator of an economy's vulnerability to financial collapse³. In this respect, the threat of a large exchange rate devaluation⁴ depends on the stock of international reserves relative to the stock of domestic credit that must be extended by the Central Bank in response to a large capital outflow. Moreover, if a country has weak fundamentals, i.e. a weak banking sector, but high net reserve ratios, it is possible that a reversal in capital inflows will not induce a devaluation. In this case, the government might simply react by running down reserves and therefore the simultaneous emergence of twin crises will not be observed for such a country.

The model is an extension of Baumgarten de Bolle (1999) but also close in spirit to Jacklin and Bhattacharya (1988) and Goldfajn and Valdes (1997). The former paper contrasts speculative and information-based bank runs, where these are characterised by two-sided asymmetric information: the bank cannot observe true liquidity needs of the depositors while the depositors are asymmetrically informed about the quality of banks' assets. The setting is that of a closed economy and there is no analysis regarding what factors determine the quality of banks' balance sheets. Nonetheless, bank runs are shown to be solely associated with the perception of poor bank prospects; there's no speculative or "sunspot" aspect to bank panics as in the classical Diamond-Dybvig (1983) set up.

The Goldfajn and Valdes (1997) paper is an open economy version of Diamond and Dybvig (1983) and it is able to replicate the observed cycle in capital flows to emerging markets: large inflows, crises, and abrupt outflows. Since their model builds on the Diamond-Dybvig framework, bank runs are purely speculative in nature and stem from a coordination failure. In contrast, the current paper uses the information-based run structure outlined

²These reforms are assumed to be of the Washington Consensus type, where the instrument used for inflation stabilisation is an exchange rate peg.

³In line with the empirical evidence of Kaminsky and Reinhart (1997) and Radelet and Sachs (1998).

⁴Which we identify with the occurrence of a currency crisis.

above and embeds it in an open economy context similar to Goldfajn-Valdes. The emergence of the twin crises is shown to be essentially linked to poor economic fundamentals, as opposed to purely sunspot phenomena. The policy dilemmas facing the domestic Central Bank are crucial for the results.

The paper is organised as follows: section 2 presents the basic, closed economy set up; section 3 deals with the open economy case and analyses the recent and controversial policy debate on the use of capital controls; section 4 is reserved for a general policy discussion on the issues presented and relates them to some recent emerging market experiences; finally, section 5 concludes.

2 A Closed Economy

We consider a three period economy, $t = 0, 1$ and 2 , consisting of a Central Bank and three kinds of agents: N depositors, M identical entrepreneurs, and a risk neutral monopoly bank. At dates $t = 0, 1$ a one period domestic storage technology is available to depositors and entrepreneurs yielding $(1 + r)$ per period for each unit invested. For simplicity, we normalise r to zero.

Entrepreneurs have the option to undertake a risky project which requires a fixed investment of I . As in Diamond (1984) we will assume that the scale of inputs needed for the investment project is greater than the personal wealth of both an individual entrepreneur and any single depositor. Furthermore, depositors are “small” relative to entrepreneurs in the sense that many are needed to finance a single entrepreneur.

At $t = 0$, I is invested in the project which is completely illiquid until $t = 2$, in other words it is not possible to invest any additional amounts after $t = 0$ and early liquidation yields strictly zero returns. Entrepreneurs are also able to take an action $a \in \{a_b; a_g\}$ at $t = 1$ which influences the return and probability of success of the project in the following manner:

$$\begin{aligned} a_g \text{ yields } & \left\{ \begin{array}{l} X \text{ with probability } p_g \\ 0 \text{ with probability } 1 - p_g \end{array} \right\} \\ a_b \text{ yields } & \left\{ \begin{array}{l} X \text{ with probability } p_b \\ 0 \text{ with probability } 1 - p_b \end{array} \right\} \end{aligned}$$

where: $p_g - p_b > 0$; $X > \frac{C_g - C_b}{p_g - p_b}$; $\frac{C_g}{C_b} > \frac{p_g}{p_b}$

Actions are unobservable to all other agents in the economy and involve costs which satisfy $C_g > C_b$. As will be shown, entrepreneurs will borrow from the bank in order to invest, and given that project returns are zero if a bad state of nature is realised, the bank will not receive any repayment on the loan in this case.

2.1 Entrepreneurs

Entrepreneurs are assumed to have the following utility function over period 2 consumption:

$$U(c) = \begin{cases} -\bar{u} & \text{if } c < \hat{c} \\ c & \text{if } c \geq \hat{c} \end{cases}$$

This formulation for utility is meant as a metaphor for risk aversion; the entrepreneur cares about meeting some basic consumption needs \hat{c} . Once this minimum consumption requirement is satisfied, the entrepreneur behaves as a risk neutral agent. Thus the above utility function formulation is also a simple way of capturing the idea of decreasing absolute risk aversion: if the entrepreneur becomes richer, he may become better equipped to meet his minimum consumption needs and hence cares less about risk.

At $t = 0$ each entrepreneur receives an endowment of $w_E < I$ and decides whether to invest this amount in the storage technology or in the risky project⁵. If the representative entrepreneur chooses to invest in the project, he will need to borrow $I - w_E$ from the bank; for this he promises a repayment R to be specified from individual rationality / incentive-compatibility considerations.

If the entrepreneur chooses to invest in the project, it must be the case that⁶:

$$p_j [X - R] + (1 - p_j)(-\bar{u}) - C_j \geq w_E$$

Where the entrepreneur's outside option is to invest all his endowment in the storage technology and hence receive w_E after two periods; we're assuming

⁵In equilibrium there is never diversification by the entrepreneur. See Baumgarten de Bolle (1999).

⁶We can also formulate an alternative outside option where the entrepreneur borrows and puts all funds in the bank. This will imply that the interest rate paid on deposits is $r^* = 0$ (since there's now no uncertainty on deposits), and thus the entrepreneur will prefer to put funds in the project if the same participation constraint holds.

that $w_E > \hat{c}$. Note that the above rationality condition is only true if $X - R - C_j \geq \hat{c}$ ⁷.

2.2 Depositors

There are two types of depositors in the economy: late and early consumers. Late consumers have utility over period 2 consumption only, while early consumers derive utility from consuming in period 1 only. At $t = 0$ individual depositors do not know their types; this is privately resolved at $t = 1$ when agents learn whether they're late or early consumers. We assume that no other agent in the economy can observe an individual's type.

We will also assume that in aggregate there is no uncertainty as to whether a consumer is "early" or "late": there's a fixed proportion λ of the depositor population which is revealed to be of the early type at $t = 1$, while $1 - \lambda$ are of the late type. These proportions are publicly known. Each depositor has an initial endowment of w_d and hence the economy disposes of total resources $D = Nw_d$.

Depositors have the following utility function:

$$U(c_t) = \begin{cases} -\bar{u} & \text{if } c_t < \hat{c} \\ c_t & \text{if } c_t \geq \hat{c} \end{cases}$$

where $t = 1, 2$ depending on whether the depositor is early or late; \hat{c} represents the minimum consumption requirement for depositors; hence entrepreneurs and depositors have the same preferences. Let $w_d \geq \hat{c}$.

