Structuring and Restructuring Sovereign Debt: The Role of Seniority*

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Abstract

Sovereigns tend to selectively default on types of debt that are easier to restructure than others. We show, within a simple model of sovereign debt with a willingness-to-pay problem and lack of exclusivity, how competition for protection against selective defaults may result in a sovereign debt that is excessively difficult to restructure in equilibrium. A bankruptcy regime for sovereigns may alleviate this inefficiency, but only if it is endowed with far-reaching powers analogous to corporate bankruptcy regimes, in particular the enforcement of seniority and subordination clauses in debt contracts. A bankrupcty regime that makes sovereign debt easier to restructure without enforcing seniority may decrease global welfare.

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1 Introduction

Sovereign debt restructuring has been a major policy issue for the international community since the mid 1990s. A new source of concern that has emerged, in particular, is that orderly debt restructuring has been made more difficult by the greater dispersion of debt holdings among a large number of small investors around the world.[1] Due to the perceived greater complexity in coordinating negotiations between debtholders and sovereigns a number of prominent commentators, a majority of G-7 countries, and the IMF have advocated ex-post policy interventions to facilitate debt restructuring. These calls for intervention have reached a culmination point when the IMF's Anne Krueger put forward the idea of a *sovereign debt restructuring mechanism* (SDRM) inspired by the U.S. corporate bankruptcy reorganization law under Chapter 11 (Krueger, 2002).[2]

The increase in debt dispersion has been largely brought about by a greater reliance on bond issues by sovereign borrowers. In the debt crises of the 1980s, most of sovereign debt was composed of syndicated bank loans and official loans. Although creditor coordination problems were not absent, it was possible for creditor banks and central bankers to negotiate with debtors and the IMF and to work out a debt restructuring agreement. The resolution of the debt crises of the 1980s also gave rise to a new framework for sovereign debt restructuring, with institutions such as the Paris Club and the London Club that helped coordinate creditors and set certain rules of the game for sovereign debt restructuring.

The framework for sovereign debt restructuring developed in the 1980s, however, is ill-equipped to deal with the more recent sovereign debt crises, which

[1] This greater dispersion of debt-holdings was one reason why the international community has at first resorted to large "bailouts" to resolve sovereign debt crises, most significantly in Mexico 1994-5. Large-scale crisis lending, however, is not a viable long-term solution to sovereign debt crises, especially when the debtor is insolvent.

[2] The notion of a "bankruptcy court for sovereigns" has a long history that goes back to Adam Smith. It has been popularized in the 1990s by Sachs (1995). See Rogoff and Zettelmeyer (2002) for a review of the recent developments on this proposal.

often involve much more severe creditor coordination problems. The nature of these coordination problems have been dramatically illustrated by the 2001 Argentine sovereign default. Its foreign debt included about 150 different bond issues, sold in 8 different jurisdictions and denominated in 6 different currencies.[3] After three years of halfhearted negotiations, the Argentine government launched a global debt exchange for 152 domestic and foreign securities amounting to 60 percent of its GDP. Although Argentina was able to successfully exchange its existing debts for lower face-value claims with a majority of creditors, it continued and still continues to face a significant fraction of holdouts as well as several pending law suits. In addition, Argentina's partial debt restructuring was hardly favorable to creditors.[4] It is not clear how and when Argentina will regain access to international debt markets, and the rescheduling of official bilateral debt has yet to take place.[5] Looking forward, no framework for sovereign debt restructuring has been put in place to deal with sovereign defaults similar to Argentina's in the future.

What would be the optimal framework for sovereign debt restructuring in the new financial environment? It is tempting to think about this question by analogy with corporate finance. The US corporate bankruptcy regime, for example, grew out of *equity receiverships* set up to deal with the restructuring of railroad bonds of large distressed railroad companies in the XIXth century, which faced essentially the same problems encountered today in sovereign defaults (Bolton, 2003). At the same time, it is also important to keep in mind the dimensions along which sovereign debt differs from corporate debt, in particular

[3] Although the Argentine default was remarkable by its size, the structure of the Argentine sovereign debt was not that different from other emerging market country debts.

[4] See Blustein (2005) for a detailed account of the Argentina debt crisis and also Bolton and Skeel (2005), Sturzenegger and Zettelmeyer (2007) and Gelpern and Gulati (2007) for an analysis of the Argentine debt exchange of 2004.

[5] Market exclusion does not seem to have been very costly if one looks at the Argentine growth rate in recent years. However, the disruption associated with the default, especially in the domestic banking sector, exacted a steep cost in terms of output loss (GDP fell by more than 15 percent in 2001-02).

the much weaker contractual enforcement resulting from national sovereignty. Unlike firms, sovereigns cannot be liquidated and there is very little income or collateral that they can credibly pledge in repayment to creditors.

Because of this weaker contractual enforcement some economists have argued in favor of maintaining the status quo (Dooley, 2000; Shleifer, 2003). They contend that the structure of sovereign debt has been deliberately designed to make debt-restructuring more difficult, partly in response to the debt crises and restructurings of the 1980s, which had revealed the full extent of the willingness-to-pay problem.[6] This view leads to the Panglossian conclusion that sovereign debt restructuring should not be made easier: a policy intervention that aims to reduce the costs of restructuring sovereign debt, while improving ex-post efficiency, will undermine ex-ante efficiency, by raising the cost of borrowing and reducing the amount of lending to emerging market countries.[7]

This paper attempts to clarify the differences between the interventionist and Panglossian views, by delineating the conditions under which a new framework for sovereign debt restructuring would be desirable, and the properties that such a framework should have. Our analysis is based on a stylized model of sovereign debt, whose main features and implications can be summarized as follows.

First, in line with the literature on the willingness-to-pay problem, we consider an environment with very weak contractual enforcement of sovereign debt contracts. We assume that the sovereign cannot credibly pledge domestic output or domestic assets in repayment of its debt, and repays only to avoid certain default costs.

[6] This is, of course, unlikely to be the only reason for the shift from bank loans to bonds in sovereign finance. To some extent, this shift is part of a wider trend towards securitization. Still, there is evidence that market participants viewed bonds as more secure than bank loans because they were more difficult to restructure (Bolton and Jeanne, 2005).

[7] The two claims of Dr.Pangloss that are relevant here are that "there is no effect without a cause" and that "everything is for the best in the best of possible worlds". In the context of sovereign debt, a more precise formulation of the Panglossian view would be that "everything is for the best in a second-best world".

Second, we derive as an equilibrium outcome the extent to which sovereign debt terms are renegotiable and analyze under what conditions it may be excessively difficult to restructure and when policy intervention is warranted. For simplicity, we introduce into our model just two types of debt: one type of debt that is fully renegotiable, and another type that is not renegotiable at all.

The third feature of our analysis follows directly from the first two. The sovereign will, in certain states of nature, *default selectively* on its renegotiable debt—that is, default only on this debt, and not on the non-renegotiable debt. The sovereign defaults on its debt for the same reason as in the willingness-to-pay literature (the cost of default is lower than the cost of fully repaying the debt), and it does so selectively because one type of debt is easier to renegotiate.

Selective defaults between different forms of debt that are more or less renegotiable—and the ex ante consequences for the equilibrium of the credit market—play a key role in our analysis. Selective defaults on sovereign debt are also a common occurrence in the real world. During most of the 1990s the differential treatment of sovereign claims has followed a pattern that is consistent with an implicit seniority of international bonds over bank loans. Sovereigns have often defaulted on their bank debt while staying current on their bonded liabilities.[8] Market participants were also well aware that such behavior resulted in an implicit seniority structure affecting the pricing and valuation of debt.[9]

In effect, selective defaults generate *de facto seniority* of non-renegotiable

[8] A total of 93 sovereigns have defaulted on their syndicated bank loans since 1975, including 20 that had bonds outstanding at the same time as their bank loans were in default. Yet, only 9 out of these 20 sovereigns also defaulted on their bonds, and the others serviced them in full (Standard and Poor's, 2003). The restructuring of Russian sovereign debt (August 1998-August 2000) is typical of this pattern. Domestic debt and Soviet era London and Paris Club debts have been restructured, while Eurobonds have been left untouched. Market participants have viewed this latest Russian debt restructuring episode as further corroboration of the sovereigns' tendency of treating creditors differently according to their power of nuisance.

