Structuring and Restructuring Sovereign Debt: The role of Seniority*

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Abstract

Most studies of sovereign debt focus on two major moral hazard problems: the sovereign's incentive to strategically default on its debts and the lenders' excessively lax lending itself driven by the anticipation of IMF bailouts. Here, we concentrate on another major moral hazard problem that arises in the absence of IMF bailouts: debt dilution. We show that to forestall debt dilution sovereigns have an incentive to make their debt excessively difficult to restructure. We argue that a policy intervention that would make seniority and priority in sovereign debt legally enforceable would at the same time eliminate this distortion towards excessively hard and fragile debt and prevent overborrowing when sovereigns are approaching financial distress.

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1 Introduction

The composition of sovereign debt and how it affects debt restructuring negotiations in the event of financial distress, has become a central policy issue in recent years. There are two major reasons why the spotlight has been turned on this question. First, the change in the *I.M.F.*'s policy orientation towards sovereign debt crises, with a proposed greater weight on '*private sector involvement*' (Rey Report, 1996), has brought up the question of how easy it actually is to get 'the private sector involved'; that is, how easy it is to get private debt-holders to agree to a debt restructuring. Second, the experience with several recent debt restructuring episodes - some of which were followed by defaults and by private litigation to recover debt payments - have raised concerns that the uncoordinated efforts of dispersed debt-holders to renegotiate sovereign debt obligations were likely to lead to substantial delays and other inefficiencies.

These concerns have led a number of prominent commentators, a majority of G-7 countries, and the *I.M.F.* to advocate ex-post policy interventions to facilitate debt restructuring (see Rogoff and Zettelmeyer, 2002, for a history and overview of the different proposals). These calls for intervention have reached a culmination point when the *I.M.F.* put forward the idea of a *sovereign debt restructuring mechanism* (SDRM) inspired by the *U.S.* corporate bankruptcy reorganization law under Chapter 11 of the 1978 Bankruptcy act.

The debate triggered by these ambitious proposals for reform of the international financial architecture has left many commentators wondering why, in the first place, sovereign debt had been structured to make it difficult to renegotiate, and why the structure of sovereign debt had evolved over the past decade or so towards a greater share of sovereign bond issues and greater dispersion of ownership of sovereign bonds. This paper is concerned with precisely these issues. Its starting point are the questions:

1) why would a forward looking sovereign want to design a sovereign debt structure that is difficult to restructure?

2) where are the contractual failures between the borrower and lenders that justify an ex-post policy intervention to facilitate debt restructuring?

Several commentators (most notably Dooley, 2000) have argued that due to the sovereign's incentive to repudiate its debts (the well known *willingness-to-pay problem*) it may be ex-ante efficient to structure sovereign debt to make it difficult to renegotiate ex-post. A policy intervention that would reduce these restructuring cost, while improving ex-post efficiency, might actually undermine ex-ante efficiency. Concretely, these commentators argue that such a policy might raise the cost of borrowing and result in a reduction of lending to emerging market countries.

This paper considers another moral hazard problem besides the sovereign' s willingness-to-pay: the problem of *debt dilution*. This problem arises whenever a sovereign approaches financial distress and raises new debt to postpone or to attempt to avoid a debt crisis. This new debt *dilutes* existing debt by reducing the amount that can be recovered by existing debtholders in a debt renegotiation.

Our paper argues that this form of debt dilution is difficult to avoid in sovereign lending, as there is no obvious way of structuring *seniority* and priority of repayment in sovereign debt renegotiations. In contrast to corporate debt, for which courts routinely enforce creditors' subordination priorities, there is no easy way of enforcing priority covenants for sovereign debt[1]. As a result, our

[1] 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 (see e.g. Fama and Miller, 1972, White 1980, Barclay and Smith, 1995, and Schwartz, 1989 and 1997). 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

paper shows that when seniority is not available *de jure*, sovereigns attempt to achieve it *de facto*, so to speak, by making their debt issues exceedingly difficult to restructure. This leads to state the analog of Gresham law for sovereign debt—in equilibrium "bad" debt structures tend to crowds out "good" ones.

