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"Original Sin," Balance Sheet Crises, and the Roles of International Lending

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"Original Sin," Balance Sheet Crises, and the Roles of International Lending

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Abstract

We present a stylized framework which encompasses a variety of "balance sheet approaches" to currency crises that have been suggested in the literature, and analyze their policy implications. The common theme is that currency and maturity mismatches in private sector balance sheets constrain the capacity of monetary and fiscal policies to deal with self-fulfilling capital account crises, and generate a role for international crisis lending. International lending could be used to back domestic last-resort lending to banks, or to loosen fiscal constraints. Provided they have a sound fiscal position in normal times, this can make countries immune to self-fulfilling crises.

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I. Introduction

A number of commentators have expressed the view that the financial crises of the 1990s were of a new kind, reflecting fragilities in the balance sheet of firms, banks and governments rather than current account imbalances.[2] Some of them have argued that the international community should take a new approach—a balance sheet approach—to the management of international financial crises.

One source of balance sheet fragility that is often emphasized is foreign currency debt. One sense in which foreign currency debt is the "original sin" (Eichengreen and Hausmann, 1999) is that it is the source of so many other problems. Foreign currency debt constrains traditional domestic policy instruments, such as monetary or fiscal policies, in dealing with economic shocks, both homemade and foreign. Almost by default, this suggests a larger potential role for international official lending, as reflected in the heavy involvement of international financial institutions in Latin America and other areas of the world suffering from "original sin." But how and why can international lending be a useful complement to domestic economic policies in these countries? More specifically, how can the role of international lending be rationalized in the context of the "balance sheet approach" to financial crises?

This paper will answer these questions in the context of a simple framework that encompasses—in a highly stylized way—several of the models that have been proposed in the recent literature on international financial crises. As we will show, the general consensus that foreign currency debt is problematic masks a surprising variety of opinions and models of the dangers involved. Rather than presenting one more model of the dangers of foreign currency debt, this paper will present a framework that is general and flexible enough to organize a discussion of the recent literature, in a way that is not dependent on inessential modeling details. The first part of the paper can be viewed as a brief tour of the literature for the practitioner. In the second part of the paper, we discuss some of the challenges for domestic policies that arise in this framework, and the potential roles for international crisis lending.

Our framework gives a stylized summary of two classes of models of balance sheet crises. The first class of models combines a currency mismatch with a maturity mismatch: debt is not only in foreign currency but also short term, typically banking deposits (Chang and Velasco, 2000; Burnside, Eichenbaum, and Rebelo, 2001a,b,c; Jeanne and Wyplosz, 2001). Crises take the form of runs on short term foreign currency debt. The second class of models involves a currency mismatch, without maturity mismatch, in corporate balance sheets (Krugman, 1999; Aghion, Bacchetta, and Banerjee, 2000, 2001a,b; Bacchetta, 2000, Schneider and Tornell, 2001). Crises involve a severe credit crunch and a fall in investment. In *both* cases, crises can be self-fulfilling, the depreciation of the exchange rate being

[2] See, among others, Dornbusch (1998), Krugman (1999, 2001), Pettis (2001), and recently Allen et al. (2002) and Calvo (2002).

validated by the real disruption it provokes. Both classes of models are supported by some evidence,[3] making it interesting to explore their policy implications.

We argue that the policy implications of the two classes of models are similar in some areas, but quite different in others. One policy implication that all balance sheet approaches seem to have in common is the relative powerlessness of domestic policies—and especially monetary policy—in protecting the economy against capital account crises. Moreover, there could be an important role for international crisis lending in both classes of models, but the nature of this role is quite different. In the first class of models (models with runs), the optimal policies should be thought of by reference to banking safety nets: lending-in-last-resort, deposit insurance, or suspension of payments. We argue that such policies do not necessarily place unrealistic demands on international crisis lending, although they raise knotty moral hazard issues, just like domestic banking safety nets. In the context of credit crunch models, international crisis lending may also have a useful role, but it has little to do with lending-in-last resort, and more with loosening credit constraints for domestic agents, including the government. A large international lender can help overcome self-fulfilling crises by lending to the government conditioning on its "true" net worth, i.e.,, its net worth in normal times, allowing it to pursue activities that mitigate the effects of the credit crunch.

There are several caveats to make. The most important one is that we look at the question from a purely ex post perspective. The "original sin" is taken as given. Obviously, however, the different policies we consider have an impact ex ante on the decisions to borrow in domestic or foreign currency (an endogeneity that several contributions in this volume look at). We briefly discuss this issue at the end of the paper.

II. Elements of a Canonical Framework

We consider a two-period model of an open emerging economy ($t = 1,2$). For the sake of brevity and *couleur locale* we call the domestic and foreign currencies "peso" and "dollar," respectively. The exchange rate S_t is defined as the time t domestic currency price of one dollar, so an increase in S means that the peso depreciates.

The objective of the model is to clarify a range of possible links between expectations about future exchange rates, S_2^e, and balance sheets—or more precisely, domestic private agent's net worth in terms of dollars, W^*. In principle, links can exist in both directions. The link from expected exchange rates to net worth follows more or less directly from the presence of unhedged foreign currency liabilities. However, the balance sheet problems caused by the expected depreciation could also be part of the fundamentals that market participants look at in deciding what exchange rate to expect. If that is the case, there could be multiple equilibria, one of which one could be pareto-dominated. Expectations of depreciated future

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[3] On the banking crisis channel, see Burnside, Eichenbaum, and Rebelo (2001c). On firm-level currency mismatches and investment, see Aguiar (2001) and Rodriguez (2002).

exchange rates could lead to low net worth, triggering an economic crisis and depreciated exchange rates which in turn validate the initial expectations.

To develop a framework that generates self-fulfilling crises of this kind we must thus construct a "loop" from S_2^e to W^* and back to S_2^e. We do so in three steps. First, we describe the link from S_2^e to net worth W^*. This step is straightforward and somewhat mechanical; it follows from balance sheet definitions and uncovered interest parity. Second, we describe two alternative links from W^* to an economic crisis state X, which is given a particular interpretation in each case. This step is not mechanical, and involves most of the economic substance of this paper. Finally, we discuss a variety of possible ways, suggested in the literature on balance sheet crises, in which X could affect future exchange rates. In contrast with the previous step, we do not formalize these alternative links because the (monetary and international) policy implications on which we focus in this paper turn out to depend only on the presence of *some* link from X to a depreciated exchange rate, not on how the particular channel is modeled. Thus it is sufficient for the purposes of this paper to assume that a link from X to expected exchange rates exists in reduced form.

A. The Link from Expected Exchange Rates to Net Worth

Assume that the peso/dollar exchange rate satisfies uncovered interest rate parity (UIP):

$$S_1 = \frac{1+i^*}{1+i} S_2^e$$

where S_2^e is the expected exchange rate, and i and i^* are peso and dollar riskless interest rates in period 1, respectively.[4]

Next, consider domestic private agents (firms, or banks) who have debts and income streams denominated in dollars and pesos. The currency composition of income streams and debts is inherited from an earlier time and it is exogenous to the analysis. Let D_t denote the agents' time t debt repayment in pesos, D_t^* their time t debt repayments in dollars, R_t their peso income and R_t^* their dollar income. Note that we assume that the peso value of the agent's

[4] The role of UIP is to monotonically relate first period interest rates to first period exchange rates, given exchange rate expectations. As long as it preserves this link, assuming a more general form of UIP—or a specific violation of UIP—will not change the structure of our framework, and multiple equilibria remain possible. For example, the results would go through if we allowed an exogenous risk premium, and would strengthen if the risk premium depended on economy-wide net worth—as in Céspedes, Chang, and Velasco (2002a, 2002b)—or directly on exchange rate expectations. This said, the presence of a "wedge" in the UIP relationship may also enhance the effectiveness of monetary policy in dealing with adverse shifts in exchange rate expectations, a point to which we return below.

cash flows is not affected by the exchange rate. However, this is not a very restrictive assumption since having a peso-denominated income stream that exhibits some exchange rate pass-through could be represented as a combination of fixed peso income and dollar income (for which pass-through is unity).

