DISCUSSION PAPER SERIES

No. 4055

ON THE CAUSES OF OVERLENDING: ARE GUARANTEES ON DEPOSITS THE CULPRIT?

Mariassunta Giannetti

FINANCIAL ECONOMICS and INTERNATIONAL MACROECONOMICS

Centre for Economic Policy Research

www.cepr.org

ON THE CAUSES OF OVERLENDING: ARE GUARANTEES ON DEPOSITS THE CULPRIT?

Mariassunta Giannetti, SITE, Stockholm School of Economics and CEPR

This Discussion Paper is issued under the auspices of the Centre's research programme in **FINANCIAL ECONOMICS and INTERNATIONAL MACROECONOMICS**. Any opinions expressed here are those of the author(s) and not those of the Centre for Economic Policy Research. Research disseminated by CEPR may include views on policy, but the Centre itself takes no institutional policy positions.

The Centre for Economic Policy Research was established in 1983 as a private educational charity, to promote independent analysis and public discussion of open economies and the relations among them. It is pluralist and non-partisan, bringing economic research to bear on the analysis of medium- and long-run policy questions. Institutional (core) finance for the Centre has been provided through major grants from the Economic and Social Research Council, under which an ESRC Resource Centre operates within CEPR; the Esmée Fairbairn Charitable Trust; and the Bank of England. These organizations do not give prior review to the Centre's publications, nor do they necessarily endorse the views expressed therein.

These Discussion Papers often represent preliminary or incomplete work, circulated to encourage discussion and comment. Citation and use of such a paper should take account of its provisional character.

ABSTRACT

On the Causes of Overlending:
Are Guarantees on Deposits the Culprit?*

Conventional wisdom holds that overlending problems and banking crises in open economies are provoked by investor moral hazard, which is caused in turn by guarantees on deposits. This Paper shows that this is not necessarily the case: guarantees on deposits may even limit the losses banks accumulate. In the model, banks may rationally accumulate bad loans if international investors have incomplete information on firm profitability and initially provide funds at low cost. In equilibrium, international investors rationally require a risk premium and banks stop renewing bad loans, only when a substantial amount of losses has been accumulated. This feature of the equilibrium does not depend on whether or not there are guarantees on deposits. Transparency and bond market development can eliminate overlending problems and prevent banking crises.

Mariassunta Giannetti
SITE
Stockholm School of Economics
Sveavägen 65, Box 6501
SE-113 83 Stockholm
SWEDEN
Tel: (46 8) 736 9607
Fax: (46 8) 31 64 22
Email: mariassunta.giannetti@hhs.se

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. Lending booms often result in widespread bankruptcies and banking crises and ex post it becomes clear that banks had been funding unprofitable projects.[1]

Guarantees on deposits have generally been considered the main cause of excessive lending to unprofitable projects (Gorton and Winton, 2002).[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-net-present-value projects.

This argument has the counterfactual implication that investors never make losses in the event of a crisis. Instead, international investors did make losses during the banking crises of the 20th century, as outright defaults and debt rescheduling were at least as frequent as bailouts (Radelet and Sachs, 1998). Moreover, in most developing countries guarantees on deposits are, if any, just partial (Goldstein and Turner, 1996) and when liabilities are denominated in domestic currency a devaluation is equivalent to a partial default, as 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 and conclude that deposit insurance does not appear to diminish the extent of market discipline. Gorton and Winton (2002) also question the relevance of the moral hazard explanation for excessive lending. An alternative explanation, however, is still missing.

This paper proposes an explanation for excessive lending that does not depend on guarantees on deposits and moral hazard. It shows that, after the liberalization of capital inflows, bank may fund negative-net-present-value projects if there are no guarantees on

---

[1] This 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 Reinahart (1999) for a detailed description of the empirical evidence.

[2] See, for instance, McKinnon and Pill (1996); Dooley (1997); Krugman (1998); Burnside et al. (2001); Corsetti, Pesenti and Roubini, (1999); Chinn and Kletzer (2000); Schneider and Tornell (2003). Guarantees on deposits play an important role also in Akerlof and Romer (1993) where overlending arises because of looting.

deposits. 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, which is well known to be difficult to evaluate.[4]

I show that incomplete information may explain why international investors initially make deposits in domestic banks at a relatively low interest rate, and only later on require a risk premium. In the model, banks do not observe whether the borrower has access to a positive-net-present-value project when they begin to lend. Overlending arises because of the large availability of funds at low cost, due to capital inflows: Profit-maximizing banks cannot credibly commit not to refinance negative-net-present-value projects once the first loan is sunk, if they are the only lender of a firm, as is common in emerging markets,[5] and have access to large amount of funds at *low* cost. Banks 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. In the early phase of the lending boom, however, 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 risk premium, 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. As a consequence, in the early phase of the financial liberalization, the probability of bank defaults is zero: Any international investor is able to withdraw her deposit in full because there are other international investors who demand deposits at the equilibrium interest rate. In equilibrium, international investors rationally do not require any risk premium, until when a substantial amount of losses has potentially been accumulated, even if they know that their bank may be insolvent.

---

[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 (2002).

[5] See Nam (1996) and Rajan and Zingales (1998) for empirical evidence on bank-firm relationships in East Asian economies, Velasco (1991) for Chile, and Drees and Pazarbaşioğlu (1995) for Nordic countries.