Our paper argues that there is a role for policy intervention in sovereign lending that would improve both ex-ante and ex-post effciency. 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 (SDRM). We argue that because of the competition between borrowers to dilute each other, sovereign debt might be excessively hard to restructure in equilibrium even from an ex ante perspective. A bankruptcy regime for sovereigns could mitigate this inefficiency by enforcing a seniority rule based on the time and the maturity of lending–by making early lenders senior to late lenders and long-term debt senior to short-term debt.

In our model, the so-called contractual approach to sovereign debt restructuring does not work. First, efficiency cannot be achieved by leaving sovereign borrowers free to include or not renegotiation-friendly clauses in their debt (the contractual approach advocated by the official sector in G-10, 1996; G-22, 1998). In equilibrium, the adoption of such clauses will be inefficiently low under laissez-faire. Second, it is also suboptimal to encourage the adoption of such clauses by a system of taxes or subsidies (as advocated by Eichengreen, 1999, or Kenen, 2001), or by making their use mandatory.

Our analysis provides support for the statutory approach to sovereign debt

(Zettelmeyer, 2003). See also Chalk (2002) and IMF (2003) for discussions of collateralized sovereign debt.

restructuring. However, we emphasize that the statutory approach may easily be welfare-reducing if it is not carefully designed. In particular, a sovereign debt restructuring mechanism that simply solves coordination failures between creditors ex post reduces welfare in our model. It is crucial that the mechanism fulfill the other functions of corporate bankruptcy regimes, in particular that it establish legal seniority between creditors and that it allow for the analog of debtor-in-possession lending to the defaulted sovereign. Our emphasis on the need of differentiating across creditors in the debt restructuring process contrasts with the conventional wisdom that creditors should be treated equally in debt restructuring agreements (G-10, 1996; G-22, 1998).

Related Literature.

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". Dooley (1995, 2000) emphasizes the conflict between official and private lenders in the competition for repayment, i.e., the question of the seniority of the official sector.[2] As documented in section 2, practioners pay a great deal of attention to the implicit seniority status of the different types of sovereign debt.

By comparison, the formal analysis of seniority in sovereign debt seems relatively underdeveloped. Kletzer (1984) analyzes the equilibrium of the sovereign debt market when creditors do not observe the borrower's total indebtedness. Cohen (1991, chapter 4) presents a 3-periods model of sovereign debt dilution and notes that the resulting inefficiency is aggravated by the absence of a bankruptcy regime for sovereigns. Detragiache (1994) conjectures that the lack of

[2] According to Dooley (2000), the "adversarial relationship between official and private creditors is the central problem for the international monetary system".

formal seniority in sovereign debt, although it is source of inefficiency, could play a useful role in preventing sovereigns from playing creditors against each other in debt restructuring negotiations.

The inefficiencies resulting from nonexclusivity in debt contracts have been studied in the literature on corporate finance. Fama and Miller (1972, chapter 4) provide an early discussion of how lenders can protect themselves from dilution by making their loans senior. Bizer and de Marzo (1992) 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 paper is structured as follows. Section 2 reviews some stylized facts on sovereign debt that motivate the theoretical analysis in the rest of the paper. Section 3 gives the main assumptions of the model. Section 4 shows how the nonrenegotiability of debt can make it effectively senior. Sections 5 and 6 analyze the equilibrium when the government respectively can and cannot commit not to dilute its debt. Sections 7 shows how non-renegotiable debt can be used to forestall dilution, as well as the efficiency costs involved. Section 8 draws some normative implications from the theory, highlighting in particular the welfare benefits of establishing *de jure* seniority in sovereign debt.

2 Evidence

This section presents evidence suggesting that there exists an implicit seniority structure for sovereign debt, and that this structure is related to the perceived difficulty with which debt can be restructured. The implicit seniority in sov-

ereign debt is an understudied topic, on which there has been very little empirical research. This section relies on the facts reported by Zettelmeyer (2003), as well as the financial press.

