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Banking System, International Investors and Central Bank Policy in Emerging Markets

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Sintesi

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Il lavoro analizza con un modello teorico il legame tra l'assetto istituzionale e la stabilità finanziaria delle economie emergenti.

La prima parte discute l'evidenza empirica che mostra come i fenomeni di eccessiva espansione del credito alla radice delle crisi bancarie delle economie emergenti si verifichino, dopo la liberalizzazione dei movimenti di capitale, soprattutto nei paesi in cui il credito bancario è la principale fonte di finanziamento. Il modello dimostra che in un tale contesto la liberalizzazione dei movimenti di capitale ha effetti destabilizzanti sul sistema bancario locale, poichè la maggiore disponibilità di fondi a basso costo crea incentivi a finanziare imprese con elevata probabilità di insolvenza. Ciò avviene in quanto la banca finanziatrice locale può trovare conveniente continuare a erogare credito ad aziende che non sono state in grado di onorare un prestito, se la continuazione dell'attività dell'impresa permette di ripagare il nuovo prestito. Tuttavia, per alcune imprese i ricavi possono risultare insufficienti a ripagare anche il debito contratto nel primo periodo, innescando un processo di accumulazione di perdite.

A causa di problemi di asimmetria informativa, gli investitori internazionali non sono in grado di distinguere se l'espansione creditizia sia dovuta al processo di accumulazione di perdite o all'aumento di profittevoli opportunità di investimento. Solo quando il livello atteso delle perdite del sistema bancario interno ha raggiunto una certa soglia, il tasso di interesse di equilibrio sui prestiti alle imprese sale dando origine a fallimenti bancari in modo apparentemente improvviso. Se la banca centrale svolge, *de iure* o *de facto*, il ruolo di prestatore di ultima istanza, ai fallimenti bancari si associa una crisi della bilancia dei pagamenti causata dall'espansione monetaria volta a fornire liquidità alle banche.

Nella seconda parte l'analisi mostra che i paesi con sistemi finanziari poco sviluppati sono più facilmente soggetti a fenomeni di contagio. Se gli investitori internazionali ritengono "simili" paesi che hanno in realtà un diverso grado di solvibilità, un aumento del tasso di interesse di equilibrio può rendere insolventi anche paesi solamente

illiquidi, causando crisi bancarie e della bilancia dei pagamenti con modalità molto simili a quelle sopra descritte.

Lo studio infine valuta alcune delle misure volte ad accrescere la stabilità finanziaria dei mercati emergenti. Le restrizioni ai movimenti di capitale pongono un limite alla quantità di prestiti che è possibile erogare, riducendo la quantità di fondi disponibili al sistema bancario, e possono perciò limitare la possibilità di processi di accumulazione di perdite. Si accresce così la stabilità finanziaria, ma a scapito dell'efficienza allocativa.

Una via per raggiungere la stabilità finanziaria senza causare distorsioni nella allocazione delle risorse è la modernizzazione del sistema finanziario dei paesi in via di sviluppo: se ci sono numerose fonti di credito, come accade in presenza di un mercato obbligazionario ben organizzato o di un sistema bancario concorrenziale, nessun intermediario ha incentivo a rinnovare prestiti a imprese non solvibili, eliminando così fenomeni di accumulazione di perdite destinati a tradursi in crisi finanziarie e valutarie.

BANKING SYSTEM, INTERNATIONAL INVESTORS AND CENTRAL BANK POLICY IN EMERGING MARKETS

Mariassunta Giannetti*

Abstract

This paper argues that the liberalization of capital inflows in a small open economy with a financial system dominated by banks may provoke a soft budget constraint distortion, because large amounts of funds become available at relatively low cost. International investors internalize the risk of accumulation of losses by the banking system only when the risk premium is sufficiently high so as to determine a positive probability that banks will default. This explains why crises occur when massive losses have already been accumulated.

In this context, international investors' incomplete information about the types of projects financed by the domestic banking system leads to crises with very similar dynamics, even if the banks are only illiquid, because a temporary increase in the cost of funds may drive illiquid banks to insolvency. This mechanism may explain contagion among countries that are equally rated by international investors but that have different investment opportunities.

Finally, the implications of different institutional arrangements for financial stability are examined. In particular, the main source of soft-budget constraint problems in emerging markets is the limited number of lenders and boom-bust cycles may arise even if the central bank does not guarantee deposits.

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Contents

1. Introduction[1]

In many developing countries, financial liberalization was followed by rapid credit expansion fueled by large capital inflows. The absorption of these capital inflows generally posed challenges in terms of their productive deployment, since they were intermediated by underdeveloped financial systems dominated by banks. Consequently, lending booms often resulted in widespread bankruptcies and banking crises. Moreover, the existence of explicit or implicit guarantees on deposits frequently transformed banking crises in runs on central bank reserves, if the central bank tried to maintain a fixed exchange rate.

This sequence of events equally describes the experiences of Chile in the early eighties, the Nordic countries in the early nineties and Korea, Thailand, and Indonesia in 1997. Many previous works noted the correlation between lending booms, banking crises, and mounting imbalances in the external account in all the above episodes (Sachs, Tornell and Velasco, 1996; Kaminsky and Reinahart, 1996; Eichengreen and Rose, 1998). Furthermore, the existence of guarantees on deposits has been considered the main cause of over-lending (McKinnon and Pill, 1996; Krugman, 1998a; Corsetti, Pesenti and Roubini, 1999).

However, lending booms and current account imbalances in the aftermath of financial liberalization are not necessarily negative. 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. 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 developing and developed countries. Therefore, the dangers posed by the combination of shallow financial markets and widely available capital due to capital inflows should be stressed, rather than the mere connection between the accumulation of

[1] I am especially grateful to Carlos Végh for long talks, encouragement, and advice. I also thank Roger Farmer, Tim Kehoe, David Levine, an anonymous referee and seminar participants at the Bank of Italy, the Vigo Workshop on Dynamic Macroeconomics, the 1999 LAMES meetings in Cancun, the 1999 EEA meeting in Santiago de Campostela and the 1999 ASSET meeting at Tel Aviv University. Of course, the usual disclaimer applies and the views expressed in no way involve the responsibility of the Bank of Italy. Email: giannetm@tin.it.

external liabilities due to current account imbalances, credit expansion, guarantees on deposits and financial crises.

This paper first provides an explanation of lending booms and banking and balance-of-payments crises in financial systems dominated by banks; it then examines the roles of domestic underdeveloped financial markets and guarantees on deposits in explaining financial instability. Finally, it concludes that over-lending by domestic banks and therefore banking crises may occur even if there is no lender of last resort.

In the model, the excessive credit expansion to unprofitable projects following the liberalization of capital movements is provoked by a "soft budget constraint distortion". This distortion arises when banks are unable to credibly commit to not refinance insolvent projects once investment costs are sunk. This, in turn, increases demand for investment *ex ante* because too many unprofitable projects are started. This problem may arise in a small open economy that has been opened to capital inflows and has few sources of credit. In fact, it is shown that the incentives to renew loans to insolvent projects disappear if there are many sources of credit, as in advanced economies where direct access to financial markets is easier and the banking systems are less concentrated. Otherwise, the relaxation of the constraints on capital movements allows banks to get large quantities of funds at low cost. This brings excess liquidity and permits the renewal of loans to insolvent projects that otherwise would not have been financed[2].

In countries where insolvent projects have been financed, the soft budget constraint distortion drives an accumulation of losses in the banking system and increases the implicit liabilities of the central bank, if this is acting as a lender of last resort. These implicit liabilities undermine the credibility of the peg when they outgrow foreign reserves. In fact, international investors believe that if there were a banking crisis the central bank would print money to guarantee the nominal value of deposits, denominated in domestic currency.

[2] The existence of a soft budget constraint distortion, due to the availability of large amounts of funds at the moment when refinancing decisions are made, has been noted in different contexts in previous works. Qian (1994), for instance, attributes the shortage of goods in socialist economies to the lack of commitment to not refinance unprofitable projects once a part of the investment costs are sunk. Furthermore, Dewatripont and

Alternatively, if deposits are denominated in foreign currency, the central bank would sell foreign reserves in an attempt to guarantee the liabilities of the defaulting banks. In either case, this may cause the exchange rate to collapse. Insolvent banks actually default when the interest rate at which international investors offer funds becomes so high that it is no longer advantageous to renew loans to insolvent projects in order to minimize the present value of the expected losses. In this case, the central bank intervenes to guarantee deposits, selling foreign reserves and therefore validating the international investors' expectations for a depreciation (or default, if deposits are denominated in foreign currency), which is what initially caused the increase in the cost of funds.

The soft budget constraint distortion that allows the financing of insolvent projects may be considered a formalization of what is now called "crony capitalism"; it is an alternative to the prevailing theories that rely on moral hazard problems due to bailout guarantees[3] or looting phenomena[4]. In contrast to the other explanations, the soft budget constraint distortion allows to analyze the subtle difference between insolvency and illiquidity when there is incomplete information about the investment opportunities in a given country; therefore, it may help to account for sequences of financial crises in countries that are equally rated by international investors. A credit boom may not only occur in a country where banks are running a Ponzi game by renewing loans to insolvent projects, but also when investment opportunities are increasing over time. If international investors have incomplete information about the determinants of the credit boom, then when the expected losses of the banking system increase enough to justify a positive probability of bank defaults, and, consequently, devaluation, the cost of funds rises also in countries where the banking system is only illiquid, but would be able to recover the loans in the long run, if the cost of funds remained unchanged. However, a temporary increase in the cost of funds may

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Maskin (1995) point out that such distortions emerge more heavily in financial systems in which the allocation of credit is centralized.

[3] On this point, see McKinnon and Pill (1996), Krugman (1998a), Corsetti, Pesenti and Roubini (1998a), Schneider and Tornell (1998). In these contributions, over-borrowing occurs because, in the presence of bailout guarantees, borrowers do not take into account the states of the world in which projects are insolvent, when choosing among different investments opportunities.

