On the causes of overlending:

Are guarantees on deposits the culprit?

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Abstract. This paper shows that overlending problems are not necessarily due to investor moral hazard and guarantees on deposits. Instead, guarantees on deposits may even limit the losses accumulated by the banking system. In fact, if international investors have incomplete information on the average quality of the investment opportunities available in a country and firms are financed by a main bank, a soft budget constraint distortion arises, because of capital inflows. I show that in equilibrium international investors rationally do not require any risk premium, until when a substantial amount of losses has been accumulated, even if there are no guarantees on deposits.

I also find that bond market development, by increasing the number of lenders, can eliminate the soft budget constraint distortion and prevent banking crises.

Keywords: Banking crises, soft-budget constraint, guarantees on deposits, bond markets.

JEL Classification: F34, F42, G21, E44

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1. Introduction

In many developing countries, the liberalization of capital inflows is followed by lending booms financed with foreign borrowing. The absorption of capital inflows generally poses challenges in terms of their productive deployment, because funds are intermediated by non-highly developed financial systems, and lending booms often result in widespread bankruptcies and banking crises. Moreover, the existence of explicit or implicit guarantees on deposits frequently transforms banking crises in runs on the foreign reserves, if the central bank tries to maintain the exchange rate fixed.¹

Guarantees on deposits have generally been considered the main cause of excessive lending to unprofitable projects.² According to the dominant view, guarantees on deposits cause moral hazard because of the lack of punishment for international investors and domestic banks in case of default. As a consequence, international investors make deposits, even if they know that domestic banks are financing negative present value projects.

This argument has the counterfactual implication that investors never make losses in the event of a crisis. Indeed, international investors did make losses during the emerging market crises of the 20th century, as outright defaults and debt rescheduling were at least as frequent as bailouts (Radelet and Sachs, 1998) and in most developing countries guarantees on deposits are, if any, just partial (Goldstein and Turner, 1996). Moreover, when liabilities are denominated in domestic currency a devaluation is equivalent to a partial default, since the international investors are interested in foreign currency returns. In accordance to the fact that investors may indeed make losses, in a recent paper, Martinez Peria and Schmukler (2001) find that depositors disciplines banks by withdrawing deposits and requiring higher interest rates when bank fundamentals deteriorate. They conclude that deposit insurance does not appear to diminish the extent of market discipline.

This paper proposes an alternative explanation of excessive lending. It shows that, after the liberalization of capital inflows, a process of accumulation of losses may arise even if there is no lender of last resort and international investors and domestic banks are not subject to problems of moral hazard. The crucial assumption of the model is that international investors cannot discern the origins of lending booms. Lending booms and current account imbalances in the aftermath of a financial liberalization are not necessarily due to the accumulation of bad loans. Capital inflows to
emerging markets may finance profitable investment opportunities that otherwise would have been foregone, and credit growth may be due to a process of financial deepening.\(^3\) The inability to discern the origins of the lending boom ultimately involves incomplete information about the average quality of the investment opportunities available in a country. This is equivalent to say that investors are unable to precisely estimate total factor productivity. This assumption is certainly plausible as the economic profession still argues about whether the growth of East Asian economies before the crisis was due to total factor productivity growth or to increasing investment in low productivity projects.\(^4\)

I show that incomplete information may explain why international investors make deposits in the domestic banks at a relatively low interest rate, even if there are no moral hazard problems, and also why they make losses in the event of a crisis.

Overlending arises in the model because the large availability of funds at low cost, due to capital inflows, creates a “soft budget constraint distortion”, if funds are provided to firms by a main bank (Dewatripont and Maskin (1995), Huang and Xu (1999)), as generally happens in emerging markets.\(^5\) In this case, banks are unable to credibly commit not to refinance negative-net-present-value projects once investment costs are sunk and, as a consequence, \textit{ex ante} demand for investment increases, because too many unprofitable projects are started.

Because of this distortion, even if banks maximize their net wealth, they have incentives to stop the process of ever-greening of loans only if the interest rate on deposits increases significantly. International investors, in turn, require a risk premium to hold deposits only if there is a positive probability of bank defaults. However, in the early phase of the lending boom, bank defaults cannot happen: Since the expected amount of bank losses is still low and the probability of having made deposits in an insolvent bank is small, the interest rate, which would compensate for such an event, is so low that banks would still have an incentive to renew loans to negative-net-present-value projects. Therefore, in the early phase of the financial liberalization, the probability of bank defaults is zero, and international investors, even if they know that their bank may be

\(^1\) This sequence of events describes equally well the experiences of Chile in the early eighties, the Nordic countries in the early nineties, and Korea, Thailand, and Indonesia in 1997. See Kaminsky and Reinhart (1999) for a detailed description of the empirical evidence.

\(^2\) See, for instance, Akerlof and Romer (1993); McKinnon and Pill (1996); Dooley (1997); Krugman (1998); Burnside et al. (1999); Corsetti, Pesenti and Roubini, (1999); Chinn and Kletzer (2000); Schneider and Tornell (2000).

\(^3\) In support of this, Caprio and Klingebiel (1996) do not find any stable relation between credit growth and credit problems in a sample that includes both developing and developed countries.

\(^4\) The debate about the origins of growth in East Asia demonstrates that the estimation of total factor productivity is a hard task for economists. For more details, see Young (1998) and Hsieh (1997).

insolvent, rationally do not require any risk premium, until when a substantial amount of losses has possibly been accumulated.

Hence, incomplete information about the quality of the investment opportunities available in a country may explain why international investors make deposits at a low interest rate in the aftermath of the liberalization of capital inflows. Only when a substantial amount of losses has been potentially accumulated, they suddenly require a huge risk premium. Contrary to the previous literature, which assume an exogenous upper bound on the losses that banks can accumulate before the crisis (Velasco (1987), Calvo and Mendoza (1996), Krugman, 1998; Corsetti, Pesenti and Roubini, 1999), I can determine endogenously the timing of the crisis and the level of bank losses.

Most importantly, the model clearly shows that the presence of a lender of last resort is irrelevant for the soft budget constraint distortion to arise and, under certain conditions, it may even limit the amount of losses that the banking system can accumulate. The only implication of the existence of guarantees on deposits is that the bank losses are a liability for the central bank and, therefore, the banking crisis is accompanied by a currency crisis, if there is a currency peg.

But if the guarantees on deposits are not at the origin of the overdraft syndromes, how can banking crises be avoided? Restriction to capital inflows would, of course, limit credit expansion, but would also limit the number of projects that are started if a country has good growth opportunities. Also attempts to lengthen the maturity of capital inflows are likely to be unsuccessful in eliminating the soft-budget constraint distortion, because they do not eliminate the possibility of renewing loans to insolvent projects.

Mechanisms that improve market discipline are, therefore, preferable. In this respect, the model suggests that greater transparency about the effective conditions of emerging economies and an increase in the number of lenders, which ultimately involves the modernization of financial markets, could improve financial stability. If international investors knew the origins of lending booms, they would not lend to countries where banks fund negative-net-present-value projects. Even if international financial institutions and, in particular the IMF, are making efforts in this direction (Fischer, 1999), it may be difficult to overcome incomplete information about the average quality of projects available in a country, since this involves an estimate of total factor productivity. The easiest way to introduce market discipline seems to increase the number of lenders. The incentives to renew loans to negative-net-present-value projects disappear, as shown by Hart (1995) and Bolton and Sharfstein (1996), if there are multiple creditors, like in advanced economies where the bond markets are more developed and the banking system is less concentrated. This eliminates the possibility of overdraft.
The remaining of the paper is organized as follows. Section 2 describes the model. Section 3 and 4 describe the equilibrium in the model with and without guarantees on deposits, respectively. Section 5 examines a few institutional arrangements that can improve financial stability and Section 6 concludes.

