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BAIL-OUT OR WORK-OUT?
THEORETICAL CONSIDERATIONS

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Abstract

In recent years, we appear to have entered an era of capital account crises. In response, a number of new crisis resolution ideas have been put forward, including the establishment of supranational institutions such as an international lender of last resort or an international bankruptcy court, temporary payments standstills and the inclusion of collective action clauses in debt contracts. This paper assesses these proposals using a theoretical model of crisis. The model underscores the importance of adapting policy interventions to the nature of the crisis at hand. For example, it finds that payments standstills and last-resort lending are an equally efficient means of dealing with liquidity crises, both ex-ante and ex-post, while creditor committees are second-best. It finds that debt-write-downs are a preferred means of dealing with solvency crises than subsidized IMF financing because of the negative moral hazard implications of the latter tool. And it finds that international bankruptcy court proposals may be superior to contractual approaches in securing such write-downs.

JEL classification numbers F33, F34. *Keywords:* Crisis resolution, International lender of last resort, Standstills, IMF.

1. Introduction

On many measures, the incidence of international financial crises increased in the last part of the 20th century (Caprio and Klingebiel (1996, 1999)). But it is not just the incidence of financial crises that has altered in recent years. So too has their nature. The recent crises in Mexico, across South-East Asia, Russia, Brazil, Turkey and Argentina were clearly rooted in the capital, rather than current, account of the balance of payments. We appear to have entered an era of capital account crises (IMF (2002)).

Theoretical models of financial crisis have developed in lockstep with crisis experience. A "third generation" of models of financial crisis has emerged (Chang and Velasco (1998), Krugman (1999)). These models combine imperfections in fundamentals (as suggested by so-called "first-generation" models) and fragility in expectations (as suggested by "second-generation" models) to explain crises. Under the third generation approach, capital account crises can originate in either fundamentals or expectations. We have "solvency" as well as "liquidity" capital account crises.

Explaining or modelling these crises, ex-post, is one matter. Devising policy plans to resolve these crises, ex-ante, is quite another. Historically, the IMF has played a pivotal role in the resolution of international financial crises. But the IMF was founded to help redress imbalances in the current account of the balance of payments. Capital account crises may potentially call for a quite different approach, or even a quite different institution. But which approach and what type of institution?

There has been no lack of public policy proposals. Several "big ideas" have been mooted. At one end of the spectrum, some have suggested the need to create, in effect, an international lender of last resort based around the IMF (Fischer (1999)) – resolving crises through international "bail-outs". At the other, some have suggested the need to create, in effect, an international bankruptcy court (Sachs (1984) and most recently Krueger (2001, 2002) of the IMF) – resolving crises through international "work-outs". In between these poles, there are several middle ground proposals. For example, some have argued for a contractual approach, with clauses in private contracts serving as a surrogate bankruptcy court (Eichengreen and Portes (1995) and most recently Taylor (2002) from the US Treasury). Others have argued for some judicious mix of limited

(rather than unlimited) official finance in combination with periodic suspensions of payments or standstills to resolve financial crises (Haldane and Kruger (2001), Council on Foreign Relations (1999)). Others still have suggested committees of creditors to resolve potential co-ordination problems among creditors (IIF (2002)).

How do we choose between these competing policy proposals? Our approach is to assess these proposals in the context of a theoretical model of financial crisis, with a well-defined welfare function. This welfare function needs to balance two, sometimes competing, objectives: *ex-post efficiency* – mitigating the costs of crisis when they occur through policy intervention; and *ex-ante efficiency* – mitigating distortions to incentives (moral hazard) induced by policy intervention. A well-defined framework for crisis resolution needs to balance these ex-post and ex-ante effects (Eichengreen and Portes (1995), Miller and Zhang (2001)).

In section 2 we develop a theoretical model of capital account crises, which generates both solvency and liquidity-based crises. Section 3 explores inefficiencies in this model, which generate a role for corrective policy intervention. In Section 4 we investigate the ex-post efficiency of some competing proposals for architectural reform – for example, the choice between "work-out" and "bail-out". Section 5 investigates the ex-ante efficiency of these same proposals. On the basis of these comparisons, Section 6 draws some policy conclusions.

2. A Model of Capital Account Crisis

The model comprises three sets of agents – private firms, international banks and a national government. Firms borrow from the banks to invest in projects with stochastic returns. Occasionally, they will face repayment problems – financial crises. As firms are representative, firm-level crises translate into country-wide crises. These then necessitate policy intervention at a national (government) or international (IMF) level.

The economy is comprised of many identical firms, each of which is small relative to the economy as a whole. At the start of the first period the representative firm invests an exogenously fixed amount, $k_1 = \overline{k}$. The firms are able to reduce their investment

after the first period, but any additional investment over and above the initial investment is assumed to be unproductive. Taken together these assumptions imply $0 \le k_2 \le \bar{k}$.

This capital investment yields an uncertain return after the two periods. At the end of the second period the output of the representative firm is given by:

$$y_2 = (a + E)k_2 \tag{1}$$

where $a > 0$ is a stochastic state variable realised at the end of the first period and E is the structural-adjustment effort of the government.

Initially, we assume that short-term lending by international banks to each firm is the sole source of finance for investment. Short-term lending is for one period only and is at an interest rate $r_1 \ge r_F$, where r_F is the exogenous risk-free rate. At the end of the first period, after the realisation of the state variable, a, the international banks decide how much lending to roll over to the second period. To begin with, we assume r_1 is exogenous.[1] The firms have no costs other than these debt-servicing costs. At the end of the second period, the profit of the representative firm is:

$$p_2 = y_2 - r_1(1 + r_2)\bar{k} - r_2 k_2 \tag{2}$$

where $r_1(1 + r_2)\bar{k}$ is the cost of servicing the interest payment on the first period loan, and $r_2 k_2$ is the financing cost in the second period.