[4] See Akerlof and Romer (1993).

drive illiquid banks to insolvency and cause currency and financial crises, even if financing of illiquid projects was optimal from a social point of view. In this case, the renewal of loans to these projects should not be considered an example of crony capitalism, but rather of what is often called relationship banking[5], which is appreciated for allowing financiers to take a longer view on investment. These destabilizing effects of a temporary increase in the cost of funds on the banking system may account for phenomena of contagion among countries that are equally rated by international investors but that have different investment opportunities. Hence, a channel of contagion can be identified that is different from those already existent in the literature[6], which rely either on irrational herding behavior or on competitive devaluation. In particular, here the spillover effect is due to incomplete information about the country type and to the illiquidity of the banking system.

It is worthwhile noting that the liquidity problems and the roots of the crises analyzed in my model differ from those that characterize the models of banking and currency crises à la Diamond and Dybvig (1983), as Chang and Velasco (1998 a and b). In these models, runs on illiquid banks happen because running to the bank is a best response if other investors are running as well and there are multiple equilibria. Instead, in my model, the increase in the interest rate burden drives ex ante illiquid banks to insolvency and a crisis may follow a temporary loss of confidence.

This paper is also related to the growing literature on the "twin-crises". As in Velasco (1987) and Calvo and Mendoza (1996), this paper points out the importance of bailout guarantees that create implicit liabilities for the central bank in explaining currency crises. However, previous contributions do not endogenize bank defaults as a function of the cost of funds, which in turn depends on the risk premium required by international investors according to their expectations on the aggregate losses of the banking system; moreover, they do not discuss the causes of the "over-lending syndrome"[7]. In contrast, I explicitly

[5] See, for instance, Rajan (1992) and Hoshi, Kashyap and Scharfstein (1991).

[6] For a complete survey, see Eichengreen, Rose and Wyplosz (1996).

model the banks' lending decisions and the characteristics of the available investment opportunities. This allows me to analyze the source of the boom-bust cycle without assuming it, and the blurred difference between countries with illiquid and insolvent banking systems. Moreover, in this context, I can analyze the role of guarantees on deposits in banking system instability and show that the soft budget constraint problem may arise even without a lender of last resort.

The remaining of the paper is organized as follows. Section 2 summarizes the stylized facts. Section 3 describes the micro-structure of the model. Section 4 and Section 5 analyze the development of currency and banking crises in countries with insolvent and illiquid financial systems, respectively. In Section 6, the effects of capital inflows, guarantees on deposits and market discipline on the financial stability of countries with different risk levels are discussed. Conclusions follow in Section 7.

2. Stylized facts

In this Section, I describe several regularities observed in a number of banking and balance-of-payments crises, which suggest the importance of underdeveloped financial markets and the lack of a variety of lenders in explaining financial instability. Analyzing the experiences of Chile in 1982, the Nordic countries (Finland and Sweden) in 1991-1992, and East Asian economies in 1997, several common features clearly emerge.

1. Corporations are highly dependent on borrowing from financial institutions and, as is common in countries with bank-based financial systems, rely heavily on debt financing. Furthermore, there are close relationships between banks and firms and loan exposures are highly concentrated. Although not efficient, the financial system appears stable before the liberalization of capital movements.

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[7] An exception is Corsetti, Pesenti and Roubini (1998a), who rely on moral hazard problems due to bailout guarantees to explain over-lending. However, also in this paper, the crisis happens when an exogenous limit on implicit liabilities is reached.

The absence of a variety of financial markets and the shortage of lenders are common features of emerging markets. Moreover, in all the cases of banking and currency crises examined relationship banking was dominant.

For instance, in Chile before the 1982 crisis, the *grupos* (large financial and manufacturing conglomerates) were highly dependent on bank loans and very often the financing bank itself belonged to the conglomerates (Velasco, 1991). Dependence on bank loans was high in Nordic countries as well. In 1980, the debt equity ratios were about 3 and 4 in Finland and Sweden, respectively, compared to less than 1/5 in the United Kingdom and 1/4 in the United States. Moreover, most commercial banks had highly concentrated loan exposures, mostly to connected non-financial corporations. Relationship banking was also dominant in East Asian economies. In South Korea, for instance, bank loans were the main source of credit and there was a particular form of bank-enterprise relationship that linked each large business group, the *chaebol*, to a main bank, the so-called principal transactions bank (Nam, 1996). Amazingly, just a few years ago, these relationship-based financial systems were extolled for allowing financiers to take a longer view on investment and they were credited with the remarkably good economic performance of the East Asian economies (Rajan and Zingales, 1998). Their weaknesses became clear in 1997.

2. Banking and balance-of-payments crises follow the lifting of restrictions on capital movements that allows banks to acquire funds abroad. These new funding opportunities, made possible by large capital inflows, permit greater credit expansion than domestic retail deposits and non-profitable projects are financed. As the first signs of banks' fragility become evident, capital inflows revert and the exchange rate collapses.

Although the financial systems of the economies that experienced banking and balance-of-payments crises seemed relatively stable when capital inflows were restricted, the lifting of these restrictions coincided with the beginning of a lending boom, backed by an accumulation of foreign liabilities by domestic banks and apparently irrational lending policies.

The 1982 Chilean crisis followed the financial liberalization of the late seventies and was preceded by massive capital inflows mainly under the form of short-term bank liabilities

(See Table 1 for the data). The expansion of bank liabilities had as a counterpart an increase in bank loans that may have in fact acted as a pull factor for capital inflows. As Velasco (1991) notes analyzing the origins of the crisis:

> *"Perhaps, the single most important factor behind the growth of domestic indebtedness was the rolling over of credits and the capitalization of interest…Furthermore, the line between a performing and a nonperforming asset becomes fuzzy when rollovers and capitalization of interest are widely used to keep many problem loans on the books."(Velasco (1991))*

By 1982, this provoked a massive increase in non-performing assets and loan defaults that required government interventions. Due to the rapid expansion of net domestic credit to rescue financial institutions, the fixed exchange rate collapsed in June 1982. The events surrounding the 1994 crisis in Mexico were very similar; the crisis was preceded by a credit boom and a large increase in non-performing loans, as noted by Edwards and Végh (1997).

The origin of the banking and balance-of-payments crises in the Nordic countries also seems to rely on the accumulation of losses by the banking system; here, the lifting of restrictions on capital movements in the eighties allowed banks to get funds abroad to finance their rapid credit expansion. As a consequence, the ratio of bank loans to nominal GDP increased to 90 per cent in 1990 from 55 per cent in 1984, in Finland, while it increased to 58 per cent from 41 per cent in Sweden. Banks' difficulties became evident in 1991, when several banks were savaged by the government and the central bank had to provide liquidity. The balance-of-payments crisis hit these economies the following year in correspondence with the EMS crisis[8].

The experiences of Korea, Thailand and Indonesia during the 1997 Asian turmoil are the most recent examples of crises driven by an accumulation of bank losses. Consider once again South Korea. In the years preceding the 1997 crisis but following the opening of the financial markets in the second half of the eighties, South Korea also experienced a pronounced increase in external borrowing by domestic banks that in turn lent these funds to

[8] The Nordic countries did not belong formally to the EMS, but had their currencies pegged to the ecu.

the private sector. The data in Table 2 show large growth rates of lending to the private sector, which averaged almost 17 per cent annually in the nineties; this is well in excess of the average growth rate of per capita GDP, which was about 7 per cent annually. As a result, at the end of 1996 the ratio of short-term external liabilities of banks reporting to the Bank of International Settlements to foreign reserves was 213 per cent. The structural weaknesses of the Korean banking system became increasingly apparent during 1997. In particular, the large exposures of banks to the highly leveraged conglomerates and the huge amount of impaired loans became evident when six *chaebols* failed. Moreover, investors discovered that the average debt-to-equity ratio of the top 30 conglomerates was over 500 per cent and that most of the loans were in effect without collateral, since group firms used cross-payment guarantees to facilitate borrowing. In order to increase the confidence of international financial markets, the government announced guarantees on the foreign liabilities of Korean financial institutions. The Bank of Korea provided liquidity and, in December, it was forced to allow the won to float freely. Investors and lenders panicked when they learned that the country's short-term external debt was approximately $104 billion (rather than the $66 billion originally reported) and that usable reserves were lower than expected. As a consequence, the Korean banks' short-term external liabilities fell dramatically, because of capital outflows, and the currency depreciated by 39 per cent.

The sequences of events were similar in Thailand and Indonesia, which also experienced lending booms fueled by capital inflows in the years preceding the crises, as is evident from Tables 2 and 3.

In all these episodes banks appear to have renewed their loans to insolvent firms. Why are there incentives for banks to over-lend after the liberalization of financial markets? In the next Section, I argue that the lifting of restrictions on capital movements causes a soft budget constraint problem because a massive amount of capital becomes available at low cost in the early phase of the financial liberalization. The Ponzi scheme only ends when the cost of funds rises because of the incipient crisis.

3. Financial systems dominated by banks are generally more illiquid and their solvency is easily undermined by variations in the cost of funds. Therefore, even if the credit boom

following financial liberalization does not drive the banking system to insolvency, banking and balance-of-payments crises may be observed.

The experience of Malaysia in 1997 provides a striking example of the vulnerability of relationship banking to external variations in the cost of funds.

In comparison to the other East Asian economies, the situation of Malaysia appears somewhat different because its banking system was relatively strong in 1997, before the onset of the crisis (International Capital Markets, 1998, IMF). In fact, following the banking crisis of 1985-1988, the asset quality of the Malaysian banking system had improved substantially. The ratio of non-performing loans to total lending fell from a peak of 35 per cent in 1987 to 3.6 per cent by mid-1997 (even though banks' total lending to the private sector had increased in Malaysia as well). However, with the onset of the crisis and the consequent increase in the cost of external funds, banks and finance companies experienced a significant deterioration in asset quality. The main source of vulnerability was the high leverage of the economy: the ratio of banks' claims on the private sector to GDP was over 140 per cent in 1996. The Malaysian authorities responded by injecting liquidity into the banking system in order to keep interest rates low regardless of the negative impact on the currency. The consequences of the crisis in Malaysia were almost indistinguishable from those in South Korea.