2. The model

The model studies the effects of capital inflows on the banking system of a small open economy. It shows that it is rational for atomistic investors, who have incomplete information about the investment opportunities available in the country, to make short-term deposits without requiring any risk premium until one period before a banking crisis may happen with positive (but strictly less than 1) probability. This is true notwithstanding investors anticipate that a crisis may happen.

The structure of the model is as follows. There are four types of agents: project managers, domestic banks, international investors and the central bank. I abstract from the existence of domestic depositors, who can be thought to have the same information of international investors and to make deposits exclusively for speculative purposes.

International investors provide capital by making deposits in domestic banks. The domestic banks decide whether or not to finance managers, who have the option to start a project at \( t=0 \) and need external financing. To continue production, projects need to be refinanced any subsequent period. The central bank defends the exchange rate peg as long as it has foreign reserves and may provide guarantees on deposits. In what follows I study the equilibrium under different assumptions on the existence of guarantees on deposits and the currency of denomination of domestic liabilities.

The interesting results of the model derive from the assumptions on the information structure. There are two levels of asymmetric information. First, the quality of a project is initially private information of the project manager. Although after one period the banks can determine the quality of a project, because they observe if the project manager paid back the loan or not, international investors do not know which kind of project has been financed by their bank. Second, international investors do not observe the country type, which depends on the average quality of the available investment opportunities, as will be explained later while describing the loan demand. That is to say, international investors do not observe the average productivity of capital in the country. This is a very plausible assumption because it is difficult and subject to disputes to precisely estimate factor productivity in emerging markets, as the debate on the determinants of
growth in East Asian economies between Young (1998) and Hsiei (1997) strikingly confirms. On the one hand, if total factor productivity is growing, expanding investment opportunities could drive the increasing loan demand. On the other hand, growth could also be sustained by increasing investment in low productivity and unprofitable projects. Since the economic profession is often unable to distinguish between these two situations, it seems plausible to assume that investors have incomplete information about the average quality of projects, and, ultimately, on the origin of the lending boom. Not only is incomplete information plausible, but it is also extremely relevant. Indeed, in the policy debate (see, for instance, Fischer, 1999), the lack of transparency on the positions built up by borrowers and lenders has been considered an important determinant of the intensity of recent crises. In marked contrast, imperfect information does not play any role in the existing explanations of financial crises, which rely either on moral hazard or on multiple equilibria and liquidity problems (Chang and Velasco, 1998a and b).

A more detailed description of each type of agent follows.

2.1 The projects

The country can be of two different types. Types differ in the average return to capital of domestic projects and cannot be distinguished by international investors. Differences in the average return to capital result from a different mix of heterogeneous projects. In what follows, I first describe the investment opportunities; after, I specify their availability in each type of country. All the assumptions on project technologies and manager incentives follow Dewatripont and Maskin (1995), who show the soft-budget constraint distortion in a two-period model.

Both country types have a continuum of project managers of mass \( l \) who can start a project at \( t=0 \). The project managers are risk neutral and their payoff is equal to the project output remaining after reimbursing the loan, if this is non negative (because of limited liability), plus some unobservable private benefits, such as perquisites or the enhancement of human capital and reputation.

The project output is homogeneous and tradable and its price in foreign currency is equal to \( P_t \). The purchase power parity holds, and therefore, the price of the good in domestic currency, \( P_t \), is equal to the nominal exchange rate, \( S_t : P_t = S_t \).

\footnote{Results are unchanged if I assume that also domestic banks do not know ex ante the country type. In the model only the relation between the bank and the project it funds is relevant and it is possible to show that aggregate uncertainty would not affect banks’ optimal decision.}
The project managers need loans from domestic banks to start their projects. The projects can be either solvent (S) or insolvent (I). No agent in the economy with the exception of the project manager can distinguish ex ante the project type.

Solvent projects generate $y_s$ units of output after one period, if $L$ units of the good have been invested. If the project is refinanced in each period, production can last forever.\footnote{I abstract from the possibility of internal financing. The assumption that managers cannot use retained profits to refinance the project is not restrictive, because the opportunity cost of reinvesting profits must be also taken into account.} The return on solvent projects is higher than the international interest rate, $i^*$, $y_s > (1 + i^*)L$. The private benefits for a project manager running a solvent project, $E_s$, are always positive. Hence, a solvent project is always started if it receives a loan.

On the other hand, an insolvent project does not generate any output in the first period, even if $L$ has been invested at $t=0$. From the second period on, it generates output $y_i$, if $L$ is invested and, like a solvent project, it can be continued forever. However, the net present value of an insolvent project is negative at $t=0$, even if the cost of funds is equal to the international interest rate and the project is never discontinued. This implies that the following condition holds:

\begin{equation}
\sum_{t=1}^{\infty} \frac{y_i}{(1 + i^*)^t} < \sum_{t=0}^{\infty} \frac{L}{(1 + i^*)^{t+1}}.
\end{equation}

This condition implies that $y_i - L(1 + i^*) < L(1 + i^*)i^*$. That is to say, the surplus generated by an insolvent project cannot recover the first period loss, because it is not sufficient to cover the interest rate burden of the initial period loan. Therefore, if the type of project were observable, there would not be any bank willing to finance insolvent projects at $t=0$, whatever the capital availability. However, once the first period loan has been lost, it is advantageous to refinance insolvent projects, if the cost of funds is sufficiently low. In particular, if the real interest rate on domestic loans is equal to the international interest rate, the following condition holds:

\begin{equation}
\sum_{t=1}^{\infty} \frac{y_i}{(1 + i^*)^t} > \sum_{t=0}^{\infty} \frac{L}{(1 + i^*)^{t+1}}.
\end{equation}

This implies that $y_i - L(1 + i^*) > 0$.

The private benefits of a project manager running an insolvent project are positive only if the project is refinanced at $t=1$ and has a chance to produce positive output. In this case, the private benefits for its manager are $E_{i/R} > 0$. In contrast, running a firm without producing any output has a stigma effect on the project manager and, therefore, if the project defaults after the first period, the
manager’s private benefits are negative $E_{I/D} < 0$. This implies that a manager with an insolvent project will not start the project, if he expects that it will not be refinanced at $t=1$.

At the aggregate level, depending on the available investment opportunities, the country may be crisis prone (type I) or not (type II). The country is type I if it is endowed both with solvent and insolvent projects, in proportions $\theta$ and $1-\theta$, respectively, while it is type II if it has only solvent projects. Besides being more productive a type II country has also growing investment opportunities. New solvent projects become available each period so that total lending grows at the same rate, whatever the country type is. In this way, capital inflows to the country are not informative about the country type, even if observed by international investors. Total lending may be increasing for very different reasons and investors cannot distinguish whether the accumulation of foreign debt and the current account imbalances are due to capital flowing to the most advantageous investment opportunities or to an over-lending syndrome. This is in marked contrast with the existing literature which assumes either that current account imbalances are bad because they are driven by an accumulation of losses by the private sector, as in Krugman (1998), or that capital inflows are good because they finance high yield investment opportunities in low saving countries (Obstfeld and Rogoff, 1995). Incomplete information on the country type can capture the widespread lack of transparency in international lending, due to the poor accounting standards of the private sector and the lack of disclosure to international investors.