We are now ready to define the agents' net worth. This is the central variable in the balance sheet approach: all the bad things, bank runs or credit crunches, happen because of insufficient or negative net worth. Using UIP and denoting by $D^* \equiv D_1^* + D_2^*/(1+i^*)$ and $R^* \equiv R_1^* + R_2^*/(1+i^*)$ the present value dollar debt and dollar income of the agent, respectively, its net worth can be expressed in terms of the expected exchange rate and the interest rate

$$(1) \qquad W^* = \frac{R_2 - D_2 + (R_1 - D_1)(1+i)}{(1+i^*)S_2^e} + R^* - D^*$$

If the agent has enough pesos to repay its peso debt in each period ($R_1 \geq D_1$ and $R_2 \geq D_2$) then its net worth is decreasing with the expected exchange rate, and could become negative for high levels of S_2^e if the agent also has dollar debt (D^*). The same would be true if we looked at the peso value of the agent's net worth.

B. The Link from Net Worth to Crises

Why is low net worth a problem? Two answers (not necessarily mutually exclusive) are given in the literature. One view emphasizes the net worth constraint on investment that is standard in corporate finance. Firms cannot borrow more than a given fraction of their net worth; thus, net worth constrains investment. This channel is invoked in Krugman (1999), Aghion, Bacchetta, and Banerjee (2000, 2001a, 2001b), and Schneider and Tornell (2001). The alternative view emphasizes the link between net worth and banking crises (Chang and Velasco, 2000; Burnside, Eichenbaum, and Rebelo, 2001b,c; Jeanne and Wyplosz, 2001). Low net worth leads to the collapse of the banking system. We now briefly develop both views.

Banking Crises

Assume that the agent is a bank. Following Jeanne and Wyplosz (2001), we assume that the bank suffers from a combination of currency and maturity mismatches, as follows: (1) its dollar debt exceeds its dollar income both in the first period and in present value terms, i.e.,, $D_1^* > R_1^*$ and $D^* > R^*$; (2) while the firm has second period income denominated in pesos, peso debt and first period peso income equals zero $(R_1 = D_1 = D_2 = 0)$. As we shall see below, assumption (1) is essential while (2) is made mainly for convenience.

Deposits are repayable on demand, and demand is served sequentially, as in Diamond and Dybvig's (1983) model of bank runs. The withdrawing depositors are randomly allocated in a queue which determines the order in which they are served. The bank repays depositors by selling its claims on future pesos for dollars in the market (unlike Diamond and Dybvig, 1983; and Chang and Velasco, 2000, we assume that the bank's assets are perfectly liquid and can be sold at their net present value in the market). If the bank does not have enough dollars to repay all the withdrawing depositors in period 1, the depositors at the end of the queue, and those who have not joined the queue, receive nothing. In the opposite case, the assets that remain in the possession of the bank at the end of period 1 are sold in period 2 to repay the remaining depositors—those who have not withdrawn in period 1. Deposits are interest-bearing, and yield the riskless international interest rate.

Under these assumptions, a fall in the bank's net worth can provoke a run. There is no run if and only if net worth is positive, i.e., if and only if

(2) $$D^* \leq R^* + \frac{R_2}{(1+i^*)S_2^e}$$

If this solvency condition is satisfied the bank can repay all its depositors irrespective of the date at which they withdraw, and depositors have no (strict) incentives to withdraw early. If this condition is not satisfied, then all depositors run on the bank at period 1. Some depositors will have to take a loss, and each depositor minimizes the likelihood of being one of them by withdrawing his deposits early. Note that in contrast with the Diamond-Dybvig model, the equilibrium is unique at the level of an individual bank. Because there are no costs to early liquidation, net worth is not affected by the occurrence of a run per se. Thus, for a given balance sheet structure, the occurrence of a run is determined only by the expected exchange rate, which is exogenous to the actions of the bank's depositors (the bank being very small).

Finally, assume that banks are heterogeneous in terms of their balance sheet characteristics. Because we have assumed that $D^* > R^*$, each bank j has a specific cut off exchange rate $\overline{S}_2^e(j)$ at which its net worth is zero. Assume that banks are infinitesimally small with total mass one, and that $\overline{S}_2^e(j)$ is continuously distributed with a cumulative distribution function $F(.)$. For a given S_2^e, all the banks for which $\overline{S}_2^e(j) < S_2^e$, i.e.,, whose net worth is smaller than zero, will suffer a run. Consequently, the fraction of banks on which there are runs in period 1, n, is a continuous and increasing function of the expected exchange rate,

(3) $$n = F(S_2^e) \qquad F' > 0, \quad F(\hat{S}_2^e) = 1$$

where $\hat{S}_2^e$ denotes the supremum of $\overline{S}_2^e(j)$, i.e.,, the exchange rate at which the highest net worth bank becomes insolvent. An expected depreciation of the peso reduces the net worth of banks, drawing a larger number into insolvency. For $S_2^e \geq \hat{S}_2^e$, all banks are insolvent.

A Credit Crunch

Next, consider the case in which there is a currency mismatch but no maturity mismatch. Specifically, we assume that all dollar debt is long term ($D_1^* = 0$), but maintain the assumption that there is a currency mismatch with respect to the present value of dollar assets and liabilities $(D_2^*/(1+i^*) > R^*)$. This case can be interpreted as a firm that relies on some income in the non-tradables sector to maintain positive net worth. For simplicity, we keep the assumption that $R_1 = D_1 = D_2 = 0$; this will be relaxed later. Dollar net worth is then:

$$(4) \qquad W^* = R^* + \frac{R_2}{(1+i^*)S_2^e} - \frac{D_2^*}{(1+i^*)}$$

An increase in S_2^e reduces the firm's net worth in period 1.[5] This does not provoke a default in period 1 since the firm does not have to repay or roll over debt in this period. However, it could constrain the quantity of new debt the firm can issue in period 1. In many corporate finance models net worth is a determinant of the firm's borrowing capacity and consequently its ability to invest.

Following Aghion, Bacchetta, and Banerjee (2001), we assume that there is a first-best level of investment, $\tilde{I}$, which the firm would like to undertake if it is not credit constrained. Whether or not it can actually invest $\tilde{I}$ depends on its borrowing capacity, which in turn is constrained by its net worth. Assuming a simple linear constraint and no internal funds, the firm's actual investment, in dollar terms, can be written as

$$(5) \qquad I = \begin{Bmatrix} \tilde{I} & \text{if} & \tilde{I} \le \mu W^*(S_2^e) \\ \mu W^*(S_2^e) & \text{if} & \tilde{I} > \mu W^*(S_2^e) > 0 \\ 0 & \text{if} & \mu W^*(S_2^e) \le 0 \end{Bmatrix}$$

From (4) it is clear that there is a sufficiently small (i.e., appreciated) level of the second period exchange rate so that $I = \tilde{I}$. Denote this level $\underline{S}_2^e$. Similarly, since we have assumed that $D_2^*/(1+i^*) > R^*$, there is a sufficiently high (depreciated) level of the exchange rate such that net worth is zero, and thus $I = 0$. Denote this $\overline{S}_2^e$. We can now define an "investment gap" u which is analogous to the bank run function (3), in the sense that it expresses the real cost of low net worth as a function of the second period exchange rate:

$$(6) \qquad u \equiv \tilde{I} - I = \begin{Bmatrix} \tilde{I} & \text{if} & S_2^e \ge \overline{S}_2^e \\ \tilde{I} - \mu W^*(S_2^e) & \text{if} & \overline{S}_2^e > S_2^e > \underline{S}_2^e \\ 0 & \text{if} & \underline{S}_2^e \ge S_2^e \end{Bmatrix}$$

[5] Because of the currency mismatch, this is true regardless of whether net worth is expressed in dollars or in pesos. The fact that we express net worth in dollars is merely a convention.