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, a risk premium emerges in equilibrium and bank defaults may happen with positive probability.

This paper improves on the previous literature also from a methodological point of view. The model is related to first-generation models of currency crises (see, for instance, Krugman, 1979), as the interest rate on deposits (which parallels the exchange rate of Krugman's model) depends on economic fundamentals, the expected bank losses, which evolve continuously. It does not have, however, the major shortcoming of these models consisting in the counterfactual implication that all variables must move continuously like economic fundamentals. Even though the underlying economic fundamentals evolve continuously, the interest rate exhibits a jump at the time of the crisis, thanks to the strategic interaction between international investors and domestic banks. Additionally, contrary to the previous literature that 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 guarantees on deposits is irrelevant for overlending to arise. In certain cases, guarantees on deposits may even limit the amount of losses that banks can accumulate: If international reserves are used to bail out insolvent banks, a banking crisis brings about a devaluation, which also affects negatively the return of domestic-currency-denominated deposits at solvent banks. In this case, international investors ask to be compensated for risk at an earlier stage, if the risk they bear increases. As a consequence, banks accumulate losses to a lesser extent.

How can banking crises be avoided, if the guarantees on deposits are not their cause? 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 overlending problems, because they do not create incentives to demand a risk premium earlier. Other mechanisms improving market discipline are preferable. 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 are making efforts in this direction (Fischer, 1999), however, it may be difficult to overcome incomplete information about the average quality of projects available in a country, as this involves an estimate of total factor productivity. Another, possibly easier, way of strengthening market discipline is increasing 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 domestic companies have multiple lenders, like in advanced economies where the bond markets are more developed and the banking system is less concentrated. This eliminates the possibility of overlending.

The remaining of the paper is organized as follows. Section 2 describes the model. Section 3 and 4 describe the equilibrium 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 of a country, to make short-term deposits without requiring a risk premium until one period before a banking crisis may happen with positive probability. This is true notwithstanding the possibility of the crisis was anticipated.

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 at any subsequent period. The central bank defends the exchange rate peg as long as it has international 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. Even if after one period the financing bank can determine the quality of the project, because it observes if the project manager paid back the initial loan or not, international investors do not know which type 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. [6] 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 estimate factor productivity, as the debate on the determinants of growth in East Asian economies between Young (1998) and Hsiei (2002) strikingly confirms. [7] 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 in a country, 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, 2000 and 2001).

A more detailed description of each type of agent follows.

2.1 The projects

Countries 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 assumptions on project technologies and manager incentives follow Dewatripont and Maskin (1995), who show the inability of banks to commit not to renew

loans to insolvent projects in a two-period model.[8] This problem is generally referred to as "soft-budget-constraint distortion".

Both country types have a continuum of project managers of mass 1 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 1. 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: $P_t = S_t$.

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.[9] 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:

(1)
$$\sum_{t=1}^{\infty} \frac{y_I}{(1+i^*)^t} < \sum_{t=0}^{\infty} \frac{L}{(1+i^*)^{t-1}}.$$

---

[6] Results are unchanged if also domestic banks do not know ex ante the country type. In the model it is relevant only the relation between the bank and the project it funds and it is possible to show that aggregate uncertainty would not affect banks' optimal decision.

[7] A similar debate developed on the determinants of US growth during the high-tech bubble.

[8] Huang and Xu (1999) make similar assumptions.

[9] 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 also must be taken into account.

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:

(2)
$$\sum_{t=1}^{\infty} \frac{y_I}{(1+i^*)^t} > \sum_{t=1}^{\infty} \frac{L}{(1+i^*)^{t-1}},$$

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, a country may be crisis prone (type I) or not (type II). A country is type I if it is endowed both with solvent and insolvent projects, in proportions θ and 1-θ, 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 a 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 overlending problems. 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 bank losses, 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 in type I countries 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. Formally, 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 a country is type I (i.e. it has a fraction $1-\theta$ of insolvent projects) with probability φ_1. In contrast, a country is type II with probability $1-\varphi_1$.

The assumptions on the information set of international investors imply that they cannot observe the output of the projects funded by the banking system.[10] 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, which 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 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).

Table1 summarizes the information about country characteristics and investors' beliefs.

---

[10] This is a direct consequence of the inability to estimate total factor productivity.

Table 1. Country types

	Type I (Insolvent)	Type II (Solvent)
Priors about the country's type	φ_I	$1-\varphi_I$
Fraction of fast projects	θ	1
Fraction of insolvent projects	$1-\theta$	0
Average return on investment after the first period	$\dfrac{\theta y_S + (1-\theta)y_I}{L}$	$\dfrac{y_S}{L}$

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_t^d, and lend to project managers at an interest rate $i_{t,k}^l$, which varies according to the project type, k. Deposits and loans can be denominated in domestic or foreign currency.

There is a continuum of banks of mass 1, which compete à la Bertrand in the loan market bidding the interest rate to get customers.[11] At $t=0$ each bank finances a project.[12] In a type II country, 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.[13]

---

[11] This assumption is common in the banking literature and aims to capture a situation of strong competition in the banking sector, as the liberalization of capital inflows is often accompanied by the deregulation of the banking sector, which makes the environment highly competitive.

[12] 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.