None of the capital is used up in the production process so the repayment of the loan principal is secured. The payment of interest on the loan, however, is not. Specifically, if $p_2 < 0$ the representative firm is declared bankrupt and defaults on its interest payments. For simplicity, we assume that if a firm is bankrupt it produces no output, so there is a lump-sum inefficiency associated with bankruptcy. The main conclusions are unaffected if we relax this assumption, providing there is still some inefficiency associated with bankruptcy. A firm's default decision is determined purely by its ability (rather than willingness) to pay; there is no strategic default.

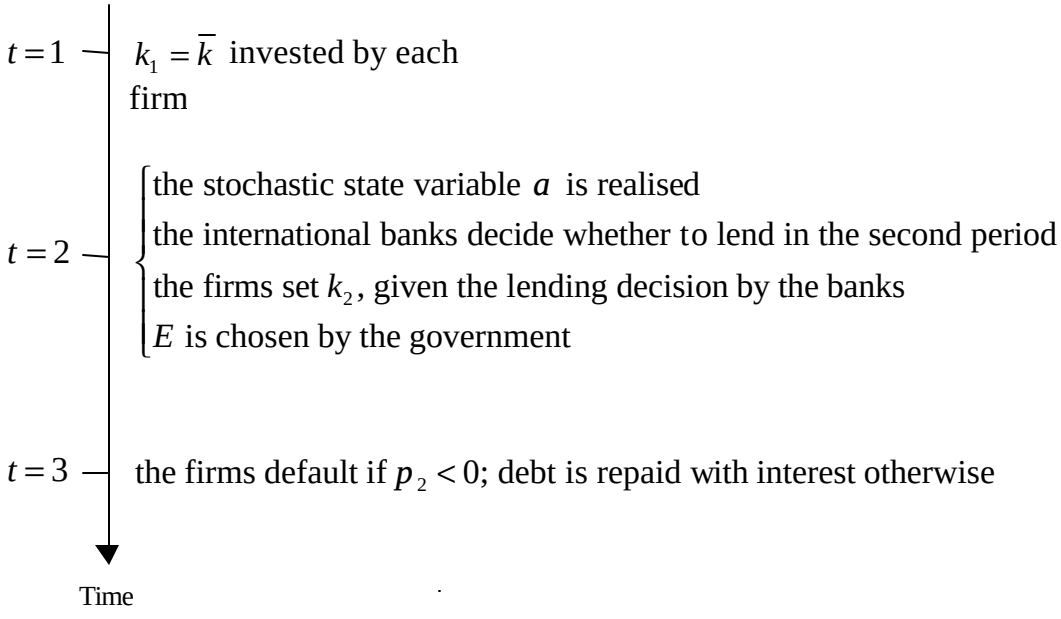
[1] In Section 5, we endogenise the return expected by the international banks from lending to the firms and we solve for the equilibrium interest rate in the first period.

International banks aim to maximise the return on their lending. They offer short-term loans to firms, giving them the option to withdraw funds after one period. If they call in their loans after the first period, or if the firms default, the banks can reinvest the sum retrieved at the risk-free interest rate. If firms default, this sum is equal to the loan principal as no interest is received on the first-period loan. As the firms are identical and the model solution symmetrical across all firms, the return on lending received by each of the international banks is the same regardless of which firm or firms it lends to and how much of any one firm's borrowing it finances. We assume that the financing provided by any one international bank is small compared with the full financing requirement of any firm. This introduces the possibility of an inefficient outcome due to a lack of coordination by the creditors of each firm when they make their individual lending decisions.

The government aims to maximise its welfare, which depends positively on the firms' profits and negatively on the amount of structural adjustment effort it undertakes. The government sets its effort level, *E*, once the realisation for a is known and after the international banks have decided how much lending to roll over to the second period. The objective function of the government at the end of the second period is:

$$U_G = \begin{cases} p_2 - z\,E^2/2 & \text{when} \quad p_2 \geq 0 \\ -z\,E^2/2 & \text{otherwise} \end{cases} \tag{3}$$

where p_2 is the profit of the representative firm and the final term is the cost to the government of its structural-adjustment effort, which is increasing in the parameter z. A summary of the timeline of the game is as follows.



In the next two sections we focus on the ex-post stage of the model: that is on decisions taken at t = 2. In Section 5 we return to the ex-ante stage, that is to decisions taken by the international banks at t=1.

3. Model Solution

The second stage of the model (period t=2) can be viewed as a game between the government and the international banks and can be solved by backwards induction.

3.1 The Strategy of the Government

If $p_2 \geq 0$ the firms repay their debts and the pay-off to the government can be written as $U_{GR} = (a + E)k_2 - r_1(1+r_2)\bar{k} - r_2 k_2 - z\,E^2/2$. If, on the other hand, the firms default, the pay-off to the government is $U_{GD} = -z\,E^2/2$. If all debt is repaid, the government will maximise its pay-off by setting $E = E^*$, where $E^* = k_2/z$. If the firms default, the government will maximise its pay-off by setting $E = 0$ and so $U_{GD} = 0$. So there is a second inefficiency associated with default; it removes the government incentive to undertake structural adjustment effort, which is otherwise output-enhancing. This creates a form of debt-overhang.

In equilibrium, the government must choose its optimal effort level, given the amount of capital investment that is financed by the international banks and given the default rule for the representative firm. In the appendix we show that a necessary and sufficient condition for the government to exert $E = E^*$ is given by:

$$a \geq (r_1(1+r_2)\bar{k} + r_2 k_2)/k_2 - k_2/2z \qquad (4)$$

Otherwise the government will exert zero effort.