The *de facto* seniority structure of sovereign debt results from the fact that different classes of creditors are treated differently in a default. The differential treatment of claims that are not legally prioritized is not a new feature of sovereign debt restructuring. This was a feature of most debt restructurings that have taken place over the last 25 years (from the Brady plan in the late 1980s and 1990s, to the more recent debt restructurings in Russia, Ukraine, Pakistan, Ecuador and Uruguay). This is true not only in the sense that multilateral official debt was generally not restructured, but also within the class of private claims. Differential treatment has taken two forms. First, defaulted instruments were often restructured on quite different terms, and second, governments have defaulted selectively on some classes of claims but not others. For example, the "Brady deals" that settled the debt crises of the 1980s restructured bank loans but not international bonds (Merrill Lynch, 1995).

Sovereign debt, which was composed of mainly syndicated bank loans in the 1970s and 1980s, has shifted gradually towards bond finance following the debt crises of the 1980s, first with the Brady deal and later with the growth in the international bond market (see Figure 1). There is no clear explanation for this change in composition, but one possible reason may be that following the debt crises of the 1980s lenders to emerging market governments had realized that syndicated bank loans were too easy to restructure. The new lenders may conceivably have counted on a lower risk of restructuring of international bonds, to the extent that these were widely dispersed, and were therefore more difficult to restructure: "There are several things that make international bonds much harder to restructure than loans. First, they typically involve many more in-

vestors than do loans, even syndicated loans. Second, they may be in bearer form so investors may be untraceable." (Michael Peterson, in *Euromoney*, October 1999). The recent debt crises and defaults of Russia and Argentina have highlighted just how difficult comprehensive debt restructuring negotiations can be among thousands of different bondholders with a wide variety of objectives.

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 international bank loans. A total of 93 sovereigns have defaulted on bank debt since 1975, including 20 issuers with bonds outstanding during the period that their bank loans were in default. Yet, only nine sovereigns in this category defaulted on their bonds, while the others serviced them in full (Standard and Poor's, 2003).

The restructuring of the Russian sovereign debt (August 1998-August 2000) was typical of this pattern. Domestic debt and Soviet era London and Paris Club debts were restructured (with international bank creditors accepting a debt exchange involving a 40 percent reduction in the NPV of their claims), while the Eurobonds were left untouched. Market participants viewed the Russian debt restructuring as an illustration of the sovereigns' tendency of treating creditors differently according to their power of nuisance: "defaulters will always try to pick off the weakest creditors first. Russia has specialized in playing off one class of creditors against another, first by defaulting on its domestic debt while keeping up its Eurobond payments and more recently by attempting to restructure Soviet-era debt..." (*Euromoney*, p. 48). It was also clear for market participants that such behavior resulted in an implicit seniority structure that had an impact on the equilibrium structure of debt: "'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, and analyst at Moody's." (*Euromoney*, p.50). "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).

The implicit seniority structure created by the Brady deal was put into question by the debt restructuring of Pakistan (1999-2001). For the first time, the Paris Club deal specifically required Pakistan to seek comparable treatment from bond holders in addition to bank loans. This change in official policy was justified as an effort to better involve the private sector in the resolution of crises. Pakistan restructured bilateral official debt, bank claims and-for the first time-Eurobonds, but not domestic debt. Although the amount of Eurobonds involved was small (they accounted for less than 2 percent of Pakistan's external debt), this debt restructuring significantly altered the market's perception of the implicit seniority structure in international sovereign debt. The announcement, in January 1999, that Pakistan would be forced to restructure its Eurobonds triggered a rise in international bond spreads issued by emerging market governments other than Pakistan in the order of 25 to 95 basis points (Zettelmeyer, 2003).