[13] Under the assumption of Bertrand competition, 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, 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. Alternatively, even if firms do not need to repay the previous period loan to switch financing bank, the lack of incentives to change financier still holds. In fact, the project manager that switches has a perfectly solvent project from the point of view of the new bank. Therefore, the assumptions on bank competition imply that $i_{t,S}^l = i_t^d$. In equilibrium, the profits from running the project must be transferred to the old financing bank to avoid default and the payoff of the manager is not increased by changing financing bank. See Rajan (1992) for details on the effects of bank competition.

The assumptions on bank competition imply that for solvent projects: $i_{t,S}^l = i_t^d$. In contrast, banks can appropriate the project's profits if previous loans have not been completely repaid (that is equivalent to say: $i_{t,I}^l = \frac{y_I}{L} - 1$).

Note that, since banks appropriate the profits of insolvent projects, the currency of denomination of loans is completely irrelevant. Therefore, in what follows, I will just consider different assumptions on the currency of denomination of deposits.

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, the interest rate must be such that banks' expected profits are equal to zero. [14]

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 in the economy only if their expected return is larger or equal to the international interest rate, i^*.

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 a country.

International investors simultaneously announce the lowest interest rate at which they would hold deposits. Since they behave competitively, their expected return is equal to the international interest rate in equilibrium. 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.

---

[14] To determine the interest rate on loans at *t=0*, i_1^l, 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 $i_1^l = \frac{i^*}{\theta} - \Xi$, where Ξ=Expected recovery of first period loss. It is necessary to assume that i_t^l 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 $(1 - \theta\phi_1)$.

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.

The central bank holds an amount *RX* of international reserves, which have zero return, and defends the exchange rate peg as long as reserves remain positive. The initial level of the exchange rate is *1*, whatever is the country type.

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 and, if they are not sufficient to cover all the claims (i.e., the losses of the defaulting banks), reserves are distributed among claimants in proportion to their initial investment. 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 run to the central bank to exchange domestic currency for foreign currency, as they are only interested in holding foreign currency. In this case, if the demand for foreign currency is larger than the international reserves, these are distributed pro rata among all claimants. This is equivalent to a devaluation of the currency and the new exchange rate is $S_t^I = \dfrac{\text{Total Claims at t}}{RX}$, where the total claims equal the bank aggregate losses in a type I country.

Whatever is the currency of denomination of deposits, if the central bank provides guarantees on deposits, 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, $\pi_{tk} = y_k - (1 + i_{tk}^l)L$, if previous period loans have been repaid. Otherwise, the financing bank appropriates profits, since $i_{t,I}^l = \frac{y_I}{L} - 1$.

- 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 loans to the projects they have 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. If there are no guarantees on deposits, international investors get nothing.

- The game ends after a banking crisis.

This sequence of events ensures that a devaluation increases the effective cost of financing investment, even if loans are denominated in domestic currency. An increase in the nominal interest rate on deposits due to an expected devaluation has real effects, because domestic currency revenues are realized before the run on international reserves and would be affected negatively by a devaluation.

The economy described above is in equilibrium if all 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 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. Massive amounts of funds are available at a low cost in the early stages of the financial liberalization, because of the interest rate's unresponsiveness to default risk. This makes 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^i. The losses of a bank that financed an insolvent project are a state variable, and their dynamics, in nominal terms, evolves according to the following difference equation:

$$(3) \qquad x_t^I = (1+i_t^d)x_{t-1}^I + \left[(1+i_t^d)S_{t-1}^I L - S_{t-1}^I y_I\right],$$

where S_{t-1}^I is the nominal exchange rate in a country endowed with insolvent projects and the initial condition is $x_0^i = L(1+i^*)$. Equation (3) shows that the level of losses of any bank at time t, x_t^i, depends positively on the previous period losses, x_{t-1}^i, and on the interest rate that must be paid on deposits, i_t^d, and negatively on the surplus from the current period production, $\left[y_I - (1+i_t^d)L\right]$. It follows immediately that the real losses are:

$\tilde{x}_t^I = \dfrac{S_{t-1}^I}{S_t^I}(1+i_t^d)\tilde{x}_{t-1}^I + \left[(1+i_t^d)L - y_I\right]$, where $\tilde{x}_t^k \equiv \dfrac{x_t^k}{S_t^I}$. [15] The losses of a bank which funded a

solvent project are always equal to zero.

Banks minimize the present value of their existing losses, which is equivalent to maximizing their net wealth. One may think that bank managers aim to minimize losses because the punishment (or the loss of reputation) is inversely related to losses. They are however impatient and discount future losses using a positive discount rate. Under these assumptions, a bank always chooses to renew a loan if the present value of losses at *t+1* is

---

[15] The nominal exchange rate at time *t* is known with certainty by domestic banks, since they know the country type. The analysis would go through if domestic banks did not know the country type. In this case, the expected exchange rate should be used instead of the actual value.

less than the losses at time t: $\dfrac{\tilde{x}^I_{t+1}}{(1+i^d_{t+1})\dfrac{S^I_t}{S^I_{t+1}}} \le \tilde{x}^I_t$. [16] 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 $y_I - (1+i^d_t)L > 0$: 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 $y_I - L(1+i^*) > 0$. If profits are negative, the project is discontinued because continuation would imply a permanent increase in the present value of the losses. Note that since banks look at a *present value,* future losses are discounted and their future value may be larger then current losses (i.e., $\tilde{x}^I_{t+1} > \tilde{x}^I_t$), even if banks renew loans only with positive current profits. This depends on the fact that current profits may not cover the interest rate payments accumulating on the initial loan.