3.2 The Strategy of the International Banks

The international banks each face an identical problem. They understand the incentives of the government and so can deduce its optimising strategy, and they also know the default rule of the firms. If the international banks believe their loans will be repaid for

sure they will be willing to lend $k_2 = \overline{k}$ and the interest rate will be the risk-free rate, $r_2 = r_F$. If, on the other hand, they anticipate that the firm(s) they lend to will default for sure, there is no interest rate at which they will continue to lend.

The strategy of each international bank will depend on what they think the government and the firms will do. This, in turn, will depend on the strategy of other banks. This is because the lending decisions of all of the international banks collectively determine k_2. From equation (4), we can see that whether or not the government exerts positive effort, and therefore whether or not there will be a default, depends not just on a, but also on k_2. Because we have assumed that each of the international banks is small in relation to the total financing requirement of each firm, this means that each bank perceives that their lending decision has a negligible impact on k_2. But collectively these decisions have an important bearing on whether firms default. If these collective beliefs of the international banks are sufficiently pessimistic, this gives rise to the potential for a liquidity crisis.

To see the effects of the international banks' collective beliefs on the equilibrium of the model, suppose that each of the international banks believes that the others will continue to lend in the second period at $r_2 = r_F$ and so they expect that $k_2 = \overline{k}$. By substitution of $r_2 = r_F$ and $k_2 = \overline{k}$ into equation (4), each international bank will expect the government to set $E = E^*$, and the firms to repay their debts, when $a \geq \tilde{a}$, where:

$$\tilde{a} = r_1(1 + r_F) + r_F - \overline{k} / 2z \qquad (5)$$

Consequently, each bank will be willing to roll over its financing to the second period. So when $a \geq \tilde{a}$, there is always an equilibrium in which all of the banks roll over their financing, the government exerts positive effort and the firms repay their debt in full.

But this is not the only equilibrium. Suppose that each of the international banks believes others will call in their loans after the first period, so $k_2 = 0$. By substitution of $k_2 = 0$ into equation (4), we can see that in this situation the government sets $E = 0$ and the firms default for sure. There is no interest rate at which the banks are willing to roll over their lending to the second period. Consequently, there is always also an equilibrium in which the banks call in their loans after the first period, the government

exerts no effort and the firms default for certain. Depending on a and the beliefs of the banks, both a default and a repayment equilibrium may be possible.

3.3 Equilibria of the Model

We can now summarise the equilibria of the model and assess their efficiency. In defining equilibria, equation (5) is central. This defines the point of fundamental insolvency for firms: the level of fundamentals at which, even if all international banks decide to rollover their loans, the firm is unable to meet its payments. So when $a < \tilde{a}$ there is a unique equilibrium in which the international banks do not roll over any lending, the government sets $E = 0$ and the firms default.

When $a \geq \tilde{a}$, however, there are multiple equilibria. One equilibrium – the default equilibrium – involves the international banks not rolling over lending, the government setting $E = 0$ and the firms defaulting. The other – the repayment equilibrium – involves the international banks rolling over the full amount, the government setting $E = E^*$ and the firms repaying the full amount of their debts.[2]

Some of these equilibria are efficient and others inefficient. We define a *capital account crisis* as a situation where there is an inefficient early liquidation of the investment projects. In defining capital account crises, it is useful to distinguish between *solvency* crises and *liquidity* crises.

Liquidity crises can occur whenever $a \geq \tilde{a}$ – when fundamentals are above the point of fundamental insolvency. In this zone, the equilibrium that obtains depends on the beliefs of the international banks. If the international banks collectively roll over their loans they will be repaid, whereas if they do not the firms will default. If lending is not rolled over the investment is liquidated early. There is a Pareto inefficiency associated with this liquidation, as there are deadweight costs of default.

Investments are liquidated early for certain whenever $a < \tilde{a}$ – that is, when fundamentals are below the point of fundamental insolvency. But this is also inefficient

for a subset of values for a within this range. To see this, note that the first-period financing costs are sunk. This means that maintaining the full investment, $k_2 = \bar{k}$, may be efficient providing the output that is created, $(a + \bar{k}/z)\bar{k}$, exceeds the second-period financing cost and the government's effort cost, $r_F \bar{k} + \bar{k}^2/2z$. That is, if $a \geq a^*$, where:

$$a^* = r_F - \bar{k}/2z \tag{6}$$

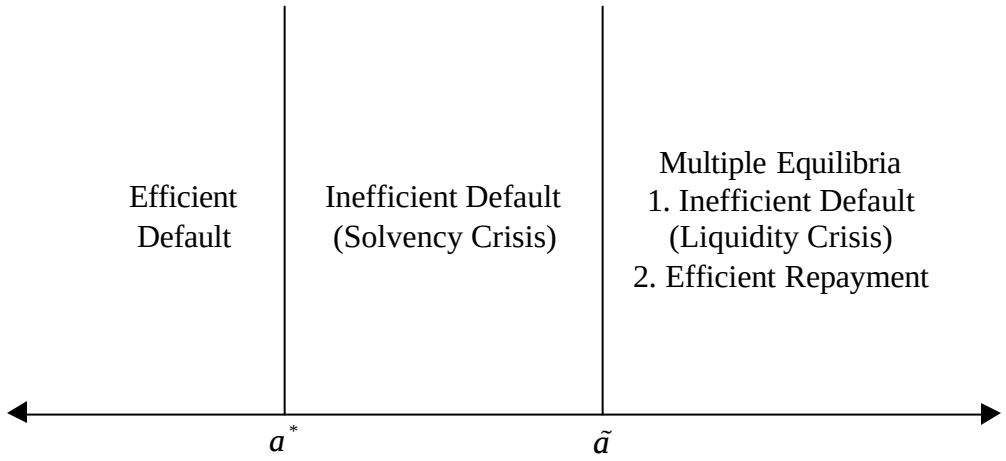
If $a \geq a^*$ the firms are able to produce output in the second period in excess of the incremental costs which are required to make this possible. Note that $a^* < \tilde{a}$ given $r_1 > 0$. If $a^* \leq a < \tilde{a}$, the firms are insolvent and the investment is liquidated early even though this is Pareto inefficient. This is because, even if the full investment is maintained, the firms are still forced to default as they are saddled with debt from the first period. Recognising this, the international banks never roll over any lending and an inefficient solvency crisis ensues.