2.3 Bank

The bank is a risk neutral agent facing fixed operational costs F and it is a monopoly both in the credit and in the deposit market. It has basically two functions: it collects funds from depositors in order to be able to lend to the representative entrepreneur, and it also monitors the entrepreneur by writing incentive-compatible loan contracts. This implicitly means that by putting their funds in the bank, depositors are in fact delegating monitoring to the bank as in Diamond (1984), since they're assumed too small and disperse to perform this function efficiently themselves. Note that in the absence of a

⁷If $X - R - C_j < \hat{c}$ then the rationality constraint becomes $-\bar{u} - C_j \geq w_E$ which is never satisfied.

bank, all depositors would only have the option of investing in the storage technology given their inability to monitor the entrepreneurs⁸.

The bank has no initial endowment and it will invest a proportion λ of its total deposits in the liquid, short term technology and the remainder in the long term project. The reason for the above strategy follows from the fact that there is no aggregate uncertainty as to depositors types: at $t = 1$ λN depositors will withdraw their funds from the bank. Its balance sheet at $t = 0$ looks as follows:

Assets	Liabilities
$M(I - w_E)$	D
λD	

where D represents total deposits at the bank and the following balance sheet condition holds for all parameters:

$$M(I - w_E) = (1 - \lambda) D$$

Finally, we will assume that the bank operates under a sequential service constraint. It services deposit withdrawals on a first come first served basis.

2.4 Central Bank

The Central Bank cares both about agents' consumption and the stability of the banking system. One can justify the first assertion by arguing that bank liabilities are central to the domestic payments system, and thus bank deposits are generally believed to enjoy a Central Bank guarantee even in the absence of an explicit deposit insurance scheme. To deal with the concern over the well-functioning of the payments system, the Central Bank uses a short term refinancing rate f which guarantees that depositors get their full deposit returns at $t = 1$.

The financial stability concern of the Central Bank also involves guaranteeing a certain level of expected profits to the banking system. This will implicitly set the short term refinancing rate. Note that the short term refinancing rate will have the dual purpose of guaranteeing adequate liquidity to the banking system and financial stability.

⁸The bank in this model is not just a coalition of depositors as in Diamond and Dybvig (1983). Although it pools the funds from these agents, it has an explicit technological (monitoring) advantage allowing it to invest in the longer term / higher return project.

2.5 Contract between Bank and Depositors

Given the above objectives of the Central Bank and the assumption on the short term refinancing rate, we will work under the assumption that the bank finances all M entrepreneurs, thus collecting funds from all N depositors⁹. The contract written by the bank with the individual depositors stipulates the returns on deposits with different profiles. Since this is a monopoly bank, on the deposit side it is able to extract all surplus from the depositors, such that for a given action implemented and thus for a given probability of solvency p_j :

$$\lambda w_d + (1 - \lambda)[p_j(1 + i_j)^2 w_d - (1 - p_j)\bar{u}] = w_d$$

This expression ensures that all $t = 0$ surplus is extracted from depositors. More specifically, the bank will return w_d to all depositors withdrawing at $t = 1$, which meets the participation constraint of early consumers with equality, and will promise a higher return to all depositors who wait until $t = 2$. Hence, the following truth-telling constraint needs to be satisfied by depositors who wait to consume at date 2:

$$p_j(1 + i_j)^2 w_d - (1 - p_j)\bar{u} \geq w_d$$

Since the bank cannot observe an individual's type it must ensure that late consumers have no incentive to immitate early consumers. Given that there is no aggregate uncertainty in the model, the bank will set i_j such that the above expression is met with equality. We will assume away a double moral hazard problem by imposing that the bank cannot steal any second period returns from depositors. The contract applying to late depositors is then:

$$(1 + i_j)^2 = \frac{1}{p_j} + \frac{(1 - p_j)}{p_j} \frac{\bar{u}}{w_d}$$

We can interpret $\frac{(1-p_j)}{p_j} \frac{\bar{u}}{w_d}$ as the risk premium component of long term deposit interest rates. Thus the higher is \bar{u} , the more risk averse are the depositors initially and hence the higher the risk premium has to be to compensate them for the increased uncertainty.

⁹See appendix for the conditions which guarantee that this is true.

2.6 Contract between Bank and Entrepreneur

To motivate the contractual inefficiency problem, we'll start off by establishing a benchmark case where the actions of a single representative entrepreneur are perfectly observed by all parties involved in contracting. In this first best case, the optimal loan contract is the solution to the following problem:

$$\begin{aligned} & \text{Max}_{R,p_j} [MR - (1 - \lambda)N(1 + i_j)^2 w_d] - F \\ \text{such that :} \end{aligned}$$

$$p_j [X - R] + (1 - p_j)(-\bar{u}) - C_j \geq w_E \quad (\text{EPC})$$

$$p_j [MR - (1 - \lambda)N(1 + i_j)^2 w_d] - F \geq 0 \quad (\text{BPC})$$

where the inequalities EPC and BPC represent, respectively, the entrepreneur's and the bank's rationality, or participation constraints. Since all entrepreneurs are identical we have written the participation constraint for a single representative entrepreneur.

Define:

$$R_j = X - \frac{1}{p_j} [C_j + w_E + (1 - p_j)\bar{u}]$$

$$MR_{jl} = (1 - \lambda)N(1 + i_j)^2 w_d + \frac{F}{p_j}$$

where $(1 + i_j)^2 = \frac{1}{p_j} + \frac{(1 - p_j)}{p_j} \frac{\bar{u}}{w_d}$ from the previous subsection. The above two equations imply, respectively, an upper and a lower bound on the repayment function according to the action that is implemented, provided $R_j > R_{jl}$.

Since the bank is a monopolist in the credit market, it will extract all the surplus from its relationship with the entrepreneur. Thus the optimal loan contract is such that $R = R_j$; note that since $R_{jl} > 0$ by definition it follows that R_j is also greater than zero. The proposition below then establishes how the bank maximises its expected profits under this benchmark case.

Proposition 1 *If the bank can perfectly observe the entrepreneur's actions, the optimal loan contract specifies that a_g be implemented.*

Proof. If the bank wishes to see the efficient action being undertaken, it sets:

$$(1 + i_g)^2 = \frac{1}{p_g} + \frac{(1 - p_g)}{p_g} \frac{\bar{u}}{w_d}$$

with the depositors and:

$$R_g = X - \frac{1}{p_g} [C_g + w_E + (1 - p_g)\bar{u}]$$

with the entrepreneurs, which yields the following expected profits:

$$E[\pi_g^*] = p_g \{M(X - \frac{1}{p_g} [C_g + w_E + (1 - p_g)\bar{u}]) - (1 - \lambda)Nw_d(1 + i_g)^2\} - F$$

Analogously, if the bank wishes to write a contract based on the inefficient action, it's expected profits will be:

$$E[\pi_b^*] = p_b \{M(X - \frac{1}{p_b} [C_b + w_E + (1 - p_b)\bar{u}]) - (1 - \lambda)Nw_d(1 + i_b)^2\} - F$$

If $E[\pi_g^*] > E[\pi_b^*] \Rightarrow E[\pi_g^*] - E[\pi_b^*] > 0$. Using the last two equations, we find that: $E[\pi_g^*] - E[\pi_b^*] = M\{p_g X - C_g - [p_b X - C_b] + (p_g - p_b)(\bar{u})\} - (1 - \lambda)Nw_d[p_g(1 + i_g)^2 - p_b(1 + i_b)^2]$