[9] For example: "It is that implicit seniority which, in part, explains why bonds have become such favoured instruments for countries raising debt in recent years, says Ernesto Martinez Alas, an analyst at Moody's. " (*Euromoney*, October 1999, p. 50). Or: "The majority of governments treated bonds as being effectively senior to bank loans, and they did so with the tacit consent of bank creditors." (Standard and Poor's, 2003).

debt relative to renegotiable debt, and the possibility of dilution of the former by the latter. Non-renegotiable debt *dilutes* existing debt by reducing the amount that can be recovered by existing debtholders in a debt renegotiation. With each new debt issue, the sovereign is tempted to lower the cost of borrowing by issuing non-renegotiable debt and thus provide a form of seniority to that issue over other outstanding debts. This can give rise to a race for seniority resulting in an equilibrium outcome where sovereign debt is excessively difficult to restructure.

Our paper argues that this form of debt dilution is difficult to avoid in sovereign lending, as there is no obvious way of enforcing *seniority* agreements. In contrast to corporate debt, for which courts can enforce creditors' subordination priorities, there is no easy way of enforcing priority covenants for sovereign debt.[10] Because seniority is not available *de jure*, sovereigns attempt to achieve it *de facto* by making their debt issues exceedingly difficult to restructure.

Our paper argues that there is, therefore, a role for policy intervention in sovereign lending that would improve both ex-ante and ex-post efficiency. This policy intervention should take the form of facilitating the enforcement of priority covenants, thus allowing sovereigns to issue debt that is both easier to renegotiate and of longer maturity. Thus, our theory has some implications for the reforms of the international financial architecture that have been discussed in recent debates, and in particular the desirability of a bankruptcy regime for sovereigns. A bankruptcy regime for sovereigns could mitigate the inefficiency

[10] There is a large corporate finance and legal literature, as well as a large body of case law, on debt seniority and priority covenants as instruments aimed at reducing the risk of debt dilution. The insights from the corporate finance literature cannot be directly transposed to sovereign debt. The seniority of corporate debt is explicit, contractually specified and enforced by courts. It is based to a large extent on collateral. In contrast, there is very little collateral that sovereigns can offer to creditors. Of the 79 developing and emerging market countries that had at least one public sector international loan or bond outstanding on January 1, 2003, the face value of collateralized debt was only 6.2 percent of the face value of total outstanding debt (Zettelmeyer, 2003). See also Chalk (2002) and IMF (2003) for discussions of collateralized sovereign debt.

associated with the race to seniority by enforcing a default seniority rule, where priority is based on a *first-in-time rule* whereby debts issued earlier have higher priority, and debts with longer maturity have higher priority.[11] We argue, furthermore, that to enforce this seniority the bankruptcy regime would not require more powers of enforcement on sovereign debtors than under the status quo.

Our conclusions are thus less Panglossian than our premises, but they do not provide support for any form of intervention that facilitates debt restructuring either. Such policy interventions, if poorly designed, could easily be welfare-reducing. In particular, a sovereign debt restructuring regime that simply solves coordination failures between creditors ex post—such as collective action clauses (or, CACs)—may well reduce welfare in our model. The main benefit of a bankruptcy regime for sovereigns, in our view, stems from the establishment of a legal seniority rule between creditors, on the one hand, and from an analog of debtor-in-possession lending to the defaulted sovereign, on the other. Our emphasis on the need to differentiate across creditors in the debt restructuring process, thus contrasts with the conventional wisdom that creditors should be treated equally in debt restructuring agreements (G-10, 1996; G-22, 1998).

Our paper is related to several lines of literature on sovereign debt and corporate finance. The idea that it may be desirable to create a debt structure that is difficult to renegotiate under limited enforcement is, of course, a familiar theme in corporate finance. See, for example Hart and Moore (1995), Dewatripont and Maskin (1995), Bolton and Scharfstein (1996), Diamond and Rajan (2001) and Diamond (2004).

The inefficiencies resulting from nonexclusivity in debt contracts have long been noted in the corporate finance literature. Fama and Miller (1972, chapter 4) provide an early discussion of how lenders can protect themselves from dilu-

[11] The first-in-time rule has been advocated for corporate debt, among others, by White (1980) and Schwartz (1989). Bolton and Skeel (2004) outline how a bankruptcy procedure for sovereigns could be designed to legally enforce such a priority rule.

tion by making their loans senior. White (1980) and Schwartz (1989) analyze how priority rules can protect against dilution. Bizer and DeMarzo (1992), on the other hand, show that seniority is not a perfect antidote to the nonexclusivity problem in the presence of debtor's moral hazard. Bisin and Rampini (2004) provides an analysis of bankruptcy regimes that is related to ours. In their paper, the institution of bankruptcy is welfare-improving because it alleviates the incentives problem resulting from the non-exclusivity of financial contracts. It achieves this benefit, furthermore, by enforcing the seniority of early lenders.

The literature on sovereign debt and the willingness-to-pay problem puts forward several explanations for why sovereigns repay their debts, ranging from the fear of market exclusion (Eaton and Gersowitz, 1981) to creditor sanctions (Bulow and Rogoff, 1989), and more recently, to the costs of collateral disruption induced by sovereign defaults (Broner and Ventura, 2007). Our model follows Sachs and Cohen (1982) or Obstfeld and Rogoff (1996) and simply assumes that the cost of default is the loss of a fraction of output following default.

Our paper is closely related to several other studies of the structure of sovereign debt. In particular, Jeanne (2004) considers a model of the choice of maturity structure of sovereign debt and argues that short-term debt, while making sovereigns more vulnerable to debt crises also induces greater fiscal discipline for the sovereign. More closely related is our companion paper, Bolton and Jeanne (2007) and Pitchford and Wright (2007), which focus on sovereign debt structure and the sovereign's bargaining power in renegotiation. Also, Wright (2004a,b and 2005) considers how competition among multiple creditors affects the efficiency of sovereign lending and also how multiple creditors can coordinate debt restructuring privately by forming creditor committees. Another study by Hale (2007) looks at the macroeconomic determinants of the composition of international debt and finds that while changes in the ratio of bonds to bank loans to private borrowers varies with macroeconomic fundamentals this

is not true for the structure of sovereign debt.

A number of authors have emphasized the importance of seniority in sovereign debt. Roubini and Setser (2004), for example, view "the absence of an enforceable priority structure for the sovereign's own debt" as "one of the basic problems [...] that arise in a debt restructuring". Tirole (2002, chapter 4) discusses the contracting externalities that may arise in the issuance of sovereign debt and mentions seniority as a possible solution to this problem. Also, Dooley (2000) also emphasizes the conflict between official and private lenders in the competition for repayment and the issue of the seniority of the official sector. Yet, the formal analysis of seniority in sovereign debt is almost nonexistent. Kletzer (1984) analyzes the equilibrium of the sovereign debt market when creditors do not observe the borrower's total indebtedness and Cohen (1991, chapter 4) presents a 3-period model of sovereign debt dilution and notes that the resulting inefficiency is aggravated by the absence of a bankruptcy regime for sovereigns. However, neither of these studies attempts a systematic formal analysis of sovereign debt structure and seniority.

The remainder paper is structured as follows. Section 2 gives the main assumptions of the model. Section 3 shows how the non-renegotiability of debt can make it effectively senior. Sections 4 and 5 analyze the equilibrium when the sovereign respectively can and cannot commit not to dilute its debt. Section 6 shows how non-renegotiable debt can be used to forestall dilution, as well as the efficiency costs involved. Section 7 draws some normative implications from the theory, highlighting in particular the welfare benefits of establishing *de jure* seniority in sovereign debt.

2 The Model: assumptions

We consider a small open economy over three periods with a single homogenous good that can be consumed or invested. The representative resident of this economy may raise funds from the rest of the world by issuing (sovereign) debt in the first two periods ($t = 0, 1$). This debt is to be repaid in the last period ($t = 2$). The funds raised in the first two periods can be used for consumption or investment purposes.