As a result of the Pakistan restructuring, there is no longer a clear sense that bonds hold priority over bank loans. Indeed, in two recent cases-Ecuador in 2000, and Uruguay in 2003-bonds were restructured but bank loans were left untouched. Perhaps in reaction to this uncertainty, lenders have tried innovative ways of making themselves de facto senior. For example, one of the two Eurobonds that creditors were offered in Ecuador's 2000 debt exchange contained a "principal reinstatement" clause, which provided for an automatic upward adjustment in principal in the event of a default. The face value of the bond holder's claim was to rise by a given amount in the event that Ecuador defaulted on the new bonds after the restructuring. Thus, incumbent bondholders received (temporary) protection from dilution that might result from new debt issuance.

The evidence suggests several stylized facts that the theory in this paper will attempt to capture and explain:

• sovereigns do not default in the same way on different classes of debt instruments and this selectivity generates an implicit seniority between debt classes;

• this seniority seems related to structural features of sovereign debt that make it more or less easy to renegotiate with creditors;

• international investors are aware of this implicit seniority structure and pay close attention to potential shifts in its determinants;

• the composition of international sovereign debt tends to shift to the class of instruments that is perceived as senior at a given point in time.

The remainder of this paper presents a theoretical framework that accounts for these phenomena and draws some normative conclusions from the theory.

3 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 period ($t = 0$). This debt is to be repaid in the next two periods ($t = 1, 2$). The funds raised in the first period 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:

$$U = V(g) + c_1 + c_2.$$

where,

1. $V(g)$ represents the gross present value of funds g raised at time 0 by issuing debt. This value may be generated through additional consumption at $t = 0$ or through public investment in infrastructure, health, schooling, etc. We do not need to specify exactly how the money raised is spent;

2. and, c_1 and c_2 denote the consumption levels of the representative resident in periods 1 and 2 respectively.

We assume that $V'(g) > 0$ and $V''(g) < 0$.

The representative resident produces stochastic output y_1 and y_2 in respectively periods 1 and 2. The probability distribution functions over output in each period are given by $f_1(.)$ and $f_2(.)$. Although this is not essential for our analysis it is convenient to think of the respective outputs in periods 1 and 2 as being independently distributed. We normalize the country's output in period $t = 0$ to $y_0 = 0$. The sovereign acts on behalf of the representative resident and maximizes his welfare.

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

$$E[U_A] = E[y_1] + E[y_2] = y_1^e + y_2^e.$$

By borrowing from the rest of the world the representative resident may be able to enhance his 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 we shall allow for two forms of *moral hazard* which limit the efficiency of the sovereign debt market. The first form is the classical *willingness-to-pay problem* in sovereign lending (Eaton and Gersovitz, 1981). The second form, *debt dilution*, where the sovereign reduces the value of outstanding debt by taking

out new risky debt is much less emphasized in the sovereign debt literature (for some important exceptions see Kletzer, 1984 and Cohen, 1991).

If sovereign debt markets were perfectly efficient and the sovereign were able to perfectly commit to repaying its debts up to its ability to repay, and also to commit not to take out new debt in periods 1 and 2, then it would raise an optimal amount of funds, g^*, in period 0 given by the first-order condition for efficient borrowing:

$$V'(g^*) = 1.$$

That is, the sovereign would raise funds up to the point where the marginal benefit of an extra unit of funds is equal to the marginal cost of borrowing (which is always 1 given our assumption that world interest rates are equal to zero). This level of borrowing is our efficiency benchmark. If, due to moral hazard the sovereign ends up borrowing more than g^* we shall say that there is *over-borrowing* and if it ends up borrowing less we shall say that there is *under-borrowing*.

The Modigliani-Miller theorem tells us that the efficient repayment stream is indeterminate and that any agreed repayment stream, with an expected value of g^* would be efficient. We assume that the period 0 expenditure is financed with long-term debt maturing in period 2. We assume that the maturity of debt is long so as to better focus on another aspect of debt structure, its renegotiability. 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 could be respectively interpreted as syndicated bank loans and bonds (Gertner and Scharfstein, 1991; Lipworth and Nystedt, 2001), or as bonds with a collective action clause versus bonds without such a clause.[3] We shall allow the sovereign to issue any combination of r-debt and n-debt.

[3] See, e.g., Eichengreen (2003) for a discussion of the role of Collective Action Clauses in sovereign debt restructuring.