However, $p_g(1 + i_g)^2 < p_b(1 + i_b)^2$ and $p_g X - C_g > p_b X - C_b$ which implies that $p_g X - C_g - [p_b X - C_b] > (p_g - p_b)(-\bar{u})$. This last expression ensures that $E[\pi_g^*] > E[\pi_b^*]$. ■

We will now analyse what happens when the bank cannot directly observe the action the entrepreneur chooses at date 1. The optimal contract in this case involves one extra constraint as the bank faces the potential costs of providing the entrepreneur with the correct incentives. The maximisation problem then becomes:

$$Max_{R,p_g} [MR - (1 - \lambda)N(1 + i_g)^2 w_d] - F$$

such that :

$$p_g [X - R] + (1 - p_g)(-\bar{u}) - C_g \geq w_E \quad (\text{EPC})$$

$$p_g [X - R] + (1 - p_g)(-\bar{u}) - C_g \geq p_b [X - R] + (1 - p_b)(-\bar{u}) - C_b \quad (\text{EIC})$$

$$p_g [MR - (1 - \lambda)N(1 + i_g)^2 w_d] - F \geq 0 \quad (\text{BPC})$$

The first inequality EPC is again the entrepreneur's participation constraint, the second EIC is the incentive-compatibility constraint; the third inequality BPC is the bank's participation constraint.

Given that these actions are now unobservable to the bank, it will have to provide the entrepreneur with the correct incentives if it wishes to have the efficient action implemented. We can thus define another upper bound on the repayment function using the incentive-compatibility constraint:

$$R_u = X + \frac{C_b - C_g}{p_g - p_b} + \bar{u}$$

where R_u is a strictly positive quantity according to the initial assumptions on the structure of the model. Let $X + \frac{C_b - C_g}{p_g - p_b} = R_z > 0$.

To simplify the analysis, we will now assume that the penalty faced by the entrepreneur when minimum consumption is not met suffices as an incentive device. In other words, provided the disutility from not meeting the requirement is large enough, the entrepreneur does need to be given any extra motivation to act prudentially. As a result, the bank does not face agency costs and is thus able to implement the first best contract $\{R_g; a_g\}$. The parameter configuration which guarantees that the penalty is large enough to imply $R_g < R_u$ is summarised in the next assumption.

Assumption 1: $\bar{u} > p_g X - C_g - w_E - p_g R_z$

We have thus established that under reasonable parametric assumptions, the bank is able to replicate the benchmark contract even under asymmetric information. As stated above, what drives this result is entrepreneurial risk aversion: since the entrepreneur cares about guaranteeing a minimum consumption level at date 2 the bank does not have to incur any costs trying to give him extra incentives to undertake the less risky action. The penalty from the risk of not meeting the date 2 consumption requirement is enough to discipline the entrepreneur at date 0.

2.7 The Effects of Partial Reform

As argued in the introduction, the definition of partial economic reforms, or put differently, the identity of the elements which render them partial in the first place has changed considerably. In the late 1970's to mid 1980's many developing countries, particularly Latin American countries, implemented a number of reforms, among which were: opening trade, balancing the budget, privatisation, and inflation stabilisation mainly in the form of nominal exchange rate anchors. The observed boom-bust dynamics following the implementation of these programmes came to be identified with the incomplete nature of these reforms¹⁰. More specifically, in many cases reforming countries suffered severe balance of payments / banking crises shortly after the implementation of the programmes. Much of the blame for the above has fallen on the failure of these countries to undertake the appropriate fiscal measures which should accompany any serious attempt at stabilising and reforming the economy. On the other hand, no particular emphasis was given to the role of the banking system; partial reforms were thus identified with the non-resolution of fiscal imbalances.

This common view was carried into the 1990's, when again many countries underwent a series of reforms in the same line as those above. The global environment had however changed considerably. With financial liberalisation and free capital movements, the health of domestic banking systems had taken centre stage as one of the most important determinants of the ultimate success of economic reforms. We argue that the failure of many emerging market governments to redefine the lines along which economic reforms are complete or partial, in particular the failure to recognise the importance of banking system soundness, has led once again to the common occurrence of balance of payments / banking crises following reforms.

Given that the purpose of structural reforms is to eliminate inefficiencies in resource allocation, as long as their implementation is (partially) successful the economy should feel some of its positive effects in the short run. In this light, we will interpret an economic reform as an unexpected wealth shock which hits the economy at $t = 1$ ¹¹. Following the discussion in Baumgarten de Bolle (1999), the motivation for this is that when reforms are announced, agents lack the ability to infer its impact on the economy. In particular, successful programmes are identified with an infinitely large set of positive

¹⁰See Calvo (1998).

¹¹See Baumgarten de Bolle (1999) for a discussion.

wealth effects (shocks) while failed reforms may result in negative wealth effects taking any value on a continuous range of negative values.

The timing of the model is now as follows:

$t = 0$: Entrepreneurs choose whether or not to invest given the contract offered by the bank. The bank and the depositors write a contract on i_j contingent on the action implicit in the loan contract written with the entrepreneur¹².

$t = 1$: Shock occurs and entrepreneurs choose an action. The nature of the shock influences entrepreneurial incentives and thus affects date 0 contracts. Late depositors reassess the economy's aggregate risk from a conjecture regarding the state of the bank's balance sheet. At this point the Central Bank may also choose to become active.

$t = 2$: Project returns are realised, depositors get returns, bank gets a repayment and possibly pays back the Central Bank for any short term financing; everyone consumes.

Given the timing structure above, some important assumptions regarding the state of information dissemination in the economy are being made. More specifically, we assume that depositors are not completely informed about the economy's parameters (fundamentals). Although at date 0 they correctly assess aggregate risk as $1 - p_g$ ¹³, the shock will induce them to reevaluate this probability of failure. In this sense, the wealth shock restores depositors' uncertainty regarding fundamentals. As we now analyse, a higher risk assessment by depositors is justified by the fact that the wealth shock worsens the moral hazard problem on the credit allocation end.

When the shock occurs, entrepreneurial wealth is augmented by $w_E^1 = w_E + \alpha$ and depositor wealth becomes $w_d^1 = w_d + \alpha$. The initial endowment w_E is committed to the project, and given investment illiquidity α cannot be added to this amount. Hence, the representative entrepreneur will choose to invest α in the storage technology, yielding α at date 2. If the wealth shock is large enough so as to guarantee the minimum consumption requirement at date 2, i.e. $\alpha \geq \hat{c}$, entrepreneurs now become indifferent towards risk. Thus, as argued in section , the entrepreneurial utility function serves as a

¹²The loan contract needs to be written at $t = 0$ given the illiquid nature of the project. Thus we rule out situations where agents wait to observe the shock before writing the contract.

¹³Presumably because the bank has repeatedly written such contracts in previous periods, so all agents are aware of the optimality of risk profile $1 - p_g$.

metaphor for preferences which exhibit decreasing absolute risk aversion.

With the shock satisfying $\alpha \geq \hat{c}$, entrepreneurial risk neutrality implies that at the initial contract R_g , it may now be optimal to switch to the inefficient action. The parameter configuration such that action switching takes place is given by:

$$p_b[X - R_g] - C_b > p_g[X - R_g] - C_g$$

Assumption 2:

$$\frac{1}{p_g - p_b}[p_b C_g - p_g C_b] > w_E + (1 - p_g)\bar{u}$$

The above assumption states that when the costs of implementing the bad action $\frac{p_b}{p_g}C_g - C_b$ are sufficiently low, the entrepreneur will be motivated to switch actions at contract R_g ¹⁴. The wealth shock eliminates the penalty $-\bar{u}$ as an incentive device and thus, when parameters obey the above inequality, the prospect of higher returns $X - C_b > X - C_g$ in the good state becomes more appealing.