For $\overline{S}_2^e > S_2^e > \underline{S}_2^e$, the real cost of a credit crunch is a continuous and strictly increasing function of S_2^e, since $W^*(S_2^e)$ is continuous and strictly decreasing in S_2^e. This is true for each individual firm, and it is true in the aggregate regardless of whether or not firms are heterogeneous. Any increase in S_2^e beyond $\overline{S}_2^e$ will cause investment to fall to zero.

C. The Link from Crises to Depreciated Exchange Rates

The final step is to construct a link from the bad consequences of net worth—a credit crunch, low investment, a banking crisis—to future exchange rates. Broadly classified, the literature has focused on three arguments:

- Low investment results in a low domestic demand for home/nontradable goods or a low domestic supply of tradable goods, which forces a real depreciation. This is the channel assumed by Krugman (1999), Chang and Velasco (2000), and Schneider and Tornell (2001) in the context of purely "real" models, i.e., models without money and nominal exchange rates.

- Low future output in conjunction with an assumption about future monetary policy, which implies that low future output feeds through to prices and (with PPP) a depreciated exchange rate (Aghion, Bacchetta, and Banerjee, 2000, 2001a; Bacchetta 2000, Jeanne and Wyplosz, 2001).

- The insolvency of corporations or banks leads to a debt-financed bail-out (Corsetti, Pesenti and Roubini,1999; Burnside, Eichenbaum, and Rebelo, 2001b,c). The increase in public debt is financed by a monetization, causing the exchange rate to depreciate.

Of these three stories, the one that is easiest to incorporate in our framework is the argument that low future output leads to depreciated exchange rates. In the context of our framework, this is convenient because it does not matter whether the output disruption comes from a credit crunch or from a banking crisis. To complete the argument, one must merely show (or assume) that the monetary authorities would want to partly accommodate the output collapse by allowing the second period exchange rate to depreciate. One story (Jeanne and Wyplosz, 2001) is that this might be optimal in order to minimize real disruptions if the authorities face a Phillips curve-type trade-off in the second period.

The debt monetization argument could also be adapted to close our stylized framework. In the context of banking crises it provides a simple alternative rationale for why one might expect a jump in the money supply and thus a depreciation of the exchange rate. Similarly, one could assume that the government guarantees and ultimately monetizes the liabilities of insolvent corporations, as in Corsetti, Pesenti, and Roubini (1999). Finally, if the ex post problem is not bank or corporate insolvencies per se but rather low investment, one could assume that the government wishes to undertake offsetting fiscal measures that ultimately lead to higher inflation, or that low investment and low output reduce direct tax revenue and force the government to rely more on the inflation tax, driving up the exchange rate.

Krugman's (1999), Chang and Velasco's (2000), and Schneider and Tornell's (2001) real exchange rate depreciations cannot be directly represented in our framework, since they require a nonmonetary, two good model. However, they give rise to essentially the same link. In the credit crunch story, low investment depreciates the real exchange rate in either the same period or in the future, either because investment is in home goods, or because it is critical to the future production of tradable goods. The same link applies in the banking crisis version of the model, except that it is the collapse of the banking system that triggers the credit crunch rather than low corporate net worth directly.

In short, low corporate net worth, underinvestment, or banking crises can be linked back to exchange rate depreciation in multiple ways. In the next section, we will focus on policy implications of our balance sheet framework for which the precise nature of this link is not critical. Consequently, we confine ourselves to assuming such a link in reduced form:

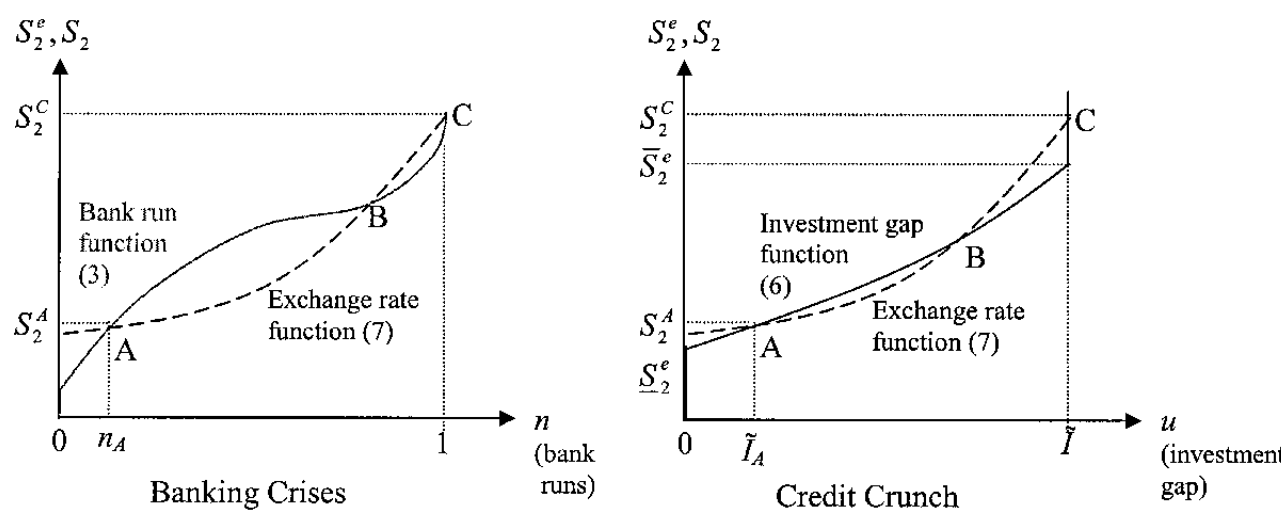
$$S_2 = G(x) \qquad G' > 0 \tag{7}$$

where x stands for either the number of runs, n (in the banking crisis model) or the investment gap u (in the credit crunch model).

D. Equilibria

Putting together the pieces derived in the last three sections, equation (7) defines the link from real economic disruptions to the second period exchange rate, while equations (3) and (6), define the links from the expected second period exchange rate to bank runs or underinvestment, respectively. In a rational expectations equilibrium, expected and actual exchange rates must be the same. Since (7), (3) and (6) all describe increasing functions, the models generically give rise to multiple equilibria, as drawn below (Figure 1).

Figure 1. Equilibria in Banking Crises and Credit Crunch Models



Except for the suggested shapes of the bank run and credit crunch functions (which are derived from a cumulative distribution function in the first case but not in the second) the left and right figures are very similar. In each case, there are two stable equilibria: a "good" equilibrium with low disruptions and an appreciated exchange rate (A), and a "bad" one with complete disruption and a depreciated exchange rate (C). The middle equilibrium B is not stable.