By contrast, when $a < a^*$, Pareto efficiency requires that the investment projects are liquidated early and that the government exerts no effort. The outcome for fundamentals is sufficiently poor that the marginal returns to continuing with the project are outweighed by their costs. In these circumstances, the firms should be allowed to go bankrupt.

Figure 1 summarises the equilibrium zones generated by the model in a-space. To the far right and far left we have zones of efficient repayment and efficient default equilibria. In between, lie solvency crises. Liquidity crises lie to the right of $\tilde{a}$.

[2] Strictly, we might also have an equilibrium in which the international banks adopt a mixed strategy. We do not discuss this further here.

Figure 1: Equilibrium Zones



4. Policy Intervention and Ex-Post Efficiency

In this section we consider whether there are interventions which can ameliorate the ex-post inefficiencies associated with capital account crises. We restrict our attention to interventions that do not make any of the affected parties worse off.

4.1 Liquidity Crises

In the model, a liquidity crisis emerges when each of the international banks calls in its loans because it believes others will do the same. Essentially, there is a coordination problem among the international banks. We consider three sets of policy proposals that might potentially resolve that problem: a temporary payments suspension or rollover of loans – as was used in Korea in 1997 and Brazil in 1999; IMF last-resort lending – as was used in Mexico in 1994/95; and committees of creditors – as were used during the international debt crises in the 1980s.[3]

Under a standstill, the international banks are forced to rollover their lending into the second period. In that event, the government is always willing to put in the optimal effort, E^*. As a result, loans are ultimately repaid in full, and so the international banks are made better off by the imposition of a standstill. The firms and the government are similarly made better off as default is averted. So a standstill intervention would be

[3] We do not consider contractual approaches or international bankruptcy courts as crisis resolution measures. That is because they are mechanisms for restructuring or writing-down debts in net present value terms, neither of which is required following a liquidity crisis.

Pareto-improving and hence feasible. Or, put differently, forced rollovers are ex-post efficient in overcoming liquidity crisis. In fact, provided the expectation of a rollover in the event of a liquidity crisis is fully credible, such a crisis will never emerge in the first place. There would be a unique repayment equilibrium when $a \geq \tilde{a}$.

Financing by the IMF is capable of achieving a similar result. Suppose that the international banks call in their loans at the end of the first period. If the IMF bridges the full financing gap, $(1+r_1)\bar{k}$, the international banks receive full repayment of their first-period loans with interest and the full investment is maintained by the firms. The government then finds it rational to choose optimal effort. The investment projects are sufficiently profitable for the IMF to be repaid with interest at the market rate (which is the risk-free rate, $r_2 = r_F$). As default is averted, all parties are made better off and the outcome is ex-post efficient. As with a standstill, if the IMF serves as a fully-credible, deep-pockets last-resort lender, liquidity crises will not materialise in the first place. This result has parallels in the banking literature, where domestic last-resort lending and payments suspensions can be shown to be equally-efficient means of dealing with bank runs (Diamond and Dybvig (1983), Wallace (1988)).[4]

Finally, a creditor committee may be able to avert liquidity crises to some degree. But unless these committees are organized economy-wide, they are unlikely to be able to eliminate liquidity crises entirely. That is because of the problem of cross-firm co-ordination, or aggregation. To see this, suppose that the creditors of a single firm are able to coordinate their lending decisions in the second period. If they continue to believe that the creditors of other firms will call in their loans after the first period, however, they would still expect the government to set $E = 0$. From (1) and (2), the firm they lend to will not default ($p_2 \geq 0$) when $k_2 = \bar{k}$ and $r_2 = r_F$, even though $E = 0$, providing $a \geq a_{CC}$, where:

$$a_{CC} = r_1(1+r_F) + r_F \qquad (7)$$

If this condition is satisfied then the creditors of the individual firm, acting in a coordinated fashion, will decide to roll over the full amount of lending at the rate $r_2 = r_F$ and this will be repaid in full as the firm does not default. If the creditors of all firms

are organized by committees, then this will be replicated throughout the economy and the government will in fact set $E = E^*$. Consequently, when $a \geq a_{CC}$ the unique equilibrium is the one where all of the international banks roll over their lending, the government sets $E = E^*$ and the firms repay their debts in full.

Note that $a_{CC} > \tilde{a}$ and so liquidity crises can still occur over a range of values. This is because we have assumed that creditors can only coordinate at the level of each individual firm. If they could coordinate at an even more aggregated level, this would further reduce the range over which liquidity crises occur. In the limit, with creditor coordination at an economy-wide level, liquidity crises would be eliminated, as with standstills and last-resort lending.

4.2 Solvency Crises

In a solvency crisis the international banks call in their loans for sure and firms are bankrupted. This is not simply a consequence of a lack of coordination among creditors. Irrespective of how much lending is rolled over to the second period, the firms will still default and so it is never profitable for the international banks to extend their lending. The outcome is, nevertheless, Pareto inefficient.

To achieve an efficient outcome, two necessary conditions must be met. First, sufficient financing must be available to maintain the full investment in the second period. Second, we need some means of preventing firms from defaulting. We consider three forms of public policy intervention which, in principle, could achieve this: subsidized IMF financing; debt write-downs organized by a central agency (an international bankruptcy court or Sovereign Debt Restructuring Mechanism (SDRM)); and collective action clauses (CACs).