Given assumption 2, if the bank keeps contract R_g in place, the entrepreneur undertakes a_b . Note that with the illiquidity of the project and the fact that investment is sunk, the entrepreneur has all the bargaining power in any renegotiation at date 1. As a result, he never accepts to renegotiate contracts in excess of R_g . The incentive-compatible contract after the shock specifies a repayment R_z that satisfies:

$$p_b[X - R] - C_b = p_g[X - R] - C_g$$

which is then shown to be,

$$R_z = X + \frac{1}{p_g - p_b}\{C_b - C_g\}$$

Remark 1 *Assumption 2 implies incentive-incompatibility of contract R_g . Since $R_z < R_g$, if the bank offers contract R_z the representative entrepreneur always accepts it*¹⁵.

¹⁴See Baumgarten de Bolle (1999) for the consistency requirements with assumption 1.

¹⁵See Baumgarten de Bolle (1999) for details.

It is clear from the above that, given depositor behaviour, the bank now faces the choice of either leaving contract R_g in place at the expense of higher exposure to project failure, or alternatively resetting contracts to R_z maintaining the risk profile but earning lower expected profits. In any case, expected profits as of period 1 are strictly lower than those of period zero, reflecting the fact that the entrepreneurial incentive distortion caused by the shock makes moral hazard resolution more costly to the bank.

Moving on to the behaviour of depositors at date 1, from the timing of the model we know that when the shock hits, *late* depositors will form a new conjecture as to the state of the bank's balance sheet leading to a new risk assessment for the economy. This risk assessment in terms of the solvency probability is assumed to be:

$$p = \delta p_g + (1 - \delta)p_b$$

where δ is a random variable with a distribution characterised by support $[0, 1]$. The realisation of δ will affect truth-telling conditions at contract i_g .

We know from above that the shock is such that $\alpha \geq \hat{c}$. Hence there exists a threshold for the solvency probability below which late depositors will now wish to withdraw early, given by the following expression:

$$\bar{p}(1 + i_g)^2 w_d + \alpha = w_d + \alpha$$

The threshold is then:

$$\bar{p} = \frac{p_g w_d}{w_d + (1 - p_g)\bar{u}}$$

If the realisation of δ is such that late depositors now assess the economy's solvency probability as below \bar{p} ¹⁶ and given sequential service constraints, they will now have an incentive to run on the bank. Note that the bank will not have adequate liquidity to meet all withdrawals. Moreover, the higher is \bar{u} , the higher is the risk premium paid on long term deposits. Since when the shock hits late depositors experience a decrease in risk aversion, they face a greater opportunity cost of withdrawing early implying a smaller range of δ realisations for which running on the bank is optimal: \bar{p} is now lower.

Given that the Central Bank cares about both liquidity and financial stability and furthermore identifies this with the maintenance of a level of

¹⁶Note that this implies a higher probability of failure $(1 - \bar{p})$ of the project, and hence higher aggregate risk for the economy.



expected profits Π , it will now provide the bank with short term financing to meet its liquidity obligations:

$$E[\pi_j^f] = p_j [MR_j - (1 + f_j)(1 - \lambda)Nw_d] - F = \Pi$$

where $j \in \{a; b\}$ and $(1 - \lambda)Nw_d$ is the amount the bank needs to borrow from the Central Bank so as to cover deposit demand at $t = 1$.

As analysed in Baumgarten de Bolle (1999), this implies that the bank could randomise its loan contracts by offering R_g to a proportion γ of entrepreneurs and R_z to the remaining $(1 - \gamma)M$ entrepreneurs. This will render the economy's aggregate risk equal to $p' = \gamma p_b + (1 - \gamma)p_g$, with $\gamma \in [0, 1]$. Note how this implies that depositors' expectations from the signal could in fact be self-fulfilling if $0 < \gamma < 1$: due to the signal, depositors conjecture that the economy's prospects have worsened which then turns out to be true.

The above result highlights how this model differs from the Diamond-Dybvig formulation with regard to the implications of a lender of last resort function for the Central Bank. In the Diamond-Dybvig framework the presence of a lender of last resort short-circuits a domestic bank run. In that case the run is triggered by a pure coordination failure, since depositors simply fear that the bank may be illiquid at the interim date. In the present context, it is the indication of potential balance sheet problems that sparks the run; hence as the lender of last resort function cannot resolve these fundamental weaknesses, it is not able to stop the run from happening. In fact, it may even end up justifying the run in the first place, as shown above, due to the policy conflicts facing the Central Bank.

The balance sheet problems mentioned previously come from the amplification of moral hazard effects on the credit allocation end, as a result of the implementation of partial reforms. Note that a key inefficiency sets the stage for the unraveling of a date 1 crisis: the inability to perfectly evaluate the condition of a bank's balance sheet. If this were possible, and to the extent that $E[\pi_g^1] = p_g \{MR_z - (1 - \lambda)Nw_d(1 + i_g)^2\} - F > \Pi$, the bank would gain by setting $\gamma = 0$ ¹⁷ and late depositors would be just as well off by not running on the bank.

The fact that there is uncertainty as to the magnitude of $E[\pi_g^1]$ relative to Π is intended to capture the quality of information disclosure in emerging economies. As argued by Rojas-Suarez and Weisbrod (1996), accounting

¹⁷That is, playing pure strategies and offering R_z to all entrepreneurs.

standards in these countries, particularly Latin America, are not sufficiently developed to allow depositors to properly evaluate the quality of banks' balance sheets. Our results are also in line with their finding that in Latin America, liquidity crises cannot be easily differentiated from solvency crises.

The lack of proper accounting standards triggers a fundamental-based run which then turns out to be self-fulfilling according to the Central Bank's intervention. The intuition for this perverse implication of CB intervention is the following: establishing a high Π serves the dual purpose of guaranteeing adequate liquidity to the financial system through short term financing and ensuring financial stability. Hence the Central Bank is faced with the classic problem of using one instrument to attain two independent policy goals. Conflicts arising from attempting to achieve these objectives simultaneously imply that being too concerned about proper liquidity provision may end up making the economy more vulnerable.

3 The Open Economy

We now turn to an open economy version of the model outlined in the previous section. In particular, we consider a situation where depositors in the banking system are foreign investors in order to analyse the interactions of bank runs and currency crises. The next subsection studies the emergence of these "twin crises" using the framework of section 2. We then go on to analyse some preventive policy options available to the domestic government

3.1 Emergence of Twin Crises

We assume that foreign investors are initially endowed with units of a foreign good y and will denote this endowment as y_d . To invest in the domestic economy, investors need to change their endowment measured in the foreign good into the domestic good w at the going exchange rate e_t as of period t . This is measured as domestic "currency" w per unit of foreign "currency" y . Foreign investors have utility over the consumption of y and hence when investment proceeds are realised they will change them back to these units at the current exchange rate. In all other respects foreign investors are identical to the domestic depositors of the previous section: they can be of the "early" or "late" types in proportions λ and $1 - \lambda$ respectively, and their period utility function is given by:

$$U(c_t) = \begin{cases} -\bar{u} & \text{if } c_t < \hat{c} \\ c & \text{if } c_t \geq \hat{c} \end{cases}$$

There exists a total of N foreign investors at $t = 0$.