The dynamics of the aggregate losses mimic those of individual losses and are 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 $1-\theta$. The law of motion of aggregate losses in real terms is:

(4) $$X^I_t = (1+i^d_t)\frac{S^I_{t-1}}{S^I_t}X^I_{t-1} + [(1+i^d_t)L - y_I](1-\theta) \quad \text{if } X^I_t > 0,$$

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

The assumptions on the parameters imply that in type I countries 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, $\overline{X}^{k\,SS} = \dfrac{[y_k - (1+i^*)L](1-\theta)}{i^*}$ and, consequently, the path of the aggregate

losses is explosive. Intuitively, this happens because the current period profits are not sufficient to cover the interest rate burden on the first period loss. Domestic banks, when they

---

[16] I use $\dfrac{1}{(1+i^d_t)\dfrac{S^k_{t-1}}{S^k_t}}$ as 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.

make the loan renewal decisions, do not take it into account because they look at the present value of the losses.

High capital requirements may limit accumulation of bank losses, as they limit the amount of deposits necessary 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: $x_0^I = (1 + i^*)L - K$. The optimal decision whether or not to renew the loan would instead remain unchanged. It is evident that the larger is K, the smaller is the level of the aggregate losses at $t=0$; for high levels of K, the initial condition is eventually at the left of the steady state and no processes of accumulation of losses occur, even if 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, before bank defaults are expected to occur.

Figure 1. Aggregate losses in an insolvent country (Type I)
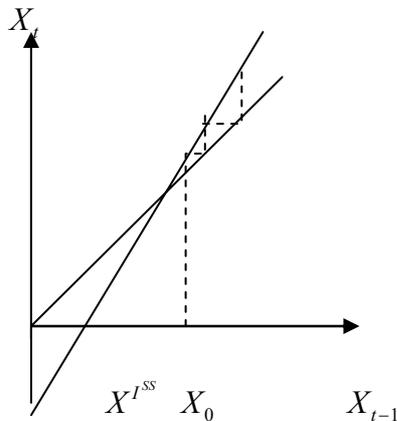
International investors cannot observe the actual level of the losses of the banking system, but know that if a country is type I (with probability ϕ_1), the dynamics of aggregate losses are described by equation (3).

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 loans to insolvent projects. In turn, this happens only if the interest rate international investors demand on deposits becomes high enough to make defaults optimal. In this case, the banks that financed insolvent projects default.

If the central bank provides guarantees on deposits and loans are denominated in domestic currency, international investors are not subject to any default risk but only to exchange rate risk. In fact, the central bank is expected to print money to guarantee the nominal value of deposits. Then, if domestic banks turn out to be actually insolvent, the international investors run to the central bank to convert domestic currency into foreign currency and a devaluation takes place if banks' losses are larger than international 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 international reserves are considered sufficient to guarantee the real value of the outstanding deposits. A crisis becomes possible, only after this limit has been reached. I show below that, indeed, this happens only after the losses of the banking system have increased above the level of international reserves.

The interest rate that the international investors require on deposits depends on the probability of a 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:

(5) $(1+i^*) = (1+i_t^d) \times \Pr ob\{no\ devaluation \mid i_t^d\} + (1+i_t^d)\frac{1}{S_t^e}\Pr ob\{devaluation \mid i_t^d\}$.

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 equal to zero in a type II country, because banks have no losses. Therefore, the central bank has no implicit liabilities and there cannot be runs on international reserves. In contrast, in a country with 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 φ_I, as the losses of the banking system reach the critical level to be determined below. The expected depreciation also contributes to determine the level of the interest rate on deposits. 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 international reserves occurs.

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 φ_I of a currency crisis (i.e. if the country is type I) when aggregate losses are X_t^I.

Based on the above considerations, it is possible to derive a relation between the shadow interest rate on deposits, $\tilde{i}_t^d$, and X_t^I. Here, I use the assumption that international investors are too small to internalize the effects of i_t^d on X_t^I, whose dynamics is described by equation (4), and take X_t^I as given. Combining this with the expected depreciation in type I countries, $S_t^I = \dfrac{X_t^I}{RX}$, it is clear that $\tilde{i}_t^d$ increases as X_t^I increases:

(6) $$1 + i^* = \left(1 - \varphi_I\right)\left(1 + \tilde{i}_t^d\right) + \varphi_I \frac{RX}{X_t^I}\left(1 + \tilde{i}_t^d\right),$$

where $\dfrac{1}{S_t^I} = \dfrac{RX}{X_t^I}$.

In equilibrium, the actual interest rate, i_t^d, will equal the shadow interest rate, $\tilde{i}_t^d$, only if there is positive probability of observing banks' defaults so that the peg is actually abandoned at t if the country is type I. Otherwise, it remains equal to the international interest rate, i^*.