IMF financing at the risk-free rate will be insufficient by itself to prevent a default. Suppose, instead, that the IMF provides financing at a subsidized rate, $\tilde{r}_2 < r_F$, that is sufficient to fill the financing gap, so that $k_2 = \bar{k}$. From (4), the subsidized financing is

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[4] In an international context, this result is discussed by, inter alia, Chang and Velasco (1998), Rogoff (1999) and Chui et al (2002).

sufficient to ensure the government sets $E = E^*$ and that the firms will not default, providing $\tilde{r}_2 \leq (a + \bar{k}/2z - r_1)/(1+r_1)$. We assume the creditor-country governments are willing to sanction lending by the IMF at a subsidized rate providing the gain to the international banks exceeds the cost of the subsidy. The gain to the banks lending to each firm is $r_1(1+r_F)\bar{k}$, whereas the cost of the subsidy is $(r_F - \tilde{r}_2)(1+r_1)\bar{k}$. The gain outweighs the cost when $\tilde{r}_2 \geq (r_F - r_1)/(1+r_1)$.

Both of these conditions are mutually compatible if (and only if) $a \geq a^*$. Subsidized lending can result in the first-best outcome provided a suitable subsidy is offered. If it is, the outcome is ex-post efficient for all parties, with firms avoiding default, international banks repaid in full and the government exerting optimal effort. In effect, there is a resource transfer from the official sector to the international banks and firms.

A second form of intervention is an international bankruptcy court that oversees the writing down of first-period debts of all international banks to all domestic firms. This proposal is akin in many ways to Krueger's (2002) SDRM idea. The court needs to secure a write-down (from, say, r_1 to $\bar{r}_1$) that is sufficient to ensure the firms do not default on their debt and that the government exerts the optimal structural adjustment effort. In this event, the international banks are willing to roll over the full amount of financing to the second period at the risk-free rate, $r_2 = r_F$, so that $k_2 = \bar{k}$.

From (4), the government will set $E = E^*$ and the firms will repay their debt if:

$$\bar{r}_1 \leq (a - r_F + \bar{k}/2z)/(1+r_F) \qquad (8)$$

With this write-down, the international banks are made better off providing $\bar{r}_1 \geq 0$. Both of these constraints can be satisfied at the same time if (and only if) $a \geq a^*$. This suggests that, as with subsidized financing, there is an economy-wide debt write-down that is able to offset the inefficiencies associated with solvency crises, while still making all parties better off. The precise distribution of gains is different between subsidized financing and write-downs, with the international banks bearing more of the burden in the second case than in the first. But in either case, public policy intervention can achieve a Pareto efficient outcome ex post.

third type of intervention is a write-down secured through collective action clauses. It is assumed that these clauses operate at the level of the individual firm, not at the economy-wide level. The precise amount of the write-down is not dictated by a centralized bankruptcy agency, but is instead the outcome of a bargaining game between each debtor and its creditors. This process may, however, be inefficient.

To see this, suppose that creditors acting at the firm-level agree to write-down their first period interest payments from r_1 to a level, $\bar{r}_1^{CAC}$, which they expect to be sufficiently low to prevent the firm from defaulting. The size of the write-down required will depend on the structural adjustment effort which the government is expected to exert. Suppose agents anticipate $E = 0$. From (1) and (2), the write-down is sufficient to prevent a default when:

$$\bar{r}_1^{CAC} \leq (a - r_F)/(1 + r_F) \qquad (9)$$

As before, the international banks are made better off as long as $\bar{r}_1^{CAC} \geq 0$ and it is possible for both constraints to be satisfied simultaneously. But if all lending is subject to firm-level collective action clauses, we would expect the debt of *all* firms to be written down in this situation. All lending will be extended to the second period. As (9) is a stronger condition than (8), this will induce the government to set $E = E^*$, which falsifies the initial conjecture that $E = 0$. This means there can be no write-down equilibrium with this expectation being held.

Now consider the alternative case where agents expect $E = E^*$. From (1) and (2), the write-down is sufficient to prevent a default when:

$$\bar{r}_1^{CAC} \leq (a + \bar{k}/z - r_F)/(1 + r_F) \qquad (10)$$

This constraint is now weaker than (10). If a write-down is negotiated for each firm which satisfies *both* (8) and (10), then the conjecture that $E = E^*$ proves to be correct, so we have an equilibrium (providing, in addition, that $\bar{r}_1^{CAC} \geq 0$). However, if write-downs are negotiated which satisfy (10), but which do not satisfy (8), the conjecture that $E = E^*$ will prove to be false, and in this situation there is no equilibrium in which a write-down is achieved.

The latter case is more likely to arise when the bargaining power rests with the international banks. In the extreme case, where all of the bargaining power rests with the international banks, the write-down will be such that the participation constraint of each individual firm (equation 10) is binding, so (8) will fail and no equilibrium will exist. In this case, the problem is essentially an aggregation one, as is the case when firm-level creditor committees are formed in response to liquidity crises.[5] In the opposite case, where all of the bargaining power rests with the firms, the write-down will be such that the participation constraint of the international banks is binding, so $\overline{r_1} = 0$. This satisfies condition (10) over the entire range, $a \geq a^*$. In this situation collective action clauses are sufficient to ensure that all of the inefficiencies associated with solvency-based crises are avoided and that each of the parties are made better off. In general, it is clear that the balance of bargaining power between parties is important in determining whether the outcome under CACs is ex-post efficient. This bargaining problem has been ignored in the policy debate on SDRM versus CACs to date.