Finally, to ensure banks’ viability, I assume that at $t=0$ the expected return on investment if the country is type I is higher than the international interest rate, even if the first period investment in insolvent projects is not productive and there is probability $1-\theta$ of not recovering the loan. In terms of the parameters of the model, this implies $\theta y_s > (1+i^*)L$.

The prior of international investors, who do not observe the country’s average return on investment, is that the country is type I (i.e. it has a fraction $1-\theta$ of insolvent projects) with probability $\varphi_i$. The country is type II with probability $1-\varphi_i$.

The assumptions on the information set of international investors imply that they cannot observe the output of the projects funded by the banking system. This can be justified on two grounds. First, developing countries' statistics are often very imprecise and unreliable. The growth of the output, even if observed, may not be easy to interpret, because the liberalization of capital inflows that is often accompanied by the liberalization of other sectors of the economy represents a structural change. This makes more difficult to distinguish between a bubble, which artificially increases the output by inflating the cost of non-traded goods, and an actual improvement in

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8 This is a direct consequence of the inability to estimate total factor productivity.
efficiency. Second, any production process involves random factors that are left out of the model for simplicity’s sake and output, if observed, could at most be a noisy signal of the country type. Even if international investors could observe such a noisy signal and update their beliefs on the country type using its probability distribution, all the results of the paper would go through, as all the agents are risk neutral. The only relevant difference in the results would be that the date of the crisis to be determined below is stochastic (i.e. a crisis would be delayed by a sequence of positive shocks to the output).

Table 1 summarizes the information about country characteristics and investors’ beliefs.

Table 1. Country types

<table>
<thead>
<tr>
<th></th>
<th>Type I (Insolvent)</th>
<th>Type II (Solvent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priors about the country’s type</td>
<td>( \phi_I )</td>
<td>( 1 - \phi_I )</td>
</tr>
<tr>
<td>Fraction of fast projects</td>
<td>( \theta )</td>
<td>1</td>
</tr>
<tr>
<td>Fraction of insolvent projects</td>
<td>( 1 - \theta )</td>
<td>0</td>
</tr>
<tr>
<td>Average return on investment</td>
<td>( \frac{\theta y_S + (1 - \theta) y_L}{L} )</td>
<td>( \frac{y_S}{L} )</td>
</tr>
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</table>

2.2 The domestic banks

Domestic banks maximize their net wealth, are risk neutral and operate at no cost. They offer deposits to international investors at the interest rate, \( i^d_t \), and lend to project managers at an interest rate \( i^l_{t,k} \), which varies according to the project type, \( k \). Deposits can be denominated in domestic or foreign currency. In contrast, I assume that loans are denominated in foreign currency. This assumption is totally irrelevant under the information assumptions of the model, since banks know the country type and can anticipate the devaluation with probability 1.\(^9\)

Note that if loans were denominated in domestic currency a devaluation that is not anticipated with probability 1 would just increase bank losses.
Without loss of generality, I assume that there is a continuum of banks of mass \( l \) and that they compete à la Bertrand in the loan market bidding the interest rate to get customers.\(^1\) At \( t=0 \) each bank funds a project.\(^1\) If the country is type II, the new projects that become available are financed by one of the existing banks. Project managers and banks are randomly matched and no manager changes financing bank.\(^2\)

The assumptions on bank competition imply that the interest rate on loans to solvent projects is equal to the interest rate on deposits: \( i_{l,S}^l = i^d_0 \). In contrast, banks can appropriate the project’s profits if previous loans have not been completely repaid as a partial repayment of the initial loan.

At \( t=0 \), since bank-firm relationships are not yet established, all banks offer the same interest rate to project managers who are indistinguishable ex ante. Because of the assumption of competition à la Bertrand this interest rate must be such that banks’ expected profits are equal to zero.\(^3\)

### 2.3 The international investors

International investors make deposits in domestic banks. They are risk neutral and are interested in the foreign currency return of their investment. Hence, they invest only if their expected return is at least as high as the international interest rate, \( i^* \).

\(^1\) This assumption is commonly done in the banking literature to capture a situation of strong competition in the banking sector. In fact, the liberalization of capital inflows is often accompanied by the deregulation of the banking sector that makes the environment highly competitive.

\(^2\) This assumption is totally irrelevant as long as losses from insolvent projects cannot be offset by profits from solvent projects. If banks behave competitively, this is always true.

\(^3\) Under the assumption of Bertrand competition in the banking system, the stability of manager-bank relationships can be achieved as an equilibrium outcome. Competition among banks ensures that after the first period the nominal interest rate on loans for managers running solvent projects is equal to the interest rate on deposits. Therefore, they have no incentive to switch financing bank.

On the other hand, if the project is insolvent and the previous period loan must be paid back before switching financing bank to avoid default, internal funds are not sufficient to pay back the loan. If an outside bank were asked for a loan, the amount of funds required would signal the quality of the project and no bank would accept to lend. See Rajan (1992) for details on the effects of bank competition.

\(^3\) To determine the interest rate on loans at \( t=0 \), \( i^l_0 \), it is necessary to consider that, if the country is type I, there is a probability \( 1-\theta \) that banks will be unable to recover the loans at the end of the first period, because they financed an insolvent project, but also that at least part of the initial period loss may be recovered in the future. Hence, the interest rate, at which banks are willing to lend at \( t=0 \), is \( i^l_0 = \frac{i^* + \Xi}{\theta} \), where \( \Xi = \text{Expected recovery of first period loss} \). It is necessary to assume that \( i^l_0 \) is not observed by international investors, because otherwise they would learn both the country and the bank type. Alternatively, if domestic banks do not observe the country type the domestic interest rate is equal across countries and the probability of not recovering the loan at the end of the first period is \( (1-\theta \phi_1) \). Again, see Rajan (1992) for details on the determination of the equilibrium interest rate.
Each international investor lends an amount of capital that is small compared to the total demand for deposits and the number of international investors is large with respect to the investment opportunities of the country.

International investors simultaneously announce the lowest interest rate at which they would hold deposits. Since they behave competitively, they have no extra profits and their expected return must be equal to the international interest rate. If this condition is satisfied and there are no restrictions to capital movements, any amount of foreign capital can flow into the economy. Therefore, the amount of capital inflows for a given interest rate is determined by the aggregate demand for loans.

The international investors may be subject either to default or exchange rate risk. The kind of risk they actually bear depends on the currency of denomination of deposits and on the role of the central bank in the economy, which I discuss in the next subsection.

2.4 The role of the central bank

In what follows, I make different assumptions on the role of the central bank, which may provide or not guarantees on deposits, to show the effects of a lender of last resort on the lending process.

The central bank holds an amount of international reserves, \( RX \), which have zero return, and defends the exchange rate peg as long as reserves remain positive. The initial level of the exchange rate is \( J \).

If the central bank provides guarantees on deposits and any bank discontinues an insolvent project and declares default, the central bank will try to reimburse the depositors. This is always possible if deposits are denominated in domestic currency, because the central bank can print domestic currency. In contrast, if deposits are denominated in foreign currency, reserves are distributed among the depositors. If these are not sufficient to cover all the losses of the defaulting banks, reserves are distributed in the same amount among all the claimants.

