

SOVEREIGN LIQUIDITY CRISIS: THE STRATEGIC CASE FOR A PAYMENTS STANDSTILL

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ABSTRACT

Is sovereign borrowing so different from corporate debt that there is no need for bankruptcy-style procedures to protect debtors? With the waiver of immunity, sovereign debtors who already face severe disruption from short-term creditors grabbing their currency reserves are also exposed to litigious creditors trying to seize what assets they can in a 'race of the vultures'.

Shielding sovereign debtors from inter-creditor conflict by authorised standstills on payments doubtless runs some risk of debtor's moral hazard. But the lack of an orderly procedure for resolving sovereign liquidity crises means that the IMF is de facto forced to bail out countries in trouble. This leads to both debtor and creditor moral hazard, as investors lend without monitoring, knowing that their investments are essentially guaranteed. The strategic case for legalising standstills is to rescue the international financial system from this 'time consistent' trap.

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“I wonder whether those who have opposed any reforms to facilitate the orderly restructuring of sovereign debt have asked themselves what will happen if and when another emergent borrower runs into trouble on a comparable scale to Mexico and is not bailed out.” Williamson (1996).

1 INTRODUCTION

By liberalizing capital movements, emerging market economies have gained access to global financing; but the volatility of capital flows — with feckless feast followed by famine — has exposed them to severe financial crisis. When, for example, lavish inflows of \$100 billion into East Asia in 1996 were followed by net outflows of \$12 billion in 1997, regional exchange rates collapsed and booming economic growth came to an abrupt halt. Deteriorating fundamentals played their part: but fickle capital flows turned reverse into rout.

At the annual International Monetary Fund/World Bank meetings in Hong Kong in September 1997, soon after the crisis hit the region, the Interim Committee of the IMF invited the Board to amend the IMF’s Articles so as to require members to liberalize capital movements. But a year later, with Russia in default, Brazil facing spreads of over 1000 basis points on its Brady debt — and Paul Krugman commending emergency use of capital controls — more sober counsels prevailed, and the focus of discussion at the meetings in Washington was on ‘strengthening the architecture’ of the international monetary system.

Initiatives have already been taken since the Mexican financial crisis of 1994/95, mainly to improve information and transparency in global finance, including “more continuous and candid surveillance ... and greater emphasis on members’ dissemination of information”, IMF (1998, p2). But this is clearly not enough. What more is to be done?

The Bank of International Settlements (BIS), in its Annual Report of summer 1998, highlighted three key issues:

“The first is the need for the private sector to take some responsibility for the ongoing provision of credit to customers to whom they had previously lent all too freely. ... Capital flows have now grown so large that public sector funds simply cannot fill all the potential gaps that might open up as capital inflows reverse. Thus, some better means of burden-sharing will be required. *A second* issue begins with the recognition that the threat of a unilateral stay on payments would help bring banks to the negotiating table earlier. Such a threat would be more credible if the international financial institutions were to announce in advance their willingness to provide further needed financing by ‘lending into arrears’ to countries whose domestic policies were deemed acceptable. The Ministers and Governors of the Group of Ten have endorsed the suggestion that the IMF should reconsider its policies in this respect. *Finally*, after the Mexican crisis the G-10 Deputies made a number of recommendations designed to facilitate crisis management.¹ None of these has so far been implemented, which raises the question of what could and should now be done in this regard.”

¹To encourage creditor coordination among bond-holders, who are not covered by the Paris or London clubs, the Report of the Deputies — following a ‘market-based’ approach —

Like the G-10 Working Party, we see inter-creditor conflict as the nub of the problem; though we put much greater emphasis on how the behaviour of creditors depends on the institutional framework governing their rights. The main point can easily be made. In the case of domestic corporate lending with multiple lenders, there is a possibility of a creditor race if there is no bankruptcy code. This lowers the amount lenders would be willing to provide ex ante; which is why there are bankruptcy codes domestically. But the equivalent does not exist internationally. In the (typical) case where a sovereign waives its immunity, it opens the possibility of assets being seized. Enhancing collateral value might be thought to raise the amount lenders would be willing to provide ex ante, but the possibility of inter-creditor conflict — of a ‘race of vultures’ — goes the other way.

To stop a creditor race, a country could always declare a unilateral standstill. But disorderly workouts are highly disruptive, as the Russian default of August 1998 has demonstrated: so seeking an IMF bailout seems a better alternative. Unless the IMF can also credibly refuse to supply funds to pay off creditors, however, there is a risk that lenders will feel free to lend indiscriminately and the functioning of capital markets will be undermined. The only way out is to change the rules of the game so that creditors are faced with the realistic prospect of ‘taking a hit’ — as when the IMF steps in under ‘justifiable’ circumstances to authorise payments standstills and debt restructuring (and prevents ‘moral hazard’ on the part of the debtor by appropriate conditionality).²

These issues have been the subject of lively previous debate. After the ‘wasted decade’ it took to resolve the Latin American debt problems of the 1980s, for example, John Williamson (1992) proposed “a legal mechanism for the revision of debt contracts a parallel to the Chapter XI proceedings under the US bankruptcy law”. Following the 1994/95 Mexican crisis, Eichengreen and Portes (1995) proposed the creation of a Bondholders Council able to negotiate the reconstruction of bond debt (together with changes in future bond covenants to permit a majority to alter terms of repayment); and Jeffrey Sachs (1995) — seeing especially how economies in transition were being treated — protested that countries needed the basic protections available to corporate borrowers, and proposed an International Bankruptcy Court. Summers (1996, p4), however, has criticised the corporate analogy as potentially misleading.³ The liberalization of capital movements has, in our view, added an important strategic dimension to the current debate. Without structural change to allow for payments standstills, there is evidently no incentive to change debt contracts as recommended by Eichengreen and Portes and in the Rey report. Worse, the moral hazard problems permeating the system threaten to vitiate the gains of liberalized capital movements — and to make capital controls an attractive alternative (Krugman, 1998).

recommended changes to the contractual provisions covering sovereign debt (so as to allow for the collective representation of bondholders; for qualified majority voting on changing the terms and conditions of the debt contract: and for sharing of proceeds among creditors), see the Rey Report (Group of Ten, 1996, pp14–6) and Eichengreen and Portes (1995). They also “viewed payments suspension with the tacit (but not formal) international official support as a helpful means of forcing creditors to reach workout agreements”, Cline (1996, p17).

²Robert Rubin, then Secretary of US Treasury, was reported to have endorsed such ideas at the time of the 1999 IMF Spring meetings, Blustein (1999).

³On two grounds: first because “the decision of a state to suspend its debt service is at least partly volitional” and second because “the safeguards against moral hazard built into domestic bankruptcy codes cannot be applied to sovereign debtors.”

The paper proceeds as follows. In Section 2 we discuss briefly how the sharing rules of corporate bankruptcy help to resolve inter-creditor conflict among the bondholders of a solvent but illiquid firm. But we note sharing rules alone may not prevent panic among short term creditors: which is why bankruptcy laws in the US and elsewhere allow firms to file for protection under Chapter XI, gaining an automatic stay on payments (followed, if necessary, by debt rollovers and write-downs).

Section 3 first describes the valuation of debt protected by sovereign immunity (using the debt rollover model of Bartolini and Dixit (1991) for the purpose) and second how these values are affected by debt write-downs arranged through the Paris Club. It ends noting how a waiver of immunity could — via the threat of a creditor grab race — reduce sovereign debt to junk bond status. In Section 4 we consider how IMF interventions might alter bond values. First there is the rise in bond values when debtors are bailed out by the IMF acting as lender of last resort — and the severe moral hazard problems that ensue. Then there are the effects of the IMF acting more like a bankruptcy court — preventing creditor races and forcing creditors to take debt service reductions. (The latter are analyzed using the no-debt-roll-over model of Lambrecht and Perraudin (1996).) Lastly, we consider how the two roles can be combined, with the same institution providing emergency finance (*pro tempore*) and legal protection and debt relief (*in extremis*). The section ends with numerical illustrations and a look at the impact of default risk on the price of Brady bonds.