To keep the analysis as tractable as possible we specify the following simple form for the utility function of the representative resident:

$$U = \delta_0 V_0 + \delta_1 V_1 + c$$

where,

1. c denotes the consumption level of the representative resident in period 2, and

2. δ_t is an indicator variable that is equal to 1 if the expenditure is made in period $t = 0, 1$, and V_t represents the utility value of the expenditure. This value may be generated through additional consumption or through public investment in infrastructure, health, schooling, etc. We do not need to specify exactly how the money raised is spent. For simplicity we shall assume that the expenditure is indivisible and that it has the same level g in periods 0 and 1. These expenditures may be efficient or not (V_t may be higher or lower than g).

The representative resident produces stochastic output y in period 2. The probability distribution over output is denoted by $f(\cdot)$. For simplicity we normalize period 0 and 1 output to zero—this assumption will be relaxed later and

does not matter for our main results. Finally, the sovereign is assumed to act on behalf of the representative resident and maximizes her welfare.

Under autarky this representative resident would only be able to achieve a welfare level of

$$E_0(U) = E_0(y).$$

By borrowing from the rest of the world she may be able to enhance her welfare. We shall take it that the sovereign debt market is perfectly competitive and that the equilibrium riskless interest rate is equal to zero. But that is not to say that the sovereign debt market is perfectly efficient. Indeed, as we already hinted at, two forms of *moral hazard* limit the efficiency of the sovereign debt market in our model: the classical *willingness-to-pay problem* in sovereign lending (Eaton and Gersovitz, 1981) and, *debt dilution* where the sovereign reduces the value of outstanding debt by taking out new risky debt.

If sovereign debt markets were perfectly efficient and the sovereign were able to perfectly commit to repaying its debts, then it would raise g in period $t = 1, 2$ if and only if this increased domestic welfare ($V_t > g$). The Modigliani-Miller theorem tells us that the first-best efficient repayment stream is indeterminate and that any agreed repayment stream, with an expected value of $(\delta_0 + \delta_1)g$ would be equivalent.

To focus our analysis squarely on the design of debt renegotiation, we shall allow the issuer to only issue long-term debt maturing in period 2. In section 10 we will explore the optimal debt-maturity structure by allowing the sovereign to issue any combination of short-term debt (maturing in period 1) and long-term debt. Here, we shall consider two forms of debt that the sovereign can issue: renegotiable debt (or *r-debt*) and non-renegotiable debt (or *n-debt*). Renegotiable debt and non-renegotiable debt can be interpreted as respectively

syndicated bank loans and bonds (Gertner and Scharfstein, 1991; Lipworth and Nystedt, 2001), or as bonds with exit consents and collective action clauses versus bonds without such clauses.[12] We shall assume that in a given period $t = 0, 1$ the expenditure is financed with one type of debt, r-debt or n-debt.

We denote by D_0 the amount of debt that the sovereign promises to repay in period 2 when it issues debt in period 0. Similarly, we denote by D_1 the promised repayments on new debt issued in period 1.[13] In period 2 the sovereign' s total liabilities coming to maturity are therefore:

$$D = D_0 + D_1.$$

There is a mixture of r-debt and n-debt if the sovereign has not issued the same type of debt in the first two periods. We respectively denote by D_r and D_n the amounts of r-debt and n-debt to be repaid in period 2.

The promise to repay D is credible only if it is in the sovereign's interest to repay ex post. We follow the sovereign debt literature by assuming that the sovereign repays its debts only as a way of avoiding a costly default. As in Sachs and Cohen (1982) and Obstfeld and Rogoff (1996), we model the cost of default as a proportional output loss, γy.[14] Obstfeld and Rogoff (1996)

[12] See Eichengreen (2003) for a discussion of the role of Collective Action Clauses in sovereign debt restructuring, and Buchheit and Gulati (2000) for a discussion of exit consents in sovereign bond exchanges.

[13] Thus, we assume that the sovereign cannot issue GDP-indexed debt $D_t(y)$. Although this is a realistic assumption—the share of GDP-indexed debt in total outstanding sovereign debt in the world is negligible—it requires an explanation. In our model a sovereign would be able to achieve the first-best by issuing GDP-indexed *n-debt*. But this is due to a somewhat artificial assumption: that γ the unit cost of default is certain (see below). An equivalent formulation of our model could have y certain, but γ uncertain. In that formulation GDP-indexed debt would obviously be of no help. What would be required is a *cost-of-default indexed debt*. It is easy to see that the informational requirements to be able to enforce such a debt instrument are likely to be prohibitive. In sum, in a richer model, where both y and γ are uncertain our analysis would apply even if the sovereign was able to issue GDP-indexed debt. To keep the analysis as simple as possible we have assumed that γ is certain and than D is independent of y.

[14] It is generally assumed in the literature that the cost of defaulting is the same whether the sovereign defaults in full or whether it repays part of its debt. This is a somewhat extreme assumption, but it is a more plausible assumption than another extreme assumption that comes to mind, by which default costs are only proportional to the size of the default. Concretely, this alternative assumption would specify default costs of $\min\{\gamma s, y - R\}$ for a

interpret this cost as a sanction, but it could also be interpreted, in our context, as the economic disruption or loss of market access induced by protracted debt restructuring negotiations.[15]

Whether creditors can be persuaded to lift the sanctions depends on whether debt is of the renegotiable or nonrenegotiable type. We assume that the holders of renegotiable debt (the r-creditors for short) can be coordinated at no cost around a debt restructuring agreement in which they consent to lift the cost γy in exchange of a payment η. In contrast, such an agreement is impossible to reach with the holders of n-debt (the n-creditors), since they are widely dispersed and the debt contract does not include any mechanism allowing them to collectively agree to a debt restructuring plan. The n-creditors automatically impose the sanction if they are not fully repaid. This inefficiency captures the idea that when debt holders are widely dispersed it will be difficult to reach an agreement acceptable to everyone in a timely fashion and to avoid free riding by hold-out creditors.[16]

shortfall in repayments $s = (D_2 - R)$. It is easy to see that under this assumption the sovereign always defaults in full when $\gamma < 1$. And when $\gamma \geq 1$ then the sovereign only defaults if it is unable to repay all its debts ($y < D_2$). And then it always repays all it can. This assumption clearly gives rise to unrealistic and implausible sovereign default behavior.

Reality is likely to lie somewhere in between these extreme assumptions and one might want to consider the more general default cost function $\gamma(s)y$, where $\gamma(s)$ is increasing in the repayment shortfall s from zero to a maximum value, $\overline{\gamma} < 1$. If $\gamma(\cdot)$ is a concave function then, when the sovereign is better off defaulting, it is optimal to always default in full and incur the cost $\overline{\gamma}y$. Our analysis would be virtually unchanged if we allowed for this more general default cost function.

On the other hand, if $\gamma(\cdot)$ is a convex function then there may be an interval of output realizations y for which it is optimal for the sovereign to repay some of its debt obligations when it defaults. Allowing for this possibility, while adding more realism to the model would not alter the main thrust of our analysis. It would however require a more involved analysis in places.

[15] The loss of market access comes from trigger strategy punishments in models a la Eaton and Gersowitz (1981). In the real world, potential new lenders are also concerned that litigating creditors could attach the repayments in court. The loss of access, in that case, lasts as long as the debt has not been successfully restructured with all creditors.

[16] This inefficiency may be incurred even though it hurts n-creditors collectively because of a free-rider problem—as in Diamond and Rajan (2001) or Jeanne (2004). For example, individual litigating creditors could hope to seize some collateral. If they litigate in an uncoordinated way, these creditors might impose an output cost on the country that is much larger than the value of collateral that they can seize. Similarly, the n-creditors may be unable to accept a voluntary decentralized debt exchange or repurchase, even an efficient one, because of free-riding by holdouts (Bulow and Rogoff, 1991).