These considerations allow me to determine the time $\hat{t}$, when a crisis may occur. This is possible only if the interest rate on deposits 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:*

$$y_I - (1 + \tilde{i}_2^d)L > 0.$$

The date $\hat{t}$, when a crisis happens in a type I country, is determined as follows:

1. *The interest rate on deposits at $\hat{t}$-1, i_t^d, satisfies equation (5). Moreover, the expected depreciation is calculated on the basis of the actual value of losses in type I countries at time $\hat{t}$ and $\mathrm{Pr}\,ob\{devaluation \mid i_t^d\} = \varphi_I$.*

2. *The interest rate at which international investors will make deposits at $\hat{t}$ is $i_{t+1}^d = \tilde{i}_{t+1}^d$ It is such that losses would permanently increase in type I countries, if loans were renewed. Formally, this implies: $y_I - (1 + i_{t+1}^d)L < 0$.*

17

If the above condition on parameters 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 $t=1$. This may happen if the country is perceived as highly risky and with very poor quality projects already at $t=0$. In what follows, for expositional 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 international reserves and the peg is abandoned with probability 1. In contrast, in a type II country one observes only a temporary increase in the interest rate and a contraction in profits, after which international investors learn that the country is solvent.

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, ϕ_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. Any country endowed with insolvent project, no matter how many (i.e., how large θ is), will experience a crisis under the assumption of the model. The larger is θ, the later after the financial liberalization the crisis will happen (the larger is $\hat{t}$), but sooner or later it will!

Since investors' claims are not satisfied sequentially, as in Diamond and Dybvig (1983) and Chang and Velasco (2000 and 2001)[17], but all 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.

Proposition 2. Uniqueness of equilibrium. *The date $\hat{t}$ when a crisis can occur in a type I country 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 φ_I. Moreover, since

---

[17] In these models, runs on illiquid banks happen because withdrawing the deposits is a best response if other investors are running as well.

$\hat{\bar{t}} > \hat{t}$, $X_{\bar{t}}^I > X_{\hat{t}}^I$, and hence the expected devaluation is larger. This implies that $i_{\bar{t}}^d > i_{\hat{t}}^d$. Hence, $y_1 - (1 + i_{\bar{t}}^d)L < 0$ and banks' defaults and the consequent monetary expansion occur at $\hat{\bar{t}} - 1$, rather than at $\hat{\bar{t}}$. Therefore, in equilibrium it should hold that $i_{\hat{\bar{t}}-1}^d > i^*$. Moreover either $\hat{\bar{t}} - 1 = \hat{t}$ and, hence, a crisis occurs at time $\hat{t}$, as I proved in proposition 1, or $\hat{\bar{t}} - 1 > \hat{t}$. In this case, $i_{\hat{\bar{t}}-1}^d > i_{\hat{t}}^d$ and therefore a crisis should occur at $\hat{\bar{t}} - 2$. Going backward, I prove that the latest time a crisis can happen is $\hat{t}$. Furthermore, a crisis cannot happen before $\hat{t}$, because , if $t < \hat{t}$, 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 $y_I - (1 + i_t^d)L < 0$. In this case, banks' defaults cause 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, $\text{Pr}ob\{devaluation / i_t^d\} = 0$ if $t < \hat{t}$. Competition among atomistic investors implies $i_t^d = i^*$ if $t < \hat{t}$. ■

The model is related to first-generation models of currency crises (see, for instance, Krugman, 1979), as the interest rate on deposits (which parallels the exchange rate of Krugman's model) depends on economic fundamentals, the expected bank losses, which evolve continuously. It does not have, however, the major shortcoming of first-generation models consisting in the counterfactual implication that all variables must move continuously like economic fundamentals. Even though the underlying economic fundamentals evolve continuously, the interest rate exhibits a jump at the time of the crisis, thanks to the strategic interaction between international investors and domestic banks.

The time path of the equilibrium interest rate also depends on the short maturity of bank liabilities. Before $\hat{t}$ no bank defaults are possible and, consequently, deposits are

perceived to be completely safe: Any international investor is able to withdraw her deposit in full because there are other international investors who demand deposits at the equilibrium interest rate. It would be different if bank liabilities had longer maturity: The interest rate of any bank liabilities with maturity longer than $\hat{t}$ would incorporate the risk of a banking crisis from *t=0*. However, this would not eliminate the soft-budget constraint distortion in the model. To show this, let $i_{t+1}^{d\,t}$ 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: $E\left(1+i_{t+1}^{d\,t}\right)=(1+i^{*})^{t}$, where *E* is the expectation operator. Even if it would be possible to determine a sufficiently long maturity such that the per-period interest rate payments are 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, $\left(1+i_{t+1}^{d\,t}\right)=(1+i^{*})^{t}$. But this implies that it would be optimal for managers with insolvent projects to ask for funds and, consequently, this cannot be an equilibrium. The only equilibrium that it is possible to sustain with long-term debt is a mixed strategy equilibrium, in which a subset of insolvent projects is refinanced and the profits from running the project one more period are zero. Longer debt maturity, however, cannot eliminate banking crises because banks would still accumulate losses funding some insolvent projects.