The experience of Malaysia suggests that an illiquid and highly leveraged banking system may be an important channel of contagion, even the system is not insolvent.

A very similar mechanism may explain Argentina's experience during the Tequila crisis. On the eve of the introduction of the Convertibility Plan in 1991, financial intermediation in Argentina had reached its lowest point. With the advent of macroeconomic stabilization, though, the banking industry registered significant productivity improvements and credit to the private sector rose. This process was interrupted by the devaluation of the Mexican Peso in December 1994, which led to a sharp increase in the perceived risk of bank liabilities. As a consequence, the interest rate on commercial banks' 30 day deposits jumped and deposits fell (see Edwards 1998). Since Argentina had a currency board, which did not allow the central bank to provide liquidity or bailout the banking system, the increase in the

interest rate on deposits may be attributed either to an increase in the perceived probability of bank defaults or to the currency board's imperfect credibility. In either case, the run on deposits and the increase in the cost of funds provoked widespread bankruptcies, bank failures and a deep recession.

The model presented in the next Section formally shows the mechanism through which illiquid banks are driven to insolvency when the cost of funds rises because international investors have incomplete information on the quality of the banks' assets.

A common element of the aforementioned episodes is the centrality of the banking system in the development of the crises. In a few cases, like Chile and Korea, the crises seem to have been unavoidable outcomes of the banks' insolvency. On the other hand, Malaysia was probably driven to insolvency by an increase in the interest rate burden, which resulted from a loss of confidence in East Asian economies. However, the crisis was made possible by the high indebtedness of the economy and the illiquidity of its banking system.

Moreover, in all cases, financial liberalization was followed by massive capital inflows and a rapid increase in bank lending. What is striking is that the financial systems appeared stable before the financial liberalization. Why did capital inflows undermine financial stability? What is specific to the financial systems of these economies? I suggest that if there is shortage of lenders and the source of funds is provided by a main bank, a soft budget constraint problem may arise when an economy is opened to capital inflows. Consequently, insolvent projects may be financed, driving an accumulation of losses by the banking system. Moreover, if international investors have incomplete information about the solvency of a country's banking system and if they attribute a positive probability to banks' default in countries that are only illiquid, then an increase in the interest rate burden may drive banks to insolvency banks, even if they would have been able to recover their loans in the long run.

In the next Section, I present a model that accounts for these common features of banking and balance-of-payments crises and that can explain why the "twin crises" seem to spread very easily among countries that are considered similar by international investors.

3. The model

The objective of the model is to study the effects of capital inflows on the banking system and the monetary policy of a small open economy with a fixed exchange rate. 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 behave as international investors and to make deposits exclusively for speculative purposes.

Capital is provided by international investors who make deposits in domestic banks. The domestic banks decide whether or not to finance projects run by the managers, who have the option to start a project at $t=0$ and who need external financing. To continue production, the project needs to be refinanced any subsequent period. The central bank provides deposit insurance and, as long as it has foreign reserves, it defends the exchange rate peg.

There are two levels of asymmetric information. First, the quality of a project is initially private information of the project manager who has the option to ask for external funds or to renounce to start the project. Even if after one period the banks can determine the quality of a project, because they observe if the project manager has repaid the loan or not, international investors do not know which kind of project has been financed by their bank. Furthermore, 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 loan demand. That is to say, international investors do not observe the average productivity of capital in a given country. This is a very plausible assumption because it is difficult and subject to disputes to precisely estimate total 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.

For expositional simplicity, I assume that the country type is common knowledge for the domestic agents involved in the lending process[9].

In this context, I show that:

i) it is rational for atomistic international investors to lend without requiring any risk premium until one period before a crisis may happen with positive probability, even if the possibility of the crisis was anticipated;

ii) countries in which banks financed illiquid projects may be driven to insolvency by a temporary increase in the cost of external funds, caused by incomplete information on the type of projects financed.

A more detailed description of each type of agent follows.

3.1 The project managers

There are three country types, which differ in their average return on capital for the available projects. They cannot be distinguished by international investors. In what follows, I first describe the investment opportunities; after, I specify their availability in each type of country. Different combinations of investment opportunities result in differences in the average return on capital between countries, and therefore, distinguish country types.

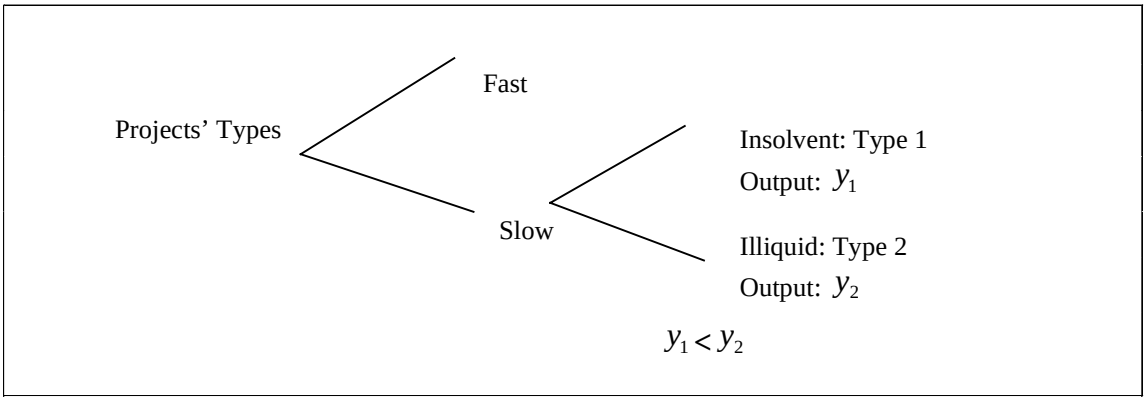
In each country, there is a continuum of project managers of mass *1* who have the possibility to start a project at *t=0*. The projects' output is homogeneous and tradable and its price in foreign currency is equal to *1*. The purchase power parity holds, and therefore, the price of the good in domestic currency, P_t, is equal to the nominal exchange rate, S_t: $P_t = S_t$.

The project managers request loans from domestic banks because they need external financing to start their projects. If refinanced at the beginning of each period, the projects can last forever.

The projects can be either fast (F) or slow[10] (S). No agent in the economy with the exception of the project's own manager, can distinguish ex ante the project type. Furthermore, slow projects may be either insolvent (type 1) or illiquid (type 2).

Figure 1

TYPES OF INVESTMENT OPPORTUNITIES AVAILABLE



Fast projects generate *y* 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. The return on fast projects is higher than the international interest rate[11], i^*: $y > (1+i^*)L$.

In contrast, slow projects do not generate any output after the first period, even if *L* has been invested at *t=0*. The loss of the initial loan creates a fixed cost for the financing bank. From the second period on, slow projects generate output y_k, if L is invested and like fast projects they can be continued forever. The level of output further differentiates slow projects between insolvent (*k=1*) and illiquid projects (*k=2*). In fact, the output can be either

[9] Results are unchanged if one removes this assumption and also domestic banks do not know ex ante the country type.

[10] In what follows, I identify the quality of a project with that of its manager.

high (y_2) or low (y_1). I assume $y > y_2 > y_1$. If the output is high ($k=2$), the project can recover its first period loss if the interest rate remains equal to the international interest rate and the project is refinanced for a sufficient number of periods. This means that:

(1) $$\sum_{t=1}^{\infty} \frac{y_2}{(1+i^*)^t} > \sum_{t=0}^{\infty} \frac{L}{(1+i^*)^{t-1}}.$$

In contrast, if after the first period output is low ($k=1$), the expected surplus of the project is negative at $t=0$, even under the most favorable conditions, that is, if the cost of funds remains equal to the international interest rate and the project is never discontinued. In this case, a slow project is insolvent and condition [2] holds:

(2) $$\sum_{t=1}^{\infty} \frac{y_1}{(1+i^*)^t} < \sum_{t=0}^{\infty} \frac{L}{(1+i^*)^{t-1}}.$$

This condition implies that $y_1 - L(1+i^*) < L(1+i^*)i^*$. This means that if $k=1$, the surplus generated by a slow project is not sufficient to recover the first period loss. Therefore, if the type of project were observable, there would not be any bank willing to finance slow projects at $t=0$, if $k=1$, whatever the capital availability. However, once the first period loan has been lost, it is advantageous to refinance slow projects, even if $k=1$, 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:

(3) $$\sum_{t=1}^{\infty} \frac{y_k}{(1+i^*)^t} > \sum_{t=1}^{\infty} \frac{L}{(1+i^*)^{t-1}} \quad \text{for all } k.$$

This implies that $y_k - L(1+i^*) > 0$. This condition on the parameters makes the "soft budget constraint" distortion possible, as I discuss describing the optimal decision of domestic banks.

Depending on the combination of available investment opportunities, a country's banking system may be either insolvent (type I country) or illiquid but able to recover initial

[11] The international interest rate might be, for instance, the return on deposits denominated in international

period losses in the long run, if the interest rate remains equal to the international interest rate (type II country) or liquid (type III country), as summarized in Table 4.

The fraction of fast projects in type I and II countries is given by θ[12]. Type I and II countries differ in the quality of available slow projects. In type I countries, there are only slow projects that produce the lowest level of output, y_1, after the first period. Hence, the banks that financed slow projects, are already insolvent at the end of the first period. In this case, as shown below, if loans to insolvent slow projects are renewed, the aggregate losses of the banking system are increasing over time. In fact, if loans are renewed, total lending rises because the expected project surplus is not sufficient to cover the interest on the initial period loss. On the other hand, a type II country is solvent but illiquid since the future output of the available slow projects is such as to recover the initial period loss. In this case, if the interest rate remains equal to the international interest rate, i^*, the losses of the banking system decrease over time. In contrast, type III countries are only endowed with fast projects. Therefore, they are liquid and solvent and the banking system cannot accumulate losses. This country type has been introduced merely for analytical convenience in order to have incomplete information also after a country reveals it is not insolvent. However, the spillover effect of a temporary increase in the interest rate due to incomplete information does not depend on this assumption.

currency. Since foreign inflation is zero in the model, it is equal to the real interest rate.