More formally, the sequence of actions in period 2 is as depicted in Figure 1. First, the government decides whether to repay its debts fully or default. Following a default, the r-creditors make a take-or-leave repayment demand of $\eta \leq D_r$. The government then accepts or rejects the r-creditors' demand. Acceptance implies a partial default on r-debt, in which the r-creditors receive a fraction η/D_r of their claims and the n-creditors are fully repaid. Rejection implies a full default in which the government repays nothing to its r-and n-creditors and incurs the sanction λy. If the offer is rejected r-creditors impose sanctions on the sovereign, in which case the sovereign might as well default on n-debt, as there is no further cost in defaulting on all debts. Figure 1 gives the payoffs of the government and its creditors under full repayment, and partial and full default.

The difference between the two types of creditors relates to their ability to act collectively, not in the size of the sanction they can impose on the debtor or in their bargaining power. The n-creditors, as a group, cannot negotiate a debt reduction with the sovereign. By contrast, the r-creditors can bargain collectively. They have all the bargaining power, since they make a take-or-leave offer. They will ask for a full repayment, $\eta = D_r$, whenever possible, and for a lower repayment only to preempt a costly sovereign default that reduces the total repayment (to zero in our model).

This formulation captures in a simple way the fact that some types of sovereign debt are more difficult to restructure than others because of coordination problems between creditors, and that these types of debt tend to get restructured less often. Here, we simplify the situation in the extreme by assuming that n-debt is *impossible* to restructure. This assumption trivially implies that debt restructuring, if it occurs, involves r-debt only. This is a simple representation of the selective defaults which, as documented in the previous section, are one way that sovereigns discriminate between different classes of creditors

in the real world.

To summarize, the timing of moves and events in our model is as follows. The sovereign begins by raising g in period 0 in the form of debt repayable in period 2. In period 1 the sovereign can issue more debt also repayable the next period. We assume that these borrowing decisions are made sequentially and that the sovereign cannot commit to its future debt management in period 0. This assumption seems reasonable as a benchmark, since in the real world there is no obvious way a sovereign can commit not to issue debt in the future. In period 2 output y is realized and debts are repaid. In case of a default the debt restructuring continuation game described above is triggered. Finally, the representative resident consumes the remaining output and the game ends.

3 Strategic Default

In this section we determine when the sovereign repays its debts in period 2 and when it defaults, taking D_r and D_n as given. The debtor country may repay all its debts, default partially, or fully. Default without restructuring results in an output loss of γy.

Let us assume that the sovereign defaults. Is the default full or partial? This depends on whether the r-creditors can make an acceptable offer $\eta \geq 0$ to the sovereign. In the event of a partial default on r-debt, the sovereign's payoff is

$$y - \eta - D_n$$

if it accepts the offer η from r-creditors. The r-creditors can make an acceptable offer, therefore, if and only if,

$$D_n \leq \gamma y. \tag{1}$$

The holders of r-debt always prefer a positive repayment $\eta \geq 0$ to a full default with no repayment. Since they have all the bargaining power, they therefore

set η at the level that makes the sovereign indifferent between a partial and a full default, or

$$\eta = \gamma y - D_n.$$

By contrast, if $D_n > \gamma y$ the r-creditors cannot make an acceptable offer and the default must be full. The sovereign is better off defaulting on all its debts than selectively defaulting on r-debt. Conditional on a default, therefore, the default is partial if y is larger than D_n/γ, and full otherwise.

When is the sovereign better off defaulting? To answer this question we only need to compare the sovereign' s payoff under no default,

$$y - D_r - D_n,$$

and its payoff under partial or full default, which in either case is

$$(1 - \gamma)y,$$

since all renegotiation rents are extracted by r-creditors. Thus, the sovereign defaults if and only if period 2 output falls below a threshold:

$$y < \frac{D_r + D_n}{\gamma}. \tag{2}$$

A partial default, therefore, occurs if and only if conditions (1) and (2) are met. Ordering these cases in terms of y then gives the following result:

Proposition 1 *The sovereign's debt repayment strategy is as follows:*

(i) full repayment: if $y \geq \frac{D_n+D_r}{\gamma}$, the sovereign fully repays its renegotiable and non-renegotiable debt.

(ii) partial default: if $\frac{D_n}{\gamma} \leq y < \frac{D_n+D_r}{\gamma}$, the sovereign fully repays its non-renegotiable debt and repays $\gamma y - D_n$ to the holders of renegotiable debt.

(ii) full default: if $y < \frac{D_n}{\gamma}$, the sovereign defaults on all outstanding debts and repays nothing.

Proof. See discussion above. ■

This proposition clarifies the notion that non-renegotiable debt is effectively senior to renegotiable debt. In the case of partial default, the allocation of the repayment between r-creditors and n-creditors is the same as if the latter enjoyed strict seniority over the former. Because of this effective seniority, n-creditors have a larger expected recovery ratio than r-creditors, so that the interest rate spread should be lower on n-debt than on r-debt.

4 Optimal debt structure under commitment

What is the ex-ante optimal combination of n-debt and r-debt? The answer to this question depends on whether the government can commit not to dilute debt issued in period 0 with new debt issued in period 1. In this section we assume that the government can credibly commit not to dilute its initial debt. We thereby isolate the only remaining moral hazard problem in our model: the classic *willingness-to-pay problem*. This assumption, although not realistic, provides a convenient benchmark for the case with no commitment, where dilution is possible.

Let us assume that the sovereign finances the expenditure in both periods $t = 0$ and $t = 1$. There are three types of debt structures to consider:

• **pure r-debt**, with r-debt in both periods: in each period the sovereign issues a promise to repay $\widehat{D}_r$ satisfying[17]

$$g = \int_0^{2\widehat{D}_r/\gamma} \frac{\gamma y}{2} f(y)dy + \widehat{D}_r \int_{2\widehat{D}_r/\gamma}^{+\infty} f(y)dy. \tag{3}$$

• **pure n-debt**, with n-debt in both periods: in each period the sovereign issues a promise to repay $\widehat{D}_n$ satisfying

$$g = \widehat{D}_n \int_{2\widehat{D}_n/\gamma}^{+\infty} f(y)dy. \tag{4}$$

[17] If this equation admits several solutions we pick the smallest one. This also applies to equations (4), (5) and (6).

• **mixed debt**, with n-debt in one period and r-debt in the other: the promised repayments $\widetilde{D}_r$ and $\widetilde{D}_n$ satisfy

$$g = \int_{\widetilde{D}_n/\gamma}^{(\widetilde{D}_r+\widetilde{D}_n)/\gamma} (\gamma y - \widetilde{D}_n) f(y)dy + \widetilde{D}_r \int_{(\widetilde{D}_r+\widetilde{D}_n)/\gamma}^{+\infty} f(y)dy, \tag{5}$$

$$g = \widetilde{D}_n \int_{\widetilde{D}_n/\gamma}^{+\infty} f(y)dy. \tag{6}$$

The mnemonic is that a debt structure with only one form of debt is denoted with a hat, whereas a structure that mixes two forms of debt is denoted with a tilde. It does not matter, viewed from period 2, if the debt has been issued in period 0 or in period 1 given that there is no seniority or first-in-time rule in place.

Given that in any equilibrium investors obtain a zero net expected return, the equilibrium welfare of the representative agent is equal to the net welfare benefit from the expenditures in the two periods plus the total expected output net of the cost of default, or:

$$U_0 = V_0 + V_1 - 2g + E(y) - \int_0^{D/\gamma} \gamma y f(y)dy,$$

where $D = 0$, $2\widehat{D}_n$, or $\widetilde{D}_n$ in respectively a pure r-debt, pure n-debt and mixed debt structure.[18] As this expression immediately reveals the representative agent's welfare is highest under the structure with the lowest D, namely the pure r-debt structure. Thus we have the following result.