Both the bank and the entrepreneur have the same characteristics as in the previous section. The Central Bank however has the added function of pegging the exchange rate, as in Chang and Velasco (1998) and Goldfajn and Valdes (1997). In order to maintain the peg, the Central Bank has a fixed stock of the foreign good y ; we will call this stock the economy's international reserves. Initially the exchange rate is set at $e = 1$ and if the CB is successful in maintaining it, $e_0 = e_1 = e_2 = 1$. We assume that the CB has an upper limit to the amount of reserves it can use to defend the peg since it is credit-constrained; it cannot borrow in the short run against future reserves. Initially it has sufficient reserves to cover the needs of "early" investors at the going exchange rate. Moreover, it can create or destroy domestic "currency" w costlessly.

Let K denote capital outflows measured in domestic currency and Y denote the stock of international reserves in the Central Bank. Following Goldfajn and Valdes (1997), we will also assume that the CB fixes a limit to the amount of reserves it is willing to sell at the original exchange rate, Y_{lim} . Given the above, when δ and the shock are realised at date 1, the exchange rate is given by:

$$e_1 = \begin{cases} 1 & \text{if } K \leq Y \\ 1 & \text{with probability } \mu \text{ if } K > Y \\ 1 + \frac{K-Y}{Y-Y_{\text{lim}}} & \text{with probability } 1 - \mu \text{ if } K > Y \end{cases}$$

where $\mu = \frac{Y_{\text{lim}}}{K}$. In effect, given sequential service constraints, μ is the proportion of investors who are able to trade domestic for foreign currency at the initial exchange rate, that is before the Central Bank reaches its reserve limit. When the limit is surpassed, the exchange rate will change to equate demand and supply.

We will consider the 2 possible scenarios for this economy, $K \leq Y$ and $K > Y$ in turn. At date 1 when the shock occurs and the new solvency probability is formulated, "late" foreign investors will have to decide whether or not to flee the economy. Provided there are sufficient reserves to meet eventual capital outflows, the threshold for the signal identifying when investors

find it optimal to flee does not change. The intuition is that if a country has weak fundamentals but high net reserve ratios, a reversal in capital flows will not induce a devaluation; the government might react by running down its reserves. Understanding this, investors will not fear a capital loss when reserve ratios are high, even when fundamentals are weak.

If investors do in fact find it optimal to flee according to the realisation of δ , a bank run occurs at date 1 but, as stated above, there is no accompanying currency crisis (devaluation). In effect, when reserves are sufficient to cover capital flows, the Central Bank is able to “buy time” until investment returns are realised. However, if aggregate risk in the economy does increase as analysed in the previous section, there is a higher probability of a bank bail out at date 2. If in fact the bank suffers losses at this time, it might then be that the CB can no longer bail it out without abandoning the peg, given that it has already lost some reserves at date 1. The upshot is that in this scenario we may possibly observe a bank run followed by a devaluation later; capital outflows generate greater vulnerability to a currency crisis. This is in line with the results of Sachs, Tornell and Velasco (1995) who find that excessive capital flows make eventual crises more likely.

Turning now to the second scenario, it is evident that if the Central Bank does not have enough reserves to cover capital outflows the bank run will be accompanied by a currency crisis. The situation is further aggravated by noting that there is now a larger range for δ realisations which generate capital outflows; the threshold is now affected by exchange rate risk.

Proposition 2 *If $K > Y$, the range of δ realisations associated with capital outflows increases compared to the case where $K \leq Y$. Furthermore, when $K > Y$ the threshold for capital outflows is higher in the case $\frac{\alpha}{\epsilon} < \hat{c}$ than if $\frac{\alpha}{\epsilon} \geq \hat{c}$.*

Proof. See Appendix.

The intuition for the above result is straightforward: if the Central Bank does not possess enough reserves to defend the peg in light of a capital flow reversal, the risk of a capital loss following from a devaluation makes investors more pessimistic regarding the economy’s prospects. This is in line with the results of Radelet and Sachs (1998). Using cross-country evidence for 22 emerging market economies, they find that a defining element of crises in these countries is the vulnerability to panic measured by K/Y ¹⁸. Such results

¹⁸Kaminsky and Reinhart (1997) also find the K/Y ratio to be highly significant in

lend support to the view that recent crises in emerging markets are more often than not driven by financial market instability. The crucial underlying hypothesis for the above is that countries with a high ratio of short term debt to reserves are more likely to suffer financial collapse.

Moreover, the higher is the reserve limit committed to defending the peg, the higher is the exchange rate risk since the bigger will be the follow-up devaluation. This will have an adverse effect on the thresholds calculated under proposition 2. In particular the solvency probability below which investors flee the economy is now higher both for $\frac{\alpha}{\epsilon} \geq \hat{c}$ and for $\frac{\alpha}{\epsilon} < \hat{c}$ ¹⁹ establishing a larger range for withdrawal realisations of δ . The intuition is as follows: since a higher reserve limit imposed with insufficient short term assets implies a higher exchange-rate devaluation, investors have more to lose by keeping their funds in the country and thus have a greater incentive to flee.

3.2 Policy Implications

Many economists²⁰ have emphasised the role of capital outflows as a source of recent foreign exchange crises in emerging markets. The usual argument is that the high volatility and short term nature of these flows magnifies considerably potential shocks to the economy, making it excessively vulnerable to financial crises. This observation has paved the way for the current controversy over the use of capital controls. Some prominent “mainstream” economists such as Paul Krugman, Joseph Stiglitz, and Dani Rodrik have strongly advocated their use while others²¹ have emphatically reminded us of the evils associated with outright market intervention.

Nevertheless, a general consensus seems to be emerging: the use of *temporary* capital controls as a means of avoiding excessive vulnerability to crises in economies that lack proper information disclosure / regulation technologies may bring more benefit than harm. Although this paper takes the stance that the capital outflow associated with currency collapses is a symptom of the underlying fundamental weaknesses rather than a cause of these crises²²,

predicting the twin crises.

¹⁹This is straightforward to show and hence we skip the details.

²⁰See Goldfajn and Valdes (1997), Chang and Velasco (1998), Chan-Lau and Chen (1998).

²¹See Rajan (1998).

²²The general consensus from many empirical investigations on the determinants of currency turmoil is that deeper fundamental problems lie at the core of foreign exchange

the model lends itself easily to the analysis of the effects of capital controls on the economy. The remainder of this section thus focuses on the debate surrounding restraints on capital flows..

3.2.1 Capital Controls: Curative versus Preventive Measures

As noted by Reinhart and Todd Smith (1997) much of the empirical work on the effectiveness of capital controls has concluded that such effectiveness is generally lost after a short period of time. For this reason, the above mentioned consensus on the use of restrictions on capital movements focuses on the use of *temporary* as opposed to *permanent* controls. Such controls may be split into two categories: restraints on inflows and restraints on outflows. As the above mentioned authors also emphasise, controls on outflows have been most prominently used once a balance of payments crisis was under way while inflow restrictions are more of a “normal times” phenomenon. This allows one to classify each type of restraint measure under the broad headings of “curative” measures and “preventive” measures.