[12] This parameter is taken to be equal in both country types only for expositional simplicity, but it could well differ without modifying the conclusions of the model.

Table 4

COUNTRY TYPES

	Type I (Insolvent)	Type II (Illiquid)	Type III (Liquid)
Priors about the country's type	φ_I	φ_{II}	$1-\varphi_I-\varphi_{II}$
Fraction of fast projects	θ	θ	1
Fraction of Illiquid Slow Projects (output after the first period = y_2)	0	$1-\theta$	0
Fraction of Insolvent slow Projects (output after the first period = y_1)	$1-\theta$	0	0
Average return on investment after the first period	$\frac{\theta y+(1-\theta)y_1}{L}$	$\frac{\theta y+(1-\theta)y_2}{L}$	$\frac{y}{L}$

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 slow projects that produce low output after the first period) with probability φ_I and that the country is type II (i.e. it has a fraction $1-\theta$ of slow projects that produce high output after the first period) with probability φ_{II}. A country is type III with probability 1- $\varphi_I-\varphi_{II}$. As is conventional in games with incomplete information, the prior about the country type is exogenously given. In contrast, domestic banks know their country type, and therefore the value of y_k, even if they cannot distinguish between fast and slow projects[13] at $t=0$.

I assume that new fast projects become available in type II and III countries in each period so that total lending grows at the same rate, whatever the country type. In this way,

capital inflows to a country are not informative about the country type, even if observed by international investors[14]. In fact, in type II and III countries, total lending increases because new fast projects are available, while in type I countries it increases because, as shown below, bad loans are renewed. Consequently, investors cannot distinguish whether capital inflows are being driven by the availability of new investment opportunities or insolvent banks are running a Ponzi game with their bad loans. Therefore, in my model the accumulation of foreign debt and the current account imbalances may be due to capital flowing to the most advantageous investment opportunities or to an over-borrowing syndrome. This is a striking difference from 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 they because finance high yield investment opportunities in low saving countries, as in models *à la* Diamond-Dybvig.

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

Project managers are risk neutral and their payoff is equal to some unobservable monetary private benefits such as perquisites or the enhancement of their human capital and reputation. The private benefits for a project manager running a fast project, E_F, are positive if the cost of funds at *t=0*, i_1^l, is such that $y-(1+i_1^l)L>0$. Hence, if this condition is satisfied, project managers will always start a project. In contrast, the private benefits for a project manager running a slow project are positive only if the project continues at least until the third period and has a chance to produce positive output. Hence, if a slow project is refinanced at *t=1*, the private benefits for its manager are $E_{S/R}>0$. In contrast, if the project

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[13] Results would not be affected if the information structure of domestic banks were the same of international investors' at *t=0*. In fact, each bank only cares of the project it financed.

[14] Derivatives allow banks to acquire off-balance sheets liabilities and this makes more difficult to estimate the true magnitude of capital flows to a country.

defaults after the first period, the manager's private benefits are negative $E_{S/D} < 0$. This implies that a manager with a slow project will not start the project, if he expects that it will not be refinanced at *t=1*. This way of modeling the soft budget constraint distortion is borrowed from Dewatripont and Maskin (1995).

A project's profits are distributed among the agents of the economy who may be thought as shareholders[15]. Because of limited liability, profits must be non-negative.

3.2 The domestic banks

Domestic banks borrow from international investors and lend to project managers. Moreover, they are risk neutral and operate at no cost.

The supply of funds to banks is perfectly elastic if there are no restrictions on capital movements, as is common in models of small open economies. Hence, capital inflows are demand determined.

I first assume that all deposits and loans are denominated in domestic currency. I will argue later that all the results remain valid when deposits are denominated in foreign currency.

Without loss of generality, I assume that each bank finances a project at *t=0*[16] and that there is a continuum of banks of mass *1*. In type II and III countries, where new fast projects become available after the first period, new project managers are financed by one of the existing banks. Project managers and banks are randomly matched.

Banks compete à la Bertrand bidding the interest rate to get customers. Firms must pay back the previous period loan if they want to switch financing bank. Therefore, only managers running fast projects would be able to switch financing bank in any period, because they are always able to pay back the loan. Competition among banks implies that after the first period the nominal interest rate that project managers pay on loans, i_t^l, is equal

[15] The assumption that managers cannot use retained profits to refinance the project is not restrictive if the opportunity cost of reinvesting profits is taken into account.

to the interest rate on deposits, i_t^d, and they have no incentive to switch financing bank[17]. In contrast, if the project manager is not able to pay back the loan at *t=1*, because he is running a slow project, the bank must decide whether to force the firm to default or to allow the project to continue and appropriate profits until losses are recovered. This decision is made in order to maximize profits. This is equivalent to minimize the present value of real losses[18] and it will be analyzed later.

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 the expected profits until the crisis equal zero[19].

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3.3 The international investors

Deposits in domestic banks are held by international investors, who are risk neutral and who are only interested in their returns in foreign currency. Hence, they invest in the economy only if their expected return is at least as high as 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 a given country. Therefore, international investors cannot

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[16] This assumption is totally irrelevant as long as losses from slow projects cannot be offset by profits from fast projects. If banks behave competitively, this is always true.

[17] These assumptions on bank competition are common in the banking literature. See, for instance, Rajan (1992).

[18] This is equivalent to maximizing the value of the bank.

[19] To determine the interest rate on loans in the initial period, i_1^l, it is necessary to consider that there is a probability 1-θ that banks will be unable to recover the loans at the end of the first period, because they financed a slow 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. Since i_1^l differs across countries if domestic banks are able to observe the country type, it is

internalize the effects of an increase in the interest rate on future losses. This assumption is very common in macroeconomics since it is frequently assumed that atomistic agents do not internalize the effects of their choices on aggregate variables.

International investors simultaneously announce the interest rate at which they want to make deposits in a country. Since they behave competitively, they have no extra profits by investing in a country. This implies that the nominal interest rate on deposits made at time *t-1*, i_t^d, must satisfy the uncovered interest rate parity $(1+i_t^d)=\frac{S_t^e}{S_{t-1}}(1+i^*)$, where S_t^e is the expected value of the nominal exchange rate at time *t*.

When the expected return is equal to the international interest rate and if there are no restrictions to capital movements, any amount of foreign capital can flow into the economy. This implies that the amount of capital inflows for a given interest rate is determined by the aggregate demand for loans.

3.4 The central bank

The central bank's role is twofold. First, it is committed to act as a lender of last resort. Hence, if any bank decides to discontinue a slow project without having recovered its initial loss and declares default, the central bank will print all the money necessary to pay the depositors. Second, it defends the exchange rate peg as long as it has positive reserves. For simplicity's sake, I assume that before the balance of payments crisis the exchange rate is equal to 1. The foreign reserves of the central bank (RX) consist of foreign bonds. I assume that the interest earned on the foreign reserves is used to finance the govenment's budget deficit, *g*, so that the level of international reserves remains constant until when there is a run on the central bank reserves. This implies that $g=i^*RX$.

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necessary to assume that this is not observed by international investors. Alternatively, if domestic banks do not observe the country type the domestic interest rate is equal across countries.

In order not to make the model trivial, I rule out the possibility of a crisis at the end of the first period by assuming that international reserves are larger than first period losses in type 1 and 2 countries: $RX>(1-\theta)L(1+i^{*})$.

Owning to the existence of a lender of last resort, international investors face only exchange rate risk; they are not subject to default risk. When banks default, the central bank pays back deposits by printing domestic currency; international investors, who have no reason to hold domestic currency, exchange it for foreign currency at the central bank. If at any time *t*, claims for foreign currency by international investors holding domestic currency are greater than the available reserves, these will be equally distributed among all the claimants. In order to not have multiple equilibria, as in Diamond Dybvig (1983), I make the assumption that there is no sequential order in satisfying claims on the international reserves. In this way, I can focus on the accumulation of bank losses as unique determinant of the crisis.

This is equivalent to a devaluation of the currency and the new exchange rate is $S_t^j = \frac{\text{Total Claims at t in country j}}{RX}$, where total claims equal the aggregate losses of the banking system. Hence, after a currency crisis, the nominal exchange rate differs according to the country type, *j*.

3.5 The timing

The timing of events within each period *t* is as follows:

- The output of projects financed in *t-1*, Y_t, is realized and sold, and the profits, if any, are distributed to domestic agents.
- Banks demand funds from international investors in order to refinance projects. Based on their beliefs on the aggregate losses of domestic banks, international investors form expectations of devaluation and decide the interest rate, i_{t+1}^{d}, at which they will offer funds to the banking system of this economy.

- After observing this offer, banks decide whether or not to renew the loan to the project they funded. In particular, solvent banks are able to pay back previous period deposits, if they do not renew the loans. In contrast, banks that funded slow projects default, if they do not renew the previous loans.
- If there are no defaults, production continues until the following period; if there are defaults, the central bank pays back the depositors. In this case, international investors convert the weak currency into foreign currency. If claims on the foreign currency exceed the existing reserves, the exchange rate depreciates.
- The game ends after a financial crisis.

This sequence of events ensures that the devaluation increases the effective cost of financing investment. In fact, though the output of the projects financed at *t-1* is sold at the old exchange rate, the cost of funds incorporates the expected devaluation that occurs when international investors makes a run on the central bank's reserves. This is evident in the expression of nominal profits at time *t*: $\pi_t = S_{t-1} y - (1 + i_t^l) S_{t-1} L$, where $i_t^l = i_t^d$. An increase in the nominal interest rate on deposits due to an expected devaluation has real effects, even if the devaluation is correctly anticipated, because the output is sold before the run on foreign reserves. Hence, the nominal interest rate on deposits is equal to the effective cost of external financing.