It will be clearer later that the currency of denomination of deposits is irrelevant for the qualitative results of the model. In fact, if deposits are denominated in domestic currency and the central bank prints money to pay back depositors, international investors will soon run to the central bank to exchange domestic currency for foreign currency, since they are interested to hold foreign currency alone. In this case, if the demand for foreign currency is larger than the international reserves, these are distributed in the same amount among all the claimants. This is equivalent to a
devaluation of the currency and the new exchange rate is 

\[ S_t' = \frac{\text{Total Claims at } t}{RX} \]

where the total claims equal the aggregate losses of the banking system.

Whatever is the currency of denomination of deposits, if the central bank acts as a lender of last resort, the international reserves may be exhausted, because the bailout guarantees create implicit liabilities for the central bank, as in Velasco (1987) and Calvo and Mendoza (1996). Consequently, banking crises are accompanied by currency crises, as is often observed in the reality.

2.5 The timing

The timing of events within each period \( t \) is as follows:

- The output of projects financed in \( t-1 \) is realized and sold, the project manager appropriates profits, 
  \[ \pi_{ik} = y_k - (1 + i_{ik})L, \]
  if previous period loans have been repaid. Otherwise, the financing bank appropriates profits, as a partial repayment of the initial period loan.

- Banks supply deposits to international investors in order to finance loans. Based on their beliefs on the aggregate losses of domestic banks and the probability of bank defaults, international investors announce the minimum interest rate, \( i_{t+1}^d \), at which they will make deposits in domestic banks.

- After observing \( i_{t+1}^d \), banks decide whether or not to renew the loan to the project they funded. Only solvent banks are able to pay back previous period deposits, if they do not renew the loans. In contrast, banks that funded insolvent projects default, if they do not renew the loans.

- If there are no defaults, production continues until the following period; if there are defaults, under the assumption that there are guarantees on deposits, the central bank pays back the depositors. International investors convert the domestic currency into foreign currency, if deposits are denominated in domestic currency.

- The game ends after a banking crisis.

The economy described above is in equilibrium if all the agents maximize their objective functions, their beliefs are confirmed and loan and deposit market clear.

Equilibria under different assumptions on the role of the central bank and the currency of denomination of deposits are described in the next two sections.
3. Banking crises with guarantees on deposits

3.1 Deposits denominated in domestic currency

This section examines the macroeconomic implications of the soft budget constraint distortion and shows that the massive amounts of funds available at a low cost, owning to the unresponsiveness of the interest rate to default risk in the early stages of the game, make the accumulation of losses possible.

As a benchmark, I consider the case in which deposits are denominated in domestic currency and the central bank provides guarantees on deposits.

The dynamics of the model depends on the banking system aggregate losses. These in turn depend on the losses of individual banks, \(x'_t\).

The losses of a bank that financed an insolvent project at time \(t\), \(x'_t\), depend on losses at \(t-1\), \(x'_{t-1}\), on the interest rate on deposits at \(t-1\), \(i^d_{t-1}\), and on the level of output, \(y_t\). In particular, current period profits, \([y_t - (1 + i'_t)L]\), decrease next period losses. The dynamics of losses expressed in domestic currency is described by the following difference equation:

\[
x'_t = (1 + i'_t)x'_{t-1} + [(1 + i'_t)S'_{t-1}L - S'_{t-1}y_t],
\]

where \(S'_{t-1}\) is the nominal exchange rate in a country endowed with insolvent projects and the initial condition is \(x'_0 = L(1 + i')\). It follows immediately that the real losses are:

\[
\tilde{x}'_t = \frac{S'_{t-1}}{S'_t} (1 + i'_t)\tilde{x}'_{t-1} + [(1 + i'_t)L - y_t], \quad \text{where } \tilde{x}'_t = \frac{x'_t}{S'_t}. \tag{3}
\]

In contrast, the losses of a bank which funded a solvent project are always equal to zero.

Banks minimize the present value of their existing losses. This assumption can be justified on the ground that that bank managers' punishment (or loss of reputation) is inversely related to the losses.

A bank always chooses to renew a loan if the present value of losses at \(t+1\) is less than the losses at time \(t\):

\[
\frac{\tilde{x}'_{t+1}}{(1 + i'_t)S'_{t+1}} < \tilde{x}'_t. \tag{4}
\]

This yields a very simple optimal decision rule for the renewal
of a loan: a loan is renewed if the following period surplus from the project is positive, that is if \( y_t - (1 + i^d_t) L > 0 \). If profits are negative, the project is discontinued because continuation would imply a permanent increase in the present value of the losses. However, as long as the interest rate on deposits remains equal to the international interest rate, it is optimal to renew the loan to insolvent projects, because by assumption \( y_t - L(1 + i^*) > 0 \).

Firm managers with insolvent projects in turn anticipate this behavior and at \( t=0 \) ask for funds because this allows them to enjoy positive private benefits.

The dynamics of the aggregate losses mimics that of the individual losses and is described by a similar deterministic difference equation. In writing the difference equation for aggregate losses, one needs to consider that in type I countries, there is a continuum of insolvent projects of mass 1−0. The law of motion of aggregate losses in real terms is:

\[
X'_t = (1 + i^d_t) \frac{S^f_{t-1}}{S^k_t} X'_{t-1} + [(1 + i^d_t) L - y_t](1 - 0) \quad \text{if} \ X'_t > 0
\]

and has initial condition \( X_0 = (1 + i^*) L(1 - 0) \). Losses remain equal to zero, otherwise, and, of course, are always equal to zero in type II countries.

The assumptions on the parameters imply that if the country is type I, aggregate losses are growing over time, even if the interest rate on deposits is equal to the international interest rate, \( i^* \) (i.e. its lowest possible value). This can be easily proved. The assumptions on projects output imply that the initial condition of the above difference equation is at the right of the steady state, \( \bar{X}^{ss}_{k} = \left[ y_k - (1 + i^*) L \right](1 - 0) \) and, consequently, the path of the aggregate losses is explosive, as the slope of the difference equation is larger than 1.

Intuitively, this happens because the current period profits are not sufficient to cover the interest rate burden on the first period loss. Domestic banks do not take it into account, when they make the loan renewal decisions, because they look at the present value of the losses. Bank managers dislike future losses less than current losses, because they discount the disutility they can incur in the future. Since the present value of the initial period loan loss remain constant, they

---

\( i^d \) is intertemporal discount rate, because I am implicitly assuming that domestic banks’ liabilities and assets must be domestic deposits. Of course, the net supply of deposits is equal to the deposits held by the international investors in equilibrium.
continue to satisfy the working capital requirements of insolvent firms, as long as this does not
increase the losses. This mechanism is even more important if one considers that often the capital
requirements to start a project may be larger than the subsequent working capital need. For
notational simplicity, here I just assume that loans are equal every period, but the reader should
keep this in mind.

In this context, high capital requirements may limit the possibility of accumulation of bank
losses, since they limit the amount of deposits needed to cover the initial period loss and, therefore,
the interest rate burden. If a bank that happens to finance an insolvent project has capital $K$, its
initial period loss that must be refinanced with deposits is: $x_0' = (1 + i^r)L - K$. The larger is $K$, the
smaller is the level of the aggregate losses. For high levels of $K$, the initial condition is eventually at
the left of the steady state of the difference equation describing the dynamics of aggregate losses
and no process of accumulation of losses occurs. However, the optimal decision whether to renew
the loan or not remains unchanged and, therefore, the soft-budget constraint distortion persists.