III. Policy Implications

What are the complications arising from the presence of balance sheet effects? It is useful to distinguish between two classes of problems.

First, even without feedback effects, the link from the expected exchange rate to net worth complicates optimal policy responses to exogenous shocks. Specifically, the currency mismatch in balance sheets can magnify the impact of shocks that have little to do with balance sheets originally. An exogenous deterioration in the fundamentals that makes a depreciation more likely (say an adverse terms of trade shock) disrupts the real economy by decreasing the net worth of firms and banks with a currency mismatch in their balance sheets. As argued above, this can lead to bank runs and/or a collapse in investment and thus a further deterioration in the fundamentals. Whether or not standard policy prescriptions on how to deal with balance of payments shocks still apply is not obvious. In general, the optimal policy response—and in particular, whether monetary policy should be tightened or loosened, and whether exchange rates should be allowed to respond—will depend on the magnitude of the shock, the extent of the underlying balance sheet vulnerability, and the remaining structure of the model (see Céspedes, Chang, and Velasco, 2001, 2002a,b; and Christiano, Gust, and Roldos, 2002) for two different approaches to this problem).

The presence of a feedback effect from balance sheets to exchange rates creates a further complication because of the possibility of self-fulfilling crises. In the framework outlined above, we have two stable equilibria, one of which dominates the other in output terms. Expectations of depreciated future exchange rates can lead to low net worth, low future output, and depreciated exchange rates which validate the initial expectations. The potential task for policy is then somewhat different: rather than looking at the optimal reaction of policy to exogenous shock in the presence of a new channel through which shocks are transmitted, the question is how policy can be used to rule out the crisis equilibrium. This is the policy question on which we concentrate in the remainder of this paper.

A. Exchange Rate Regimes and Dollarization

In principle, the problems described in the previous section can arise both under pegs and in floating regimes. What is important is the possibility of an adverse shift in expectations about future exchange rates, S_2^e. This could be either an expected devaluation (in a pegged regime) or just a depreciation (in a floating regime). Conditioning on given balance sheet mismatches, what matters is not the nature of the exchange rate regime per se, but the likelihood that the monetary authorities will resist a depreciation of the domestic currency. In particular, an exchange rate regime which credibly fixes S_2 removes self-fulfilling crises for all the specifications of our framework (in Figure 1, this would imply a completely horizontal exchange rate function (7), intersecting functions (3) and (6) in point A only). This could be an argument in favor of full dollarization: if a country permanently adopts the dollar as its currency, the currency mismatch problem disappears.

However, there are two caveats to this argument:

First, in our framework, the possibility of self-fulfilling currency crises disappears only if dollarization is viewed as sufficiently hard to reverse. If there is any chance that the economy will be "re-pesified" in an economic crisis, then dollarization is no different in principle from any other hard peg. Whether it makes a difference will depend on whether dollarization introduces costs to devaluation, from the perspective of the monetary authorities, that exceed those of other pegged regimes. In terms of Figure 1, the question is whether the exchange rate function becomes sufficiently flat that equilibrium B disappears. Depending of what one thinks about the reversibility of dollarization, this may or may not be the case.

Second, there are versions of the balance sheet approach to international financial crises which involve no currency at all (in particular, Krugman, 1999, Chang and Velasco, 2000, and Schneider and Tornell, 2001). In these models, the currency mismatch problem is replaced by the assumption that the net worth of domestic firms depends on revenues from the sale of home (or nontradable) goods, and the role of the nominal exchange rate in our framework is assumed by the real exchange rate. Adverse expectational shifts no longer refer to the value of the currency, but rather to real economic variables such as the level of investment, the level of domestic demand for home goods, or the domestic supply of tradable goods. In these circumstances, multiple equilibria can arise even if the economy is fully and irreversibly dollarized, taking the argument that the exchange rate regime is irrelevant to the possibility of balance sheet crises one step further.

Finally, it bears repeating that this view is correct only as long as balance sheet mismatches themselves are not endogenous to the currency regime. It is sometimes argued that flexible exchange rate regimes reduce currency mismatches because they encourage hedging in the corporate and banking sectors.[6] If this were true, a flexible regime would be preferable because it reduces the underlying balance sheet problem. As an empirical matter, however, the argument remains controversial,[7] and it is outside the scope of our analysis, which takes mismatches as a given.

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[6] Burnside, Eichenbaum, and Rebelo (2001a,c); Goldstein (2002).

[7] Consistent with the view that flexible exchange rates reduce mismatches, Martinez and Werner (2001) find that after the 1994 currency collapse and adoption of a floating regime, Mexican corporations reduced their unhedged foreign currency exposure. However, in a cross-country study, Arteta (2002) finds that flexible regimes are associated with a higher share of dollar deposits but not dollar credit. According to that study, exchange rate flexibility thus seems to exacerbate currency mismatches in the banking system.

In the remainder of this paper, we assume that the simple solution to currency mismatches—irrevocable dollarization—is either unfeasible or undesirable for reasons outside our model. This forces us to consider the scope of economic policies in an environment that in principle allows for the possibility of adverse exchange rate expectations, taking mismatches as a given. We begin with a discussion of domestic policy and then turn to the potential roles for international lending.

B. Monetary Policy

Can domestic monetary policy in a floating exchange rate regime deal with the basic inefficiency introduced by the presence of foreign currency debt, i.e., eliminate the equilibrium at point C? In the two examples considered so far, the answer is clearly "no." This can be seen from the fact that the peso interest rate, *i*, does not appear in the balance sheet expressions (2) and (4). In the examples we have focused on so far, monetary policy is thus irrelevant: net worth is *entirely independent* of how domestic interest rates are set. This extreme result is a consequence of the assumption that $R_1 = D_1 = D_2 = 0$, which implies that net peso income in the first period $(R_1 - D_1)$ is zero. As a result, net worth in equations (2) and (4)—given international interest rates and dollar assets and liabilities—depends only on today's dollar value of *future* pesos, i.e., on

$$\frac{R_2}{(1+i^*)S_2^e} \equiv \frac{(1+i)}{(1+i^*)S_2^e} \cdot \frac{R_2}{(1+i)} = \frac{1}{S_1} \cdot \frac{R_2}{(1+i)}$$

Raising the interest rate appreciates the exchange rate today and thus the dollar value of peso income today, but at the same time it reduces the peso value of future peso income. If the period 1 net peso cash flow is zero, the two effects cancel out, and domestic monetary policy is impotent. For an increase in interest rates to be the right policy response, the agent must have a positive net cash flow in terms of pesos in period 1, whose dollar value is increased by the appreciation (or which can be invested at the high interest rate, to put it in another way). This can be seen by going back to the net worth definition (1):

$$(8) \qquad W^* = \frac{R_2 - D_2}{(1+i^*)S_2^e} + \frac{(R_1 - D_1)(1+i)}{(1+i^*)S_2^e} + R^* - D^*$$

Both the first and the last two terms on the right hand side are independent of domestic monetary policy, and the impact of domestic interest rates works entirely through first period net income.