5. Policy Intervention and Ex-Ante Efficiency

So far we have considered various policy proposals on ex-post efficiency grounds. But as important an element of crisis resolution is *ex-ante* efficiency. Do these policy interventions generate moral hazard – for example, by encouraging debtors and creditors to undertake excessive or unduly risky investment and lending?
The ex-ante effects of policy intervention in international financial crises have been widely discussed in the literature. But this literature faces a basic identification problem. A fall in a country's borrowing costs is consistent with moral hazard. But it is also consistent with optimal policy intervention to offset a capital market imperfection.

In what follows we attempt to identify distortions to ex-ante decision-making induced by public policy intervention. Specifically, we assess whether the effects of policy intervention on ex-ante (t = 1) borrowing decisions are welfare-improving (offsetting a capital market imperfection) or welfare-depleting (inducing moral hazard). In our

[5] Krueger (2002) discusses this aggregation problem in the context of a sovereign with multiple bond issues, each with their own set of collective action clauses. This is behaviourally identical to the issue being modelled here, only with multiple borrowers rather than instruments.

model, ex-post inefficiencies arise because projects are funded with debt. We therefore take as a benchmark a project that is financed purely with equity.[6]

5.1 Expected Returns with No Policy Intervention

We consider two measures of ex-ante efficiency: first, the interest rate demanded by the banks when making loans to the firms at the beginning of the first period (r_1); and second, the profits expected by the firms from the initial investment at t = 1. These provide useful summary statistics of the incentives facing each of the parties when they make their lending and investment decisions under the different regimes.[7]

We first need to endogenise the first-period interest rate, r_1. We assume that the distribution of a takes the following simple form:

$$a = \begin{cases} a_H & \text{with probability } = p \\ a_L & \text{with probability } = 1-p \end{cases}$$

where a_L and a_H are defined to lie within the regions where, respectively, a solvency crisis and a liquidity crisis may occur. We assume that, if there are multiple equilibria, the probability of there being a liquidity crisis is equal to g, where $0 \le g \le 1$.

First, we consider the benchmark case. In this set-up, with equity-financing alone, and no debt, capital account crises never occur. The expected profits of each firm are given by the weighted sum of the two possible a outcomes, plus the benefit which comes from optimal structural adjustment effort by the government, less the opportunity cost of funds if $\bar{k}$ had been invested at the risk-free rate for two periods, $r_F(2+r_F)\bar{k}$.[8]

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[6] We call this the benchmark rather than the optimal case because in all of the cases we consider there is an ex-ante inefficiency as a result of creditors' failure to internalise the cost to the government of exerting structural adjustment effort. As this inefficiency is common across all regimes, however, it does not affect the welfare comparisons. The benchmark is also not first-best because we do not consider explicitly optimal debt-equity choices for the firm.

[7] The expected profit of each firm is positive under all of the possible regimes, so firms always choose to make the initial investment. However, we can say that the incentive to invest is stronger under one regime if the expected profit under that regime is higher. A follow-up paper extends the model to incorporate equity investment, so that relative investment incentives can be explored explicitly (Irwin and Vines (2002)). It finds the same moral hazard implications as those found here, but in a model where firms' investment and capital structure choices are explicitly modelled, rather than implicitly inferred.

[8] Alternatively, we could think of (11) as defining the expected return to equity holders, dividing through by $\bar{k}$.

$$Ep_2^B = \left[(1-p)a_L + pa_H + \bar{k}/z - r_F(2+r_F)\right]\bar{k} \quad (11)$$

where the superscript denotes the outcome in the benchmark case.

Consider now the model with debt replacing equity, but still with no policy intervention. In this case, if there is no crisis the banks expect to receive full repayment. But in the event of crisis they expect to receive only $r_F\bar{k}$. This is the maximum amount the international banks can earn on their capital in the second period, if the firms become bankrupt at the end of the first period. So the payoff expected by the international banks is:

$$EU_B^N = r_F\bar{k} + p(1-g)r_1(1+r_F)\bar{k}$$

where the superscript indicates that this is the outcome with no intervention. The equilibrium value for r_1 can be determined by the condition that EU_B^N must equal the opportunity cost of the lending, which is again equal to $r_F(2+r_F)\bar{k}$. This gives:

$$r_1^N = r_F / p(1-g)$$

which is increasing in r_F and g, but decreasing in *p*.

Using this, the profit expected by the firms is given by:

$$Ep_2^N = p(1-g)(a_H + \bar{k}/z - r_F)\bar{k} - r_F(1+r_F)\bar{k}$$

Note that expected profit – and hence ex-ante efficiency – in the no intervention case is lower than in the benchmark case. In other words, the incentive to invest is sub-optimally low (or the cost of borrowing sub-optimally high) compared with the benchmark. There is an over-pricing problem in international capital markets. This difference is increasing in a_L and g. As a_L rises the cost of a solvency crisis increases, and when g rises the probability of a liquidity crisis increases.

5.2 Expected Returns with Policy Intervention in Liquidity Crises

The effect of both standstills and IMF financing at the market rate in liquidity cases is to result in $g = 0$. This will reduce the equilibrium interest rate and firms' expected profit:

$$r_1^L = r_F / p \quad (12)$$

$$Ep_2^L = p(a_H + \bar{k}/z - r_F)\bar{k} - r_F(1+r_F)\bar{k} \quad (13)$$

where the superscript indicates that this is the outcome with intervention in the event of a liquidity crisis only. The effect of both last-resort lending and standstills is to push profits closer to their benchmark level. Though borrowing costs are lower and investment incentives higher as a result of policy intervention, this is not because of induced moral hazard. It is because the policy interventions are expected to overcome ex-post inefficiencies which would otherwise result in higher prices in capital markets. In this sense, intervention in liquidity crises – be it standstills or last-resort lending – is unambiguously welfare-enhancing. There are both ex-ante and ex-post efficiency gains. At the same time, however, expected profits in (13) are still below the benchmark level, given by (11). That is because there is still an inefficiency associated with the deadweight costs of solvency crises, to which we now turn.