In what follows, I assume that the level of capitalization of the banking system is such that
processes of accumulation of losses can occur in equilibrium and set $K$ equal to zero for notational
simplicity.

Figure 1 represents the laws of motion of aggregate losses in a type I country in the periods
antecedent the crisis, when there are no expectations of devaluation and the banking system
capitalization is such that processes of accumulation of losses actually occur in equilibrium.

**Figure 1. Aggregate losses in an insolvent country (Type I)**

![Figure 1](image)

International investors cannot observe the actual level of the losses of the banking system,
but know that if the country is type I (with probability $\phi_1$), the dynamics of the aggregate losses are
described by equation (3).
When and under what conditions does a crisis occur? The economy described in the previous section experiences a banking crisis only if it is no longer optimal for domestic banks to renew the loans to the insolvent projects. In turn, this happens only if the interest rate the international investors demand on deposits becomes high enough to make defaults optimal. In this case, the banks that financed insolvent projects declare that they do not have sufficient resources to pay back their depositors and default.

If the central bank is credibly committed to act as a lender of last resort and deposits are denominated in domestic currency, the international investors are not subject to any default risk but only to the exchange rate risk. In fact, the central bank is expected to print money to guarantee the nominal value of deposits. If domestic banks turn out to be actually insolvent, the international investors run to the central bank to convert domestic currency into foreign currency. A devaluation happens if banks’ losses are larger than foreign reserves.

Hence, the interest rate on deposits must remain equal to the international interest rate, indicating that there is no expected depreciation, as long as foreign reserves are considered sufficient to guarantee the real value of the outstanding deposits. A crisis becomes possible, only after this limit has been reached.

The interest rate that the international investors require on deposits depends on the probability of devaluation, which in turn depends on the interest rate on deposits, and on the magnitude of the expected depreciation. The expected return on deposits must be equal to the international interest rate and, therefore, the following condition must always be satisfied:

\[
(1 + i_t^d) = (1 + i_t^d) \times \Pr\{\text{no devaluation} \mid i_t^d\} + (1 + i_t^d) \frac{1}{S_t} \Pr\{\text{devaluation} \mid i_t^d\}.
\]

The probability of devaluation is evaluated by international investors according to their beliefs on the expected losses of the banking system and on the country type. Of course, the probability of devaluation is conditional on the interest rate on deposits at time \( t \), because insolvent banks must have an incentive to declare default.

The probability of bank defaults is always strictly less than 1, because if the country is type II banks have no losses. Therefore, the central bank has no implicit liabilities and there cannot be runs on foreign reserves. In contrast, if the country has insolvent projects, losses are bound to rise above the level of international reserves. Hence, international investors expect that a balance-of-payments crisis will occur with probability \( \varphi_t \), as the losses of the banking system reach the critical level to be determined below.

To determine the timing of the crisis, I define a shadow interest rate on deposits, following the methodology of Flood and Garber (1984). The shadow interest rate on deposits is defined as the
interest rate at which investors are willing to lend, if there is probability $\phi$, that the aggregate losses are $X_t^i$.

The return international investors expect to get on deposits depend on the expected depreciation if the country is type I. The nominal exchange rate at time $t$ in a type I country, $S_t^i$, is equal to 1 if $X_t^i < RX$ or if there is no run on reserves, while $S_t^i = \frac{X_t^i}{RX}$, if $X_t^i > RX$, and a run on foreign reserves occurs. It is possible to derive a relation between the shadow interest rate on deposits, $i^d_t$, and $X_t^i$. With probability $\phi$, one unit of domestic currency will be worth only 1 unit of foreign currency because a devaluation happens. The shadow interest rate must compensate investors for this risk. The expected value of investing in domestic deposits is equal to the international interest rate if $\phi$ satisfies the following condition:

$$1 + i^d_t = (1 - \phi)(1 + \tilde{i}^d) + \phi \frac{RX}{X_t^i} (1 + \tilde{i}^d).$$ \hspace{1cm} (6)

From equation (6), it is clear that $\tilde{i}^d$ increases as $X_t^i$ increases, under the assumption that international investors are too small to internalize the effects of $i^d_t$ on $X_t^i$.

In equilibrium, the actual interest rate, $i_t^d$, will equal the shadow interest rate, $\tilde{i}^d$, only if the probability of a devaluation is actually $\phi$, at $t$. Otherwise, it remains equal to the international interest rate, $i^*$.

These considerations allow me to determine the time $\hat{t}$, when devaluation may occur. This is possible only if the effective cost of external financing is such that it is no longer optimal for insolvent banks to renew their loans.

**Proposition 1. The timing of the crisis.** Let's assume that the following condition on the parameters is satisfied:

$$y_t - (1 + \tilde{i}^d) L > 0.$$ 

The date $\hat{t}$, when a crisis happens if the country is type I is the first date at which the following conditions are jointly satisfied:

1. The interest rate on deposits at $\hat{t}$, $i^d_{\hat{t}}$, must satisfy equation (6).
2. The interest rate at which international investors will make deposits at \( t \), \( i_{t+1}^d = \tilde{i}_{t,t} \), is such that losses would permanently increase, if loans to insolvent projects were renewed (i.e. \( y_t - (1 + i_{t+1}^d)L \leq 0 \)).

If the condition on parameters given in Proposition 1 is not satisfied, the model has no equilibrium in pure strategies and, as a consequence, a subset of the insolvent projects is not refunded at \( t=1 \).\(^{16}\) Intuitively, this may happen if the country is perceived as highly risky and with very poor quality projects. In what follows, for expository simplicity, I assume that the shadow interest rate always satisfies this condition. However, none of the results of the model would change if only a subset of the insolvent projects was continued after the first period.

Proposition 1 implies that at \( \hat{t} \), if the country is type I, the central bank prints money to guarantee the nominal value of deposits. Hence, there is a run on foreign reserves and the peg is abandoned with probability 1. In contrast, if the country is type II one observes only a temporary increase in the interest rate and a contraction in profits, after which international investors know that the country is solvent.\(^{17}\)

Note that the losses of the banking system in type I countries may increase well above the international reserves: The longer a crisis is delayed, the harsher it will be since it will involve larger bank losses. Interestingly, the greater is the reputation of a country (i.e. the lower is the probability, \( \phi_I \), that the country has insolvent projects), the later the crisis will happen and the larger the losses accumulated by insolvent banks and the devaluation will be. Banking crises are also very frequent, as any country endowed with insolvent project, no matter how large \( \theta \) is, will experience a crisis under the assumption of the model. The larger is \( \theta \), the later the crisis will happen after the financial liberalization (the larger is \( \hat{t} \)).

Since investors claims are not satisfied sequentially, as in Diamond and Dybvig (1983) and Chang and Velasco (1998 a and b)\(^{18}\), but all the investors get a share of the available resources proportional to their investment in the event of bank defaults, the model features an unique equilibrium. This implies that there is a unique date when a financial crisis can occur, as proved in Proposition 2.

\(^{16}\) Giannetti (1999) shows that, even if the condition on parameters in Proposition 1 is not satisfied, a subset of the insolvent project is funded. The equilibrium of the model is as described above, but involves a randomization in the decision whether or not to renew loans to insolvent projects at \( t=1 \).