The need for institutional change is formalised in Section 5, using an extensive form game to demonstrate how the IMF is being forced into constant bailouts, which offer investors full guarantees and undermine their incentives to monitor. The case for official standstill procedures is as a mechanism to ‘bail-in’ private creditors. We illustrate how bail-ins can help the IMF to avoid this ‘time consistency trap’⁴ and so reduce systemic moral hazard. The last section summarises and considers the recommendations in the recent report of the G22 Working Group on International Financial Crises.

2 BOND VALUATION AND CORPORATE BANKRUPTCY

Why should market economies have bankruptcy procedures, which diminish the legal rights of individual creditors and increase the risk of ‘debtor’s moral hazard’? The — perhaps surprising — answer is that inter-creditor conflict among bondholders poses even greater risks to the value of corporate assets. Reducing the incentives for grab races is the primary motivation of bankruptcy law (Jackson, 1982, 1986).

To illustrate, consider two corporate bondholders, A and B, who bought identical holdings when the company was doing well. When they learn that the company is unable to pay the full interest due, i.e., that it is in technical default, each creditor could *either* accelerate the debt (demand payment of principle) and — failing that — grab the assets; *or* choose to hang on, waiting for better times. In the absence of cooperation and/or an orderly bankruptcy procedure, the creditors of a solvent but illiquid firm face a ‘*prisoner’s dilemma*’, as shown by the payoff matrix, Table 1 (where the first figure in each cell gives the payoff to A, the second to B, measured, say, in thousands of dollars).

⁴To use the terminology of Kydland and Prescott (1977) in their classic paper on rules rather than discretion.

		<i>Creditor B</i>	
		Hangs on	Grabs assets
<i>Creditor A</i>	Hangs on	31, 31	→ 0, 40
	Grabs assets	40, 0	→ 20, 20

Table 1: The prisoner’s dilemma and the grab race.

If bonds in issue, with face value of 100, have a current market value of 62 (assumed to be less than the discounted value of expected profits, but more than the scrap value of 40), the payoffs when *both* hang on are 31 each, shown in the top left cell. But if B is to hang on, A will be tempted to do better by going for the assets, worth 40. Even if B were also to go for the assets, it would be better for A to get a half share than nothing at all. So it always pays A not to wait. By symmetry, the same goes for B, i.e., for each player, grabbing the assets is the dominant strategy. The Nash equilibrium (shown by the arrows in the table) is for the creditors to force the solvent firm into premature liquidation.

In bankruptcy, creditors of the same seniority are given equal treatment (and special concessions made in the period prior to bankruptcy are overturned). In our example the ‘equal treatment’ principle implies creditors get 20 each no matter who grabs first, forcing bondholders to choose between *both* hanging on, (worth 31 each), or sharing the collateral equally (worth 20 each). So the firm should stay in business.

If creditors are free to withdraw short term financing, however, the sharing provisions described above may not be enough to ensure the firm avoids closure, as Radelet and Sachs (1998) point out. This is because cash left in the firm is equally divided on closure, so creditors who agree to roll over short-term loans will lose out relative to the those who refuse. This is shown in Table 2, where the loss to the creditor who rolls over is indicated by $\epsilon > 0$, and the creditor game has two equilibria (indicated by arrows).⁵

		<i>Creditor B</i>	
		Hangs on	Grabs assets
<i>Creditor A</i>	Hangs on	31, 31	← 20- ϵ , 20
	Grabs assets	20, 20- ϵ	→ 20, 20

Table 2: Ranked coordination and creditor panic.

With short term financing, ‘liquidation only’ bankruptcy procedures (such as Chapter VII of the U.S. code) may rule out the prisoners dilemma, but they leave in place a *coordination game* where a creditor panic may lead to the inefficient equilibrium: fearing that B is going to pull the plug, it is rational for A to do so too. So bankruptcy laws in the

⁵Lambrecht and Perraudin (1996) and Perraudin (1995) show that a bankruptcy law which fails to overturn all concessions will have the same effect.

US and elsewhere allow firms to file for protection against creditors in such circumstances. Under Chapter XI of the US code, for example, debtors can be granted an automatic stay on debt payments; and the court may oversee a financial reconstruction designed to avert the liquidity problem, with lengthened debt maturity or a debt equity swap.

The formal model we use below involves long term bonds, and allows for discussion of debt and debt service write-downs: but it does not include short term debt which has proved to be the Achilles heel of recent countries in crisis. (Radelet and Sachs's preferred interpretation of the crisis in East Asia is a panic by short term creditors.) So we treat the triggering of 'grab races' among long term bondholders as a metaphor for creditor panic in a model with a richer liability structure.

3 SOVEREIGN IMMUNITY AND THE PARIS CLUB

An obvious difference between corporate and sovereign debt arises from the doctrine of *sovereign immunity* — the principle that the assets of the government are not subject to commercial law: so they cannot be seized for non-payment of debt, for example. But appearances may deceive. As Obstfeld and Rogoff (1996, p352–3) put it: “The legal doctrine of sovereign immunity would appear to exempt the property of foreign governments from the jurisdiction of domestic courts. ... Over the years, however, as a result of considerable evolution, the practical application of the doctrine has increasingly given creditors leverage to retaliate against defaulting sovereigns. In modern times, the ability of countries expressly to waive sovereign immunity in their commercial contracts has strengthened the rights of their creditors, thereby paving the way for an expansion of international lending. ... Most developing-country government debt contracts after 1976 have contained explicit waivers... (which) have made it more difficult for sovereigns that repudiate their debt to engage in international trade, and their existence supports the assumption that creditors can impose direct sanctions on a reneging sovereign debtor. ”⁶

Obstfeld and Rogoff acknowledge that creditor's legal rights of direct punishment can make it difficult for a country in default to gain access to new international loans. If creditors can also take legal action to attach current cash flows (including possibly new disbursements from the IMF), they can indeed exercise powerful sanctions over current debt service capacity, which we refer to later as 'strangulation by litigation'.⁷

⁶Obstfeld and Rogoff (1996, p353) also observe that “starting in 1952, United States adopted a policy of restricted sovereign immunity, which distinguished between governmental activity *sui generis* (for example, diplomatic missions) and governmental activities (including commercial activities) that private persons can also conduct. The latter, but not the former, can be subject to standard domestic commercial law. This doctrine was formalized in the United States by the Foreign Sovereign Immunities Act (FSIA) of 1976, and in Britain by the State Immunity Act of 1978.”

⁷But there is a difference between corporate and sovereign debt in the rights of creditors over cash reserves held by the debtor. Unlike the corporate case, it is doubtful that sovereign bondholders have the right to seize reserves of a country in default (Gordon and Millenkovich, 1997; Mohr, 1991); and, as Bulow and Rogoff (1988, 1991) have pointed out, this casts doubt on the advisability of using reserves to 'buy back' sovereign debt.

This has implications for the issue of debtor’s ‘moral hazard’ — the concern that the cash flows available to service sovereign debt are more manipulable than is the case for corporate debt. If foreign lenders have only limited power directly to punish sovereign borrowers, the relevant constraint on debt repayments will generally be a country’s *willingness to pay* rather than its *ability to pay* (Eaton and Gersovitz, 1981) and bond values will reflect the outcome of the strategic game between lender and borrower. In the present climate, however, where borrowers in Latin America and East Asia have made great sacrifices of output rather than default on debt, there seems little doubt about their willingness to pay when threatened by their creditors. The key issue is whether creditors have the right incentives. In our view, the issue of borrowers cheating lenders seems much less important than ‘investor’s moral hazard’, where the lenders fail to monitor because of official guarantees.⁸

How to proceed in valuing sovereign debt is a matter of judgement. Bartolini and Dixit (1991), for example, take the position that “[t]o keep ... analysis simpler and to counterbalance the attention that has been devoted to strategic default, we consider only illiquidity as the reason for the debt problem. Some would argue that it is the more important issue in reality anyway” (p829). As we believe that creditor sanctions are quite effective, we generally focus on the capacity to pay — except when explicit allowance is made for the adverse incentive effects of investor guarantees.