Proposition 2 *Under a pure willingness-to-repay problem it is optimal for the sovereign to issue r-debt in both periods.*

Proof. See discussion above. ■

This proposition defines the sense in which the renegotiable and nonrenegotiable debts can be viewed as respectively "good" and "bad" in our model. If

[18] Recall that in a pure r-debt equilibrium deadweight default costs can be avoided through ex-post debt restructuring. Similarly, under a mixed debt equilibrium deadweight costs for a partial default on r-debt can be avoided.

the government could commit not to dilute, it would never issue n-debt. This striking result is in part driven by our assumption that r-creditors are able to appropriate the entire amount γy in debt renegotiations following default. Thus, n-debt does not have an advantage over r-debt in extracting repayment from the sovereign. If the bargaining power of the r-creditors were lower than 1 the sovereign might have to issue n-debt in order to increase its pledgeable output.[19] We focus on the extreme case where r-creditors have all the bargaining power in renegotiation for expositional reasons. In this case there is a clear prediction on the optimal form of debt in a pure willingness-to-pay problem. As we shall see in the following sections, however, in the presence of both a willingness-to-pay and a dilution problem it is generally optimal for the sovereign to issue a strictly positive amount of n-debt as a way of mitigating dilution.

5 Dilution with non-renegotiable debt

We now relax the assumption on commitment made in the previous section and assume that the sovereign can reoptimize in period 1 in a discretionary way. We will show that under a weak and plausible assumption on the probability distribution of output there cannot be an equilibrium with only r-debt in this case, as the sovereign then always dilutes outstanding r-debt with n-debt in period 1. We also establish, however, that there can never be an equilibrium with pure n-debt.

The equilibrium debt type in period 1 is determined by a simple rule: the sovereign issues the type of debt with the lowest interest rate. This is because expected consumption is given by,

$$E(c) = \int_0^{D/\gamma} (1-\gamma) y f(y) dy + \int_{D/\gamma}^{+\infty} (y - D) f(y) dy,$$

[19] In the opposite polar case where the creditors have no bargaining power, the sovereign would be unable to issue r-debt since it would always default on it. The case with intermediate bargaining power is analyzed in our companion paper Bolton and Jeanne (2007).

where D is total debt repayment, irrespective of debt types.[20] The sovereign's problem is thus to minimize D, which is achieved in period 1 by issuing the debt with the lowest interest rate.

It is possible to show that the interest rate is lower on r-debt than on n-debt if the only type of debt outstanding is n-debt (because of the higher recovery value of r-debt in defaults). It follows that if the sovereign has issued n-debt in period 0, then it does not re-issue the same type of debt in period 1. Thus we have the following result.

Proposition 3 *There is no equilibrium in which the sovereign issues n-debt in both periods 0 and 1.*

Proof. See the appendix. ■

But, is there an equilibrium in which the sovereign issues r-debt in both periods? The answer is negative if the interest rate is lower on n-debt than on r-debt in period 1, after the sovereign has issued $\widehat{D}_r$ of r-debt in period 0, that is if $\widetilde{D}_n \leq \widehat{D}_r$. This inequality may or not be satisfied, in general. We show in the Appendix that it is satisfied if the following assumption holds:

Assumption 1. *The output density function $f(\cdot)$ is increasing in the interval $[0, 2\widehat{D}_r/\gamma]$, the interval of output levels for which there is default under pure r-debt.*

This assumption is both weak and intuitive. An increasing density $f(\cdot)$ ensures that selective defaults, in which n-debt dominates r-debt, are more likely than full defaults, in which r-debt dominates n-debt. It is satisfied for most usual specifications of $f(\cdot)$ if default is a tail probability event. This is the case, for example, of any bell-shaped function $f(\cdot)$ if the probability of default is lower than 1/2. Under Assumption 1 we have the following result.

[20] This is due to the assumption that r-creditors have all the bargaining power, so that the sovereign always loses γy in a default.

Proposition 4 *Consider an equilibrium in which the sovereign engages in investment expenditures in both periods $t = 0, 1$ and cannot commit to a particular debt structure. Then, under Assumption 1, the sovereign issues a mixture of n-debt and r-debt.*

Proof. See the appendix. ■

Welfare is lower than under commitment by an amount $\int_0^{\widetilde{D}_n/\gamma} \gamma y f(y) dy$. This represents the welfare cost of full defaults induced by the n-debt issued in period 1. Under laissez-faire there is, thus, an excessive level of n-debt issued relative to the first-best (in which there is no n-debt).

The nature of the problem faced by the sovereign here is essentially one of time consistency. The sovereign would like to commit not to issue n-debt but it is not able to do so. We discuss in section 9 how this problem can be solved contractually or through the creation of new institutions.

6 Non-renegotiable debt to forestall dilution

The analysis in the previous section might suggest that n-debt should be eradicated. We now show that such a conclusion would be hasty because it misses an important benefit of n-debt, which is that it cannot be diluted. The holders of long-term n-debt are protected against dilution by their effective seniority. The sovereign, therefore, may issue some of its long-term debt in the form of non-renegotiable debt to forestall dilution.

One of the costs of dilution of r-debt by n-debt is the deadweight cost of a full default. But another, more subtle, cost is that dilution creates incentives for overinvestment in period 1. A sovereign with no outstanding debt always makes an efficient investment decision: spend if and only if the expenditure is socially efficient ($V_1 > g$) and finance the expenditure with r-debt. But the sovereign's decision may be distorted by the presence of outstanding r-debt.

To see this, suppose that the sovereign has issued $\widetilde{D}_r$ of r-debt in period 0, under the expectation that there will be another investment expenditure in period 1 financed with n-debt. This expectation is rational if the sovereign is indeed better off financing the expenditure in period 1, or if:

$$V_1 + \int_0^{(\widetilde{D}_r+\widetilde{D}_n)/\gamma} (1-\gamma) y f(y) dy + \int_{(\widetilde{D}_r+\widetilde{D}_n)/\gamma}^{+\infty} (y - \widetilde{D}_r - \widetilde{D}_n) f(y) dy > \int_0^{\widetilde{D}_r/\gamma} (1-\gamma) y f(y) dy + \int_{\widetilde{D}_r/\gamma}^{+\infty} (y - \widetilde{D}_r) f(y) dy.$$

Substituting for

$$g = \widetilde{D}_n \int_{\widetilde{D}_n/\gamma}^{+\infty} f(y) dy,$$

and rearranging this condition can be rewritten as:

$$V_1 > \underline{V} \equiv g - \widetilde{D}_n \int_{\widetilde{D}_n/\gamma}^{\widetilde{D}_r/\gamma} f(y) dy - \int_{\widetilde{D}_r/\gamma}^{(\widetilde{D}_r+\widetilde{D}_n)/\gamma} (\widetilde{D}_n + \widetilde{D}_r - \gamma y) f(y) dy. \quad (7)$$

Note that the right-hand term $\underline{V}$ is lower than g, implying that the investment expenditure might be undertaken in period 1 even if it is inefficient. The sovereign's decision is biased towards excessive spending through dilution.

In contrast, if the sovereign had issued n-debt in period 0, there is no dilution bias since n-debt cannot be diluted. So n-debt is a double-edged sword: *n-debt is an instrument of dilution, but it is also a weapon against dilution.* The dual nature of n-debt is very important for the normative analysis that follows.

Expropriation of outstanding debt through dilution requires both a default and a debt restructuring. Intuitively, thus, a debt issue that is more difficult to restructure should also be more difficult to dilute. This intuition is captured in a stark way in our model, as n-debt cannot be diluted *at all,* because when period 0 n-creditors are not fully repaid, no other creditors are.[21] In contrast,

[21] This extreme outcome is driven by our assumption that the recovery value of debt is zero in a full default. If the recovery value of n-debt were positive, the n-debt issued in period 0 could be diluted in period 1 (by issuing more n-debt if n-creditors were effectively senior to r-creditors in the restructuring process). Even in this case, however, it would remain true that n-debt is diluted less often than r-debt.

renegotiable debt can be diluted by subsequent issues of either renegotiable or non-renegotiable debt.

7 Equilibrium

Suppose now that V_1 is uncertain in period 0, and that it could take values that are strictly lower than g but no lower than $\underline{V}$:

Assumption 2. *V_1 is uncertain viewed from period 0. It is lower than g with a nonzero probability but higher than $\underline{V}$ with probability 1:* $\Pr(V_1 < g) > 0$ *and* $\Pr(V_1 < \underline{V}) = 0$.