\(^{17}\) International investors know that an insolvent country would have experienced a crisis with probability 1 and update their beliefs on the country type.

\(^{18}\) In these models, runs on illiquid banks happen because withdrawing the deposits is a best response if other investors are running as well.
Proposition 2. Uniqueness of equilibrium. The date $\hat{t}$ when the crisis occurs if the country is type I is unique.

Proof. By contradiction, assume that international investors continue to make deposits at the international interest rate until $\hat{t} - 1 > \hat{t}$ and that they expect a devaluation to take place at $\hat{t}$ in a type I country. In this case, the interest rate they require on deposits at $\hat{t} - 1$, $i_{\hat{t}}^d$, must take into account that a devaluation will occur with probability $\varphi$. Moreover, since $\hat{t} > \hat{t}$, $X_{\hat{t}} > X_{\hat{t}}'$, and hence the expected devaluation is larger. This implies that $i_{\hat{t}}^d > i_{\hat{t}}^*$. But then $y_1 - (1 + i_{\hat{t}}^d)L < 0$ and banks’ defaults and the consequent monetary expansion occur at $\hat{t} - 1$, rather than at $\hat{t}$. Therefore, in equilibrium it should hold that $i_{\hat{t}-1}^d > i_{\hat{t}}^*$. Moreover either $\hat{t} - 1 = \hat{t}$ and, hence, a crisis occurs at time $\hat{t}$, as I proved in proposition 1, or $\hat{t} - 1 > \hat{t}$. In this case, $i_{\hat{t}-1}^d > i_{\hat{t}}^d$ and therefore a crisis should occur at $\hat{t} - 2$. Going backward, I prove that the latest time a crisis can happen is $\hat{t}$.

Furthermore, a crisis cannot happen before $\hat{t}$, because $y_1 - (1 + \hat{i}_t^d)L > 0$, if $t < \hat{t}$ and banks do not find optimal to default.

Furthermore, the interest rate on deposits only rises one period before the crisis, as is proved in proposition 3.

Proposition 3. The interest rate on deposits only rises one period before the crisis. Formally, this means that $i_t^d = i^*$ if $t < \hat{t}$.

Proof. A crisis happens when the interest rate on deposits required to compensate for the expected depreciation is so high that the condition for loan renewals to insolvent projects is not satisfied, that is if $y_T - (1 + i_T^d)L < 0$. In this case, banks’ defaults endogenously generate a monetary expansion that causes a run on the central bank’s reserves. If the outstanding losses of the banking system imply a lower expected depreciation, it is still advantageous to renew loans to insolvent projects. Hence, there are no defaults and the monetary expansion does not take place. Since investors are rational agents, $\text{Prob}\{\text{devaluation} / i_t^d\} = 0$ if $t < \hat{t}$. Competition among atomistic investors implies $i_t^d = i^*$ if $t < \hat{t}$.

In this respect, the model can be considered a first generation model of currency crisis (like Krugman, 1979), because rational economic behavior driven by fundamentals that evolve smoothly
over time (the expected bank losses) involves a dramatic and apparently sudden banking crisis, after
the increase in the interest rate on deposits.

Of course, the time path of the equilibrium interest rate depends on the short maturity of
bank liabilities. Before \( t_0 \) no bank defaults are possible and, consequently, deposits are perceived to
be completely safe. It would be different if bank liabilities had longer maturity. The interest rate of
any bank liabilities with maturity longer than \( t_0 \) would incorporate the risk of a banking crisis from
\( t=0 \). However, this would not necessarily eliminate the soft-budget constraint distortion in the
model. To show this, let \( i_{t+1}^{d} \) be the interest rate on bank liabilities with maturity \( t \). In equilibrium,
the expected return on debt of maturity \( t \) must be equal to the international interest rate; therefore,
the following condition must be satisfied:
\[
E\left(1 + i_{t+1}^{d}\right) = (1 + i^*)^t,
\]
where \( E \) is the expectation operator.

The per period interest rate on debt of maturity \( t \) is lower than the interest rate on deposits
at time \( t_0 \), \( i_{t+1}^{d} \), and this implies that at \( t=1 \) there may still be incentives to renew the loan to
insolvent projects. Therefore, the soft budget constraint distortion is not eliminated.

Furthermore, although it is always possible to determine a sufficiently long maturity such
that the per-period interest rate is high enough to eliminate the soft-budget constraint distortion, this
cannot be an equilibrium. In fact, if no insolvent project are expected to be financed at \( t=0 \), debt is
risk free and, therefore, \( i_{t+1}^{d} = i^* \). But this implies that it would be optimal for managers with
insolvent projects to ask for funds, because they can anticipate that \emph{ex post} it could be optimal for
banks to renew the loan. Consequently, \( i_{t+1}^{d} = i^* \) cannot be an equilibrium. It is possible to prove
that the only equilibrium with debt of sufficiently long maturity is one in which a subset of the
insolvent project is refinanced and the surplus from running the project one more period is equal to
zero. Therefore, longer debt maturity cannot eliminate banking crises. Furthermore, it is not obvious
that it would be optimal for banks to have long-term liabilities, as these imply a commitment to pay
interests on funds, even if banks terminate insolvent projects and no new profitable opportunities
are around.\(^{20}\) This may help to explain why the most of liabilities of developing countries are short-
term.

\underline{3.2 Deposits denominated in foreign currency}

\(^{19}\) In fact, this satisfies the following arbitrage condition:
\[
(1 + i^*)^t = (1 + i^*)^{t-2}(1 + i_{t}^{d})E\left(1 + i_{t+1}^{d}\right).
\]

\(^{20}\) Of course, banks would default only when debt becomes due.
All the conclusions of the model remain qualitatively unchanged if I assume that deposits are denominated in foreign currency. Proposition 1 to 3 can be easily extended to determine the date of the crisis and the only relevant difference is that now international investors are subject to default risk rather than to exchange rate risk. However, interesting differences about the timing and the intensity of the banking crises emerge.

The main difference with the benchmark case examined above is that the probability of making a loss if deposits are denominated in foreign currency is smaller. In fact, since there is no exchange rate risk, but only default risk, those investors who have made deposits in solvent banks will not be affected by a banking crisis. In contrast, depositors of insolvent banks expect to get only a share of the available international reserves that is proportional to their investment. Consequently, the shadow interest rate on deposits, \( \tilde{i}_t \), is now defined as follows:

\[
(7) \quad \left(1 - \phi_t\right) + \phi_t \left(\frac{D_t - X_t}{D_t} + \frac{X_t RX_t}{D_t X_t}\right) \left(1 + \tilde{i}_t\right) = \left(1 + \hat{i}_t\right),
\]

where \( D_t \) is the total amount of deposits at time \( t \), \( \frac{D_t - X_t}{D_t} \) and \( \frac{X_t RX_t}{D_t X_t} \) are the fraction of depositors at solvent and insolvent banks respectively, and \( \frac{RX_t}{X_t} \) is the fraction of reserves that depositors of insolvent banks receive.

For any value of the expected losses of the banking system the shadow interest rate is now lower than in equation (6), because the depositors of solvent banks do not lose anything.