We begin, therefore, with Bartolini and Dixit’s method of valuing illiquid sovereign debt. They calculate the market value on the assumption that there are debt rollovers in bad states where interest cannot be paid in full, i.e.,

$$dD/dt = rD - X, \quad \text{when } X < rD, \quad (1)$$

where D is the face value of debt with a coupon rate r , i.e., the coupon rate is the same as the interest rate, and where the capacity to pay, X , follows a geometric Brownian motion. Specifically,

$$dX/X = \mu dt + \sigma dw \quad (2)$$

where w is the standard Weiner process, with $E(dw) = 0$, and $E(dw)^2 = dt$. Their findings are illustrated in Figure 1, where $x = X/D$ on the horizontal measures the current capacity to pay relative to the face value of debt outstanding; and the market discount on the face value is indicated by schedule OB . When interruptions to interest payments are unlikely, bonds stand close to par (OB is close to 1). But bond values sag when the current capacity to pay is low relative to the debt that needs servicing, and OB goes to zero as x falls to zero.⁹

The borrower faces problems of illiquidity whenever X is less than rD , i.e., when $x < r$; and rolling over debt in this fashion seems reasonable *so long as the capacity to pay is*

⁸This distorts the incentives facing debtors, as lenders effectively connive in slack performance — with systemic consequences discussed in Section V below.

⁹As they explain, the market value schedule OB consists of two segments joined together at $x = r$. When debt service capacity exceeds the rate of interest, the volume of debt remains unchanged, and x varies only with X ; otherwise it is also affected by the rolling-up of interest payments, i.e., both X and D vary: with arbitrage these two segments join smoothly when $x = r$.

expected to grow at least as fast as debt. Since

$$\begin{aligned} E(dx)/x &= E(dX)/X - E(dD)/D \\ &= (\mu - r + x)dt, \end{aligned} \tag{3}$$

the condition for this to hold locally is $x \geq r - \mu$. If x lies below this critical value, the debtor is essentially ‘insolvent’, and rolling over of debt is a way reducing rather than simply postponing payment (see Blanchard and Fischer, 1989 and Cohen, 1996).

Consider, for example, the non-stochastic case where $\sigma = 0$ and the dynamics of x in the illiquid region, $x < r$, are governed exactly by

$$dx/x = (\mu - r + x)dt. \tag{4}$$

The value of debt is shown by *OSF* in the figure where debt stands at par for $x(0) > r - \mu$, i.e., on the line segment *SF*. Even for starting values such that $r - \mu < x(0) < r$, x is increasing and must ultimately cross into the liquid region where $x > r$. If, on the other hand, $x(0) < r - \mu$, x is decreasing and, in the limit as x approaches zero, debt grows at the rate of interest. In these circumstances, where the face value of the debt exceeds the discounted capacity to pay, the debtor is insolvent and the debt rollover is a form of Ponzi game. As long as the debtor ‘stays in business’, the value of debt will match the ‘equity’ value, i.e., $v(0) = x(0)/(r - \mu)$, shown as *OS* in the figure. But for countries drowning in debt like this, rollovers are not the answer — a write-down is needed. For inter-governmental long-term loans, the forum for this restructuring is the Paris Club where, after the debt crisis in 1980s, it was agreed to reduce the stocks of debt of the severely indebted low income countries in special circumstances, World Bank (1995).

Reverting to the stochastic case, we can use Bartolini and Dixit’s framework to study the workings of the Paris Club for a borrower who has been rolling over debt for some time. Assume specifically that when x falls $r - \mu$, debt is written down by 50%, so x jumps to $2(r - \mu)$. If this is unanticipated (and not to be repeated) then debt values promptly increase from U_1 to U_2 ; but creditors have clearly ‘taken a hit’ (because of the curvature of the function *OB*,¹⁰ U_2 is less than double U_1). How will debt values behave when the operations of the Paris Club are fully anticipated? The formal analysis is given in Appendix A and the results are illustrated in Figure 1. With 50% writedowns triggered whenever x falls to $r - \mu$, debt values will lie on the curve A_1A_2P . This satisfies the arbitrage condition that there is no loss of value for the creditors at the moment when the debt is formally written down. (The average debt price A_2 is twice A_1 as they lie on the ray through the origin.) Does this mean that creditors are not making concessions under the arrangements for Paris Club restructuring? The answer would be yes, if the debt was issued below par at prices indicated by schedule by A_1A_2P : so the debtor pays up-front for the privilege of ex post write-downs.¹¹ But if sovereign debt was issued at par, then creditors are indeed making a transfer.

¹⁰Note that the schedule *OB* lies beneath *OSF*: while equity claims lie on the line *OSE*, bondholders face an upper limit to pay-outs in good states, and this pulls bond values downwards even to the left of $x = r - \mu$.

¹¹Alternatively, lenders could charge a coupon rate $c > r$ to recoup anticipated write-downs, see Bartolini and Dixit (1991).

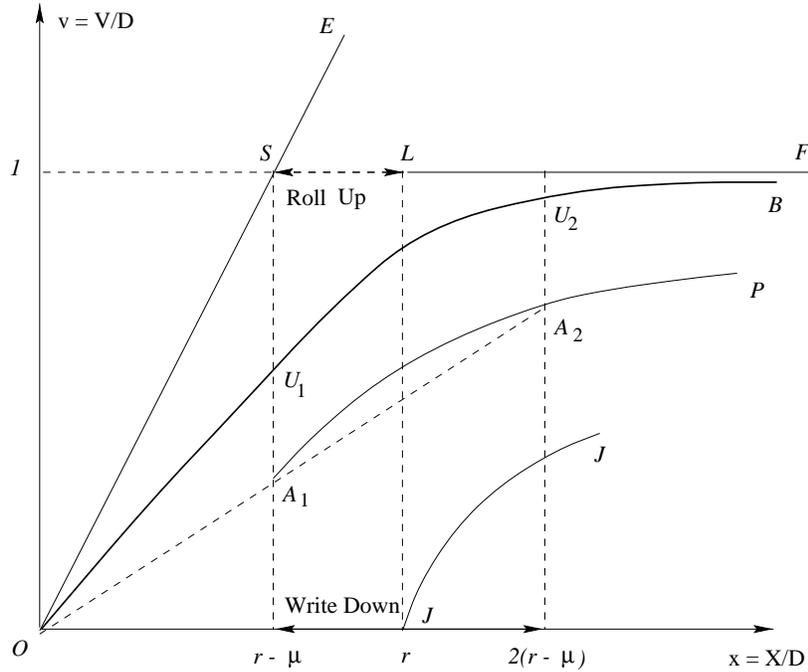


Figure 1: Rollovers, write-downs and races.

If the sovereign had waived immunity, however, asset-grabbing might trigger a creditor race. How will this affect the value of bonds? On the corporate analogy, one would expect bond values to fall towards their collateral or ‘junk’ value, with the latter being reached when the creditor race can first legally begin, i.e., when $x = r$. The curve JJ in Figure 1 illustrates the effects of ‘strangulation by litigation’ in the special case where collateral values are close to zero. If this seems fanciful, consider the Russian debt repudiation of late 1998 where the government threatened unilaterally to write down debt held by foreign residents (by about 96 cents in the dollar) and foreign creditors responded by threatening to seize Russian assets world-wide. A senior banker was reported as saying, “If they don’t sit down and negotiate, they are going to be sued all over the world. All their assets will be attached. Every time an Aeroflot aircraft lands, it’s going to be seized.” (Harris and Ostrovsky, 1998).¹² The substantial losses sustained by hedge funds on Russian debt have been blamed for the subsequent sell-off of Latin American debt and Brazilian debt crisis (Calvo, 1999).

¹²Since the debt was denominated in rubles (not in dollars), it is not obvious that the foreign creditors can sue the Russian government: what court would hear the case, and how could judgement be enforced? Nor is it clear they can seize state assets like Aeroflot planes, which belong to state bodies rather than the state itself. But what will happen when Russia goes into default on commercially-held external debt?

4 LIQUIDITY CRISES AND THE ROLE OF THE IMF

Grant that creditor panic is a risk. Consider first how debtors may avoid technical default by the use of emergency financing (supplied by a ‘lender of last resort’); and then how payment standstills (authorized by a ‘bankruptcy court’) might be used to stop creditor races and to allow for debt restructuring. Last of all, consider whether these two roles may be complementary. In what is, admittedly, a crude simplification of complex reality, we assume that it is the IMF that could play these two roles, and find that they are complementary.¹³

4.1 *Providing liquidity: IMF as lender of last resort*

When the Bank of England was managing the Gold Standard in the 19th century, Walter Bagehot recommended that, to avert the liquidity crises afflicting the City of London, it should act as a ‘lender of last resort’, providing cash without limit to solvent borrowers (at a penal rate of interest). In the world of the late 20th Century, the IMF has increasingly been called upon to perform a similar role, supplying liquidity to member countries in financial crisis (Fischer, 1999). The IMF has not, until recently, charged penal rates for emergency lending; and nor has it, until recently, been able to disburse its funds quickly. But it does have the power to impose strict ‘conditionality’ designed to enhance capacity to pay by improving economic performance.