Does the more general balance sheet structure underlying equation (8) still give rise to multiple equilibria, and could domestic monetary policy be used to eliminate the "bad" equilibrium? It depends. Consider first the bank run model, which assumed that banks are heterogeneous in terms of their balance sheet characteristics. There is obviously a trivial case where $R_1 - D_1$ is greater than zero for all banks. In this case, defending the first period exchange rate—i.e., tightening monetary policy in the face of an adverse shift in expectations—will always work: no matter how depreciated S_2^e is, there is always a sufficiently high interest rate so that positive net worth can be restored. But this is not the case when banks are heterogeneous in the sense that $R_1 - D_1$ is greater than zero for some but smaller than zero for others. Assume that in this case the central bank sets i to minimize the number of bank runs, i.e., the share of banks with positive net worth, taking S_2^e as given. Denote the central bank's reaction function by $i(S_2^e)$, and by $N(S_2^e)$ the corresponding number of insolvent banks. Then, assuming that $R^* - D^* < 0$, it is easy to see that $N(S_2^e)$ is monotonically increasing in S_2^e.[8] The only difference relative to the previous section is that $N(S_2^e)$ is bounded from above by the fraction of banks for which $R_1 - D_1 < 0$, since it is always possible to maintain the solvency of the other banks through a sufficiently tough interest rate defense. Thus, if the exchange rate function (7) is steep enough (see Figure 1) multiple equilibria will continue to exist. While monetary policy can minimize the impact of adverse exchange rate expectations on the banking system in the first period, it cannot prevent bank runs from occurring. Since the share of banks that suffer from runs remains a positive function of exchange rate expectations, monetary policy will not, in general be able to rule out self-fulfilling crises.

The same logic can be applied to the credit crunch model. Again, there is a trivial case where an interest rate defense always works: this is the case when $R_1 - D_1 > 0$ holds for all firms. If $R_1 - D_1$ is greater than zero for some firms but smaller than zero for others then there will again be an optimal first period monetary policy that seeks to minimize the damage from adverse exchange rate expectations. In this case, the policy would set the interest rate so as to maximize the volume of investment at any given S_2^e. Denote this maximum volume $I(S_2^e)$. Using an argument exactly analogous to the one in footnote 4, it can be shown that $I(S_2^e)$ is decreasing in S_2^e, i.e., that the investment gap is increasing in S_2^e (again, the critical property is that for any given interest rate, net worth is falling in S_2^e). As a result, Figure 1 still applies and multiple equilibria will still exist in general.

The main conclusion is thus that monetary policy will be rendered ineffective, in the sense that it cannot protect the economy from adverse shifts in expectations with real costs, for a wide range of balance sheet problems. However, this conclusion is subject to two caveats.

The first caveat refers to assuming uncovered interest parity. For given exchange rate expectations S_2^e, UIP implies that interest rate policy and exchange rate policy are one and the same thing. This rules out a strategy in which the central bank seeks to prop up net worth by *both* maintaining the interest rate low *and* the exchange rate appreciated. In particular,

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[8] Because the net worth of *all* banks is decreasing with S_2^e, it cannot be the case that the monetary authorities manage to reduce the number of bank runs when S_2^e increases (if they could, this would mean that interest rate policy was not optimal to begin with).

sterilized intervention—selling dollars in the open market, while keeping interest rates constant—is ineffective.

As was mentioned earlier, there are plausible violations of UIP which would impose an even tighter constraint on monetary policy, for example, if risk premia tend to move together with exchange rate expectations and net worth. But UIP might also be violated in the sense that perfect capital mobility does not hold, either because foreign and domestic bonds are not perfect substitutes, or because of capital controls. Everything else equal, this would mitigate the impact of adverse shifts in exchange rate expectations and increase the power of monetary policy. Within certain bounds, the monetary authorities may be able to control both interest rates and exchange rates, i.e., sterilized intervention might be feasible.[9] Whether or not this would be enough to eliminate the "bad" equilibrium in Figure 1 is of course an open issue; it depends on the degree to which sterilized intervention is feasible.

A second channel which we have implicitly ruled out is the possibility that monetary policy could directly affect the net flows—in particular, through an effect on peso income—that make up the bank and firm balance sheets in our model. Again, dropping this assumption would weaken our conclusions but may not overturn them. Assume, for example, that some units in the economy are never constrained in their investment or spending, and that the first period income R_1 of the banks or firms we have considered so far depends on spending by these units. Then, by lowering interest rates the monetary authorities might be able to stimulate R_1 directly, in addition to changing the net present value of R_2 and D_2. In itself, this need not invalidate the conclusions; it just adds one additional channel which the monetary authorities have to consider when optimally setting first period interest rates in an environment of heterogeneous agents. However, it is of course possible to conceive of a situation where this "direct revenue effect" of monetary policy is so strong that it maintains high net worth for a wide range of second period exchange rate expectations, and eliminates the "bad" equilibrium.[10] This is just saying that the analysis presented in this paper should be

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[9] To give one example, consider a proportional tax t on capital inflows. Then, from the first period perspective of (risk-neutral) foreigners, flows into the country will not occur if $(1+i^*) > (1+i)\cdot(1-t)(S_1/S_2^e)$. Conversely, from the perspective of residents who want to repatriate their investment in the second period, outflows will not occur if $(1+i) > (1+i^*)\cdot(1-t)(S_1/S_2^e)$. It follows that there will be no flows as long as interest rates are in the range $\frac{(1+i^*)}{(1-t)}\frac{S_2^e}{S_1} > (1+i) > (1+i^*)\cdot(1-t)\frac{S_2^e}{S_1}$. For given expectations S_2^e, the monetary authorities can manipulate interest rates in this range while keeping the exchange rate unchanged

[10] This would be the case if the effect of lose monetary policy on R_1 is so strong that it generates a positive first period net cash flow $R_1 - D_1$ which is sufficiently large to outweigh the negative impact of the discounted second period cash flow. In Figure 1, this amounts to

viewed as relevant to situations where balance sheet effects are important relative to more traditional channels for monetary policy.

C. Fiscal Policy

To discuss fiscal policy, it is necessary to introduce the government into our framework. In the following, we limit ourselves to a simple extension in which we assume that government spending subject to an intertemporal budget constraint can in principle make up for the bad effects of bank runs and/or private underinvestment. The problem is that this constraint may become binding in a balance sheet crisis, limiting the government's capacity to deal with the consequences of adverse exchange rate expectations just when it is needed most. Thus, economy-wide balance sheet mismatches could place limitations on the use of fiscal policy which are similar in flavor as the ones discussed for monetary policy in the preceding section.

The simplest way to introduce the government in our framework is as an additional agent alongside firms or banks, subject to its own net worth constraint. In principle, there are two channels through which this government could break the vicious circle that leads to self-fulfilling runs: in the first period, through measures to limit the banking crisis (through bank recapitalization) or the investment gap; in the second period, by altering the feedback from these disruptions to future exchange rates. Since we have not modeled the latter except through the reduced form relationship assumed at the end of Section II.C, we focus on the former.

To maximize the potential beneficial impact from fiscal policy, we abstract from the possibility that the government itself could be subject to runs. This means assuming that government net worth, W_G^* , is described by equation (4) (the net worth constraint for firms, with no short term dollar debt) rather than (2) (the net worth constraint for banks). In the government context, local currency receipts R could be interpreted as taxes, while local currency liabilities D could be interpreted either as domestic debt or as expenditures (say, entitlements). The government may or may not have foreign currency liabilities—the arguments that follow only require a private sector balance sheet mismatch, but not necessarily an additional currency mismatch in the government balance sheet.

We focus on the credit crunch story (an analogous argument could be made for the bank run story). In principle, there are three avenues through which the government could mitigate the aggregate investment shortfall: first, by improving the net worth position of firms through either transfers or a tax cut, second, through public investment, and third, as an additional source of lending for credit-constrained private firms. The first of these two channels are about fiscal policy as it is conventionally understood, and assuming that private and public investment are perfect substitutes, they are essentially equivalent. In contrast, the third

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shifting the bank run or investment gap functions up until they no longer intersect with the exchange rate function (except on the y axis).