In the present context, the definitions of curative and preventive refer to the point in time at which the measure is implemented. We can think of curative measures as those being pursued at date 1, once agents realise that the withdrawal queue facing the bank is too long. On the other hand, preventive measures are implemented at date 0 with the purpose of providing all contractual parties with an ex-ante safety buffer. We will first consider curative measures in the form of taxes on capital flows; we then turn to a discussion of preventive measures.

Restraints on capital outflows are advocated to the extent that they are aimed at slowing the speed of such outflows or completely preventing them when the economy is faced with the possibility of a sudden and destabilising withdrawal of capital during a time of “uncertainty”. Such restriction on capital movements can be achieved through the direct or implicit imposition of a tax on outflows. We now analyse this instrument using the results from the previous subsection, for the case $K > Y$ ²³. As seen previously, if the stock of international reserves is insufficient to cover capital outflows, the associated exchange rate risk implies the following thresholds for capital

crises rather than international capital flows. See Sachs, Tornell and Velasco (1995) and Kaminsky, Lizondo and Reinhart (1997).

²³The case $K \leq Y$ is less interesting since, as seen previously, if capital outflows occur they do not immediately materialise into a currency collapse.

flight²⁴:

If $\frac{\alpha}{e} \geq \hat{c}$;

$$\hat{p} = \frac{p_g[\mu e(y_d + \alpha) + (1 - \mu)(w_d + \alpha)] - p_g \alpha}{w_d + (1 - p_g)\bar{u}}$$

If $\frac{\alpha}{e} < \hat{c}$;

$$p' = \frac{p_g[\mu e(y_d + \alpha) + (1 - \mu)(w_d + \alpha)] + p_g e \bar{u}}{w_d + (1 - p_g)\bar{u} + p_g(\alpha + e\bar{u})}$$

Introducing a tax rate of τ on capital outflows, the above expressions become respectively:

$$\hat{p} = \frac{p_g(1 - \tau)[\mu e(y_d + \alpha) + (1 - \mu)(w_d + \alpha)] - p_g \alpha}{w_d + (1 - p_g)\bar{u}}$$

and,

$$p' = \frac{p_g(1 - \tau)[\mu e(y_d + \alpha) + (1 - \mu)(w_d + \alpha)] + p_g e \bar{u}}{w_d + (1 - p_g)\bar{u} + p_g(\alpha + e\bar{u})}$$

Clearly, a tax on capital outflows imposed at date 1 affects the threshold probability of solvency below which foreign investors flee the economy. As a result, introducing this instrument diminishes the range of solvency probabilities for which bank runs and currency crises materialise. Nonetheless, this may turn out to be very costly for the emerging market economy in the long run. The adverse credibility effect of imposing a sudden restriction on capital movements may seriously curtail future foreign lending to the economy, thus compromising future productive investment opportunities. Moreover, several empirical studies²⁵ have found that controls on outflows can be easily evaded, undermining the ability of this policy tool in stemming capital flight thus avoiding financial turmoil.

3.2.2 Reserve Requirements

As discussed above, restraints on inflows serve a preventive function: their main objective is to disallow a massive entrance of capital and hence avoid the

²⁴See the proof for proposition 2 in the Appendix.

²⁵See Mathieson and Rojas-Suarez (1993) and Reinhart and Todd Smith (1997).

consequences of a sudden capital reversal. We will model inflow restrictions as Chile-type reserve requirement ratios on intermediated foreign deposits. In response to a sharp inflow of capital starting in 1991, Chile has levied selective capital restraints primarily on inflows. Such restraints take the form of non-remunerated reserve requirements to be deposited at the Central Bank for one year.

Suppose that at date 0 the Central Bank requires the bank to keep a proportion $0 < \beta < 1$ of its total deposits as cash reserves. The bank's balance sheet will look as follows:

Assets	Liabilities
$M_1(I - w_E)$	D
$(\lambda + \beta)D$	

where M_1 will now be determined by the resource constraint:

$$M_1(I - w_E) = (1 - \lambda - \beta)D$$

Note that since the bank now has less resources available to lend, $M_1 < M$ and it will thus have to ration lending to some entrepreneurs.

In the original Baumgarten de Bolle (1999) paper, the traditional reserve requirement on the bank could be used to control for solvency risk. This was due to depositor passivity at $t = 1$ and hence the fact that increasing the reserve requirement ratio rendered the bank less able to dump the consequences of an aggregate risk increase on depositors. In the present context this is no longer true: since depositors are of different types and the bank is imperfectly informed at the individual level, it is constrained to operate by servicing withdrawals sequentially. This eliminates the scope for passing on to depositors the aggregate risk externality: they can now successfully run on the bank and hence are no longer passive.

The upshot is that introducing a reserve requirement on the bank reduces the number of entrepreneurs it is able to finance, but may have no effect on investors' incentives to run on the bank. As long as $\beta < 1 - \lambda$, the introduction of reserve requirements may not diminish the range of circumstances for which fundamental-based runs occur. However, if the bank is required to retain some cash reserves in excess of λD , it has an additional cushion in case of a sudden capital outflow. The Central Bank now has to extend only $(1 - \lambda - \beta)D$ as opposed to $(1 - \lambda)D$ when the run materialises. Since $(1 - \lambda - \beta)D = K' < (1 - \lambda)D = K$, reserve requirements will be beneficial

as long as $(1 - \lambda - \beta)D \leq Y < K$. In this case, capital outflows will not evolve into a currency crisis at date 1 and this in turn will affect investors' incentives to flee: if the reserve requirement is such that the above inequality holds, the threshold solvency probability no longer involves exchange rate risk and is therefore lower. The range of δ realisations for which investors run on the bank is then diminished.

The setting of reserve requirements to achieve the benefits described above does not come without costs. In particular, one should note that non-remunerated²⁶ reserve requirements impose a tax on banks subject to them and thus encourage disintermediation to institutions and markets free from these instruments. As noted by Johnston (1999) some countries have responded to the above problem by either eliminating the reserve requirement ratio altogether or substantially reducing it. Furthermore, many argue that due to the growing sophistication of financial markets, "leakages" may force authorities to cast an ever-widening net of administrative controls in order to maintain an effective grasp on capital. This evolutionary effect may end up bringing the economy more harm than benefit to the extent that controls spill over to other areas such as trade.

4 Discussion

The characteristic imperfections of emerging markets described in this paper and the policy options analysed in the previous section suggest a clear sequencing structure to economic reforms in these countries. To the extent that information disclosure is poor and moral hazard is severe, one should not attempt to implement Washington Consensus type reforms without first taking account of the constraints imposed by the state of the banking system. In this respect, imposing preventive measures on the financial intermediary *a la Chile* and only then implementing the remaining reforms, seems a sound course of action.

The danger of seeing the gradual undermining of the preventive measures mentioned above, however, makes a case for the resolution of the information disclosure problem. In this sense, if one believes that accounting standards are superior in foreign-owned banks, there is good reason for allowing the internationalisation of the domestic banking system by lifting restrictions on their entrance. On the other hand, as argued in Baumgarten de Bolle (1999),

²⁶Or alternatively when remuneration is below market rates.

foreign banks are generally more diversified away from economy specific risks. Hence, the fact that their balance sheets are potentially less affected by country-specific shocks may imply that more positive signals are received by investors and consequently there is less scope for fundamental-based runs.

We also share the view that while it may be tempting to unilaterally impose capital controls on outflows to deal with a crisis in the short term, as Malaysia has recently done, the longer term consequences are likely to be very harmful. The Latin American experience of the 1980's has already shown us that this approach to crisis resolution may be inefficient, widely circumscribed, and may cost a lot in terms of future capital market access.