The sovereign may issue debt in period 0 to finance the expenditure g, and again in period 1 to finance consumption c_1. We respectively denote by D_{02}^r and D_{02}^n the amount of r-debt and n-debt that the government promises to repay in period 2 when it issues debt in period 0. Similarly, we denote by D_{12}^r and D_{12}^n the promised repayments on new debt issued in period 1. In period 2 the sovereign' s liabilities of respectively r-debt and n-debt coming to maturity are therefore:

$$D_2^r = D_{02}^r + D_{12}^r,$$

and

$$D_2^n = D_{02}^n + D_{12}^n,$$

and the sovereign' s total liabilities are

$$D_2 = D_2^r + D_2^n.$$

The promise to repay D_2 is credible only if it is in the sovereign's interest to repay. We follow the sovereign debt literature by assuming that the sovereign repays its debts only as a way of avoiding a costly default. Like Sachs and Cohen (1982) and Obstfeld and Rogoff (1996), we model the cost of default as a proportional output loss, γy_2.

Critically for our analysis we decompose this cost into two components:

$$\gamma y_2 = \rho y_2 + \lambda y_2.$$

The first component is a deadweight cost that the country must bear whenever it fails to repay its debt in full (it can be interpreted as a reputational cost of default, or a collateral output loss resulting from capital flight or a banking crisis, for example). The second component is a sanction that creditors may impose or waive (the output loss resulting from litigation by creditors in foreign courts or from trade sanctions, for example). The various default costs considered in

the literature on sovereign debt fall in one or the other category (see Eaton and Gersowitz, 1981, for the first type, and Bulow and Rogoff, 1989, for the second type). The first component is a clear deadweight cost of default. It is an output loss incurred by the contracting parties following a default. The second component, on the other hand, is a cost that can be avoided if the creditors can be persuaded to waive sanctions in debt renegotiations following default.

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 around an agreement in which they consent to lift the sanction λy_2 in exchange of a payment η. By contrast, such an agreement is impossible to reach with the holders of n-debt (the n-creditors), because they are dispersed and the debt contract does not include any mechanism allowing creditors to collectively agree and commit to a debt restructuring plan. The n-creditors automatically impose the sanction if they are not fully repaid.[4]

More formally, the sequence of actions in period 2 is as depicted in figure 2. First, the government decides whether to repay its debts fully, or default on its r-debt, on its n-debt or on both. Defaulting on any type of debt triggers the payment of the reputational cost ρy_2. Whether the country bears the sanction λy_2 depends on the type of debt that is defaulted on. Defaulting on the n-debt induce the n-creditors to impose the additional cost λy_2. By contrast, defaulting on the r-debt leads to a negotiation between the government and the r-creditors. The r-creditors announce the amount η for which they are ready to lift the sanction; then the government accepts and pays η to the r-creditors, or rejects the creditors' proposal and bears the sanction. Note that the r-creditors

[4] The sanction might be imposed even though it hurst the n-creditors collectively because of a free-rider problem. For example, the litigating creditors could hope to seize some collateral. If they litigate in an uncoordinated way, the creditors might impose an output cost to the country that is much larger than the value of collateral that they can seize.

have all the bargaining power since they make a take-or-leave offer. However, they have effective bargaining power only if the n-creditors do not impose the sanction (which cannot be imposed two times).

The government issues debt in period 0 to finance g; it then reissues debt in period 1 to finance current consumption. It takes these decisions so as to maximize the representative resident's welfare. We assume that this optimization is sequential and discretionary. The government decides in period 1 the structure of the debt issued in period 1; it cannot commit to this decision 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.

The following sections characterize the optimal debt structure going through several steps. Section 4 starts with the equilibrium repayment behavior of the government in period 2, showing that n-debt enjoys a form of effective seniority over r-debt. Section 5 shows that if commitment were possible, the government would issue r-debt only in period 0. Section 6 shows that such a strategy is not time consistent, however, since the government is tempted to dilute the r-debt in period 1. Section 7 derives the equilibrium (time consistent) strategy, which under fairly general conditions is to issue n-debt in period 0.