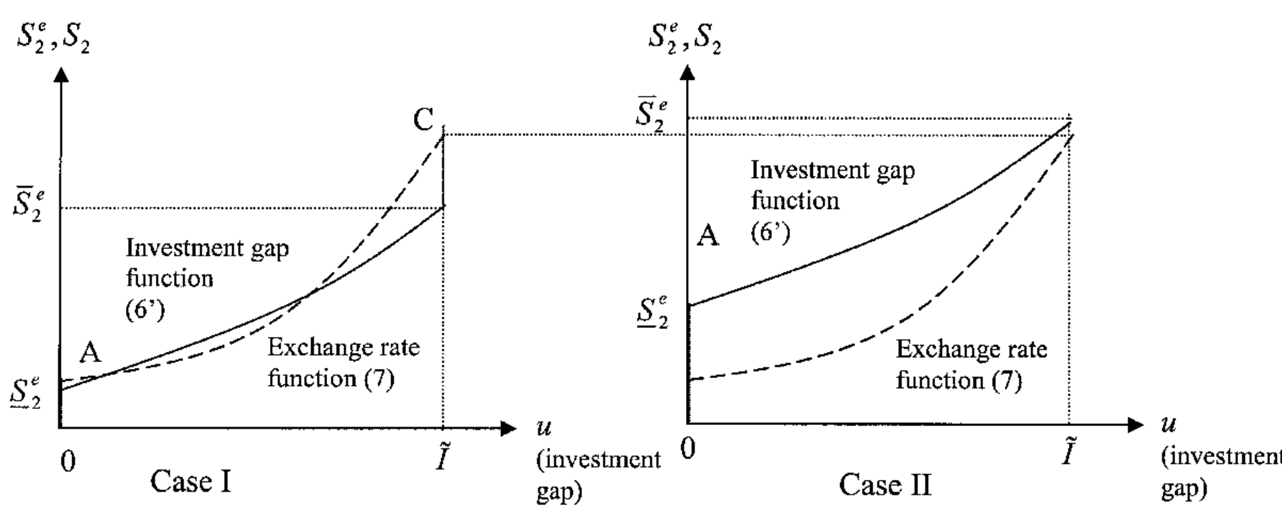
channel is somewhat different. Here, the government does not actually spend funds but serves as a financial intermediary, borrowing from capital markets and lending to firms. In practice, we rarely see the government performing such functions, presumably because they require specialized monitors, such as commercial banks. We thus focus on the conventional fiscal policy channels, but briefly return to the financial intermediation story below.

Assume that the government can increase the aggregate net worth of firms either through a first period tax cut or an increase in transfers, constrained only by its own net worth. If we assume that the government can borrow up to its net worth, this is the same as saying that the government can finance an increase in aggregate investment subject to its intertemporal budget constraint. If the government's objective is to close the economy-wide investment gap as far as possible, the aggregate gap will then be defined like in equation (6), except that investment is now constrained by *total* private and public sector borrowing capacity, $\max\{0,\mu W^*(S_2^e)\}+\max\{0,W_G^*(S_2^e)\}$, and the thresholds $\underline{S}_2^e$ and $\overline{S}_2^e$ are redefined as the exchange rates at which total rather than private borrowing capacity becomes equal to $\tilde{I}$ and equal to zero, respectively.

$$(6') \qquad u \equiv \tilde{I} - I = \begin{Bmatrix} \tilde{I} & \text{if} & S_2^e \geq \overline{S}_2^e \\ \tilde{I} - \max\{0,\mu W^*(S_2^e)\} + \max\{0, W_G^*(S_2^e)\} & \text{if} & \overline{S}_2^e > S_2^e > \underline{S}_2^e \\ 0 & \text{if} & \underline{S}_2^e \geq S_2^e \end{Bmatrix}$$

Comparing (6') and (6), it is clear that the effect of the investment subsidies is to shift the investment gap function up. The thresholds $\underline{S}_2^e$ and $\overline{S}_2^e$ must be at least as high as before, and for each exchange rate level at which the private sector is credit constrained, the investment gap must be smaller than before (strictly smaller if the government has strictly positive net worth at that exchange rate level). But is it enough to eliminate the bad equilibrium? The answer depends on the solvency of the government, as illustrated in Figure (2).

Figure 2. Equilibria in Credit Crunch Model with Government



If the upward shift in the investment function gap function relative to Figure 1 is small (Case I), then the presence of an investment subsidy policy will lower the investment gap conditioning on the good equilibrium (point A) and may remove it altogether, but it does not rule out the inferior equilibrium (point C). In this case, pooling the government borrowing capacity with that of the private sector does not add all that much. Case II illustrates a situation where the extra borrowing capacity makes a big difference. At the equilibrium exchange rate level corresponding to point C in Case I, the Case II investment gap is just a little too small to validate the depreciated exchange rate level. Thus, there is a unique equilibrium at A.

A similar effect could be achieved by government *lending* to individual firms rather than fiscal policy. Since the underlying market failure is one of coordination among private creditors, the government can reduce this failure by acting as a large financial intermediary, lending to firms in the amount of the difference between their borrowing capacity conditioning on the "good" equilibrium outcome, and their actual borrowing given expected exchange rates. However, as long as the government relies on funds borrowed in the capital markets, this lending policy can never be more effective in removing the "bad" equilibrium than the fiscal policy described above, since the same economy-wide borrowing constraint will apply as in equation (6'). While government intermediation could overcome the private creditor coordination failure with respect to firms, it remains constrained by a private creditor coordination failure with respect to its *own* borrowing.

The lesson is that the government can improve matters—be it through tax cuts, transfers, public investment, lending, or bank recapitalization—only if it is "solvent enough" even in the adverse circumstances of a balance sheet crisis. This solvency standard is much more stringent than the conventional definition of fiscal solvency, which typically refers to positive government net worth conditioning on current exchange rates. In contrast, being solvent enough to rule out a self-fulfilling balance sheet crisis means having sufficient net worth to close the investment gap (or recapitalize banks), *even conditioning on the depreciated (crisis) exchange rate.*

We have so far assumed that government net worth is given for any second period exchange rate level. However, fiscal policy may have some control over government net worth through measures to cut expenditures or improve tax administration. To the extent that applying these measures pushes government solvency over the critical threshold where the country is no longer vulnerable to adverse shifts in expectations, this creates a rationale for fiscal adjustment as a preventive measure. Of course, if policy measures of this kind are applied at the onset of a crisis, they will only work if their direct contractionary effects on output do not fully offset the expansionary benefits of the activities that they are meant to finance, namely investment and/or bank recapitalization.

D. International Crisis Lending

International crisis lending is the one area in which the distinction between the credit crunch channel and the bank run channel of balance sheet crises really matters. We begin by restating the Jeanne-Wyplosz (2001) argument about international lending as support of last resort lending targeted to specific banks, and then turn to the question of how, if at all, international lending might play a role in the context of the credit crunch model.

Throughout the section, we interpret "international crisis lending" as international *official* crisis lending. However, this is merely a reflection of the fact that in the past, large-scale lending to emerging market governments during a crisis has come mainly from official sources, namely IFIs and in some cases, bilateral creditors. What is essential in our framework is merely that the lender be *large*, in the sense that it acknowledges the endogeneity of exchange rates to its lending. In principle, a syndicate of banks could be a large lender in this sense. In practice, however, contingent credit lines from banks or bank syndicates have been rare, so there seem to be difficulties in placing large-scale crisis lending in the hands of the private sector (for reasons outside our framework).