Grant that, true to its name, the IMF can supply the necessary funds. How is one to represent the conditionality attached to them? Terms designed to promote faster growth, for example, will focus on raising μ . Say, instead, the condition is that capacity to pay, X , never falls below $(r - \mu)D$, which is sufficient to ensure that the country will be able to service all its debts — including those with the IMF. (It is in fact stronger than necessary to protect IMF lending, which has seniority.) In principle, this condition can be satisfied by borrower putting in extra effort needed to establish a ‘reflecting barrier’ at $x = r - \mu$. The result, illustrated in Figure 2 where the schedule OE represents the ex ante solvency constraint, is that existing debts will always stand at par along the line segment SF — and the IMF can be repaid in full. This outcome, a special case of the Bartolini and Dixit model, shows that that countries can roll over their debt without threatening bond values — so long as they respect the long run solvency constraint.

The expectation of performance-related bail outs of this kind may, nevertheless, pose significant risk of moral hazard; with emerging market debt standing at par, creditors have little incentive to monitor; and reduced monitoring allows the debtor puts in less ‘effort’ to maintain debt service capacity. In the words of the G22 Report (1998, p4): “The perception that sufficient official assistance may be made available to allow a country to meet all contractual obligations without commensurate commitments from the private sector may distort the incentives of both creditors and debtors, encouraging some creditors to take unwarranted financial risk and some debtors countries to follow inappropriate policies.”

¹³In what follows we use the Bartolini and Dixit (1991) model to study the IMF as lender of last resort, but we switch to the simpler specification of Lambrecht and Perraudin (1996) when considering standstills.

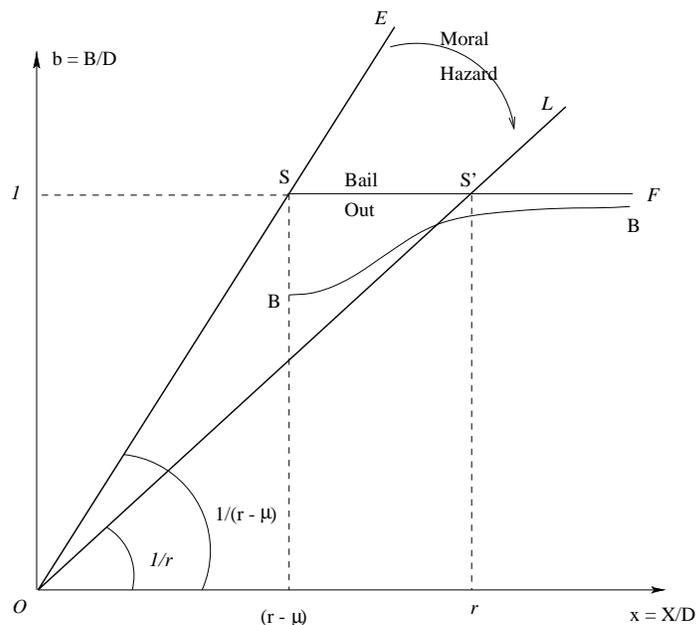


Figure 2: Bail outs and moral hazard.

Could these incentive effects be serious enough to undermine the IMF's role of lender of last resort? Take a simple illustration where this could be so. Let the lack of monitoring reduce the growth rate of debt service capacity, μ , to zero. In that case the ex ante solvency constraint falls ex post to OL which intersects SF at S' where $x = r$, i.e., just where illiquidity sets in, see Figure 2. Any IMF lending on the aforementioned conditions would now involve supporting an insolvent borrower, which runs counter to Bagehot's principles. (The conditionality no longer ensures that the IMF can be fully repaid *and* that existing creditors' bonds remain at par. The curve BB gives the average value of debt in the Bartolini and Dixit model when x is reflected at $x = r - \mu$, with the formal solution outlined in Appendix B. Without real resource transfers from the IMF, continued bail-outs of existing creditors are unsustainable.)

This illustrates the dilemma facing the IMF in trying to act as lender of last resort. If it does not provide emergency finance, creditor panic could severely affect the debtor's capacity to pay. If it does provide the funds needed to service the debt, then creditors will cease to exert any discipline. Debtors face either too much discipline or not enough! This leads one to consider another role for the IMF, where the model is not Bagehot's lender of last resort but that of a bankruptcy court, and the focus is on avoiding default by promoting debt restructuring, not by providing liquidity.

4.2 Payment standstills: IMF as a bankruptcy court

To highlight the contrast of roles, let the IMF disburse no emergency funds, but instead authorise a payments standstill — to last until an agreement is reached between creditor

payments when liquidity is constrained. This reflects the role of the IMF in protecting debtors as they renegotiate their obligations in bad times.

Without sovereign immunity, debt values may improve on account of ‘collateral enhancement’, as shown by the schedule EE in the Figure. (This is drawn tangent to the line labeled CC giving the value of collateral — see Appendix D for detail and Section IV.3 below for discussion of Brady bonds.) On the other hand, if debtors are not protected by an official payments standstill, their failure fully to service the debt at X_d would be a act of unilateral default, which could trigger accelerator clauses leading to creditor race, pulling bond values down to JJ (derived formally in Appendix E), which matches CC at $X = r$, the point of default. Note that creditor panic can sharply increase the cost of attracting any new finance: after the Russian default in 1998, for example, Ukraine faced costs of up to 30% to refinance its dollar borrowing. There is also the risk of creditor fears becoming self-fulfilling (Obstfeld, 1994).

4.3 Lender of Last Resort and Bankruptcy Court Combined

What if the roles of lender of last resort and bankruptcy court are combined, with the same institution supplying both emergency finance and legal protection? Consider in particular a scenario of ‘bail out’ followed by ‘write-down’, where in phase one, a liquidity crisis, the IMF supplies sufficient finance for the creditor to receive full debt service; but in phase two, when things degenerate so that insolvency threatens, the debtor benefits directly from debt service reductions. In broad-brush terms, these correspond to the two stages of Latin America Debt Crisis in 1980’s, with the Baker Plan, 1986–88, focusing on supplying finance for countries to ‘grow out of debt’, followed in 1989 by the Brady Plan for ‘debt and debt service’ reductions (Cline, 1995, p237).¹⁵

It appears to us that that these two roles are complementary. While it is true that there is a bailout in phase one, *moral hazard is checked because the bailout is expected to give place to a debt service reduction if things get worse*, so creditors still have the incentive to monitor. This argument is developed more fully in Section V. Here we use the Lambrecht and Perraudin (1996) model of debt valuation to illustrate, see Figure 4. Let debt of face value, $D = 1$, be fully serviced so long as debt service capacity is above $X_d = r$. This presents no problem for X greater than X_d ; but in a liquidity crisis, when X lies between X_b and X_d , the debtor will need emergency financing from the IMF to maintain its debt service. So far so good for the creditor. But when capacity falls to $X_b = r - \mu$ and the country is in danger of ‘drowning in debt’, let the IMF authorize a payments standstill and an ‘interest holiday’ lasting until capacity recovers to X_d , so creditors get nothing as long as $X < X_d$. As shown in the figure, the value of debt is no longer independent of past history of payments: between X_b and X_d there are two different valuations. The upper curve

¹⁵Cline summarizes as follows: “A debt strategy originally intended to orchestrate lending until countries could increase exports and restore creditworthiness (the Baker Plan) [gave] way to a forgiveness plan that had the predictable effect of cutting off new long-term lending from the banks (the Brady Plan). However, the broadly cooperative, market-oriented nature of the forgiveness plan contributed to an atmosphere of confidence for other categories of creditors, including bond holders, so that renewed capital flows through other channels accomplished the return to the capital market.”