4 Effective seniority

In this section we determine how the sovereign repays its debts in period 2, taking D_2^r and D_2^n as given. The government may repay its debts fully, or default on its r-debt, on its n-debt or on both. Full or partial default implies that domestic output is automatically reduced by the deadweight loss ρy_2. If the government defaults on its n-debt, furthermore, domestic output is reduced by the sanction λy_2, which comes on top of ρy_2.

Table 1 gives the sovereign' s and creditors' payoffs under the three relevant

scenarios: full repayment, partial default on each type of debt, and full default. The only payoffs that require an explanation are those under partial default on r-debt (column 2) . When making their offer the r-creditors, knowing that the n-creditors cannot make any concession, anticipate that the sovereign could reject the offer and get the full default payoff $(1-\gamma)y_2$, or accept the offer and get $(1-\rho)y_2 - \eta - D_2^n$. The most r-creditors can, therefore, be repaid is $\eta = (\lambda y_2 - D_2^n)^+$ and this is the offer they make in equilibrium, given that they have all the bargaining power.

Table 1. **The Payoffs**

	full repayment	partial default (r-debt)
country	$y_2 - D_2^r - D_2^n$	$(1-\rho)y_2 - (\lambda y_2 - D_2^n)^+ - D_2^n$
r-creditors	D_2^r	$(\lambda y_2 - D_2^n)^+$
n-creditors	D_2^n	D_2^n
total	y_2	$(1-\rho)y_2$

Table 1 (continued)

	partial default (n-debt)	full default
country	$(1-\gamma)y_2 - D_2^r$	$(1-\gamma)y_2$
r-creditors	D_2^r	0
n-creditors	0	0
total	$(1-\gamma)y_2$	$(1-\gamma)y_2$

Notice that the parties' period-2 payoffs have been specified under the assumption that the sovereign consumes the entire period-1 output y_1 in period 1. It turns out that there is no loss of generality in our model in assuming that the sovereign consumes net output as it accrues. The reason is that the sovereign is assumed to be risk neutral. Moreover, if the sovereign decided to save part or all of y_1 until period 2 there would be no change in the sovereign' s debt repayment decision. Indeed, the sovereign's decision to repay the debt is entirely driven by the cost of default, which is proportional to period-2 output, and is therefore not affected by any savings decision in period 1.[5]

[5] This is an important simplifying feature of our model, which is specific to the sovereign

Given this payoff structure, what is the optimal strategy for the government? First, note that for the government, partial default on n-debt (column 3) is unambiguously dominated by full default (column 4). Thus the case of partial default on n-debt can be ruled out: if the government selectively defaults, it is necessarily on its r-debt.

The country will loose at least γy_2 in a debt renegotiation, so if $D_2^r + D_2^n \leq \gamma y_2$ the country repays the two types of debt without renegotiating. If $D_2^r + D_2^n > \gamma y_2$ there are two cases to consider. If $D_2^n \leq \lambda y_2$, the r-creditors make a take-or-leave demand to be repaid $\lambda y_2 - D_2^n$. The government is indifferent between accepting and rejecting this offer, and we assume that it accepts.

If $D_2^n > \lambda y_2$, the country prefers a full default, which costs γy_2, to a partial default which would cost at least $D_2^n + \rho y_2 > \gamma y_2$. In this case the creditors receive nothing.

Partial default, thus, occurs if and only if

$$\frac{D_2^n}{\lambda} \leq y_2 < \frac{D_2^r + D_2^n}{\gamma}$$

which in turn is possible only if $\frac{D_2^n}{\lambda} < \frac{D_2^n + D_2^r}{\gamma}$, or

$$\frac{D_2^n}{\lambda} < \frac{D_2^r}{\rho}. \tag{1}$$

If this condition is not satisfied, then there are only two cases: either $D_2^n + D_2^r \leq \gamma y_2$ and the government repays all its debts, or $D_2^n + D_2^r > \gamma y_2$ and the government repays nothing and bears a deadweight loss γy_2.