5.3 Expected Returns with Policy Intervention in Solvency Crises

A solvency crisis occurs when $a = a_L$. To isolate the effects of a solvency crisis, we assume that liquidity crises never occur ($g = 0$). First, we deal with debt write-downs, before examining the effects of subsidized IMF-financing. The effect of a write-down on the expected pay-off to the international banks depends on the generosity of the write-down. The minimum write-down implies $\bar{r}_1 = (a_L - r_F + \bar{k}/2z)/(1+r_F)$ and the maximum implies $\bar{r}_1 = 0$. Suppose the actual write-down is somewhere within this range. The expected pay-off to the international banks, EU_B^{WS}, is:

$$EU_B^{WS} = (1-p)\bar{r}_1(1+r_F)\bar{k} + pr_1(1+r_F)\bar{k} + r_F\bar{k}$$

Given the condition that $EU_B^{WS} = r_F(2+r_F)\bar{k}$ we can solve for r_1^{WS}:

$$r_1^{WS} = r_F/p - \bar{r}_1(1-p)/p \quad (14)$$

which is lower than r_1^L providing $\bar{r}_1 > 0$; that is, providing some of the benefit from the write-down accrues to the international banks.

The profit expected by firms turns out to be independent of $\bar{r}_1$ and therefore how generous the write-down is expected to be:

$$Ep_2^{WS} = \left[(1-p)a_L + pa_H + \bar{k}/z - r_F(2+r_F) \right] \bar{k} \quad (15)$$

The cost to the international banks from any write-down is effectively passed on to the firms through a higher interest rate. This is because we assume the international banks act competitively. Consequently, regardless of how generous any write-down is expected to be, the profit expected from the initial investment is the same.

The expected profit is now identical to the benchmark case. Although borrowing costs are lower than in the no intervention case, this does not reflect induced moral hazard. It again reflects the effects of policy intervention in overcoming a capital market over-pricing problem. For this reason, write-downs in solvency crises are strictly welfare-enhancing.

Finally, consider the effect of subsidized IMF-financing. We assume that creditor-country governments bear the cost of the subsidy and are not able to pass this on to the international banks. These banks now receive a full repayment regardless of the realisation for a, so $EU_B^{FS} = (r_1(1+r_F)+r_F)\bar{k}$, where the superscript indicates that this is the outcome with subsidized IMF-financing in response to a solvency crisis. The equilibrium interest rate is simply the risk-free rate, $r_1^{FS} = r_F$.

The profit expected by the firms will depend on whether the financing subsidy is at the maximum or minimum level. If it is at just the minimum level, then expected profit becomes:

$$Ep_2^{FS} = (1-p)\bar{k}^2/2z + p(a_H + \bar{k}/z)\bar{k} - pr_F(2+r_F)\bar{k} \quad (16)$$

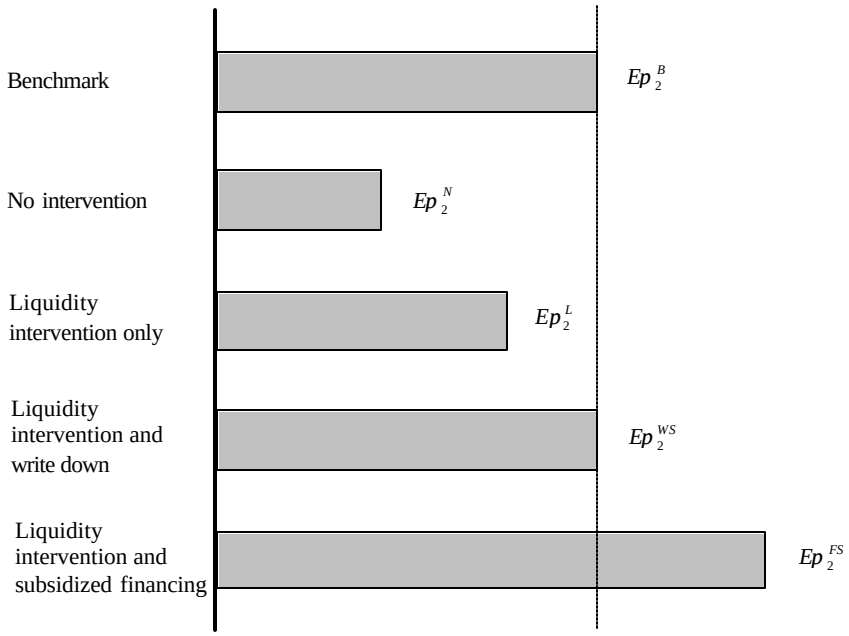
which is higher than Ep_2^{WS} by an amount which is precisely equal to the expected cost of the subsidy:

$$Ep_2^{FS} - Ep_2^{WS} = (1-p)(r_F - \tilde{r}_2)(1+r_F)\bar{k} \quad (17)$$

So expected profits under subsidized IMF-financing are higher than either the benchmark or the equilibrium under write-downs. In this case intervention does induce moral hazard as investment incentives are raised to sub-optimally high levels. There is

an ex-ante efficiency cost to set against the ex-post efficiency gain.[9] The effects of various forms of policy intervention on firms' expected profits – and hence on firms' investment incentives and moral hazard – are summarised in Figure 2.

Figure 2: Expected Profit



Moral hazard might also arise because firms have an incentive to take on riskier investments. Suppose that the firms are able to alter the distribution of a in a way which is mean-preserving (and which is subject to the restrictions on the values that a_L and a_H may take). This means that $(1-p)a_L + pa_H = \text{constant}$, or equivalently, $da_L / da_H = -p/(1-p)$. By differentiation of equations (15) and (16) each with respect to a_H, subject to this condition, it is clear that the firms will choose to take on more risk – that is, raise a_H and lower a_L – under subsidized financing, whereas they will be indifferent to the level of risk under a write-down regime. The reason for this is that the firms can raise the expected value of the subsidy by lowering a_L under the subsidized-financing regime. No such issue arises with write-downs.