5 Concluding Remarks

Using a simple structure for the bank's traditional liquidity transformation role, we have shown how financial crises might arise as a direct result of policy makers' disregard as to how financial intermediaries propagate shocks to the economy. The mechanism driving the result is that a (partial) economic reform generates positive wealth shocks which may aggravate the moral hazard problem faced by the bank on the credit allocation end, through decreasing entrepreneurial risk aversion. As monitoring becomes more costly to the bank, late depositors may become more sceptical regarding the quality of the bank's balance sheet through their perception of increased uncertainty of fundamentals. In reassessing negatively their evaluation of the economy's aggregate risk profile, investors' withdrawal incentives change generating a fundamental-based bank run. The bank's need for liquidity and resulting Central Bank intervention ends up justifying depositors' aggregate risk conjecture.

In the open economy setting, when the Central Bank intervenes, liquidity provision may become incompatible with pegging the exchange rate and hence the run will evolve into a fully-fledged currency crisis. We thus find that the threat of a large devaluation depends on the stock of international reserves relative to the stock of domestic credit that must be extended by the Central Bank in response to a large capital outflow. Moreover, when a country has a weak banking sector but high net reserve ratios, it is possible that a reversal in capital flows will not induce a devaluation. In this case, the government might simply react by running down reserves and therefore the simultaneous emergence of twin crises will not be observed.

To deal with the twin crises scenario, we have studied preventive and curative measures in the form of capital controls. Although both may be helpful in circumventing crisis scenarios, each presents its own drawbacks. Controls on capital outflows may seriously harm an economy's future access to world capital markets hampering future productive investment opportunities. On the other hand, controls on inflows run the risk of having to be ever-widened as agents learn ways to circumvent them; the more disseminated these controls become the higher the risk of their negative spillovers into other economic sectors. Nonetheless, the model provides some useful insights as to the optimal sequencing of economic reforms in economies characterised by poor information disclosure / regulation technologies.

References

- [1] Aizenman, Joshua. 1999. "Reserve Requirements on Sovereign Debt in the Presence of Moral Hazard: on Debtors or Creditors?". NBER Working Paper no. 7004.
- [2] Baumgarten de Bolle, Monica. 1999. "Perverse Dynamics of Exchange-Rate-Based Stabilisations: The Role of the Banking System". mimeo. London School of Economics.
- [3] Calvo, Guillermo and Carlos Vegh. 1999. "Inflation Stabilization and BOP Crises in Developing Countries". NBER Working Paper no. 6925.
- [4] Chang, Roberto and Andres Velasco. 1998. "Financial Crises in Emerging Markets: A Canonical Model". NBER Working Paper no. 6606.
- [5] Demirguç-Kunt, Ash and Enrica Detragiache. 1998. "Financial Liberalisation and Financial Fragility". IMF Working Paper no. 83.
- [6] Dooley, Michael P. 1997. "A Model of Crises in Emerging Markets". NBER Working Paper no. 6300.
- [7] Diamond, Douglas and Philip H. Dybvig. 1983. "Bank Runs, Deposit Insurance, and Liquidity". *Journal of Political Economy*, vol. 91, no. 3. pp. 401-418.
- [8] Diamond, Douglas. 1984. "Financial Intermediation and Delegated Monitoring". *Review of Economic Studies* LI. pp.393-414.

- [9] Eichengreen, Barry and Andrew Rose. 1998. "Staying Afloat When the Wind Shifts: External Factors and Emerging Market Banking Crises". NBER Working Paper no. 6370.
- [10] Freixas, Xavier and Jean-Charles Rochet. **Microeconomics of Banking**. The MIT Press, Cambridge, Massachusetts.
- [11] Gavin, Michael and Ricardo Hausmann. 1996. "The Roots of Banking Crises: The Macroeconomic Context". Inter-American Development Bank Working Paper no. 318.
- [12] Goldfajn, Ilan and Rodrigo Valdes. 1997. "Capital Flows and the Twin Crises: The Role of Liquidity". mimeo. International Monetary Fund.
- [13] Huang, Haizhou and Chenggang Xu. 1998. "Financial Institutions, Contagious Risks, and Financial Crises". mimeo. London School of Economics.
- [14] Johnston, R. Barry. 1998. "Sequencing Capital Account Liberalizations and Financial Sector Reform". 1998. IMF Paper on Policy Analysis and Assessment 98/8.
- [15] Kaminsky, Graciela and Carmen Reinhart. 1997. "The Twin Crises: The Causes of Banking and Balance of Payments Problems". CEPR Conference on Speculative Attacks and Foreign Exchange Reserves.
- [16] Kaminsky, Graciela, Saul Lizondo and Carmen Reinhart. 1997. "Leading Indicators of Currency Crises". IMF Working Paper 97/79.
- [17] Krugman, Paul. 1997. "Are Currency Crises Self-Fulfilling?". NBER Annual Macroeconomics Conference.
- [18] Krugman, Paul. 1992. **Currencies and Crises**. The MIT Press, Cambridge, Massachusetts.
- [19] Krugman, Paul. 1998. "Saving Asia: It's Time to get Radical". Fortune, September 7.
- [20] Obstfeld, Maurice. 1994. "The Logic of Currency Crises". NBER Working Paper no. 4640.

- [21] Radelet, Steven and Jeffrey D. Sachs. 1998. "The East Asian Financial Crisis: Diagnosis, Remedies, Prospects". Brookings Papers on Economic Activity.
- [22] Rajan, Ramkishan. 1998. "Restraints on Capital Flows: What are they?". Institute of Policy Studies (IPS), Singapore. Working Paper no. 3.
- [23] Reinhart, Carmen and R. Todd Smith. 1997. "Temporary Capital Controls". mimeo. University of Maryland.
- [24] Rojas-Suarez, Liliana and Steven Weisbrod. 1996. "Managing Banking Crises in Latin America: The Do's and Don'ts of Successful Bank Restructuring Programs". Inter-American Development Bank Working Paper no. 319.
- [25] Rojas-Suarez, Liliana and Steven Weisbrod. 1996. "Banking Crises in Latin America: Experience and Issues". Inter-American Development Bank Working Paper no. 321.
- [26] Sachs, Jeffrey, Aaron Tornell, and Andres Velasco. 1996. "Financial Crises in emerging Markets: The Lessons from 1995". NBER Working Paper no. 5576.
- [27] Salanie, Bernard. 1998. **The Economics of Contracts**. The MIT Press, Cambridge, Massachusetts.
- [28] Uribe, Martin. 1997. "Exchange-Rate-Based Inflation Stabilisations: The Initial Real Effects of Credible Plans". *Journal of Monetary Economics* (39). pp. 197-221.
- [29] Wyplosz, Charles. 1998. "Globalized Financial Markets and Financial Crises". mimeo. Graduate Institute of International Studies, Geneva.

A The Supply of Bank Loans

In this section we will establish conditions which guarantee the optimality of financing all M entrepreneurs. At date 0 the bank can choose between 2 strategies: gathering funds from investors to finance all entrepreneurs, in which case it must pay investors a risk premium on interest rates as it needs

to compensate them for their non-diversification. Alternatively, it can allow investors to diversify their investment portfolio, in which case the bank no longer has to pay them the risk premium but on the other hand will only have the resources to fund $\widetilde{M} < M$ entrepreneurs.