This assumption is meant to make the problem interesting without adding unnecessary complications. The assumption that V_1 can be lower than g implies that dilution has a positive distortionary welfare cost equal to $\int_{\underline{V}}^{g}(g - V_1)h(V_1)dV_1$, where $h(\cdot)$ is the pdf of V_1. The role of the assumption that V_1 remains above $\underline{V}$ is only to ensure that the sovereign would always dilute outstanding r-debt in period 1. Without this assumption one would have to compute the probability of dilution as the solution of a fixed-point problem, and this added analytical complication bring no additional economic insight.[22]

Under Assumption 2 the equilibrium is relatively simple to characterize. First, we know that the sovereign issues both n-debt and r-debt (by Proposition 4). But which type of debt is issued first? If V_1 is known ex ante to be larger than g, then the sovereign is indifferent between issuing n-debt in period 0 or in period 1. But if V_1 is smaller than g with positive probability the sovereign is strictly better off issuing n-debt in period 0: the deadweight loss from full defaults is the same as when n-debt is issued in period 1, but the spending decision in period 1 is efficient. It follows that issuing n-debt in period 0 dominates issuing it in period 1.

[22] The details are available upon request to the authors.

Proposition 5 *The sovereign finances investment expenditures with n-debt in $t = 0$, and when $V_1 > g$ with r-debt in $t = 1$.*

Proof. See discussion above. ■

In sum, it is optimal to use n-debt as a protection against dilution rather than as a tool of dilution, and therefore to issue n-debt early.

8 Public Policy

If sovereign debt is inefficiently structured to make debt restructuring harder, is there a case for policy intervention, and if so, how should policy be designed to alleviate the severity of debt crises? We take up these questions in this section. In recent years there has been a lively policy debate around these issues, especially following the proposal by Anne Krueger (2002), the IMF's deputy managing director, to set up a *Sovereign Debt Restructuring Mechanism* (SDRM). This ambitious project failed to gain enough support in the international community and the main outgrowth of this debate has been the spread of collective action clauses (CACs) in new sovereign bond issues. These clauses allow for the reduction in the payment terms of a bond issue if a super-majority of bondholders (often a 2/3 majority) approves a proposed *haircut*. If a debtor wants to renegotiate the payment terms of a bond issue with collective action clauses, it can approach the trustee representing the bondholders with a renegotiation offer, who in turn can put the proposal to a vote of all bondholders. While in the past CACs were mainly found in sovereign bonds issued in London under English law, almost all recent bond issues whether in New York or London contain such clauses (see Gelpern and Gulati, 2007). This development has generally been greeted favorably by most commentators, but as our analysis below shows it is not at all obvious that it is desirable to facilitate debt restructuring by inserting such clauses into sovereign bond contracts.

8.1 Making debt easier to restructure

Making debt easier to restructure does not always improve ex ante efficiency in our model. To see this, suppose that all debts are made renegotiable in one way or another (e.g., through collective action clauses, or a bankruptcy regime). The benefit is that the deadweight cost of full defaults disappears. But the cost is that the period-1 investment decision is now distorted because of dilution. Under Assumption 2 dilution will be systematic in period 1. Then, making debts easier to renegotiate increases welfare if and only if the deadweight loss from full defaults is larger than the welfare loss from dilution. That is if:

$$\int_0^{\widetilde{D}_n/\gamma} \gamma y f(y) dy > \int_{\underline{V}}^{g} V_1 h(V_1) dV_1.$$

One can construct examples in which this condition is satisfied or not, so that it is generally ambiguous whether the introduction of CACs or other institutions that facilitate debt restructuring increase welfare. Making debt easy to renegotiate could also generate credit rationing in period 0. To see this, suppose that the country's pledgeable income is sufficient to finance the expenditure in one period only ($g < \gamma E(y) < 2g$). Then the sovereign cannot finance the expenditure in period 0 because of the expectation of dilution in period 1. This is so even though investment might more efficient in period 0 than in period 1 ($V_0 > V_1$). Making debt renegotiable might reduce sovereigns' ex ante access to external finance, as many commentators have emphasized (e.g. Shleifer 2003).

Proposition 6 *Making all debts renegotiable (through mandatory collective action clauses or a bankruptcy regime) may increase or decrease welfare, and leaves welfare below the first-best level.*

Proof. See discussion above. ■

8.2 Establishing seniority

One reason that CACs have an ambiguous impact on welfare, and always leave welfare below the first-best level, is that they do not address the underlying source of inefficiency: the nonexclusivity problem and the resulting "race to seniority". Sovereigns have an incentive to bias their debt structure towards debt that is harder to restructure as a way of achieving *de facto* seniority and thus limit the extent of debt dilution. A sovereign engages in this form of inefficient debt structuring because there is no easy way of implementing seniority *de jure*. A sovereign bankruptcy institution could, however, enforce debt seniority and priority, as is the case for corporate bankruptcy. By replacing *de facto* seniority prevailing under laissez-faire with a *de jure* seniority a sovereign bankruptcy mechanism could result in substantial efficiency improvements. In our model a time-based priority rule where early lenders (who have lent in period 0) are senior to later lenders (who are lending in period 1) would lead to a Pareto improvement.

For concreteness, consider the sovereign debt restructuring procedure where all creditors are required to delegate renegotiation authority to a creditor committee, who has the exclusive right to make a restructuring proposal $\hat{\eta}$. The sovereign can only accept or reject the offer. If the sovereign rejects the offer the restructuring game ends, with the sovereign getting $y(1-\gamma)$ and creditors getting no debt repayment.[23] If the sovereign accepts the offer his payoff is $y-\hat{\eta}$ and creditors get $\hat{\eta}$. Creditors would then collectively concede a "haircut" of

[23] An alternative end-game could be to let the sovereign revert back to uncoordinated renegotiations with creditors. The sovereign's payoff in that case would be unchanged but creditors' payoffs could be higher, with n-creditors again benefiting from their higher de facto seniority. It would seem that under this alternative end-game incentives towards the introduction of de facto seniority may still be present. But this is not the case under the procedure we described, where a creditor committee makes a take-it-or-leave it offer $\hat{\eta}$. This would only be true if n-creditors also had a veto right in the sovereign debt restructuring procedure and could insist on getting their outside option payoff. Interestingly, even if the procedure were to grant such a veto right it would still bring about an ex-post and ex-ante efficiency improvement, as it would be able to overcome the non-renegotiation constraint of n-debt.

$\frac{D-\hat{\eta}}{D}$. The repayment $\hat{\eta}$ the sovereign agrees to make is then distributed among creditors according to absolute priority, with priority based on a first-in-time issuance rule. That is, for a given debt $D = (D_{02} + D_{12})$, the holders of the debt claim D_{12} would not recover anything out of the agreed repayment $\hat{\eta}$ until the holders of the debt D_{02} are paid in full.

Such a bankruptcy mechanism would not need to be endowed with more enforcement powers relative to the sovereign debtor than we have assumed so far. Conditional on a total repayment γy, the sovereign would have no reason to object to the enforcement of this seniority rule, which does not affect domestic welfare. The only agents who lose from the implementation of seniority are the n-creditors who have lent in period 1. However, the new mechanism would make those creditors lose most of their power of nuisance—they no longer have the option to free-ride because of the statutory mechanism of coordination, and they would lose any legal backing for the implementation of sanctions.

Note that the enforcement of this rule would entirely eliminate the sovereign's incentives to dilute the outstanding debt at time $t = 1$. Thus welfare would be at the first best level. We emphasize this conclusion in the proposition below:

Proposition 7 *Under a perfectly enforceable* de jure *priority rule for sovereign debt a country can achieve an optimal debt structure which puts its welfare at the (commitment) first-best.*

Proof. See discussion above. ■

The above highly simplified procedure is an idealization that works in the context of our simple model. Real world sovereign debt restructurings are, of course, much more complex and a difficult policy issue is how a seniority rule for sovereign debt can be legally enforced in practice. This problem is taken up in some depth in Bolton and Skeel (2004), who outline a bankruptcy procedure

to enforce a (first-in-time) seniority rule through a combination of classification, voting by seniority classes, and a *cram-down rule* adapted to fit the sovereign debt context.