As before, in equilibrium, the actual interest rate on deposits will equal the shadow interest rate only if there is a positive probability of bank defaults. The insolvent banks in turn have incentives to default only if the profits from continuing the project become negative (i.e. if \( y_1 - (1 + \hat{i}_t) L < 0 \)). Therefore, the interest rate on deposits will rise only after the date determined in proposition 1, because \( \tilde{i}_t \) is smaller than \( \hat{i}_t \) for any value of the aggregate losses. Hence, if the country is actually insolvent, the banking crisis is delayed but harsher, because it happens when a larger amount of losses has been accumulated.\(^{21}\)

4. Banking crises with no guarantees on deposits

\(^{21}\) Of course, since international reserves are exhausted, the exchange rate peg will be abandoned after the country defaults.
A widely used explanation of unsustainable credit expansion is that, if there are guarantees on deposits, the interest rate on foreign borrowing is not responsive to the risk of bank defaults, because investors lack incentives to acquire information on domestic borrowers (see, for instance, Krugman, 1998). In this section, I show that overlending is not necessarily due to moral hazard. In fact, under the assumptions of the model, processes of accumulation of losses that lead to banking crises may happen even if there are no guarantees on deposits. Intuitively, this depends on the fact that, also without guarantees on deposits, the risk of having invested in an insolvent bank actually determines a rise in the interest rate only when there is a positive probability of bank defaults. As before, this depends on the interest rate at which international investors are willing to make deposits, and ultimately on the level of the aggregate losses of the banking system.

It is useful to note that, if there is no lender of last resort, the currency of denomination of deposits is irrelevant, because there are no implicit liabilities for the central bank, which can undermine the credibility of the exchange rate peg. The only risk that the international investors are subject to is the default risk.

Since no international reserves are supplied to foreign investors to compensate bank losses, the shadow interest, $\tilde{i}^{s}$, is defined as follows:

\[
\left(1 - \phi\right) + \phi \left(\frac{D - X}{D}\right) \left(1 + \tilde{i}^{s}\right) = \left(1 + \tilde{i}\right),
\]

where $\left(\frac{D - X}{D}\right)$ is the fraction of deposits at solvent banks that can be fully recovered. According to equation (8) the shadow interest rate on deposits must compensate for the risk that the fraction of deposits at bad banks is lost.

As long as the interest rate on deposits compensates for the probability that there insolvent banks which may default at time $t$, risk neutral international investors are willing to make deposits.\(^{22}\)

The dynamics of the aggregate losses and the date when the interest rate on deposits actually rises are determined like in Proposition 1. It is also easy to show that proposition 2 and 3 still apply.

Interestingly, depending on the level of the international reserves and on the aggregate losses of a country the shadow exchange rate defined by equation (8) may be higher or lower than $\tilde{\tilde{i}}^{s}$, defined by equation (6). In particular, if the level of international reserves is much lower than

\(^{22}\) In contrast to Diamond and Dybvig (1983) no multiple equilibria can arise here because there is a probability greater than zero that all the banks in the country are solvent and liquid. As long as an investor is compensated for this risk she is willing to make deposits no matters what the other investors do.
the aggregate losses of the banking system, and deposits are relatively larger than losses, for an investor who made deposits in domestic currency the expected loss is larger when there is a lender of last resort. In fact, with guarantees on deposits she would make a loss even if she had invested in a solvent bank, because of the devaluation. Consequently, under these conditions, the shadow value of the interest rate is higher if there are guarantees on deposits. Since, as shown in the previous section, insolvent banks actually default only when at the current interest rate on deposits the profits from continuing the project are negative, the banking crisis occurs at an earlier date if there are guarantees on deposits. Insolvent banks accumulate less losses when the nominal value of deposits is guaranteed rather than when there is no lender of last resort. In striking contrast with the moral hazard theory of over-lending, not only guarantees on deposits are not a necessary condition for excessive lending, but they can even limit it.  

The empirical evidence also seems to support these conclusions on the irrelevance of guarantees on deposits. Lane and Sarisoy (2000) find that the presence/absence of deposit insurance schemes does not help to explain the cross-country variation in the surge in private capital inflows to emerging markets in the early 1990s. This suggests that capital inflows are not driven by moral hazard problems.

From a theoretical point of view, the results do not depend on any of the particular assumptions done in the model. For instance, the explicit consideration of domestic lenders would not affect the conclusions at all. Even if domestic lenders are interested in the domestic currency value of their deposits (rather than in the return in foreign currency), the monetary expansion needed to guarantee the nominal value of deposits is likely to cause inflation and to reduce their purchasing power, that is, what domestic depositors are ultimately interested in.

As noted before higher capital requirements could eliminate the possibility of processes of accumulation of bank losses, even if they do not eliminate the soft-budget constraint distortion. However, this condition may be difficult to fulfill in emerging economies, where the banking system is often chronically under-capitalized.

Other institutional arrangements that may succeed in improving the banking system stability are examined in the next section.

5. Institutional arrangements for financial stability

5.1 Restrictions to capital inflows

23 In contrast, \( \bar{t}^d \), defined in equation (7), is always lower than \( \bar{t}^d \). This implies that, if all the deposits are denominated in foreign currency, the amount of losses accumulated in an insolvent country before a crisis is always larger if there are guarantees on deposits.
The lack of restrictions on the growth of bank lending is key for the development of a crisis in the model. In fact, the soft budget constraint occurs because the supply of funds from international investors is infinitely elastic for a small open economy perfectly integrated with the rest of the world. When the economy is closed to capital inflows the funds that domestic banks can intermediate are limited by domestic saving and banks can credibly commit not to renew loans to insolvent projects. This can explain why financial instability seems to affect emerging economies only after the liberalization of capital inflows.

Figure 2 shows the loan demand and the supply of funds from international investors before the interest rate on deposits increases above the international interest rate.

Figure 2. Equilibrium in the market for deposits

Capital controls by altering either the cost of funds or the scale of inflows could eliminate the soft budget constraint distortion and improve financial stability, as is compatible with the empirical studies showing that capital controls helped to prevent financial crises during the 1979-1993 period (Eichengreen, Rose and Wyploz, 1996). If bank lending cannot grow (rigid supply of funds), banks would be credibly committed not to renew loans to insolvent projects. Consequently, their managers would not ask for financing, because if the loan is not renewed at $t=1$ they prefer not to start an insolvent project (because of their negative private benefits).

In this model, by adopting capital controls, a type I country with no new investment opportunities available may achieve financial stability at no cost. In fact, if any of these measures are adopted, international investors can rule out the possibility that the banking system is
accumulating losses. However, the use of quantitative restrictions is not desirable if new profitable investment opportunities become available, because preventing credit expansion would also limit the growth prospects of the economy. In this case, for signaling to international investors that the banking system is not accumulating losses and preventing the rise in the cost of external financing, new profitable investment opportunities would not be financed. In this respect, a tax on capital inflows, which increases the cost of funds up to the point that the project surplus becomes negative \( y_1 - (1 + i_{\text{IR}}) L < 0 \) is preferable, because it increases the cost of capital, but does not prevent the credit expansion. In this model, this instrument actually permits reaching the first best without any distortion, whatever the country type, because, once projects are financed, demand for external capital is rigid. However, if demand for capital depends negatively on the capital cost, profitable projects are also affected and investment and output are reduced.

Short-term capital controls which lengthen the maturity of bank liabilities are also ineffective in eliminating the soft-budget constraint distortion because, as discussed before, there is no equilibrium in which no insolvent projects are refinanced even if bank liabilities are long term.