3.2 Deposits denominated in foreign currency

The main conclusions of the model remain qualitatively unchanged if deposits are denominated in foreign currency. Proposition 1 to 3 can be easily extended to determine the date of the crisis. The only relevant difference is that now international investors are subject to default risk rather than to exchange rate risk. Interesting differences about the timing and the intensity of the banking crises also emerge: The probability of making a loss if deposits are denominated in foreign currency is now 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, $\tilde{\tilde{i}}_{t}$, is now defined as follows:

$$(7) \quad \left((1-\phi_1) + \phi_1 \left(\frac{D_t - X_t}{D_t} + \frac{X_t}{D_t} \frac{RX}{X_t} \right) \right) \left(1 + \widetilde{\widetilde{i}}_t^{\,d} \right) = \left(1 + i^* \right),$$

where D_t is the total amount of deposits at time t and $\dfrac{D_t - X_t}{D_t}$ and $\dfrac{X_t}{D_t}$ are the fractions of

deposits at solvent and insolvent banks, respectively.

For any value of the expected losses of the banking system the shadow interest rate is now lower than in equation (6).

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. Analogously, the insolvent banks default only if the profits from continuing the project become negative (i.e. if $y_1 - (1 + i_t^d)L < 0$). It follows that the interest rate on deposits will rise only after the date determined in proposition 1, because $\widetilde{\widetilde{i}}_t$ is smaller than $\widetilde{i}_t$ for any value of the aggregate losses. Hence, if the country is actually insolvent, the banking crisis is delayed but is harsher, because it happens when a larger amount of losses has been accumulated.[18]

4. Banking crises with no guarantees on deposits

A widely used explanation for overlending relies on guarantees on deposits: Since investors would not make losses in the event of bank defaults, the interest rate on deposits would not be responsive to risk. 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. 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. International investors, however, are subject to default risk.

---

[18] Of course, since international reserves are exhausted, the exchange rate peg will be abandoned after the country defaults.

The shadow interest is defined as follows:

(8)
$$\left((1-\varphi_1) + \varphi_1 \left(\frac{D_t - X_t}{D_t} \right) \right) \left(1 + \widetilde{\widetilde{i}}_t^{\,d} \right) = (1+i^*).$$

This takes into account that an international investor expects to lose her deposit if it is at an insolvent bank.

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 $\widetilde{i}_t^{\,d}$, defined by equation (6). In particular, if the level of international reserves is much lower than the aggregate losses of the banking system, and deposits are relatively larger than losses, for investors who made deposits in domestic currency the expected loss is larger when there are guarantees on deposits. In fact, with guarantees on deposits they would make a loss even if they 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 could occur at an earlier date if there were guarantees on deposits. Insolvent banks would accumulate smaller losses when the nominal value of deposits is guaranteed. In striking contrast with the moral hazard theory of overlending, not only guarantees on deposits are not a necessary condition for excessive lending, but they can even limit it. [19]

The empirical evidence also seems to support these conclusions on the irrelevance of guarantees on deposits and moral hazard problems: 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 and this may suggest 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

---

[19] In contrast, $\widetilde{\widetilde{i}}_t^{\,d}$, defined in equation (7), is always lower than $\widetilde{\widetilde{i}}_t^{\,d}$. 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.

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 undercapitalized.

5. Institutional arrangements for financial stability

This Section examines different institutional arrangements that may help to prevent accumulation of bank losses and banking crises.

5.1 Restrictions to capital inflows

The lack of restrictions on the growth of bank lending is key for the development of a crisis in the model. Accumulation of bank losses 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. 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
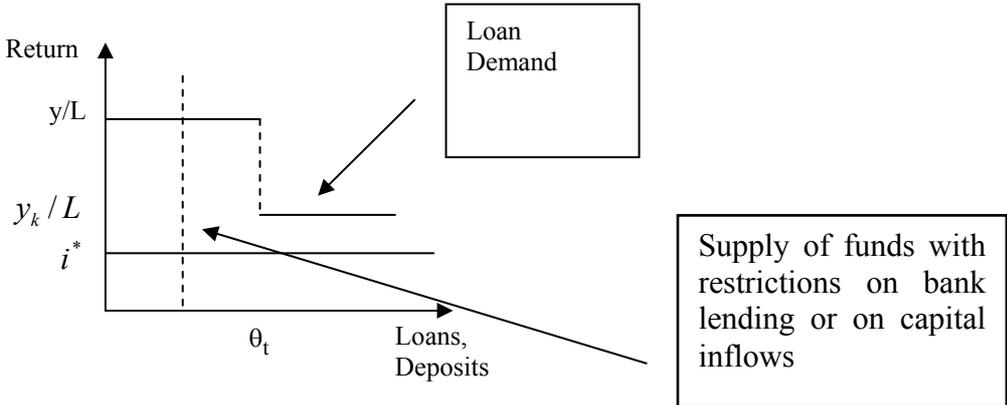
Capital controls by altering either the cost of funds or the scale of inflows could eliminate the soft budget constraint distortion and improve financial stability. This is consistent with the empirical studies showing that capital controls helped to prevent financial crises during the 1979-1993 period (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 and, consequently, their managers would not ask for financing.

In this model, by adopting capital controls, a type I country with no new investment opportunities 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, as in type II countries, because preventing credit expansion would also limit the growth prospects of the economy. For signaling to international investors that the banking system is not accumulating losses, 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 $\left(y_1 - (1 + i^*_{TAX})L < 0\right)$ 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 cost of capital, 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 shown above, in equilibrium 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 reduce 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 risk, if no guarantees on deposits are provided. International investors can perfectly anticipate a banking crisis, if they know the country type. Consequently, the supply of funds at *t=1* is no longer perfectly elastic (see figure 3). At *t=1*, international investors demand at most θ*L* units of deposits. The interest rate is infinite for any amount of deposits larger than that.