4. The development of the "twin" crises

This Section examines the macroeconomic implications of the soft budget constraint distortion and shows that the massive amounts of funds made available at a relatively 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 in countries endowed with insolvent slow projects (type I countries) possible. This is basis of banking and balance-of-payments crises.

The dynamics of the model depends on the banking system aggregate losses. These in turn depend on the losses of individual banks. The losses of a bank that financed a slow project are a state variable, and their dynamics evolves according to a difference equation that varies according to the type of slow project, *k*, where $k \in \{1,2\}$. In nominal terms, the losses of an individual bank are $x_t^k = (1+i_t^d)x_{t-1}^k + \left[(1+i_t^d)S_{t-1}^k L - S_{t-1}^k y_k\right]$, as long as $x_{t-1}^k > 0$[20]. Afterwards, banks' profits are distributed to shareholders and, therefore, losses remain equal to zero. Consequently, the real losses are: $\tilde{x}_t^k = (1+i_t^d)\frac{S_{t-1}^k}{S_t^k}\tilde{x}_{t-1}^k + \left[(1+i_t^d)L - y_k\right]$, where $\tilde{x}_t^k \equiv \frac{x_t^k}{S_t^k}$. The nominal exchange rate at time *t* in a type *k* country is known with certainty by domestic agents, and, in particular, banks, since they know the country's type.

As is evident from the above difference equation, the losses of a bank that financed a project of type *k* at time t, $\tilde{x}_t^k$, depend on the interest rate on deposits at *t-1*, i_t^d, and the level of output, y_k.

Banks choose whether or not to refinance a slow project in order to minimize the present value of the existing losses, which is equivalent to maximizing net wealth. In particular, 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*: $\frac{\tilde{x}_{t+1}^k}{(1+i_{t+1}^d)\frac{S_t^k}{S_{t+1}^k}} < \tilde{x}_t^k$[21]. This yields a very simple sufficient condition for the renewal of a loan: a loan is renewed if the following period surplus from the project is positive, that is, $y_k - (1+i_t^d)L > 0$. Otherwise, an insolvent project will always be

[20] Of course, losses of banks in type 3 countries, where all projects are fast, are always equal to zero.

[21] I use $\frac{1}{(1+i_t^d)\frac{S_{t-1}^k}{S_t^k}}$ as intertemporal discount rate, because I am implicitly assuming that domestic banks' liabilities and assets must be domestic deposits. Of course, their net supply in equilibrium is equal to the deposits hold by the international investors.

discontinued because an increase in following period losses would imply a permanent increase in the present value of the losses. In contrast, a bank that funded an illiquid project may find it optimal to renew a loan even if current period profits are negative, if losses will be decreasing over time even after the temporary increase in the cost of funds (i.e. after the bank has revealed it is not insolvent). Formally, this happens if $\tilde{\tilde{x}}^2_{t+1} < \tilde{\tilde{x}}^{2^{SS}}$, where $\tilde{\tilde{x}}^{2^{SS}}$ is the steady state of the difference equation describing the losses of an illiquid bank.

It follows immediately from the previous discussion that as long as the interest rate on deposits remains equal to the international interest rate (when international investors do not expect any depreciation), it is optimal to renew the loan to a slow project, whether it is solvent or not, because by assumption $y_k - L(1+i^*) > 0$.

If the project is discontinued, the bank defaults.

The dynamics of the aggregate losses mimics that of the individual losses and is described by a deterministic difference equation, which varies according to the country type, *k*. This depends on the quality of available projects, as has been pointed out above. Of course, the losses of the banking system are always equal to zero in type III countries, where all projects are fast.

In writing the difference equation for aggregate losses, one needs to consider that in countries endowed with slow projects, there is a continuum of projects of mass $1-\theta$. Therefore, if $k \in \{I, II\}$ the law of motion of aggregate losses in real terms is:

$$X_t^k = (1+i_t^d)\frac{S_{t-1}^k}{S_t^k} X_{t-1}^k + [(1+i_t^d)L - y_k](1-\theta) \quad \text{if } X_t^k > 0 \tag{4}$$

and has initial condition $X_0 = (1+i^*)L(1-\theta)$. Losses remain equal to zero, otherwise[22].

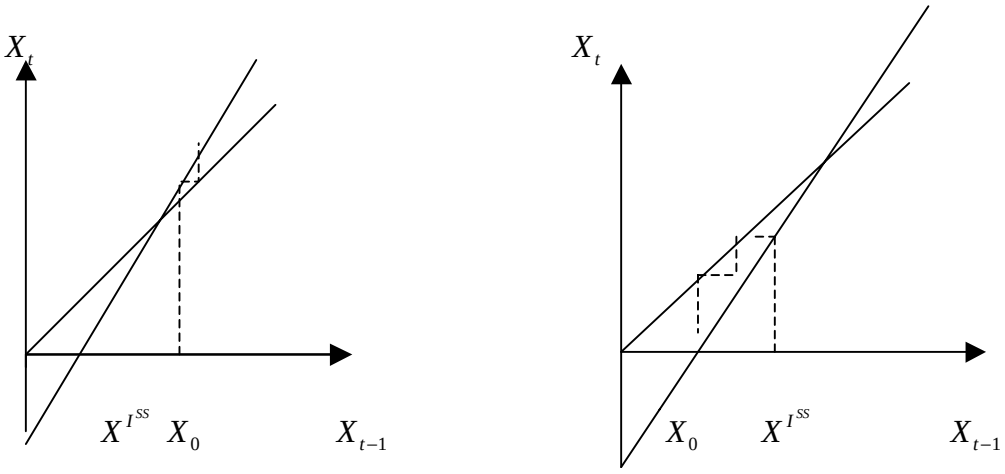
The key difference between type I and type II countries is that in type I countries (i.e. countries having insolvent slow projects), losses grow over time, even if the interest rate on

deposits remains equal to the international interest rate, i^*, while in a type II countries, losses decrease over time and can be recovered if the cost of funds remains equal to i^*. This follows immediately from the assumptions made on the parameters characterizing the two types of slow projects. The aggregate losses of an economy grow over time as long as the initial condition is at the right of the steady state of the previous difference equation. This is always true if $k=I$. In fact, the steady state of equation (4) as long as $S_{t-1}^k = S_t^k = 1$ is $\overline{X}^{kSS} = \frac{[y_k - (1+i^*)L](1-\theta)}{i^*}$ and the conclusion follows immediately from the assumptions on the parameters that characterize the output stream of insolvent slow projects. The explanation is that if $y_k = y_1$, then the expected surplus is not sufficient to cover the interest rate burden on the first period losses; therefore, aggregate losses grow over time. However, when banks make the decision whether or not to renew a loan, they do not consider this because they look at the present value of the losses. In contrast, if slow projects are solvent, as is the case in type II countries, the initial condition is at the left of the steady state of the previous difference equation and losses decline over time. In Figure 2 the laws of motion of aggregate losses in type I and II countries in the phase antecedent to the crisis when there are yet no expectations of devaluation are presented.

[22] When losses are recovered firms and banks' profits are distributed.

Figure 2

INSOLVENT COUNTRY (TYPE I) **ILLIQUID COUNTRY (TYPE II)**



When do the losses of the banking system become unsustainable and a crisis occur? I first examine the development of a crisis in a type I country, assuming that international investors' prior beliefs of having financed a type I country are ϕ_I.

The economy described in the previous Section experiences a banking crisis when the interest rate which international investors demand for deposits becomes so high that it is no longer optimal for domestic banks to renew their loans to insolvent slow projects. In this case, the banks that financed insolvent projects declare that they do not have sufficient resources to pay back their depositors and they default. The central bank, which acts as a lender of last resort, intervenes by printing money in order to pay back the depositors, who run to the central bank to convert domestic currency into foreign currency. A devaluation takes place if banks' losses are larger than foreign reserves. As previously noted, since the central bank is credibly committed to act as a lender of last resort, international investors who make deposits are not subject to any default risk but only to the exchange rate risk. Hence, the interest rate on deposits remains 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.

But when does the interest rate actually incorporate the depreciation risk? I show that this happens only one period before a crisis hits a type I country and possibly a few periods after the losses of its banking system have increased above the level of foreign reserves.

The interest rate that international investors require on deposits depends on the probability of a devaluation at any given interest rate and on the magnitude of the expected depreciation. International investors make deposits in the domestic banking system only if they have the same expected return as they would on deposits denominated in foreign currency. Therefore, the expected return on deposits must satisfy the following condition at *t-1*:

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

In determining the expected return, one must take into account that the exchange rate may be either abandoned at *t* or not. The probability of devaluation is estimated by each international investor according to the expected losses of the banking system and his individual beliefs on the country type. Moreover, the probability of devaluation is conditional on the interest rate on deposits at time *t*.

Investors believe that there are three country types, which have different banking situations and, therefore, different probabilities of abandoning the exchange rate peg. In particular, as shown above, in type II countries, the aggregate losses of the banking system decrease over time, when $i_t^d = i^*$, because illiquid projects are recovering their initial period loss. Hence, the probability of a balance-of-payments crisis is zero, since under the assumptions of the model the banking system's losses in illiquid countries are always less than the foreign reserves, if there have not been any temporary increases in the cost of funds. Moreover, in type III countries, banks have no losses; therefore, the central bank has no implicit liabilities and there cannot be runs on foreign reserves. In contrast, in a country with insolvent projects, losses are always 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 central bank reserves occurs. Of course, international investors do not observe a country's aggregate level of the losses but based on the structure of the economy they can determine their level at time *t* in type I countries.