4.4 Bond values with ‘sovereign immunity’ — and with a waiver

Before reporting some of the alarming discounts that have appeared on Brady bonds for Bulgaria and Brazil, we first illustrate how inter-creditor conflict can affect asset values by numerical examples. Though we use the same parameters for growth and variability of capacity to pay as Bartolini and Dixit (1991), unlike them we consider bonds with no rollover (i.e., the income contingent bonds of the last section) beginning with those protected by ‘water-tight’ sovereign immunity, see Table 3.

With the growth of capacity to pay set at 1%, and σ , the measure of variability in X , equal to 0.2, we find that bond values $V_S(r)$ are a reasonably healthy 73% of par even when the capacity to pay has fallen to the trigger for technical default, i.e., $X = r = X_d = 4\%$: and they rise to 88% of par when debt service capacity is twice the default trigger, see $V_S(2r)$. (The effects of varying σ and μ are also shown: halving volatility almost halves the discount at the trigger, while doubling the growth rate of capacity adds 6 points.)

	$V_S(r)$	$V_S(1.5r)$	$V_S(2r)$
		$\mu = 1\%$	
$\sigma = 0$	100	100	100
$\sigma = 0.1$	91	98	99
$\sigma = 0.2$	73	83	88
		$\mu = 2\%$	
$\sigma = 0.2$	79	88	92

Table 3: Value of debt with ‘sovereign immunity’.

What if the country was to waive sovereign immunity, as is common for emerging market economies? Figure 3 above shows there are two influences on bond values: the first, ‘collateral enhancement’, tends to raise the value of the bonds; the second, ‘a creditor grab race’, tends depress them. In the absence of a bankruptcy code or creditor coordination, the corporate analogy suggests that asset grabbing will take place at the earliest moment legally possible, namely $X = r = X_d$, i.e., when the country defaults on its interest payments; and this provides the relevant boundary condition for bond values (technically $V_N(r) = C$, where C is the collateral that can be seized at the point of technical default and the subscript N signifies that there is no code in place).

For the not-too-improbable case of a country with widely dispersed holdings of its debt but few assets abroad worth seizing, the ‘enhancement’ effect of waiving immunity will be negligible, but the ‘prisoner’s dilemma’ will be acute — particularly if the bond holders are thought to include a ‘vulture’ or two!¹⁷ The impact of waiving immunity in this case is illustrated by the line JJ in Figure 3, which starts from (almost) zero at X_d and rises asymptotically to par as X_d increases. This is admittedly extreme; so consider instead the

¹⁷If there are N creditors with equal seniority and equal holding of the debt, as long as the collateral value C is greater than the value of debt while waiting, $V(X_d)/N$, the grab race turns out to be the unique subgame perfect equilibrium in the absence of a bankruptcy code.

case of Brady debt.

Under the Brady Plan the face value of debt was collateralised in the form of US ‘deep discount’ bonds; but when these are discounted back from the due date (often twenty years or more in the future) the face value is not fully collateralised. Though interest payments are guaranteed out of an escrow account for 15 months, non-payment still constitutes technical default; so it seems that the debt of a Brady ‘backslider’ runs the risk of a creditor race if it fails to meet a coupon payment. How might this affect bond values?

Take the case where the US Treasury collateral is 40% of the face value. With a waiver of sovereign immunity and no expectation of a credit race, bond values would be pretty healthy, particularly if debt capacity is well above the crisis level, $X_d = r$. In the top row of Table 4, for example, we show bonds valued more than double the collateral for X twice the crisis level. (For the equations used see the Appendix: the parameters are $\sigma = 0.2$ and $\mu = 0$.) What if debt service capacity X falls from $2r$ to $1.5r$, for example? The top row suggests a modest 5% fall in bond values from 85 to 81 is the appropriate revaluation.

But what if ‘vultures’ begin to circle? Is there any danger of a market break? The official collateral behind Brady bonds cannot be grabbed, but any (additional) assets which can be seized may trigger a creditor race (so long as they exceed the value of the vulture’s holding by enough to cover the costs of litigation). Assuming that there are enough other assets to tempt a litigious bondholder, but they are in total negligibly small relative to the size of the market as a whole, we can assume that the Brady bonds will fall to the value of the 40% collateral at the point of technical default.¹⁸ Imposing this boundary condition gives the values shown in the second row of the table. For $X = 1.5r$ (and $\sigma = 0.2$) the threat of a grab race knocks 25% or so off bond values, so bonds would go to 60. From the assumed starting value of 85, this represents a drop of almost 30%: and this is well before debt service capacity has fallen to crisis level!

	$V(r)$	$V(1.5r)$	$V(2r)$
V_S : No run expected: ‘as if’ there was a code	71	81	85
V_N : Run expected	40	60	70

Table 4: A run on Brady Debt?

There are as yet no technical defaults on Brady bonds, but litigation triggered by defaults on sovereign debt¹⁹ suggests that it does not take much to tempt vultures. Absent a bail out or an authorized standstill, things will be fairly bleak for the debtor country. If creditors refuse to roll up the interest payments and accelerate debt instead, it will be forced to suspend its debt service unilaterally — which could severely damage its trading prospects

¹⁸The value of the Brady can be split into two parts, that of the ‘deep discount’ backing and that of the interest rate ‘strip’. In the circumstances described, the former will be unaffected, but the latter will tend towards zero.

¹⁹One creditor has pursued a claim of \$120 million dollars through five different jurisdictions, while another is trying to attach sovereign assets held in London in pursuit of a claim of only \$20 million. It looks as if expected gains of say \$50 million is enough to expose a country to the risk of being taken to court if it defaults on its interest payments.

and access to capital markets.²⁰ In particular, efforts of creditors to attach overseas assets could prevent access to inflows of funds.

How plausible is it that international bond markets might be subject to markets breaks described above? We offer two illustrations: first Bulgaria in late 1996 and 1997, when market commentary suggested a clear risk that the Brady Bond coupons would not be paid and the country risk premium rose to alarming levels of about 2000 basis points (20 percentage points); second Brazil in 1998, in the wake of the Russian bond default mentioned above, when the monetary authorities were forced to push interest rates to over 40% to defend the currency against a speculative attack, and there was talk of default on domestic debt. The long-dated Brazilian Brady Bond (10 1/8 2027) issued close to par in 1997 fell dramatically by over a third in value, from over 90 in August to under 60 in early September, 1998, and the corresponding spread over the US yield curve rose by about 700 basis points, roughly from 5% to 12%.

5 WHY THE RULES OF THE GAME NEED TO BE CHANGED

A salient feature of recent financial crises is that official lenders led by the IMF have been forced to provide bailouts in almost all cases; and this has effectively guaranteed the creditor's investment in sovereign debt. The recent Russian default is an exception: but the dire state into which this has plunged the economy serves to underline the pressures on the IMF to intervene. To see why changing the rules of the game is needed to limit excessive bail-outs and to make the global financial system less crisis prone, we first analyse a two player strategic game between a creditor and the IMF representing the debtor — as in stage two of the Latin American debt crisis when the IMF decided to help the debtors on the terms of the Brady Plan. The timing of events plays a key role, and it is the creditor who has the first mover advantage: nevertheless, standstills can prevent the IMF being manoeuvred into supplying emergency financing. Second we show how standstills can reduce moral hazard in the global financial system by increasing private sector monitoring.

5.1 IMF bail-outs: the 'time consistent trap'

Consider a sovereign liquidity crisis where the debtor is solvent (worth 130) but the current capacity to pay is insufficient to service debt (with face value of 100). The actions available to the creditor and the IMF are as follows: the creditor may either *roll over* the debt or '*grab*' the assets, i.e., withdraw funds or seize the collateral; while the IMF, acting for the debtor, can either *bail out* the debtor or take *no action*.

These actions and the resulting payoffs are shown in Table 5. As the arrows indicate, there are two Pareto-efficient Nash equilibria on the diagonal of this normal form game (which resembles the Battle of the Sexes). In the top left (*Rollover, No action*), the debtor is in good shape as the rollover involves some concessionality; the creditor's payoff is only 80, leaving 50 for the debtor. In the bottom right (*Grab, Bail-out*), the creditor's demand

²⁰A country faced with severe trade dislocation of this sort — which is costly to the borrower without benefiting the creditor, see Thomas (1996) — is, we suggest, not unlike a company being forced by its creditors prematurely to stop trading.

for accelerated payment of face value is met thanks to emergency funding by the IMF, with the remaining net worth of 30 going to debtor — minus a cost of 5 needed to satisfy tough IMF conditionality! The off-diagonal payoffs for $(Grab, No\ action)$ highlight the losses that may occur when the IMF refuses a bailout — the creditor gets the collateral, worth 40, but the debtor is ‘punished’ (gets nothing) as trade is strangled because of unilateral default. (As there is no need for bailout when the creditor rolls over debt, the diagonal payoffs for $(Rollover, Bailout)$ are the same as for $(rollover, No\ action)$.)