9 Extensions

9.1 Short-term debt

Another way that the sovereign could forestall dilution is by issuing short-term debt. Short-term creditors cannot be diluted because they get to roll over their claims at terms that reflect the dilution risk. This approach, however, involves costly continuous monitoring by the lenders of the sovereign's debt issues. But to the extent that it is effective at reducing dilution, a short maturity debt structure could reduce the need for the kind of reforms that we have discussed in the previous section. In this section we introduce short-term debt into the model, and show that it is not always an effective tool to forestall dilution. Without any loss of generality we restrict attention to renegotiable debt (and drop the subscript r to alleviate the notations).

Thus, suppose that the sovereign issues short-term debt in period 0, D_{01}, to be rolled over in period 1. The debt is repaid in period 1 out of first-period output y_1 and/or the proceeds of any new debt issued in period 1, D_{12}. This raises the possibility of a default in $t = 1$. As before, we assume that the sovereign chooses not to default in period 1 as a way of avoiding a default cost γy_1, and also that short-term creditors have all the bargaining power in any debt restructuring. Hence short-term creditors receive γy_1 in a default (on r-debt). In addition as seems realistic, we assume that the sovereign cannot finance the expenditure g in period 1 following a default on its debt issued in period 0.

To keep the analysis as simple as possible, we consider an equilibrium in which y_1 is known in period 0, and the sovereign finances the expenditure g in

both periods $t = 0, 1$. The sovereign, thus, issues D_{01} and D_{02} in period 0, D_{12} in period 1, and does not default in period 1. The equilibrium conditions then are,[24]

$$g = D_{01} + \int_0^{\frac{D_{02}+D_{12}}{\gamma}} \frac{D_{02}}{D_{02}+D_{12}} \gamma y f(y) dy + D_{02} \int_{\frac{D_{02}+D_{12}}{\gamma}}^{+\infty} f(y) dy, \qquad (8)$$

and,

$$D_{01} + g = y_1 + \int_0^{\frac{D_{02}+D_{12}}{\gamma}} \frac{D_{12}}{D_{02}+D_{12}} \gamma y f(y) dy + D_{12} \int_{\frac{D_{02}+D_{12}}{\gamma}}^{+\infty} f(y) dy.$$

The first equation says that the expenditure g is financed by short-term debt D_{01} (which is repaid with certainty since there is no default in period 1) and by long-term debt D_{02}. The second equation says that the new expenditure g and the rollover of the short-term debt D_{01} are financed by output y_1 and by issuing new short-term debt D_{12}. The value of D_{12} is, of course, rationally anticipated in period 0.

The equilibrium must satisfy two incentive constraints. First, the sovereign should be better off financing the expenditure in period 1. We shall denote by $D'_{12} < D_{12}$ the short-term debt issued in period 1 if the sovereign chooses not to finance the expenditure. In that case, D'_{12} is given by:

$$D_{01} = y_1 + \int_0^{\frac{D_{02}+D'_{12}}{\gamma}} \frac{D'_{12}}{D_{02}+D'_{12}} \gamma y f(y) dy + D'_{12} \int_{\frac{D_{02}+D'_{12}}{\gamma}}^{+\infty} f(y) dy.$$

And the incentive constraint becomes:

$$V_1 + \int_0^{\frac{D_{02}+D_{12}}{\gamma}} (1-\gamma) y f(y) dy + \int_{\frac{D_{02}+D_{12}}{\gamma}}^{+\infty} (y - D_{02} - D_{12}) f(y) dy \geq$$
$$\int_0^{\frac{D_{02}+D'_{12}}{\gamma}} (1-\gamma) y f(y) dy + \int_{\frac{D_{02}+D'_{12}}{\gamma}}^{+\infty} (y - D_{02} - D'_{12}) f(y) dy \qquad (9)$$

for all $D'_{12} < D_{12}$.

[24] Recall that y refers to second period output.

This constraint determines a minimum level of V_1 above which the sovereigns spends g in period 1. One can show that this threshold $\underline{V}$ is strictly lower than g if there is some long-term debt issued in period 0 ($D_{02} > 0$)[25], and is equal to g if the sovereign issues only short-term debt in period 0 ($D_{02} = 0$). In other words, the spending decision in period 1 is not distorted by dilution if the expenditure is entirely financed by short-term debt in period 0. Issuing only short-term debt and rolling it over period by period, thus, seems to be a simple panacea for the sovereign's time-consistency problem.

Unfortunately, however, there is another incentive constraint to take into account, that of no default in period 1. The country does not default if

$$V_1 + \int_0^{\frac{D_{02}+D_{12}}{\gamma}} (1-\gamma) y f(y) dy + \int_{\frac{D_{02}+D_{12}}{\gamma}}^{+\infty} (y - D_{02} - D_{12}) f(y) dy \geq$$
$$(1-\gamma) y_1 + \int_0^{\frac{D_{02}}{\gamma}} (1-\gamma) y f(y) dy + \int_{\frac{D_{02}}{\gamma}}^{+\infty} (y - D_{02}) f(y) dy. \qquad (10)$$

As shown in the appendix, this incentive condition may not hold if the sovereign finances the period 0 investment expenditure only with short-term debt. Under a short-term debt structure, this incentive constraint can only be satisfied if the default cost γy_1 is large enough. When this is not the case, the sovereign must issue some long-term debt in period 0. We summarize the above discussion in the following proposition.

Proposition 8 *The first best is achieved if the sovereign can finance the expenditure g in $t = 0$ with short-term renegotiable debt that is rolled over in period 1. This is possible only if the cost of default in period 1 is large enough:*

$$\gamma y_1 > 2g - V_1.$$

Proof. See appendix. ■

[25] For $D_{01} = 0$ the level of $\underline{V}$ is given by (7).

When y_1 is risky it is even harder to efficiently forestall dilution by issuing short-term debt, as the sovereign would default on its outstanding debt in period 1 whenever there is a sufficiently negative output shock in that period. Thus, the main insight from this analysis is that a strategy of forestalling dilution by relying on short maturity debt has some limits, and may come with a cost in terms of financial fragility. As a result, the sovereign may issue long-term debt even if this creates incentives for debt dilution and overborrowing in the future.

9.2 Optimal dilution

One concern one might have with the strict enforcement of a time-based priority rule is that it may give rise to a debt overhang problem and put the sovereign in a position ex post where it cannot borrow to finance valuable investments because it has already accumulated too much debt. As a way of reducing this risk it may, thus, be desirable to allow for some debt dilution.[26] Alternatively, it may be desirable to allow for deviations from an absolute priority rule under the sovereign bankruptcy regime, as is the case in corporate bankruptcy. We explore this idea in this section by assuming that dilution can help the sovereign to finance a solvency-enhancing policy action in times of financial distress. For simplicity, suppose that y is observed in period 1, so that creditors know whether the sovereign is going to default in period 1. Instead of an expenditure g we shall allow the sovereign to take an action in period 1 that can reduce the negative impact of a default on the domestic economy. This action increases domestic output by $(\alpha + \beta)y$ in period 2, but requires an expenditure of αy in period 1. To keep the analysis as simple as possible, we assume that this increase in domestic output cannot be pledged in repayment to foreign creditors. We further assume that the country is not able to finance the new expenditure with period 1 output, so that it has to borrow αy in period 1.

[26] Diamond (1993) presents a model in which dilution plays a useful role as a buffer against negative shocks.

If the bankruptcy court gives absolute priority to the period 0 lenders, then the sovereign cannot raise any new funds in period 1. For the country to be able to finance the welfare-enhancing expenditure in period 1, the bankruptcy regime would have to violate the seniority of early lenders. Thus, suppose that the bankruptcy court grants protection to a sovereign only if it is insolvent (when $\gamma y < D_{02}$) and suppose that the bankruptcy court grants higher priority to new lenders to cover the expenditure αy. Under these assumptions the country's budget constraint and ex ante welfare are given by respectively

$$g = (1-\alpha)\int_0^{\frac{D_{02}}{\gamma}} yf(y)dy + D_{02}\int_{\frac{D_{02}}{\gamma}}^{+\infty} f(y)dy,$$

and

$$U_0 = V_0 - g + E_0(y) + \beta\int_0^{\frac{D_{02}}{\gamma}} yf(y)dy.$$

The expected cost of dilution arising from the new priority lending in period 1 is captured in the term in α in the first equation. Because of this cost the sovereign must promise a larger D_{02} to finance the same g, and therefore faces a higher probability of default (for the same level of borrowing g). The second equation captures the welfare benefit of dilution (the term in β). As these expressions make clear, as long as β is higher than α it is preferable to allow for dilution or to grant higher priority to new lenders in period 1.