Based on these considerations, it is possible to derive a relation between the shadow interest rate on deposits, $\tilde{i}_t^d$, and X_t^I. The shadow interest rate is defined as the interest rate at which investors are willing to lend, if there is probability ϕ_I of a depreciation (i.e. if the country is type 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 therefore they take X_t^I as given. Combining this with the expected depreciation in type I countries, $S_t^I = \frac{X_t^I}{RX}$, it is clear that, $\tilde{i}_t^d$ increases as X_t^I increases:

$$1 + i^* = (1 - \varphi_I - \varphi_{II})(1 + \tilde{i}_t^d) + \varphi_I \frac{RX}{X_t^I}(1 + \tilde{i}_t^d). \tag{6}$$

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* in type I countries. Otherwise, it remains equal to the international interest rate, i^*.

These considerations allow us to determine the time $\hat{t}$, at which a crisis may occur. In an insolvent country, a crisis occurs, when the interest rate on deposits becomes responsive to the losses of the banking system through the expected depreciation. This implies that there must be positive probability of observing a devaluation. In turn, 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 and they default. The existence of a lender of last resort and a credible commitment to defend the exchange rate peg rule out the possibility of a balance-of-

payments crisis if X_t^I<RX, or if the country type is either type II (since $X_t^{II} < RX$ at all times before a crisis becomes possible in type I countries) or type III.

Proposition 1. The timing of the crisis in insolvent countries. *Two conditions must be satisfied to observe a balance of payment crisis in type I countries:*

1. *The interest rate on deposits at* $\hat{t}$*-1,* $i_{\hat{t}}^d$*, must satisfy condition [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* $\Pr ob\{devaluation \mid i_{\hat{t}}^d\} = \phi_I$.

2. *The interest rate at which international investors will make deposits at* $\hat{t}$*,* $i_{\hat{t}+1}^d$ [23]*, is such that losses would permanently increase in type I countries, if loans were renewed (i.e.* $y_1 - (1+i_t^d)L < 0$*). Hence, insolvent banks default and the central bank intervenes by printing money. This implies that at* $\hat{t}$ *in type I countries, there is a run on central bank reserves and the peg is abandoned with probability 1.*

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 a higher devaluation. Moreover, it is interesting to note that 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 higher will be the devaluation.

Proposition 2. Uniqueness of the timing of the crisis. *The date* $\hat{t}$ *at which banking and currency crises occur in type I countries is unique.*

Proof. By contradiction, assume that international investors continue to make deposits at the international interest rate until $\tilde{t} - 1 > \hat{t}$ and that they expect a devaluation to take at $\tilde{t}$

[23] Of course, this is determined from equation (5), in order to ensure that the expected return on deposits is equal to the international interest rate.

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

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

Furthermore, there are no signals that announce a crisis since the interest rate on deposits only rises one period before, as is proved in the following proposition.

Proposition 3. *The interest rate 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 $y_1 - (1+i_t^d)L < 0$. 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, $\Pr ob\{devaluation / i_t^d\} = 0$ if $t < \hat{t}$. This implies $i_t^d = i^*$ if $t < \hat{t}$.

The effects of an interest rate increase in type II countries are considered in the next Section.

5. Contagion and sequences of financial crises

Let us now consider a type II country. The possibility of a balance-of-payments crisis at date $\hat{t}$ can immediately be ruled out since the losses of the banking system, $X_{\hat{t}}^{II}$, are lower than the international reserves. However, an increase in the interest rate due to international investors' incomplete information about the country type may also destabilize the banking system of solvent but illiquid countries.

In particular, three different scenarios are possible depending on the differences between the parameters characterizing illiquid and insolvent projects.

In the most favorable scenario, firms' current profits shrink temporarily and the interest rate burden of domestic banks increases, but there are no long-run consequences. This is the case if the increase in the interest rate burden does not increase the aggregate losses of the banking system to the point that future project surpluses are no longer sufficient to cover the interest rate payments on deposits. This means that the aggregate losses must still be decreasing over time after $\hat{t}$+1, even if $i_{\hat{t}}^{d}$ and $i_{\hat{t}+1}^{d}$ are higher than the international interest rate. Formally, this implies that after the temporary rise in the interest rate when the dynamics is once again described by the difference equation [4], the new initial condition is still on the left of the steady state: $X_{\hat{t}+1}^{II} < \overline{X}^{II\,SS}$.

An increase in the interest rate has no immediate consequences on the solvency of the banking system in a country with illiquid projects, if the difference in the average level of productivity between the two country types is large enough, because in this case the current profits of illiquid projects would remain positive. Formally, this is true if $y_2 - y_1$ is sufficiently large. Alternatively, solvency is less likely to be impaired, even if current profits become temporarily negative, the lower the losses of the banking system in type II countries at $\hat{t}$, when the exchange rate peg is no longer completely credible. In fact, if the banking system has recovered most of its initial losses, an increase in the interest rate does not imply a huge increase in the interest rate burden. This is more likely to happen if international investors attribute a small probability to the country's being type I (ϕ_I small). In this case,

the shadow interest rate on deposits is lower, and the amount of losses that a type I country must accumulate before i_t^d increases sufficiently to cause banks to default is higher. Therefore, $\hat{t}$ is higher and the banking system of a type II country has recovered most of the losses due to informational problems in the aftermath of the financial liberalization, when the exchange rate risk rises.

The second scenario is that current profits remain positive, but the temporary increase in the interest rate burden causes the losses of the banking system to rise to the point that future project surpluses are no longer sufficient to cover the interest rate burden on deposits. As follows from previous considerations, this scenario is more likely if a country is considered insolvent with high probability. In this case, the interest rate on deposits increases when losses are still large in type II countries and the increase in the interest rate burden makes banks insolvent. From $\hat{t}$ +1 on, losses increase over time and banks default at $\hat{\hat{t}}$ to be determined similarly to $\hat{t}$. If a crisis does not occur at $\hat{t}$, international investors can rule out the possibility that the country has insolvent projects. Hence, the updated probability of having financed a type II country is: $\Pr ob\{k = II \mid t \geq \hat{t}\} = \frac{\phi_{II}}{1-\phi_I}$. Even if investors can rule out the possibility of being depositors at insolvent banks, the interest rate increase may be harmful for the banking system of type II countries. If the parameters' values are such that the increase in the interest rate burden makes the country insolvent (i.e. $X_{\hat{t}+1}^{II} > \overline{X}^{II\,SS}$ after the temporary increase in the interest rate), investors believe that the exchange rate peg will be abandoned in type II countries but maintained in type III countries. Besides this, the timing of the crisis is described by Proposition 1.

Finally, there is the case in which the differences between illiquid and insolvent projects are so subtle that illiquid banks default as well at $\hat{t}$. In this case, in type II countries there is no balance-of-payments crisis. Hence, the interest rate on deposits is determined assuming a probability of devaluation equal to ϕ_I as before.

These results are summarized in Proposition 4.

Proposition 4. The effects of an increase in the interest rate in type II countries. *A temporary rise in the interest rate may cause one of the following effects in a solvent country where banks have financed illiquid projects:*

1. *A temporary squeeze on domestic profits.*
2. *Illiquid banks become insolvent. A banking crisis and a run on the central bank's reserves occur at time* $\hat{\hat{t}}$*, several periods after the initial rise in the interest rate. The dynamics of the crisis is analog to that described in Proposition 1.*
3. *A banking crisis at* $\hat{t}$*.*

A mechanism of the type described above may well account for sequences of financial crises and phenomena of contagion among countries that are equally rated by international investors (i.e. investors' beliefs about their type are described by the same probability distribution), but that have different unobservable investment opportunities.

Consider the following example: country A is type I and therefore, has insolvent banks running a Ponzi game bound to end in a financial crisis at time $\hat{t}$, as described in the previous Section. Instead, in country B, there are a few slow projects but these are illiquid and all the initial losses would be recovered if international investors continued to lend at the international interest rate. However, if condition $X^{II}_{\hat{t}+1} > \overline{X}^{II\,SS}$ holds, a financial crisis in country A is followed by a financial crisis in country B. This happens because a temporary loss of confidence has permanent effects on the liabilities of the banking system. In country B, however, the renewal of loans to slow projects is not negative, since it allows liquidity problems to be overcome and, therefore, it is desirable from a social point. Indeed, the financing of illiquid but profitable projects was often considered one of the benefits of relationship based financial systems, and credited for allowing financiers to take a longer view on investment. Notwithstanding this, a financial system based on relationship banking may be easily destabilized since a temporary increase in the interest rate may sooner or later provoke a banking crisis. Hence, this kind of mechanism can account for the rapid spread of the crisis among East Asian economies, and help to explain why this model of bank-firm relationship suddenly imploded and began to be called crony capitalism. In particular, my

model shows that in the presence of incomplete information about the solvency of the projects financed by the banking system a relationship-based financial system is vulnerable to a sudden increase in the interest rate at which funds are available from the rest of the world due to a temporary loss of confidence. In fact, a temporary increase in the interest rate burden may have permanent effects on banks' solvency and it can spark sequences of banking and balance-of-payments crises.

The framework I described hereby may be easily extended to the case in which banks' liabilities are denominated in foreign currency. The mechanism driving the crisis is similar in this case for both country types. If liabilities are denominated in foreign currency, international investors are not subject to exchange rate risk, but default risk is present. In fact, even if the central bank provides guarantees on deposits, it has only a finite quantity of foreign reserves to pay back depositors since it is cannot print foreign currency. Therefore, the interest rate goes up because the perceived risk of default becomes positive as the expected losses surpass the upper limit determined in Proposition 1. Moreover, the spillover effects on type II countries are the same as described in Proposition 4.

6. Different institutional arrangements and vulnerability to financial crises

This Section analyzes the characterizing elements of financial systems of countries endowed with slow projects, in order to understand the determinants of financial instability, and it suggests different institutional arrangements.