		IMF/Debtor	
		No action	Bailout
Creditor	Rollover	$(\mathbf{80}, \mathbf{50})$	\longleftrightarrow $(80, 50)$
	Grab	$(40, 0)$	\longrightarrow $(\mathbf{100}, \mathbf{25})$

Table 5: A liquidity crisis: outcomes and payoffs.

As far as the IMF and the debtor are concerned, $(Rollover, No\ action)$ is the preferred outcome and it might appear that the IMF can secure this outcome by simply refusing all bailouts. Given that the creditor has *first mover advantage*, however, this is not a credible threat and it is the other equilibrium which is selected. To see this, we represent the game in extensive form in Figure 5, letting nature first determine either a good or a bad state.²¹ In the good state, the debtor has sufficient resources to service the debt, and there will be no strategic interactions between the creditor and the IMF: so we ignore this branch. In the bad state, the country is in a liquidity crisis, and the creditor can choose either voluntarily to roll over the debt or to attack (accelerate repayment). Only then is it the IMF’s turn to move. With rollovers, no action is called for; but asset grabbing by the creditor is so disastrous for both the creditor and the debtor that the IMF will be forced to act (even though this involves a 100% guarantee for the creditor).

When the equilibrium is ‘refined’ by specifying this realistic move order, there is only one (sub-game perfect) Nash equilibrium — constant bailouts: using backward induction, the creditor will opt for attack rather than roll over — knowing that the IMF responds with a bailout. This is the ‘time consistent trap’ facing the IMF (and its partner institutions who supply emergency funds). To escape, the IMF must be able credibly to threaten not to bail the debtor out. How is this achieved? The answer, we believe, is by changing the rules of the game to enable the IMF to act like a bankruptcy court²² as well as lender of last resort. How this changes the equilibrium is shown by adding the option of a *standstill* to the extensive game, see the dashed line in the figure. In the last stage of the game, it is obvious that the standstill dominates the bailout as the appropriate IMF response to an attack. (As the creditor is forced to accept a debt service reduction this leaves 70 for the debtor.) Consequently, the creditor, faced with burden-sharing under the standstill (i.e., ‘having a haircut’ or ‘taking a hit’), will prefer to rollover rather than grab assets.

²¹In fact, the probability of either state is endogenous, as discussed below.

²²By protecting debtors from premature liquidation, and by allowing for financial restructuring — including possible debt writedown — subject to the conditionality needed to ensure appropriate effort on the part of debtor.

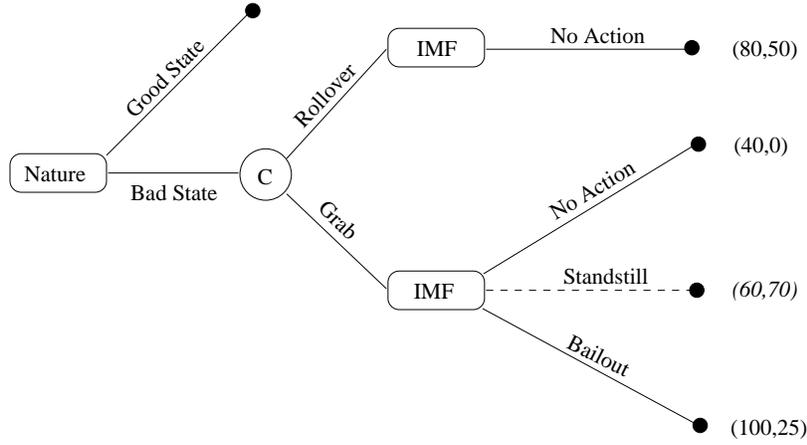


Figure 5: The strategic case for a payments standstill.

In the above account — and in Figure 5 — it is ‘nature’ that initially determines whether there is a good or bad state: but this is a crude simplification. In reality, the probability of good or bad outcomes will depend on the rules of the game in the global financial system. If, for example, there is no standstill mechanism and the IMF is trapped into guaranteeing bailouts for investors, there will be no incentive for the latter to monitor their investments and the probability of failure will go up, unless domestic regulators take firm action to prevent this. (A dramatic illustration of this argument is provided in Krugman (1998a), where deposit guarantees generate such inflated asset values — ‘Pangloss’ values — that financial collapse will occur in all but the best of all possible worlds!)

5.2 How bail-ins can reduce moral hazard

How bail-ins can both solve the time consistency problem facing the IMF and also prevent the degradation of the global financial system due to moral hazard is indicated in Figure 6. On the horizontal axis M measures the losses due to moral hazard, e.g., investment failures attributable to lack of monitoring; while the vertical axis measure the quantity of official bail-outs, expected (B^e) and actual (B). Assume that moral hazard increases with expected bail-outs, e.g., $M = B^e$, as shown by the incentive constraint OI (the 45 degree line). Let the cost of not bailing out the debtor in a grab race be $(100 - B)^2$, where 100 represents emerging market economies’ currency exposure (the value of their short term foreign currency liabilities net of reserves); and assume the IMF minimises losses due to both moral hazard and creditor grab races as shown by the iso-loss function L , conditional on expected bail-outs B^e .²³ This generates the reaction function labelled RR .

²³Specifically assume it minimises the hyperbolic function

$$L = M + \alpha(100 - B)^2/2$$

subject to $M = B^e$, where coefficient α measures the gravity of attack by creditors.

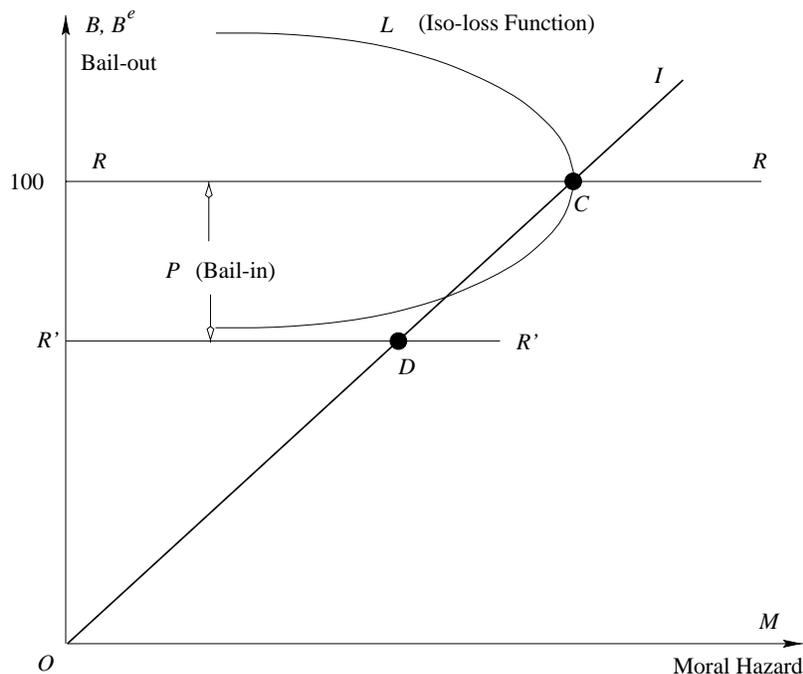


Figure 6: Time consistency, bail-outs and bail-ins.

To reduce moral hazard, the IMF might like to encourage the belief that there will be no bail-outs, i.e., $B^e = 0$. But this is not credible: as discussed above the time consistent solution is that people expect and obtain 100% bail-outs with all the moral hazard that this implies, as shown here at C , the intersection of the incentive schedule OI with the reaction RR .

How can the international financial system avoid this socially inefficient outcome? Consider first the role of private sector bail-ins, shown in the figure by moving the loss function and the associated reaction function vertically down from RR to $R'R'$ where the vertical distance represents the extent of anticipated private sector bail-in.²⁴ On the assumption that the private sector bail-in limits moral hazard through monitoring, the new time consistent equilibrium at D involves less official funding and less moral hazard. This is the logic of our proposal for official authorisation of payment standstills/bail-ins.