More direct instruments of intervention for achieving financial instability may be more desirable. These are considered next.

5.2 Transparency

Banking crises arise in the model because of the two layers of asymmetric information. Improvements in transparency that eliminate either one of the two rule out the soft budget constraint distortion.

On the one hand, policies that improve transparency at the micro level (as, for instance, improvements of accounting standards) and make bank screening technologies more accurate would rule out the possibility that insolvent projects are funded in equilibrium. On the other hand, provision of better information on the macroeconomic conditions would help investors to evaluate the investment opportunities available in a country and, therefore, to price correctly the risk, if no guarantees on deposits are provided. In fact, international investors can perfectly anticipate a banking crisis, if they know the country type, and, consequently, the supply of funds in \( t=1 \) is no longer perfectly elastic (see figure 3). In \( t=1 \), international investors demand at most \( 0 L \) units of deposits, if they know that the country is type I.\(^{24}\) The interest rate is infinite for any amount of deposits larger than that.

\(^{24}\)This implies that the interest rate required by international investors, \( i_d^2 \), is contingent on the level of deposits, \( D_1 \).
The supply of funds can provide a commitment technology for banks not to refinance insolvent projects. As a consequence of international investors’ behavior, it would not be optimal for project managers to start insolvent projects in $t=0$.

If guarantees on deposits are provided and the country type is common knowledge, however, moral hazard problems arise as in McKinnon and Pill (1996), Krugman (1998) and Corsetti, Pesenti and Roubini (1999): international investors do not make any losses until bad loans are greater than the international reserves. In $t=1$, the supply of funds would still be perfectly elastic, if $\theta L$ is less than the international reserves, and insolvent projects would be started and refunded.

Therefore, attempts to disseminate information, like the IMF’s creation of the special data dissemination standard, would achieve financial stability only in a world without guarantees on deposits. Such a strategy encounters two sorts of problems. First, it is an arduous task to achieve perfect information about the quality of the investment opportunities available in a country, since it involves an estimation of the total factor productivity (and the economic profession did not provide any certain answer, yet!). Second, besides to the insolvency problems analyzed in this paper, banks are subject to illiquidity problems and runs that make guarantees on deposits welfare improving.

The next subsection suggests that, in contrast, financial development can bring financial stability without provoking inefficiencies.

### 5.3 Financial market development

Why is there more evidence of soft budget constraint and excessive credit expansion in emerging markets than in advanced economies? In this section, I argue that the existence of a
plurality of lenders in more advanced financial systems eliminates the incentives to renew loans to insolvent projects.

A common characteristic of the financial systems of emerging markets is that they are relatively concentrated and based on the association of a few private banks with dominant economic groups. Typically, the source of funds is concentrated in a single financing bank. The nature of borrower-lender relationships is different in more advanced financial markets, where there is a plurality of financial intermediaries and firms can go directly to the financial market to get funds.

In what follows, I show that if a borrower has many lenders and there are no dominant sources of credit, then no one has an incentive to renew loans to insolvent firms. This is proved formally by looking at the best responses of $N$ domestic lenders, informed about the project type, who face the decision of whether to renew or not a loan to a firm which cannot repay it at $t=1$. I assume that each lender provided $1/N$ of the capital needed to start the project.$^{25}$

There are two cases to be considered. First, consider the case of an insolvent project ($k=1$). In this case, if somebody else is renewing the loan, the optimal response is not to renew. This allows the recovery of the first period loan, under the assumption that a project cannot be continued without paying the creditors who do not wish to renew, and the investment ends with a loss equal to zero. In contrast, renewing the outstanding loan would imply a positive loss even in the most favorable case in which all the other $N-1$ creditors are renewing as well. In fact, in this case the expected payoff under the most favorable conditions, that is, if any other lender is renewing every period and the interest rate at which funds are available from international investors remains equal to the international interest rate, is:

$$\frac{1}{N} \left[ \sum_{i=1}^{\infty} \frac{y_i L (1+i^*)}{(1+i^*)^t} - L(1+i^*) \right],$$

which is negative by assumption.

The expected payoff is even lower if any of the other lenders do not renew, since in this case the creditors who decide to renew must pay back the loan to creditors who do not want to. Hence, the best response, if any of the other lenders is renewing the loan and the firm financed at $t=0$ is insolvent, is not to renew the loan.

What if nobody else is renewing? If the lender does not renew her loss is equal to the first period loan: $(1+i^*) \frac{L}{N}$; if she does renew, she must pay back the loans of the other $N-1$ lenders and the expected payoff is:

$$\sum_{i=1}^{\infty} \frac{y_i L (1+i^*)}{(1+i^*)^t} - L(1+i^*).$$

The difference between the two expected payoffs is negative, if the number of lenders is sufficiently large. In fact, this is:
\[
\sum_{i=1}^{\infty} \frac{y_i - L(1 + i^*)}{(1 + i^*)^t} - \frac{N-1}{N} \frac{L}{N} (1 + i^*) = \sum_{i=1}^{\infty} \frac{y_i - L(1 + i^*)}{(1 + i^*)^t} - L(1 + i^*) \text{ in the limit for } N \to \infty. \] 

This is negative by assumption. Hence if there are sufficiently many creditors, not renewing the loans to insolvent projects is a dominant strategy.

Anticipating this, the project managers do not ask for funding at \(t=0\), because their private benefits from starting a project that never produce any output are negative. Therefore, a coordination problem among lenders can eliminate the soft-budget constraint distortion arising in markets in which the decision to reinvest is centralized, as is well-known in the corporate finance literature (see, for instance, Hart (1995)).

If projects were funded by many lenders, the accumulation of losses by the banking system would not take place and there would not be any banking crises.\(^{26}\) This supports the common wisdom that to fully benefit from openness and financial liberalization, a country must take significant steps towards modernizing its domestic financial system. In particular, bond market development eliminates the soft budget constraint distortion, even if depositors acquire no information on the quality of banks’ assets, and establishes market discipline.

6. Conclusions

This paper suggests that the combination of shallow financial markets, lack of transparency and widely available capital due to capital inflows may be more important than moral hazard problems owning to guarantees on deposits to explain the high frequency of banking crises in emerging markets. The moral hazard problems that lead to overlending in the existing literature emerge as a special case of the model presented in this paper, under the unrealistic assumption that international investors exactly know the investment opportunities available in a country.

From a normative point of view, the paper suggests that banking crises can be avoided through financial development. In particular, the development of bond markets is key to achieve financial stability, because the soft budget constraint distortion disappears if credit is provided by many lenders, as happens in advanced economies.

The model could be extended in several directions. First, a more strategic role could be attributed to the central bank, in order to analyzes the instruments apt to signal the quality of the banking system of a country. This would avoid the temporary increase of the cost of funds in

\(^{25}\) See Hart (1995) for a similar argument.

\(^{26}\) Indeed, many policymakers now blame the lack of bond markets for the rot that led Asia into crisis (The Economist, September 2\(^{nd}\), 2000)
solvent countries and the contraction in firms’ profits that this implies. Second, by extending the model to several countries that are similar in the beliefs of the international investors, but actually differ in the quality of available investment opportunities, it would be possible to get useful insights on the phenomena of contagion that frequently affect bank-based financial systems.

References


27 Giannetti (2002) extends the model in this direction.


*The Economist*, September 2nd, 2000, Asia’s missing market.