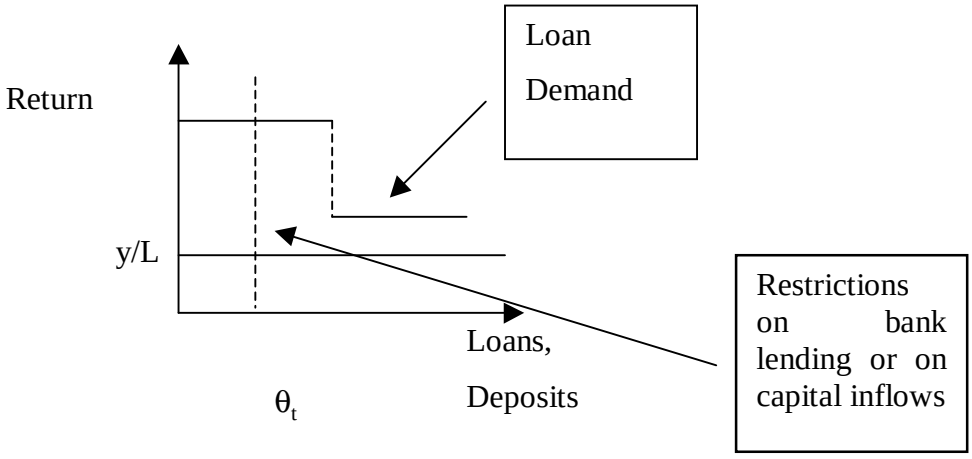
6.1 Restrictions on capital inflows

The lack of restrictions on the growth of bank lending and the consequent accumulation of foreign debt are the first elements necessary for the development of a crisis in the model. This may occur because the supply of funds from international investors is infinitely elastic in a small open economy integrated with the rest of the world, at least as long as investors do not perceive any exchange rate or default risk.

Figure 3 shows loan demand and the supply of funds from international investors before the interest rate on deposits increases above the international interest rate because the occurrence of a crisis takes on positive probability.

Figure 3

EQUILIBRIUM IN THE CREDIT MARKET



The availability of large quantities of external capital, due to capital inflows, would definitively be desirable if there were no information asymmetries, since foreign borrowing would be used to finance profitable investment opportunities such as fast projects or illiquid slow projects. In fact, these kinds of investment generate enough output to service the external debt. In this case, foreign borrowing stimulates growth in the economy, since it allows the pursuit of all profitable investment opportunities. However, the existence of asymmetric information about the country type and the heterogeneity of investment opportunities create the possibility that bank lending increases because bad loans are renewed to insolvent projects and interest is capitalized. In this case, the distortion arises because managers endowed with insolvent slow projects ask for external financing, if they expect that the loan will be renewed after one period. A limitation on the funds available to the banking system would eliminate this kind of distortion. If bank lending cannot grow, banks would be credibly committed to not renew loans to insolvent slow projects and,

consequently, their managers would not ask for financing. Alternatively, the same result could be achieved through a tax on capital inflows by increasing the cost of external funds, the soft budget constraint distortion can be eliminated. This happens if the after tax cost of funds makes the project surplus negative: $y_1 - (1 + i^*_{TAX})L < 0$.

Capital controls by altering either the cost of funds or the scale of inflows may indeed eliminate the soft budget constraint distortion that drives the accumulation of losses by the banking system. An empirical study by Eichengreen, Rose and Wyploz (1996) confirms that capital controls helped prevent financial crises during the 1979-1993 period.

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, as in type II countries, 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, taxes on capital inflows are preferable because they increase the cost of capital, but do not prevent credit expansion. In this model, this instrument actually permits reaching the first best without any distortion, whatever the country type, because when 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. Therefore, less distorting methods for achieving financial stability should be found.

6.2 Absence of guarantees on deposits

A widely used explanation of unsustainable credit expansion is that in the presence of guarantees on deposits the interest rate on foreign borrowing is not responsive to the risk of bank defaults (see, for instance, Krugman, 1998a). The failure of the cost of funds to

internalize default risk may contribute to the soft budget constraint distortion, since it reduces the cost of renewing loans. Can the elimination of bailout guarantees enhance financial stability in this context?

To answer to this question I must first examine how the interest rate on deposits is determined in equilibrium, when risk neutral depositors are not covered by bailout guarantees and then I must analyze how this changes the incentives of banks to renew loans to slow projects. It will be evident that even without guarantees on deposits the interest rate becomes responsive to risk only when there is a positive probability of observing bank defaults. As before, this depends on the interest rate at which international investors are willing to make deposits, since the decision whether to renew loans or not is made on the basis of the current surplus from investment.

Each atomistic investor is willing to make deposits in the economy described above if the expected return on deposits is equal to the international interest rate. The probability that deposits are paid back at the end of the period depends on:

1. The fraction of non performing loans in a country with slow projects of type *k* at date *t*, $\psi_t^k \equiv \frac{X_t^k}{Z_t}$, where Z_t is the amount of capital inflows at time *t*, which is equal to the deposits of international investors in domestic banks at time *t*.

2. The probability that insolvent banks default at *t*. This occurs when the cost of funds increases to the point that it is no longer advantageous to renew loans to slow projects. This depends on the interest rate required for deposits at *t* and on the type of slow projects.

Therefore, the interest rate on deposits is determined by the following condition:

(7)

$$[1-\phi_I\psi_t^I \Pr ob\{default \mid i_t^d, k=I\} - \phi_{II}\psi_t^{II} \Pr ob\{default \mid i_t^d, k=II\}](1+i_t^d) = 1+i^*.$$

In equation (7), not only loans to insolvent banks in type I countries must be considered in determining the risk of bank defaults, but also loans to illiquid banks in type II

countries. In fact, if the interest rate on deposits grows too high, banks in type II countries may default as well.

In the game without guarantees on deposits, there are two types of equilibrium. Depending on the parameters' values, either all slow projects are started and refinanced after the first period or only a subset of them is.

Shadow interest rates must be defined, as in the previous Section. We must now consider the interest rates on deposits that international investors would demand if they expected either that both types of slow projects will be discontinued, $\tilde{\tilde{i}}_t^d$, or else that only type 1 slow projects will not be refinanced, $\hat{\hat{i}}_t^d$, in the event of a crisis. These are respectively:

(8) $$[1-\phi_I\psi_t^I-\phi_{II}\psi_t^{II}](1+\tilde{\tilde{i}}_t^d)=1+i^*$$

and

(9) $$[1-\phi_I\psi_t^I](1+\hat{\hat{i}}_t^d)=1+i^*.$$

If at the shadow interest rate all managers with slow projects ask for financing, then all projects are started and continued after the first period, even if there are no guarantees on deposits. This is true if either $y_1-(1+\tilde{\tilde{i}}_2^d)L>0$ or $y_1-(1+\tilde{\tilde{i}}_2^d)L<0$, but $\tilde{x}_2^2<\tilde{x}^{2SS}$ and $y_1-(1+\hat{\hat{i}}_2^d)L>0$. These conditions imply that at the relevant shadow interest rate renewing the loan to slow projects is optimal. In this case, there are no defaults at *t=1* and $i_2^d=i^*$. Hence, the cost of funds may fail to internalize the risk of bank default even without bailout guarantees. This is because investors know that banks with slow projects default only if it is no longer advantageous for them to renew loans at the current interest rate on deposits. Otherwise, there is no risk connected with depositing in domestic banks.

The development of the banking crisis is very similar to the one analyzed in Proposition 1. In particular, the cost of funds rises only if there is positive probability of bank defaults, which is only possible if the banking system of a type I country has accumulated a sufficient amount of losses. A banking crisis occurs in a type I country at $\tilde{t}$,

if $y_1 - (1+\hat{\tilde{i}}^d_{t+1})L < 0$. In this case, the temporary increase of the cost of funds may destabilize the banking system of a type II country as well. Moreover, if if current period profits are negative ($y_2 - (1+\tilde{\tilde{i}}^d_{t+1})L < 0$) and the level of losses would permanently increase ($\tilde{x}^2_{t+1} > \tilde{x}^{2^{SS}}$), a banking crisis happens in type I and II countries at the same time.

On the other hand, if at the shadow interest rate at least insolvent slow projects would not ask for financing, then the absence of guarantees on deposits may limit the number of insolvent projects that are refinanced, but it will not eliminate the possibility of a banking crisis. This is the case if at the shadow interest rate it is unadvantageous to renew loans both to insolvent and to illiquid projects ($y_1 - (1+\tilde{\tilde{i}}^d_2)L < 0$, $\tilde{x}^2_2 > \tilde{x}^{2^{SS}}$), or else, only if loans are not renewed to insolvent projects alone($y_1 - (1+\tilde{\tilde{i}}^d_2)L < 0$, $\tilde{x}^2_2 < \tilde{x}^{2^{SS}}$, but $y_1 - (1+\hat{\tilde{i}}^d_2)L < 0$). In this case, there may exist an equilibrium in which only a subset of insolvent slow projects is refinanced, but all of them will be started. In particular, banks refinance insolvent slow projects with probability *p*. This is an equilibrium if:

i) Managers with insolvent slow projects have a non-negative expected payoff from starting the project: $pE_{S/R} + (1-p)E_{S/D} \geq 0$.

ii) Banks, which financed an insolvent slow project, are indifferent between renewing the loan or not at *t=1*: $y_1 - (1+i^d_2)L = 0$. Therefore, it is optimal to renew with probability *p*.

iii) International investors' expected return is equal to the international interest rate: $(1+i^d_2)[1-\phi_I(1-p)\psi^I_2] = 1+i^*$.

iv) It is always possible to find p such that ii) and iii) are jointly satisfied, if $y_1 - (1+\hat{\tilde{i}}^d_2)L < 0$ holds. Such an equilibrium exists if p satisfies i).

In this equilibrium, defaults at *t=2* reveal the country type. If there are defaults, investors learn that the country is type I and they no longer lend. In this case, a type II country reveals it is not insolvent, but it may still be hurt by the higher cost of funds. In fact,

if there are no guarantees on deposits it is even more likely that the increase in the cost of funds above the international interest rate will destabilize the banking system in illiquid countries because this occurs when losses are still high in the early periods of the game. Hence, the increase in the interest rate burden may drive the banking system to insolvency in type II countries for a wider range of parameters.