Ordering these cases in terms of y_2 gives the following result.

Proposition 1 *The country period 2 repayment strategy is as follows:*

(i) full repayment: if $y_2 \geq \frac{D_2^n + D_2^r}{\gamma}$ the country fully repays its renegotiable and non-renegotiable debt.

debt problem. In a corporate debt problem, in contrast, any accumulated cash-flow can be seized by creditors upon default. Therefore, the decision on how much cash-flow to accumulate in earlier periods has an important bearing on the corporate borrower's future default decision.

(ii) partial default: if $\frac{D_2^n}{\lambda} \leq y_2 < \frac{D_2^n + D_2^r}{\gamma}$ *the country fully repays its non-renegotiable debt and repays* $\lambda y_2 - D_2^n$ *to the holders of renegotiable debt.*

(ii) full default: if $y_2 < \frac{D_2^n}{\lambda}$ *the country defaults 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 risk premium should be lower on n-debt than on r-debt.

5 Optimal debt structure under commitment

What is the optimal debt structure? The answer depends on whether the government can commit not to dilute the debt issued in period 0 by issuing new debt in period 1. In this section we assume that the government can credibly commit not to dilute. The only moral hazard involved in sovereign lending, thus, is the classical problem of willingness-to-pay. This assumption, although not realistic, provides a convenient benchmark of comparison with the case where dilution is possible.

It is not difficult to see that in equilibrium, the government commits not to issue new debt in period 1. Given the initial lenders' participation constraint, the country's ex ante welfare is given by

$$U_0 = V(g) - g + E_0(y_1 + y_2) - E_0(\ell), \tag{2}$$

where ℓ is the deadweight cost of default. The money raised through debt issued in period 1 does not appear in expression (2), as period-1 lenders have to be promised an expected period 2 repayment that exactly offsets the utility

gain that the country derives from increasing consumption in period 1. The only effect of issuing debt in period 1, therefore, is to increase the frequency of default, which increases $E_0(\ell)$ and reduces ex ante welfare.

Thus all the debt maturing in period 2 is issued in period 0. We now show that it is optimal for the sovereign to only issue r-debt.

Proposition 2 *Under a pure willingness-to-repay problem the sovereign issues only renegotiable debt and ends up under-borrowing.*

Proof. See appendix. ■

This striking result is driven by our assumption that r-creditors are able to appropriate the entire amount λy_2 in debt renegotiations following default. In the other extreme where the bargaining power in debt renegotiations is entirely in the hands of the sovereign it may be optimal for the sovereign to issue n-debt as a way of commiting to making high debt repayments. In general, for intermediate bargaining powers it may be optimal to issue some n-debt.

We focus on the extreme case where r-creditors have all the bargaining power in renegotiation for expositional reasons. In that case there is a clear outcome 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 may be optimal for the sovereign to issue n-debt as a way of mitigating dilution.

6 Dilution with renegotiable debt

In this section we relax the assumption on commitment made in the previous section but assume that the sovereign has access to r-debt only. We show that the commitment not to dilute is time-inconsistent, and that the time-consistent

borrowing strategy involves excessive defaults and a lower level of expenditure g than under commitment.

Suppose that the sovereign issues r-debt D^r_{02} in period 0 and consider now the sovereign's incentive to issue new r-debt in period 1. The new debt is a promise to repay D^r_{12} (on top of D^r_{02}) in period 2. We shall also suppose that the realization of output in both periods, y_1 and y_2, is known in period 1 at the time the sovereign makes his decision whether to issue more debt.