Bank Runs

One feature of the "bad" equilibrium C in Figure 1, is that both "truly insolvent" banks suffer from runs—those that have negative net worth even at the appreciated second period exchange rate S_2^A associated with the "good" equilibrium—and "conditionally solvent" banks which would have positive net worth in "normal" circumstances, i.e., for $S_2 = S_2^A$. Now suppose the domestic monetary authorities announce a policy of either lending dollars to conditionally solvent institutions that require them in the event of a run, or guarantees on the dollar deposits of these institutions.[11] If the monetary authorities have enough reserves to back these policies, both of these policies would eliminate the "bad" equilibrium by guaranteeing the continuing operation of conditionally solvent banks. "Truly insolvent institutions" would still suffer from runs and collapse, but their collapse, by definition, is consistent with the relatively appreciated exchange rate S_2^A. The bad equilibrium disappears because the banking collapses that are allowed by the authorities are too minor to validate depreciated exchange rate expectations.

More formally, let n denote the number of bank *collapses* and n_A the number of banks that collapse even in the "good" equilibrium A, i.e., the "truly insolvent" banks.[12] The effect of

[11] As argued by Jeanne and Wyplosz (2001), lending or selling dollars in the open market will not work since this amounts to a sterilized intervention, which is ineffective because of UIP (see Section III.A above).

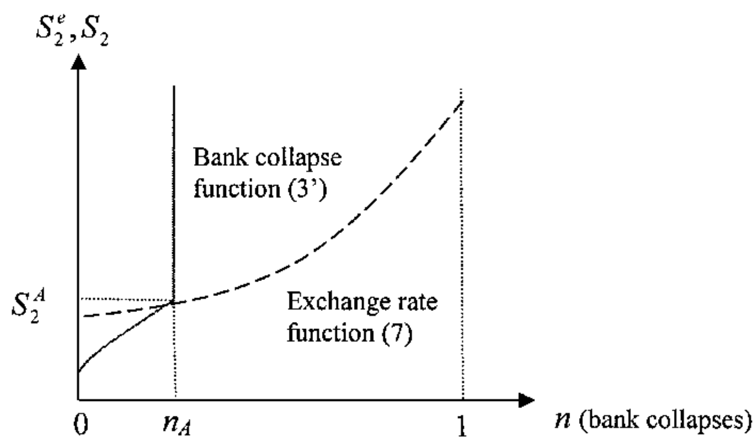
[12] If the central bank's strategy is to guarantee dollar deposits of conditionally solvent banks, bank collapses and bank runs coincide (any run causes a collapse). In constrast, discount window lending prevents the collapse of banks that suffer a run, so runs and collapses are not identically the same. With n defined as collapses rather than runs, Equation (7) holds without change, reflecting the assumption that economic activity and the second period exchange rate are determined by the number of banks that continue to operate.

the authorities' intervention policies is to place an upper bound on the number of banks that can collapse:

(3') $$n = \min\{n_A, F(S_2^e)\}$$

where $F(S_2^e)$ is defined as before, i.e., as the mass of banks that become insolvent at a given expected exchange rate. Equation (3') guarantees that the number of banking collapses will never exceed those that occur in the "good equilibrium", which is unique, as can be seen from Figure 3.

Figure 3. Equilibrium in Banking Crisis Model with Last Resort Lending



To the extent that the domestic monetary authorities have insufficient reserves to cover the foreign currency liquidity gap (i.e., $R_1^* - D_1^*$) for each of the conditionally solvent banks, this way of ruling out the "bad" equilibrium provides a natural justification for an international lender of last resort. Thus, the role of international lending in the bank run model is to lend dollars to the domestic monetary authorities in sufficient amounts to enable it to implement the domestic financial safety net described above.

Credit Crunch

Does the relatively straightforward role for international crisis lending that arises in the bank run model carry over to the credit crunch model? The answer is clearly no. In the credit crunch model there are no runs, and consequently there is no role for a domestic financial safety net that might require foreign backing. The problem is not that conditionally solvent institutions go belly up: in the credit crunch model, such institutions make it to the second period, since they have no short run dollar liabilities. Instead, real costs arise from the fact that net worth constrains investment.

In this context, the potential role for international lending is quite different from the bank run case. Two possible channels seem worth considering.

Logically, the most straightforward mechanism would be one where access to international official financing—either directly or through the intermediation of the government—substitutes for the lack of access to private credit markets when firms are net-worth constrained. As Krugman (1999, p. 42) observes, official "credit lines would have to do more than provide balance-of-payments financing, or even provide lender-of-last-resort facilities to banks: they would have to make up the credit being lost by firms, so as to allow investment to continue." To implement the "good" equilibrium in our framework, each credit constrained firm would need to receive an official loan in the amount of the difference between what it could borrow in the "good" equilibrium and what it can borrow in the capital market, i.e., $\mu W^*(S_2^e) - \mu W^*(S_2^A)$. In this case, the "investment gap" would be capped at u_A, the level associated with the good equilibrium (see Figure 1), and investment gap function (7) from Figure 1 would be replaced by a new function that looks exactly like the bank collapse function (3') depicted in Figure 3.

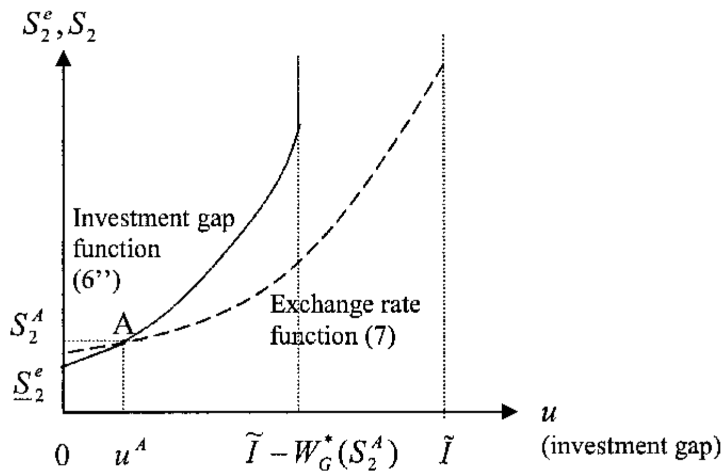
One difficulty with this approach is that the lender needs to know not just whether a firm is "conditionally solvent" or not, but its net worth both in current circumstances and in a hypothetical "normal" state. Governments are not generally equipped to collect this information, much less international lenders. Perhaps for this reason, we see comparatively little direct financial intermediation from the government, and little direct lending from official lenders to private sector firms in emerging markets. While there are some exceptions, such as lending to private corporations by the International Finance Corporation and some of the regional development banks, these seem to be motivated by credit constraints associated with the underdevelopment of domestic financial markets and political risk (which may be lower for official lenders), rather than the temporary exclusion from private capital markets owing to adverse currency expectations or capital account reversals.