The absence of guarantees on deposits can eliminate the soft budget constraint distortion only when it is not advantageous to refinance all the illiquid slow projects when no insolvent projects have been started. This happens if $y_2 - (1+\hat{i}_2^d)L < 0$, where $1+\hat{i}_2^d \equiv \frac{1+i^*}{1-\phi_{II}\psi_2^{II}}$.

In this case, there exists an equilibrium in which banks refinance illiquid projects with probability *q*, the interest rate on deposits at *t=1* is $1+i_2^d \equiv \frac{1+i^*}{1-\phi_{II}(1-q)\psi_2^{II}}$, and $y_2 - (1+i_2^d)L = 0$, if $qE_{S/R} + (1-q)E_{S/D} \geq 0$. The conditions for the existence of such an equilibrium are even more restrictive because $q < p$, and the previous inequality, which is the participation constraint of project managers, is less likely to be satisfied.

In this equilibrium, which arises in situations of extreme illiquidity, a few illiquid projects are discontinued and, therefore, profitable investment opportunities are forgone.

Proposition 5. The absence of guarantees on deposits and the soft budget constraint distortion. *Without guarantees on deposits, the soft budget constraint distortion is generally not eliminated (i.e. there exist equilibria in which insolvent projects are refinanced).*

The soft budget constraint problem may be eliminated only if the interest rate that international investors require on deposits internalizes risk from the very early stages of the game. In turn, this is possible only if the share of deposits that banks are unable to pay back is already considered very high at the end of the first period. Hence, not providing guarantees on deposits may stabilize the banking system only in situations of extreme

illiquidity and this implies costs in terms of forgone investment opportunities because several illiquid projects which would be profitable in the long run are not financed.

6.3 Market discipline

Why is there more evidence of soft budget constraint problems 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, as emerges from the stylized facts in Section 2, 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. I show that if a borrower has many lenders and there are no dominant sources of credit, then noone has an incentive to renew loans to insolvent firms; however, loans to firms that are solvent in the long run, but are facing illiquidity problems will be renewed.

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.

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 recovery of the first period loan and the investment ends with a loss equal to zero, because a project cannot be continued without paying the creditors who do not wish to renew the loan. 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 low, 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.

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 renew. 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: $\sum_{t=1}^{\infty}\frac{y_1 - L(1+i^*)}{(1+i^*)^t} - L(1+i^*)$. The difference between the two expected payoffs is negative, if the number of lenders is sufficiently large. In fact, this is: $\sum_{t=1}^{\infty}\frac{y_1 - L(1+i^*)}{(1+i^*)^t} - \frac{N-1}{N}L(1+i^*)$, which is equal to $\sum_{t=1}^{\infty}\frac{y_1 - L(1+i^*)}{(1+i^*)^t} - L(1+i^*)$ in the limit. 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. On the basis of the assumptions on their private benefits, the project managers would not ask for funding at *t=0*, and the accumulation of losses by the banking system that causes financial instability would not take place.

Therefore, a coordination problem among lenders can eliminate the soft-budget constraint distortion arising in markets in which the decision to reinvest is centralized. This method, well-known in the corporate finance literature (see, for instance, Hart (1995)) represents the only way to impede insolvent slow projects from being started without increasing the cost of funds and, therefore, reducing the share of domestic profits.

What if *k=2* and, therefore, slow projects are illiquid but not insolvent? In this case, under my informational assumptions, it is advantageous to renew if other lenders are not

renewing and if the cost of funds remains low[24]. In fact, the payoff from renewing is $\sum_{t=1}^{\infty} \frac{y_2 - L(1+i^*)}{(1+i^*)^t} - \frac{N-1}{N} L(1+i^*) > 0$. Hence, illiquid projects are never discontinued at *t=1*.

This analysis 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, I find that the introduction of market discipline through competition of intermediaries operating in a country eliminates the soft budget constraint distortion, even if the central bank provides bailout guarantees and depositors acquire no information on the quality of banks' assets.

7. Conclusions

This paper shows that it may be rational for financing banks to renew loans to insolvent projects, once they have incurred sunk costs, if funds are available in large quantities and at relatively low cost from international investors. This drives an accumulation of losses by the banking system, while the nominal interest rate fails to internalize risk in the early stages of financial liberalization. In fact, the interest rate on deposits rises only when the expected losses are so high that there is a positive probability that banks will default.

Moreover, the rise in the cost of funds is associated with bank defaults and balance-of-payments crises not only in countries where banks financed insolvent projects, but also where profitable illiquid projects were financed. In fact, a temporary increase in the interest rate burden may drive banks that financed illiquid slow projects to insolvency, even if loan renewal was optimal from a social point of view.

In this context, in which the accumulation of losses is driven by a soft budget constraint distortion and there is contagion because of incomplete information about the country type, it is possible to revise the conclusions about the negative effects of bailout

[24] This is easy to check by looking at the sign of previous payoffs for *k=2*.

guarantees. The absence of bailout guarantees cannot eliminate the soft budget constraint distortion. Limitations on capital inflows can achieve this goal but are also likely to result in the forgoing of profitable investment opportunities. In contrast, market solutions appear more desirable. In fact, the model showed that soft budget constraint problems are more likely to happen in emerging markets where credit is provided by a main source of finance and there are incentives to renew loans to slow projects, even if these are insolvent. The existence of multiple credit source in more advanced financial systems eliminates the soft budget constraint distortion through the strategic interaction of the multiple sources of credit. Hence, stability may be achieved through the modernization of the financial system and the development of bond markets. In fact, if markets are developed and there are many lenders, international investors can rule out the possibility that a country's banking system is insolvent and crises no longer occur in the model.

Tables

Table 1

CHILE, 1982

	1975	1976	1977	1978	1979	1980	1981	1982
Outstanding Short-term Liabilities (in percent of GDP)	12.1	9.2	10.1	13.5	16.4	21.9	30.3	48.9
Loans of Banking System to private sector (in percent of GDP)	6.4	8.9	14.8	20.3	28.2	40.2	54.9	61.7

Source: Velasco (1996)

Table 2

LENDING BOOM IN EAST ASIAN ECONOMIES

Rate of growth of bank lending to the private sector						
	1991	1992	1993	1994	1995	1996
Korea	20.78	12.55	12.94	20.08	15.45	20.01
Indonesia	17.82	12.29	25.48	22.97	22.57	21.45
Thailand	20.45	20.52	24.03	30.26	23.76	14.63
Malaysia	20.58	10.79	10.80	16.04	30.65	20.24

Source: Corsetti, Pesenti, and Roubini (1998)

Table 3

FINANCIAL FRAGILITY OF EAST ASIAN ECONOMIES

Short-term liabilities towards BIS banks as percent of foreign reserves. End of 1996.			
Korea	Indonesia	Thailand	Malaysia
213	181	169	47

Source: Corsetti, Pesenti, and Roubini (1998)

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.

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.

Calvo, G. (1996), "Varieties of capital-market crises", University of Maryland, mimeo.

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.

Chang, R. and A. Velasco (1998a), "Financial fragility and the exchange rate regime", NBER Working Paper, No. 6469.

Chang, R. and A. Velasco (1998b), "Financial crises in emerging markets: a canonical model", NBER Working Paper, No. 6606.

Cole, H. L. and T. J. Kehoe (1996), "A self-fullfilling model of Mexico's 1994-1995 debt crisis", *Journal of International Economics*, Vol. 41, pp. 309-30.

Corsetti, G., P. Pesenti and N. Roubini (1998), "What caused the Asian currency and financial crisis?", Banca d'Italia, Temi di Discussione, No. 343.

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.

Diaz-Alejandro, C. (1985), "Good-Bye financial repression, hello financial crash", *Journal of Development Economics*, Vol. 19, pp. 1-24.

Dooley, M. P. (1997), "A model of crises in emerging markets", NBER Working Paper, No. 6300.

Drees, B. and C. Pazarbasioglu (1995), "The Nording banking crises: pitfalls in financial liberalization?", IMF Working Paper, No. 95/61.

Edwards, S. and C. A. Végh (1997), "Banks and macroeconomic disturbances under predetermined exchange rates", *Journal of Monetary Economics*, Vol. 40, pp. 239-78.

Edwards, S. (1998), "Interest rate volatility, capital controls and contagion", NBER Working Paper, No. 6756.

Eichengreen, B., A. K. Rose and C. Wyplosz (1996), "Contagiuos currency crises", NBER Working Paper, No. 5681.

Eichengreen, B. and A. K. Rose (1998), "Staying afloat when the wind shifts: external factors and emerging market banking crises", NBER Working Paper, No. 6370.

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

Giavazzi, F. and M. Pagano (1990), "Confidence crises and public debt management", in R. Dorbusch and M. Draghi, eds., *Public Debt Management: theory and history*, Cambridge, Cambridge University Press.

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

Hsieh, S. (1997), "What explains the industrial revolution in East Asia? Evidence from factor markets", University of California, Berkeley, mimeo.

Hoshi, T., A. Kashyap, and D. Scharfstein (1991), "Corporate structure, liquidity, and investment: evidence from Japanese panel data", *Quarterly Journal of Economics*, Vol. 27, pp. 33-60.

IMF, *International capital markets*, various issues.

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

Krugman, P. (1998b), "Fire-sale FDI", Massachusetts Institute of Technology, mimeo.

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.

Qian, Y. (1994), "A theory of shortage in socialist economies based on the soft budget constraint", *American Economic Review*, Vol. 84, pp. 145-56.

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, pp. 40-8.

Sachs, J., A. Tornell and A. Velasco (1996), "Financial crises in emerging markets: the lessons from 1995", *Brookings Papers on Economic Activity*, pp. 147-215.

Salant, S. W. and D. W. Henderson (1978), "Market anticipations of government policies and the price of gold", *Journal of Political Economy*, Vol. 86, pp. 627-48.

Schneider, M. and A. Tornell (1998), "Lending booms and assets price inflation", Harvard University, mimeo.

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 D.C., 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. 6657.

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