Figure 3. Equilibrium in the market for deposits without incomplete information
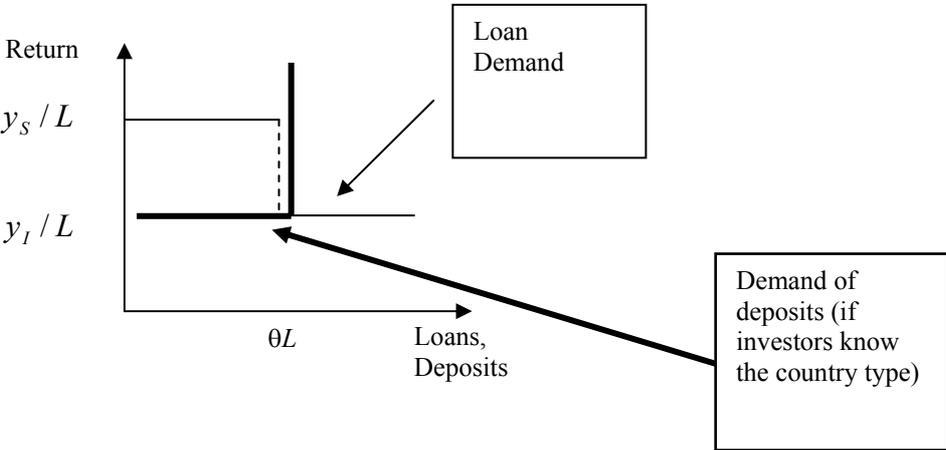
The supply of funds can provide a commitment technology for banks not to refinance insolvent projects. As a consequence of investors' behavior, these would not be started at all in *t=1*.

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 θ*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, as 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 that can make guarantees on deposits welfare improving in certain contexts.

5.3 Financial market development

Why is there more evidence of 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 underdeveloped financial systems is that they are relatively concentrated and based on the association of a few 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 access directly 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, 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 or not to renew a loan to a firm which cannot repay it at $t=1$. I assume that each lender provided $1/N$ of the working capital needed to start the project.[20] There are two cases to be considered. First, consider an insolvent project ($k=1$). In this case, if somebody else is renewing the loan, the optimal response of a financier is not to renew. This allows the recovery of the first period loan, if the 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: $\frac{1}{N}\left[\sum_{t=1}^{\infty}\frac{y_1 - L(1+i^*)}{(1+i^*)^t} - L(1+i^*)\right]$,

which is negative by assumption.

---

[20] See Hart (1995) for a similar argument.

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: $(1+i^*)\dfrac{L}{N}$; if she does renew, she must pay back the loans of the other N-1 lenders and the expected payoff is: $\sum_{t=1}^{\infty}\dfrac{y_1-L(1+i^*)}{(1+i^*)^t}-L(1+i^*)$. The difference between the two expected payoffs is negative, if the number of lenders is sufficiently large. In fact, this is:

$\sum_{t=1}^{\infty}\dfrac{y_1-L(1+i^*)}{(1+i^*)^t}-\dfrac{N-1}{N}L(1+i^*)$, which is equal to $\sum_{t=1}^{\infty}\dfrac{y_1-L(1+i^*)}{(1+i^*)^t}-L(1+i^*)$ in the limit as $N\rightarrow\infty$. This, in turn, is negative by assumption. Hence if there are sufficiently many creditors, not renewing the loans to insolvent projects is a dominant strategy and the project managers do not ask for funding at $t=0$. Therefore, a coordination problem among lenders can eliminate the soft-budget constraint distortion and help avoiding banking crises.

If projects were funded by many lenders, the accumulation of losses by the banking system that causes financial instability would not take place and there would not be any banking crises.[21] 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, favoring bond market development eliminates the soft-budget-constraint distortion, even if depositors acquire no information on the quality of banks' assets.

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 overlending problems. The moral hazard problems that lead to overlending emerge as a special case of the model presented in this paper, under the assumption that international investors exactly know the investment opportunities available in a country.

---

[21] Indeed, many policymakers now blame the lack of bond markets for the East Asia crisis (*The Economist*, September 2nd, 2000)

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 processes of accumulation of bank losses do not occur 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, to analyze 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 solvent countries and the contraction in firms' profits that this implies. Second, extending the model to many 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.[22]

References

Akerlof, G. A. and P. M. Romer (1993), "Looting: the economic underworld of bankruptcy for profit", *Brookings Papers on Economic Activity*, pp. 1-73.

Bolton, P. and D. Scharfstein (1996), Optimal debt structure and the number of creditors, *Journal of Political Economy*, Vol.104, pp. 1-25.

Burnside C., M. Eichenbaum and S. Rebelo (2001), Prospective deficits and the Asian currency crisis, *Journal of Political Economy*, Vol 109, pp. 1155-1197.

Calvo, G. and E. Mendoza (1996), "Mexico's balance-of-payments crisis: a chronicle of a death foretold", *Journal of International Economics*, Vol. 41, pp. 235-64.

Caprio, G. Jr. and A. D. Klingebiel (1996), "Bank insolvency: bad luck, bad policy, or bad banking?", Annual World bank Conference on Development Economics, 1996, Washington, D.C., The World Bank, pp. 79-104.