An alternative solution advocated by Eichengreen and Portes (1995), and Eichengreen (1998) is the use of contingent debt contracts to allow for ex post bail-ins via sharing and majority voting rules in a Bondholders Council. Though this market-based ‘contract’ approach has many attractions and has been endorsed by G-10 and G-22 Committees, it

²⁴Thus if P measures the volume of bail-ins, then the loss function can be written as

$$L = M + \alpha(100 - P - B)^2/2$$

and the reaction function moves down from 100 to $100 - P$, i.e., from RR to $R'R'$.

has not been adopted in practice.²⁵ The logic of our analysis implies that these ‘voluntary’ changes are unlikely to be implemented without the credible threat of a payments standstill. Buiter and Sibert (1999), in their recent proposal to attach rollover options to short term lending, explicitly assert that these should be *mandatory* (they would like all Fund members to agree that contracts without such provisions would not be enforceable in their courts).

If the system continues to promise bailouts which encourage carefree lending and callous capital flight, emerging countries could be forced to take things into their own hands and impose outright capital controls. This is what Malaysia has done.²⁶ Far better, we believe, to change the rules of the game so that countries do not have to cut themselves off from global financial system in this way.

6 CONCLUSION: A BASLE CLUB?

In the quotation at the head of this paper, opponents of orderly procedures for debt restructuring were asked to contemplate what would happen to an emerging market which was in trouble and received no bail-out. Subsequent Russian default has provided the illustration needed: its plight is so bad that some say it should no longer be called an emerging market; and the contagion effects spread not just to Ukraine but as far away as Brazil. This illustrates the pressures on the IMF to bail out the next country in trouble. The strategic case for having an orderly procedure is to avoid the current situation where international institutions are being forced into ‘bailouts’ that have progressively undermined incentives to manage risk in world financial markets. Taking more explicit account of the role of short term creditors — with their privileged access to the exit — can only add to the case for Chapter XI-style procedures.

The G-22 Report on International Financial Crises (released at the time of the Fund/Bank Meetings in October 1998) has re-emphasized the need for creditor coordination and changes in contracts to secure this. Recognizing that, where a temporary suspension of payments cannot be avoided, “a disorderly workout is against the interest of debtors creditors and the international community”, it argued that the interests of all parties would be furthered by allowing “the international community to signal its willingness to provide conditional financial support”. It specifically supported an IMF policy of “providing financial support for policy adjustment, despite the presence ... of arrears on the country’s obligations to private creditors, including arrears on marketable debt instruments”, and went somewhat further than its predecessor, the Rey Report, in discussing the idea of amending Article Viii 2(b) of the IMF’s articles of Agreement to provide for a mandatory stay of enforcement of actions against a sovereign or against private debtors in the event of an interruption in debt

²⁵A related device, the setting up of contingent credit lines, has been adopted by Argentina and Mexico, but the arrangement covers only a small part of the foreign currency debt that may one day face rollover problem. More extended discussion of these and other measures for crisis prevention and resolution is available in Bhattacharya and Miller (1999), Eichengreen (1999) and Griffith-Jones (1999), for example.

²⁶The fact that countries like mainland China and India escaped contagion from the East Asian crisis is commonly attributed to the inconvertibility of their currency on capital account, Miller and Zhang (1998b); something other emerging market countries cannot fail to notice.

payments. But not much further; as it concluded “Such an amendment does not appear feasible at the present time.”²⁷

In our view the time has come for changes in the international financial system to limit those creditor rights whose unfettered exercise threatens social efficiency. As sovereign debt becomes more like commercial debt, it is only to be expected that rules governing these international bond markets will imitate the institutional features of domestic bond markets.²⁸ It is said of commercial bankruptcy law that it affect far more cases than those that come to court, due to the incentives it sets up for ‘bargaining in the shadow of the law’: and the same would surely apply in the international context. Whether the power to limit creditor rights should be given directly to the IMF or to some other quasi-legal agency charged with renegotiating debt contracts — to be called, perhaps, the Basle Club²⁹ — is an interesting and important issue needing further discussion.

²⁷Richard Gordon has suggested to us that an easier path to achieve some of the same ends would be for sovereigns to exempt payments in arrears from the IMF from their waivers of sovereignty.

²⁸At the time of the Fund/Bank Meetings in 1998, the *Economist* carried an article making a similar point, “When countries go bust”, October 3, 1998. The speeches of then US Treasury Secretary Mr Robert Rubin at the time of IMF 1999 Spring meetings, referred in footnote 2, suggested that the official American position might be moving in this direction. See also the Buiters and Sibert proposal, discussed in “Calming the waters”, *Economist*, May 1, 1999.

²⁹By analogy with the Paris and London Clubs: this label would be especially appropriate if such an institution was established by the new Forum for Financial Stability, set up at the BIS in 1999 to assess the vulnerability of the global financial system and to identify and oversee the actions needed to address them, Tietmeyer (1999). Other titles suggested include the International Debt Restructuring Agency (Williamson, 1992) or the Global Restructuring Agency (Edwards, 1998) — more accurate, perhaps, but less appealing.

Appendices

A Rollover and debt reduction: the Paris Club

Here we derive the value of sovereign debt in the Bartolini and Dixit (1991) framework taking explicitly into account the effect of an anticipated writedown of the face value when an exogenous trigger of capacity to pay is reached (a similar model without rollover is in Cohen, 1993). As in the text, we assume that the capacity to pay follows a geometric Brownian motion

$$dX_t/X_t = \mu dt + \sigma dw. \quad (\text{A1})$$

In the absence of debt writedown, the face value of the debt evolves as

$$dD_t/dt = \begin{cases} 0, & \text{if } X_t \geq rD_t \\ rD_t - X_t, & \text{if } X_t < rD_t. \end{cases} \quad (\text{A2})$$

So the outstanding debt is unchanged when the capacity to pay is at least the interest payment of the debt; but it is rolled over when the capacity falls short of the required interest payment.

Denote the value of debt by $V^U(X, D)$ for $X \geq rD$ and by $V^L(X, D)$ for $X < rD$. In the region where $X \geq rD$, the arbitrage condition for $V^U(X, D)$ requires

$$\frac{1}{2}\sigma^2 X^2 V_{XX}^U(X, D) + \mu X V_X^U(X, D) - rV^U(X, D) + rD = 0, \quad (\text{A3})$$

and for $x < rD$

$$\frac{1}{2}\sigma^2 X^2 V_{XX}^L(X, D) + \mu X V_X^L(X, D) + (rD - X)V_D^L(X, D) - rV^L(X, D) + X = 0, \quad (\text{A4})$$

where subscripts denote partial derivatives.

Assume the anticipated debt reduction occurs at the point where the capacity to pay just reaches the solvency constraint, $X = (r - \mu)D$, and the fraction of debt reduced is exogenous and given by ϵ , then no arbitrage for debt values before and after the writedown must satisfy

$$V^L((r - \mu)D, D) = V^U((r - \mu)D, (1 - \epsilon)D). \quad (\text{A5})$$

Here, we assume ϵ is large enough that the current capacity to pay, $X = (r - \mu)D$, is sufficient to cover the new interest payment after the restructuring, $r(1 - \epsilon)D$.