An alternative channel, which may be more relevant, is to use international lending to loosen fiscal constraints, i.e., to enable the government to run a fiscal policy that is more supportive of aggregate investment than it otherwise could in crisis times. In the example outlined in the previous section, this would work as follows. The international lender would announce that for any exchange rate in excess of the "good" equilibrium level, it is prepared to extend credit to the government in the amount which it could borrow from private markets in the "good" (appreciated) equilibrium. The effect of this policy is to cap the overall investment gap at $\tilde{I}$ minus the government net worth arising in the "good" equilibrium, $W_G^*(S_2^A)$. Assuming that $W_G^*(S_2^A)$ and $W^*(S_2^A)$ are strictly positive, equation (6') becomes

$$(6'') \qquad u \equiv \tilde{I} - I = \begin{cases} \tilde{I} - \max\{0, \mu W^*(S_2^e)\} - W_G^*(S_2^A) & if \quad S_2^e \geq S_2^A \\ \tilde{I} - \mu W^*(S_2^e) - W_G^*(S_2^e) & if \quad S_2^A > S_2^e > \underline{S}_2^e \\ 0 & if \quad \underline{S}_2^e \geq S_2^e \end{cases}$$

where $\underline{S}_2^e$ is defined as before, i.e., as the exchange rate level where the economy can borrow in the full amount $\tilde{I}$. Comparing (6') and (6''), it is evident that below $S_2^e = S_2^A$ the investment gap is unchanged, i.e., the same economy-wide borrowing constraint applies. In this appreciated region, no crisis lending takes place. Above $S_2^e = S_2^A$, however, international crisis lending allows a higher level of investment. Thus, the presence of the official lender has the effect of "kinking up" the investment gap schedule at $u = u^A$. This could remove the bad equilibrium, as shown in Figure 4. In equilibrium, net worth $W_G^*(S_2^A)$ materializes, enabling the large lender to be fully repaid.

Figure 4. Equilibrium in Credit Crunch Model with Lending to the Budget



Note, however, that unlike last resort lending in the bank run case, international lending to the fiscal authorities does not inevitably remove the bad equilibrium. In Figure 4, we could have drawn the investment gap function (6'') such that the maximum investment gap $\tilde{I} - W_G^*(S_2^A)$ close enough to $\tilde{I}$ to give rise to a second intersection of (6'') with exchange rate function (7). The figure would then look much like Case I in Figure 2, and multiple equilibria would continue to exist. The critical parameter that determines whether or not international lending to the fiscal authorities removes the "bad" equilibrium in the credit crunch model is $W_G^*(S_2^A)$, the net worth of the government in the "good" equilibrium.

The main conclusion from this section is that although credit crunches and banking crises play analogous roles in our framework and have similar causes—a coordination failure in capital markets, made possible by the underlying fragility of balance sheets—the implications for international crisis lending are quite different. In the bank crisis model, the coordination failure can be removed completely using discount window-type last resort lending, backed by the foreign exchange reserves provided by an international agency such as the IMF. An analogous policy in the credit crunch case would be firm-specific crisis lending in the full amount of the investment shortfall, but there does not seem to be a plausible real world counterpart for this type of lending. A more plausible mechanism is lending to the budget, allowing a more expansionary fiscal policy, which raises aggregate investment. In this case, however, the volume of crisis lending will be constrained by *government* net worth conditional in the "good" equilibrium, as opposed to economy-wide net worth. Depending on the solvency of the government in the noncrisis times, this may or may not be enough to rule out the "bad" equilibrium.

To summarize: conditional on private balance sheet mismatches, the presence of a crisis lender helps the government protect the economy from balance sheet crises along two dimensions. First, a central bank that can borrow reserves internationally does not need to hold reserves itself to rule out runs on conditionally solvent banks. Second, the presence of official crisis lending reduces the standard of fiscal solvency that must be met to make a country immune to balance sheet crises. Without a crisis lender, the government needs to be "supersolvent", in the sense that government net worth *in the circumstances of a crisis* (i.e., conditioning on depreciated exchange rates and/or high interest rates) needs to be sufficiently large to make up for the shortfall in private sector net worth. With a crisis lender, it is sufficient if government net worth in *normal*, noncrisis times balances this shortfall.

IV. Conclusion

This paper has focused on a particular risk generated by currency and maturity mismatches in corporate and financial sector balance sheets: the risk of self-fulfilling financial and currency crises. Even within the confines of this focus, we find a surprising variety of models with sometimes quite different policy implications. To the practitioner, the balance sheet approach might seem to involve a mind-boggling range of policies (from fiscal policy to lending-in-last resort). On this basis, one could conclude that the "balance sheet approach" is difficult to specify, and does not result in a well-defined approach to dealing with emerging market crises.

However, as we have tried to show in a stylized framework that encompasses the main ideas from a number of models, this variety masks some common themes. We have focused on two. First, balance sheet vulnerabilities place tight constraints on the capacity of domestic policies (monetary and fiscal) to deal with capital account crises. Second, the fact that balance sheet crises cannot take place without a coordination failure among private creditors implies a potentially important role for large-scale crisis lending, moral hazard concerns notwithstanding.

The main results of this paper are elaborations of these two themes. They can be summarized in six points.

1. Conditional on the presence of private sector balance sheet vulnerabilities—in particular, currency mismatches—balance sheet crises are largely independent of the exchange rate regime.

2. Private sector balance sheet mismatches put monetary policy in a bind. If it defends the exchange rate by raising interest rates, it will lower the present value of future domestic currency income. If it lets the exchange rate go, it will lower the *dollar* value of both current and discounted future income. If firms or banks have dollar liabilities, there is a problem

either way. In general, there will be a trade-off, so that for a given balance sheet structure of the private sector, there is a monetary policy that minimizes the damage from an adverse shift in exchange rate expectations. But this minimal damage may still be big enough to trigger a crisis in which the currency collapses.

3. Even assuming that there are fiscal policy measures that directly limit the crisis—for example, public investment, transfers or tax cuts that support the capacity of private firms to undertake investment, or recapitalization of insolvent banks—the government may not be able to take enough of these measures because it cannot finance them (other than through monetization of debt). This is because its *own* net worth, and thus its ability to borrow, are likely to be constrained in a crisis because of high interest rates and/or depreciated exchange rate expectations.

4. The preceding argument implies that there are benefits of a fiscal adjustment prior to the crisis, if this puts the government over the threshold where it can take measures that limit crisis damage to an extent that invalidates any adverse shift in expectations. Note that the implicit solvency standard is very high, since the government must be able to finance these measures *in crisis circumstances*, i.e., conditioning on depreciated exchange rates.

5. International crisis lending can help in two ways that are quite different, depending on the nature of the balance sheet crisis. In the context of bank runs, it can lend to domestic monetary authorities in the amount needed to operate a dollar discount window, or guarantee the dollar deposits of "conditionally solvent" banks (i.e., banks that have positive net worth in "normal" times). This limits bank runs to the "truly insolvent" banks, and prevents the bad state in which even conditionally solvent banks collapse. In the context of a credit crunch, the international lender can loosen fiscal constraints, allowing the fiscal authorities to implement policies that mitigate the decline in aggregate investment. It does so by lending to the government in the amount that the government could borrow from private markets conditional on the realization of the good equilibrium, rather than conditional on actual (depreciated) exchange rate expectations.

6. While last resort lending in a bank run context fully removes the coordination failure that causes a self-fulfilling crisis, crisis lending to the budget may not. This is because the level of official crisis lending to the budget is constrained by the government's pre-crisis solvency. While the presence of a large official lender in crisis times obviates the need to hold foreign reserves in order to implement a domestic financial safety net, a sound fiscal position thus remains necessary if crisis lending to the budget is to have its desired effect.

Our analysis was limited in several important ways. First, we have looked at a special aspect of the question—the case where the crisis is self-fulfilling. Second, we took a purely ex post perspective. One must also think of how ex post policies change the financial structure ex ante. Then one has to compare the merits of stabilization policies ex post with those of regulation ex ante. Clearly a lot more research is needed before we can think of the balance sheet approach to crises as a set of policy prescriptions—as opposed to a new way of thinking about crises.

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