Proposition 9 *It may be optimal for the bankruptcy court to grant seniority to post-default lenders over pre-default lenders.*

Proof. See discussion above. ■

The right to grant higher priority to new lenders given to a bankruptcy court is essentially the same as the right to grant debtor-in-possession lending in corporate bankruptcy regimes. Note that the original creditors suffer from the dilution so they would never vote for it if given the opportunity. The optimal conditional dilution policy cannot, therefore, be implemented simply

by coordinating creditors ex post. The court must be granted the discretionary power of deviating from the absolute priority rule.

10 Concluding Comments

We have shown that under *laissez faire* equilibrium sovereign debt structures are likely to be inefficient. In the absence of any seniority rule sovereigns have an incentive to dilute outstanding debt that is relatively easy to restructure (bank debt) by issuing debt that is hard to restructure (sovereign bonds). At the same time, if debt markets anticipate such dilution, sovereigns may also have an incentive to issue bonds (hard to restructure debt) as a way of forestalling future dilution. Our analysis, thus, does not support the Panglossian view that sovereign debt contracts are efficient ex ante and that there is no scope for welfare-improving reforms. Our model mainly points in the direction of policy interventions that aim to enforce an absolute priority rule for sovereign debt, and highlights potential weaknesses of recent policies towards facilitating restructuring directly by inserting collective action clauses into bond contracts.

To keep the analysis tractable we have abstracted from a number of potentially relevant issues. Mainly, we have ignored agency problems between issuing country governments and their citizens. In our model it is always desirable to relax credit constraints in the international debt market because governments are assumed to be benevolent. But this would not be the case if decisions were taken by self-interested policymakers who do not maximize domestic welfare. We have also not touched on the important issue of the currency denomination of debt. We leave these issues for future research.

APPENDIX

Proof of Proposition 3

Assume that the sovereign issues $\widehat{D}_n$ in period 0 in the expectation of issuing $\widehat{D}_n$ in period 1. In period 1 the sovereign could deviate and issue instead D_r satisfying,

$$g = \int_{\widehat{D}_n/\gamma}^{(\widehat{D}_n+D_r)/\gamma} (\gamma y - \widehat{D}_n) f(y)dy + D_r \int_{(\widehat{D}_n+D_r)/\gamma}^{+\infty} f(y)dy.$$

One has $D_r < \widehat{D}_n$, implying that the deviation is indeed optimal. To see this, note that the r.h.s. of the equation above is increasing in D_r and, using (4), strictly larger than g for $D_r = \widehat{D}_n$.

Proof of Proposition 4

$\widetilde{D}_n$ must be smaller than $\widehat{D}_r$ if replacing $\widetilde{D}_n$ by $\widehat{D}_r$ in (6) raises the r.h.s. (otherwise $\widetilde{D}_n$ would not be the smallest solution to (6)). Thus a sufficient condition for $\widetilde{D}_n \leq \widehat{D}_r$ is

$$\widehat{D}_r \int_{\frac{\widehat{D}_r}{\gamma}}^{+\infty} f(y)dy > g = \int_0^{\frac{2\widehat{D}_r}{\gamma}} \frac{\gamma y}{2} f(y)dy + \widehat{D}_r \int_{\frac{2\widehat{D}_r}{\gamma}}^{+\infty} f(y)dy,$$

or

$$\widehat{D}_r \int_{\frac{\widehat{D}_r}{\gamma}}^{\frac{2\widehat{D}_r}{\gamma}} f(y)dy > \int_0^{\frac{2\widehat{D}_r}{\gamma}} \frac{\gamma y}{2} f(y)dy.$$

This can also be written $m(\widehat{D}_r/\gamma) > 0$, where $m(\cdot)$ is the function: $x \mapsto x\int_x^{2x} f(y)dy - \int_0^{2x} \frac{y}{2} f(y)dy$. We have $m'(x) = \int_x^{2x}(f(y) - f(x))dy$, which is positive if $f(\cdot)$ is increasing and negative if $f(\cdot)$ is decreasing. Thus, if $f(\cdot)$ is increasing in the interval $[0, 2\widehat{D}_r/\gamma]$ $m(\cdot)$ is increasing in the interval $[0, \widehat{D}_r/\gamma]$ which, together with $m(0) = 0$, implies $m(\widehat{D}_r/\gamma) > 0$. Hence, Assumption 1 implies $\widetilde{D}_n < \widehat{D}_r$, which implies that there is no equilibrium with r-debt in both periods.

Proof of Proposition 8

Equation (9) can be rewritten

$$V_1 \geq \underline{V} = g - \eta,$$

where η is the benefit of dilution,

$$\eta = \int_0^{\frac{D_{02}+D'_{12}}{\gamma}} \left(\frac{D_{02}}{D_{02}+D'_{12}} - \frac{D_{02}}{D_{02}+D_{12}} \right) \gamma y f(y) dy + \int_{\frac{D_{02}+D'_{12}}{\gamma}}^{\frac{D_{02}+D_{12}}{\gamma}} \left(D_{02} - \frac{D_{02}}{D_{02}+D_{12}} \gamma y \right) f(y) dy,$$

which is strictly positive if $D_{02} > 0$ and equal to zero if $D_{02} = 0$.

After simple manipulations using (8) and (**??**), the incentive constraint (10) can be written,

$$\gamma y_1 \geq 2g - V_1 - \int_0^{\frac{D_{02}}{\gamma}} \gamma y f(y) dy - D_{02} \int_{\frac{D_{02}}{\gamma}}^{+\infty} f(y) dy.$$

If $\gamma y_1 < 2g - V_1$ this condition can be satisfied only if $D_{02} > 0$.

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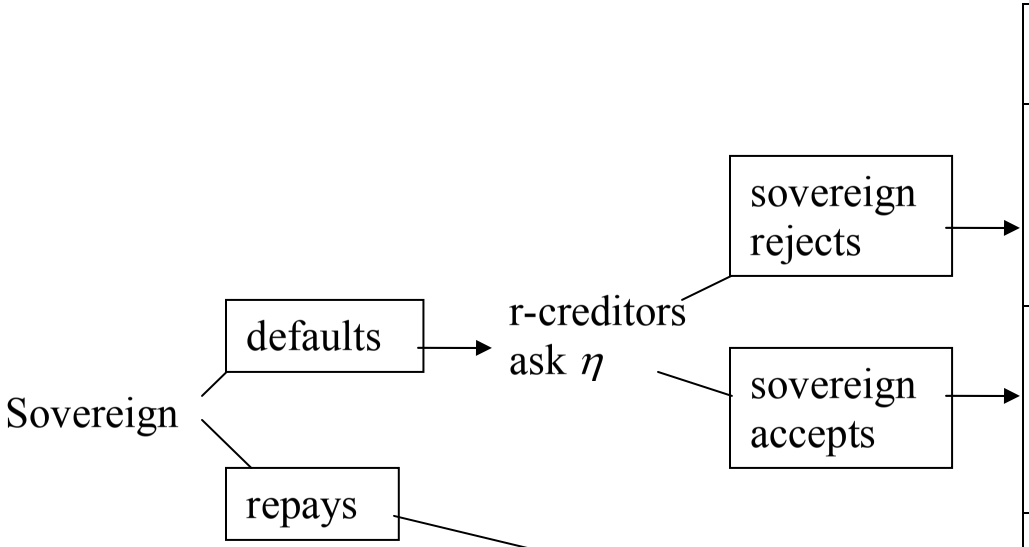
Figure 1. The repayment game in period 2



Payoffs

	Sovereign	r-creditors	n-creditors
Full Default	$(1-\gamma)y$	0	0
Partial Default	$y-\eta-D_n$	η	D_n
No Default	$y-D_r-D_n$	D_r	D_n