[9] As Eaton (2002) discusses, this inefficiency could be removed by levying a tax on creditors. In our model a tax on lending by the international banks of $t^* = \left[r_F(2+r_F) - a_L - \bar{k}/2z \right](1-p)/\, p(1+r_F)$ would remove the moral hazard problem associated with the subsidized bail-out regime. The information and technical capacity required to implement the optimal tax are so great to render this infeasible.

6. Policy and Practical Implications

What policy conclusions do we draw? First, the model makes clear the importance of using different crisis resolution tools for different types of crisis. Liquidity crises call for one set of tools; solvency crises for another, quite different set. A range of crisis resolution tools is not just desirable for offsetting capital account crisis inefficiencies; it is essential.

Second, for *liquidity* crises, the model suggests an exact equivalence between standstills and bail-outs as a means of offsetting ex-post inefficiencies. Indeed, in theory, the very existence of either of these mechanisms, provided they are perfectly credible, should be sufficient to rule out liquidity crises.

Perhaps more surprisingly, the model also establishes an exact equivalence between standstills and official financing on ex-ante efficiency grounds in liquidity crises. Both may result in a lowering of borrowing costs for countries, compared with the counter-factual, no-intervention case. But far from implying moral hazard, this fall in borrowing costs reflects a correction of the over-pricing problem otherwise associated with liquidity crises. Conventional wisdom about IMF bail-outs inducing moral hazard needs, importantly, to be qualified in this respect.

That is fine in theory, but what about in practice? For example, to remove completely the threat of a liquidity crisis, IMF financing would in principle need to be unlimited. In practice, the resources of the IMF are finite. The belief that IMF financing is limited would tend to increase the incidence of liquidity crises. Ironically, the more limited the resources of the IMF, the greater the likelihood of these resources needing to be used. This may support the case for the greater use of payments standstills in liquidity crises, which are an equally (ex-ante and ex-post) efficient crisis-resolution tool, at least in the model developed here.[10]

Finally, the model suggests that creditor committees may also be able to help in liquidity crises. But they are unlikely, by themselves, to remove entirely the potential

[10] For a more detailed examination of the arguments and counter-arguments compare Roubini (2002) and Haldane et al (2002).

for liquidity crisis unless they are organized at an economy-wide level. Moreover, it is unclear how a committee enforces co-ordination across creditors, as there is no single agent to oversee enforcement, unlike for standstills and official lending. For that reason, such committees are likely to be distinctly second-best in dealing with the inefficiencies associated with liquidity cases.

Third, turning to *solvency*-based crises, the model suggests an equivalence between official financing and write-downs from an ex-post efficiency perspective. But to be effective in solvency crises, IMF financing needs now to be subsidized, possibly significantly so. Indeed, for low enough values of a, IMF financing would need to take the form of a gift – negative interest rates – rather than a loan to offset ex-post inefficiencies. Moreover, this action comes at a moral hazard cost. Firms and banks may be induced to over-invest or to seek out riskier projects, cross-subsidized by the official sector. So taking ex-ante and ex-post efficiencies together, there is a clear case for favouring work-outs over bail-outs in the handling of solvency crises.

There are several operational ways of organising such workouts. The IMF's SDRM is one (Krueger (2002)); CACs in bond contracts are another (Taylor (2002)). From the model, it is unclear, however, whether the contractual route can resolve all of the co-ordination problems associated with debt restructuring. They face an aggregation problem, discussed in Krueger (2002). And they also face a bargaining problem, if debtors and creditors cannot voluntarily settle on an appropriate write-down. More subtly, we show that if the bargaining power rests entirely with the international banks, the bargaining problem will aggrevate the aggregation problem. For that reason, the SDRM is likely to be a preferred means of organising sovereign workouts.

As things stand, relatively limited progress has been made towards implementing the contractual approach, while the SDRM idea remains embryonic. Given the importance of these mechanisms for securing an efficient write-down in solvency cases, there is a pressing need to push ahead with their implementation. In the absence of efficient write-down mechanisms, it is possible creditor-country governments could be tempted to sanction subsidized-financing in the event of a solvency crisis. That would bring short-run benefits, but at the expense of longer-run moral hazard costs. Some of those costs are currently being felt by Argentina.

Appendix

The representative firm will default on its debt if $p_2 < 0$. Given (1) and (2) this will be the case if $E < \bar{E}$, where:

$$\bar{E} = -a + (r_1(1+r_2)\bar{k} + r_2 k_2)/k_2 \qquad \text{(A1)}$$

If $\bar{E} \leq 0$ there can be no equilibrium in which the firms default, so the unique equilibrium is the one where the government sets $E = E^*$ and all debt is repaid. On the other hand, if $E^* < \bar{E}$, there can be no equilibrium in which debt is repaid, so the unique equilibrium is the one where the government sets $E = 0$ and the firms default. If $0 < \bar{E} \leq E^*$, both government strategies are feasible. The government prefers to set $E = E^*$ providing $U_{GR}(E^*) \geq 0$. This condition is satisfied if

$$a \geq (r_1(1+r_2)\bar{k} + r_2 k_2)/k_2 - k_2/2z$$

ie, if condition (4) in the main text is satisfied. Condition (4) is stronger than the condition for $E^* \geq \bar{E}$, but weaker than the condition for $\bar{E} \leq 0$. Consequently, it is both necessary and sufficient for the government to set $E = E^*$ and for all debt to be repaid by the firms. If this condition fails the government will set $E = 0$ and the firms will default.

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