Chang, R. and A. Velasco (2000), "Financial fragility and the exchange rate regime", *Journal of Economic Theory*, Vol. 92, pp. 1-34.

Chang, R. and A. Velasco (2001), "Financial crises in emerging markets: a canonical model", *Quarterly Journal of Economics*, Vol. 116, pp. 489-517.

Chinn M. and Kletzer K. (2000), International capital inflows, domestic financial intermediation and financial crises under imperfect information, in R. Glick ed., *Financial Crises in Emerging Markets*, New York Cambridge University Press.

---

[22] Giannetti (2003) extends the model in this direction.

Corsetti, G., P. Pesenti and N. Roubini (1999), "Paper Tigers? A model of the Asian crisis", *European Economic Review*, Vol. 43, pp. 1211-36.

Dewatripont, M. and E. Maskin (1995), "Credit and efficiency in centralized and decentralized economies", *Review of Economic Studies*, Vol. 62, pp. 541-55.

Diamond, D. W. and P. H. Dybvig (1983), "Bank runs, deposit insurance, and liquidity", *Journal of Political Economy*, Vol. 91, pp. 401-19.

Dooley, M. (2000), A model of crises in emerging markets, *Economic Journal*, Vol. 110, pp. 256-272..

Drees, B. and C. Pazarbaşioğlu (1995), "The Nordic Banking Crises: Pitfalls in Financial liberalization?", IMF Working paper, No. 95/61.

Fischer, S. (1999), Reforming the International Financial System, *Economic Journal*, Vol. 109, pp. F557-F576.

Flood, R.P. and P.M. Garber (1984), "Collapsing exchange-rate regimes: some linear examples", *Journal of International Economics*, Vol. 17, pp. 1-14.

Giannetti, M. (2003), Bank-firm relationships and contagious banking crises, *Journal of Money, Credit and Banking*, Vol. 35-2, pp. 239-261.

Goldstein M. and P. Turner (1996), Banking crises in emerging economies: origins and policy options, BIS Economic Papers No.46.

Gorton, G., and A. Winton, 2002, Financial Intermediation, in G. Constantinides, M. Harris, and R. Stulz, eds.: *Handbook of the Economics of Finance*, Amsterdam NL, North Holland.

Hart, Oliver (1995), *Firms Contracts and Financial Structure*, Oxford, Oxford University Press.

Hsieh, S. (2002), "What explains the industrial revolution in East Asia? Evidence from factor markets", *American Economic Review*, Vol. 9, pp. 502-526.

Huang, H. and C. Xu (1999), Financial institutions and the financial crisis in East Asia, *European Economic Review*, Vol. 43 pp.903-914.

Kaminsky, G. L. and C. M. Reinhart (1999), "The twin crises: the causes of banking and balance-of-payments problems", *American Economic Review*, Vol. 89, pp. 473-500.

Krugman, P. (1979), "A model of Balance of Payment Crises", *Journal of Money, Credit and Banking*, Vol. 11, pp. 311-25.

Krugman, P. (1998), "What happened to Asia?", mimeo, Massachusetts Institute of Technology.

Lane, P. R. and S. Sarisoy (2000), Does deposit insurance stimulate capital inflows?, *Economic Letters*, Vol. 69, pp. 193-200.

Martinez Peria, M. S. and S. L. Schmukler (2001), Do Depositors Punish Banks for Bad Behavior? Market Discipline, Deposit Insurance, and Banking Crises, *Journal of Finance*, Vol. 56, pp. 1029:1051.

McKinnon, R. and H. Pill (1996), "Credible liberalization and international capital flows: the overborrowing sydrome", in T. Ito and A. O. Krueger, eds., *Financial deregulation and Integration in East Asia*, Chicago, Chicago University Press.

Nam, Sang-Woo (1996), "The principal transactions bank system in Korea and a search for a new bank-business relationship", in T. Ito and A. O. Krueger, eds*., Financial deregulation and Integration in East Asia*, Chicago, Chicago University Press.

Obstfeld, M. and K. Rogoff (1995), *Foundation of International Macroeconomics*, Cambridge MA, MIT University Press.

Radelet, S. and J. Sachs (1998), The East Asian financial crisis: Diagnosis, remedies and prospects, *Brookings Papers on Economic Activity,* pp.1-90.

Rajan, J. (1992), "Insiders and outsiders: the choice between informed and arm's-length credit", *Journal of Finance*, Vol. 47, pp. 1367-400.

Rajan, R. G. and L. Zingales (1998), "Which capitalism? Lessons from the East Asian crisis", *Journal of Applied Corporate Finance*, Vol. 11, 40-8.

Schneider, M. and A. Tornell (2003), "Lending booms and speculative crises", forthcoming *Review of Economic Studies*.

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

Velasco, A. (1987), "Financial crises and balance of payment crises. A simple model of Southern Come experience", *Journal of Development Economics*, Vol. 27, pp. 263-83.

Velasco, A. (1991), "The Chilean Financial System,1975-85", in V. Sundararajan and T. J. T. Balino, eds., *Banking Crises: cases and issues*, Washington DC, International Monetary Fund.

Young, A. (1998), "Alternative estimates of productivity growth in the NIC's: a comment on the findings of Chang-Tai Hsieh", NBER Working paper, No. 665.