Case 1: Diversification

Investors' utility is given by:

$$U(c) = \begin{cases} -\bar{u} & \text{if } c < \hat{c} \\ c & \text{if } c \geq \hat{c} \end{cases}$$

and we have assumed that their initial wealth endowment is always sufficient to cover minimum consumption needs, $w_d > \hat{c}$. Since preferences involve a penalty of not meeting the consumption requirement, investors have an incentive to hedge against the risk of not meeting \hat{c} by diversifying their investment portfolio. Risk hedging involves choosing a proportion $0 < \varphi < 1$ of w_d to invest in the storage technology and hence $1 - \varphi$ to invest in deposits. Given the above preference specification, optimal diversification involves choosing φ such that $\varphi w_d = \hat{c}$.

The bank's balance sheet will then look as follows:

Assets	Liabilities
$\widetilde{M}(I - w_E)$	$(1 - \varphi)D$
$\lambda(1 - \varphi)D$	

where $\widetilde{M} = \frac{(1-\lambda)(1-\varphi)D}{I-w_E}$. The interest rate on long term deposits will then be given by: $(1 + i_g)^2 = \frac{1}{p_g}$. In this case, expected profits will be given by the following expression:

$$\widetilde{E(\pi_g)} = \widetilde{M}p_gR_g - (1 - \lambda)(1 - \varphi)D - F$$

Case 2: Non-Diversification

If investors do not diversify, we have the same situation as that described in subsection 2.3. In this case, the bank needs to pay a risk premium on deposits such that the interest rate is given by: $(1 + i_g)^2 = \frac{1}{p_g} + \frac{(1-p_g)}{p_g} \frac{\bar{u}}{w_d}$. Expected profits are then:

$$E(\pi_g) = Mp_gR_g - (1 - \lambda)D \left\{ 1 + \frac{(1 - p_g)\bar{u}}{w_d} \right\} - F$$

Financing all entrepreneurs by paying investors the risk premium on deposits is superior to financing fewer entrepreneurs with a lower deposit interest rate if: $E(\pi_g) > \widetilde{E}(\pi_g)$. This will be true provided the following inequality is observed:

$$E(\pi_g) - \widetilde{E}(\pi_g) = [M - \widetilde{M}]p_g R_g - (1 - \lambda)D \left\{ 1 + \frac{(1 - p_g)\bar{u}}{w_d} - (1 - \varphi) \right\} > 0$$

which is equivalent to,

$$[M - \widetilde{M}]p_g R_g > (1 - \lambda)D \left\{ \frac{(1 - p_g)\bar{u}}{w_d} + \varphi \right\}$$

Using the fact that $M = \frac{(1-\lambda)D}{I-w_E}$ and $\varphi = \frac{\hat{c}}{w_d}$, the above inequality reduces to:

$$\frac{(1 - I + w_E)}{I - w_E} \hat{c}(p_g R_g) > (1 - p_g)\bar{u}$$

This establishes condition on parameters such that the bank finds it optimal to finance all entrepreneurs by paying investors the appropriate risk premium.

Note that if this is not the case, the economy is even more vulnerable to market sentiment: if the bank allows diversification, there is no *threshold* for the solvency probability below which depositors run. As long as the realisation of δ obeys $0 < \delta < 1$ everyone *always* withdraws since there is no opportunity cost: given that all depositors are essentially risk neutral at date 0, there are no costs associated with foregoing the risk premium at date 1 in the case of a run as there is no such premium. We can see this from late investors' participation constraint $p_g(1 + i_g)^2 w_d = w_d$; if $0 < \delta < 1$ then $\bar{p} = \delta p_g + (1 - \delta)p_b < p_g$ and the participation constraint is not satisfied.

Taking this into account, it might be preferable not to let diversification occur at the expense of lower bank profits so as to have some indirect control over financial fragility.

B Proof of Proposition 2

Proof. If $K \leq Y$ there is no exchange rate risk; furthermore, given that $\alpha \geq \hat{c}$ investors become risk neutral after the shock such that the threshold below which late investors withdraw early is given by:

$$\bar{p} = \frac{p_g w_d}{w_d + (1 - p_g)\bar{u}}$$

Note that if everyone flees the economy at date 1, the size of capital flows is equal to $K = N[w_d + \alpha]$.

Considering now $K > Y$, we will first look at $\frac{\alpha}{e} \geq \hat{c}$. In this case the threshold will be given by the following expression:

$$\hat{p} \left\{ \frac{(1 + i_g)^2 w_d}{e} \right\} + \frac{\alpha}{e} = \mu[y_d + \alpha] + (1 - \mu) \left[\frac{w_d + \alpha}{e} \right]$$

Using the fact that $(1 + i_g)^2 = \frac{w_d + (1 - p_g)\bar{u}}{p_g w_d}$, the above will imply the following threshold:

$$\hat{p} = \frac{p_g [\mu e y_d + (1 - \mu)w_d + \mu\alpha\{e - 1\}]}{w_d + (1 - p_g)\bar{u}}$$

Due to the devaluation, $e > 1$ which implies that $e y_d > w_d$ and $\mu\alpha\{e - 1\} > 0$. Hence $\hat{p} > \bar{p}$ and there is a larger range of signals for which investors now flee due to exchange rate risk. Note that we want to constrain parameters such that $0 < \hat{p} < 1$.

If $\frac{\alpha}{e} < \hat{c}$, the threshold will be given by:

$$p' \left\{ \frac{(1 + i_g)^2 w_d}{e} + \frac{\alpha}{e} \right\} + (1 - p')(-\bar{u}) = \mu[y_d + \alpha] + (1 - \mu) \left[\frac{w_d + \alpha}{e} \right]$$

which implies,

$$p' = \frac{p_g [\mu e (y_d + \alpha) + (1 - \mu)w_d + \mu\alpha\{e - 1\} + \alpha + e\bar{u}]}{w_d + (1 - p_g)\bar{u} + p_g(\alpha + e\bar{u})}$$

We will now show that $p' > \hat{p}$. Let $A = \mu e (y_d + \alpha) + (1 - \mu)w_d + \mu\alpha\{e - 1\}$ and $B = w_d + (1 - p_g)\bar{u}$; hence $\hat{p} = \frac{p_g A}{B}$ and $p' = \frac{p_g A + p_g(\alpha + e\bar{u})}{B + p_g(\alpha + e\bar{u})}$.

$$\hat{p} - p' = \frac{p_g A [B + p_g(\alpha + e\bar{u})]}{B [B + p_g(\alpha + e\bar{u})]} - \frac{B [p_g A + p_g(\alpha + e\bar{u})]}{B [B + p_g(\alpha + e\bar{u})]}$$

This expression will reduce to:

$$\hat{p} - p' = \frac{p_g(\alpha + e\bar{u})[p_g A - B]}{B[B + p_g(\alpha + e\bar{u})]} < 0$$

where the inequality follows from the fact that $0 < \hat{p} < 1$ and hence $p_g A < B$. As a result, $\hat{p} < p'$ as we wanted to show. The intuition for this result is that if $\frac{\alpha}{e} < \hat{c}$ there is an additional source of exchange rate risk. In other words, a big devaluation offsets the effects of the wealth shock on investors' risk aversion: the fact that this is now non-diminishing renders fleeing the country more attractive or reduces the opportunity cost of foregoing the risk premium in interest rates. ■