As in Bartolini and Dixit (1991), the conditions for debt rollover are

$$V^L(rD, D) = V^U(rD, D) \quad (\text{A6})$$

$$V_X^L(rD, D) = V_X^U(rD, D). \quad (\text{A7})$$

Finally, the asymptotic condition for V^U is

$$\lim_{X \uparrow \infty} V^U(X, D) = D. \quad (\text{A8})$$

Following Bartolini and Dixit (1991), let $x = X/D$ and the average value of debt $v = V/D$, then (A3) and (A4) become

$$\frac{1}{2}\sigma^2 x^2 v_{xx}^U(x) + \mu x v_x^U(x) - r v^U(x) + r = 0, \quad \text{for } x \geq r, \quad (\text{A9})$$

$$\frac{1}{2}\sigma^2 x^2 v_{xx}^L(x) + \mu x v_x^L(x) + (\mu - r + x) x v_x^L(x) - x v^L(x) + x = 0, \quad \text{for } r - \mu \leq x < r; \quad (\text{A10})$$

with rollover conditions replaced by

$$v^L(r) = v^U(r), \quad (\text{A11})$$

$$v_x^L(r) = v_x^U(r). \quad (\text{A12})$$

The no arbitrage condition for the discrete debt reduction now becomes

$$v^L(r - \mu) = (1 - \epsilon) v^U\left(\frac{r - \mu}{1 - \epsilon}\right), \quad (\text{A13})$$

and the asymptotic condition (A8) is replaced by

$$\lim_{x \uparrow \infty} v^U(x) = 1. \quad (\text{A14})$$

Incorporating asymptotic condition (A14), the ordinary differential equation (A9) yields the following solution

$$v^U(x) = 1 - A x^{\theta_-}, \quad x \geq r \quad (\text{A15})$$

where $A > 0$ is an arbitrary constant and $\theta_- < 0$ is the negative root of the quadratic equation

$$\frac{1}{2}\sigma^2 \theta(\theta - 1) + \mu \theta - r = 0. \quad (\text{A16})$$

To solve for (A10), we first find the homogenous solution v^H which satisfies

$$\frac{1}{2}\sigma^2 x^2 v_{xx}^H(x) + \mu x v_x^H(x) + (\mu - r + x) x v_x^H(x) - x v^H(x) = 0. \quad (\text{A17})$$

Let $z = -2x/\sigma^2$, (A17) is simplified to

$$z v_{zz}^H(z) + (b - z) v_z^H(z) + v^H(z) = 0, \quad (\text{A18})$$

where $b = -2(r - \mu)/\sigma^2 < 0$. This Kummer's equation has the solution as a linear combination of the following two linearly independent functions

$$v^H = A'(1 - z/b) + B z^{1-b} {}_1F_1[-b; 2 - b; z], \quad (\text{A19})$$

where A' and B are two arbitrary constants and ${}_1F_1[\cdot]$ is a Kummer's function (see Slater, 1960, pp2-3). A particular solution to (A10) is $v^P = 1$, so the general solution to (A10) is given by

$$v^L(x) = 1 + A' \left(1 - \frac{x}{r - \mu}\right) + B' x^{1-b} {}_1F_1[-b; 2 - b; -2x/\sigma^2], \quad r - \mu \leq x < r \quad (\text{A20})$$

where B' is also an arbitrary constant. Using boundary conditions (A11)–(A13), one can solve uniquely A , A' and B' .

B Lender of last resort and moral hazard

In the text, we have shown that the debt value will stand at par when IMF conditionality takes a simple form of reflecting barrier at $x = r - \mu$ and when liquidity is provided for $r - \mu < x < r$. This is the case where there is no moral hazard. However, when lack of monitoring generates moral hazard, debt value will fall. Here, we calculate the value of debt where a fall of μ to zero is fully anticipated. The solutions are similar to those in the previous section, with θ_- replaced by $\theta_-(\mu = 0)$ and b by $b(\mu = 0)$. In particular, let $\theta' = \theta_-(\mu = 0)$ and $b' = b(\mu = 0)$, the debt values are given by

$$v^U(x) = 1 - Ax^{\theta'}, \quad \text{for } x \geq r, \quad (\text{B21})$$

$$v^L(x) = 1 + A' \left(1 - \frac{x}{r - \mu} \right) + B' x^{1-b'} {}_1F_1[-b'; 2 - b'; -2x/\sigma^2], \quad \text{for } r - \mu \leq x < r. \quad (\text{B22})$$

Boundary conditions (A11) and (A12) are still valid in determining the arbitrary constants while (A13) is replaced by the condition for the reflecting barrier

$$v_x^L(r - \mu) = 0, \quad (\text{B23})$$

where μ indicates effort in the absence of IMF providing liquidity. Conditions (A11), (A12) and (B23) are sufficient to solve for the debt value and to obtain schedule BB in Figure 3.

C Valuation of sovereign debt with ‘water-tight’ immunity

In what follows we assume that debts are not rolled over if current capacity falls short of the interest payments. Creditors may or may not agree to debt service reductions so that the amount due is limited to the current capacity to pay depending on the institutional circumstances. We evaluate these debts under three different conditions: first with ‘water-tight’ sovereign immunity, second without immunity but with a bankruptcy code and third with neither immunity nor bankruptcy procedures. This section calculate sovereign debt under the first condition. The other cases are dealt with in Appendices D and E.

Let the fixed coupon payment of debt be b . When $X_t > b$ full coupon is paid and otherwise X_t is paid. Assume that X_t follows (A1), then in the absence of arbitrage the equilibrium condition for the debt must satisfy the following condition

$$rV(X) = \begin{cases} b + \mu XV'(X) + (\sigma^2/2)X^2V''(X), & \text{if } X > b, \\ X + \mu XV'(X) + (\sigma^2/2)X^2V''(X), & \text{if } X \leq b. \end{cases} \quad (\text{C24})$$

The boundary conditions to (C24) are given as follows. When X is sufficiently high, the value of debt is almost at par, i.e., $\lim_{X \rightarrow \infty} V(X) = b/r$; when the capacity falls to zero, nothing is paid, so the value of debt is zero ($X = 0$ is an absorbing point). As the switch between the full and partial payments is reversible, value matching and smooth pasting conditions apply.

Using these boundary conditions one can solve the value of debt as

$$V(X) = \begin{cases} \frac{b}{r} + \frac{1}{\xi_+ - \xi_-} \left[(\xi_+ - 1) \frac{b}{r - \mu} - \xi_+ \frac{b}{r} \right] \left(\frac{X}{b} \right)^{\xi_-} & \text{if } X > b, \\ \frac{X}{r - \mu} + \frac{1}{\xi_+ - \xi_-} \left[(\xi_- - 1) \frac{b}{r - \mu} - \xi_- \frac{b}{r} \right] \left(\frac{X}{b} \right)^{\xi_+} & \text{if } X \leq b. \end{cases} \quad (\text{C25})$$

D Collateralized debt with a bankruptcy code

In Appendix C, creditors cannot seize the assets of the sovereign. In this section, we consider what happens if the debt is collateralized, i.e., the creditors can seize the assets of the sovereign when bankruptcy occurs.

With a strictly positive collateral value, C , the value of debt will eventually value match and smooth paste to C at the point of bankruptcy, X_b . So the only boundary conditions which are different from C are

$$V(X_b) = C, \quad (\text{D26})$$

$$V'(X_b) = 0. \quad (\text{D27})$$

These imply that the solution for the value of the debt is given by

$$V(X) = \begin{cases} b/r + A_- X^{\xi_-}, & \text{if } X > b, \\ X/(r - \mu) + B_+ X^{\xi_+} + B_- X^{\xi_-} & \text{if } X \leq b. \end{cases} \quad (\text{D28})$$

Using boundary conditions one can solve for the bankruptcy trigger X_b and these coefficients. Specifically, we find

$$X_b = -\frac{(1 - \xi_- \mu/r) b^{1-\xi_+}}{\xi_- - 1} X_b^{\xi_+} + \frac{\xi_- (r - \mu)}{\xi_- - 1} C, \quad (\text{D29})$$

$$A_- = -\frac{X_b^{-\xi_-}}{\xi_- - \xi_+} \left[(1 - \xi_+) \frac{X_b}{r - \mu} + \xi_+ C \right] - \frac{(\xi_+ \mu/r - 1) b^{1-\xi_-}}{(r - \mu)(\xi_- - \xi_+)}. \quad (\text{D30})$$

These equations are used to generate numerical examples.

E Collateralized debt without bankruptcy code

As we have argued in the text, in the absence of a bankruptcy procedure, creditor races may occur with debt values matching the collateral value C at the default trigger $X_d = b$. (Since this switch is irreversible, smooth pasting condition is not applicable.) With this boundary condition the pricing of sovereign debt is just a ‘first passage option’, which pays the full coupon if debt service capacity has not yet hit the coupon value and pays the collateral the first time the debt service capacity hits the coupon value. This can be easily solved to yield

$$V(X) = \begin{cases} b/r - (b/r - C)(X/b)^{\xi_-}, & \text{if } X > b, \\ C, & \text{if } X \leq b. \end{cases} \quad (\text{E31})$$

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