Suppose to begin with that the realization of output y_2 is such that $D^r_{02} < \gamma y_2$. The country is then solvent absent any new debt issue. The representative resident's payoff is then given by:

$$\begin{aligned} U_1 &= y_1 + D^r_{12} + y_2 - (D^r_{02} + D^r_{12}) \qquad \text{if } D^r_{02} + D^r_{12} \leq \gamma y_2, \\ &= \left(y_1 + \frac{D^r_{12}}{D^r_{02} + D^r_{12}} \lambda y_2 \right) + (1-\gamma) y_2 \quad \text{if } D^r_{02} + D^r_{12} > \gamma y_2. \end{aligned}$$

The payoff from the public expenditure g is sunk in period 1, and has been ommitted from these expressions for simplicity. The sovereign's payoff from period 1 onwards, then, is just the sum of c_1 and c_2.

The first expression corresponds to the case where the amount of new debt D^r_{12} is small enough to keep the country solvent. Then the country will repay with certainty so that the proceeds of the new loan are D^r_{12}. Since the country entirely repays D^r_{12} in period 2, welfare does not depend on D^r_{12}: there is no strict welfare gain from borrowing in period 1. We assume then that the country, being indifferent, does not issue new debt.

The second expression corresponds to the case where the amount of new debt is large enough to force the country into default in period 2. Then the proceeds of the new loan are equal to the total repayment conditional on a default, λy_2, times the share of the new creditors in the aggregate claims, $D^r_{12}/(D^r_{02} + D^r_{12})$. In practice, sovereign debt restructuring often takes the form of a pro-rata "hair-

cut" across multiple debt issues, as we are assuming here. It is precisely the lack of clear seniority of existing debt over newly issued debt in debt renegotiations that is the source of debt dilution moral hazard in sovereign lending[6].

Because of this pro-rata haircut, the sovereign's payoff at $t = 1$ is now strictly increasing with D_{12}^r. Each additional dollar of debt costs nothing to the representative resident (who loses γy_2 in a default anyway), and can be sold at a positive price to the new lenders. This comes at the expense of the long-term creditors who see their claims diluted.

Conditional on a default the country's welfare is then bounded above by

$$y_1 + \lambda y_2 + y_2(1-\gamma) = y_1 + y_2(1-\rho).$$

We shall assume for simplicity that this payoff can always be attained by issuing a sufficiently large new debt D_{12}^r in period 1.

In equilibrium, the country does not dilute its initial debt D_{02}^r if and only if the resulting welfare, $(y_1 + y_2 - D_2^r)$ is higher than the welfare under dilution, $y_1 + y_2(1-\rho)$. This defines an upper bound for debt above which the sovereign will have an incentive to dilute the initial debt:

$$D_{02}^r \leq \rho y_2. \tag{3}$$

Note that while condition (3) was derived under the assumption that the country was solvent ($D_{02}^r \leq \gamma y_2$), an insolvent sovereign, knowing that the default cost will have to be paid anyway, systematically dilutes its long-term creditors. So condition (3) is both necessary and sufficient for dilution not to occur. We summarize our discussion of the incentives towards debt dilution in the proposition below.

[6] In the case of corporate debt, debt dilution moral hazard can be eliminated by making older debt senior to new debt. Subordination clauses or security agreements in debt contracts are enforceable in courts and are routinely included in corporate debt contracts (Smith and Warner, 1979). This is, however, not the case for sovereign debt.

Proposition 3 *The sovereign dilutes its r-debt in period 1 and defaults in period 2 if and only if period 2 output falls below a threshold*

$$y_2 < \frac{D_{02}^r}{\rho}. \tag{4}$$

Proof. See discussion above. ■

The trade-off involved in diluting long-term debt is that this increases period 1 consumption at the cost of a reduction in period 2 consumption due to the default cost. When output y_2 is relatively low then the gains from repaying D_{02}^r and not defaulting are small. At that point it becomes tempting to borrow more and dilute the existing debt. More generally, the government has a tendency to overborrow and dilute when it approaches financial distress.[7]

In equilibrium, debt dilution will be anticipated and initial lenders will demand a higher repayment to compensate for such dilution. This will result in an even higher overall cost of borrowing, even lower borrowing in period 0, but sometimes over-borrowing in period 1, as we now show.

The equilibrium level of debt D_{02}^r that must be issued in period 0 to finance a level g of public expenditure under discretion is easily derived. As the long-term creditors are repaid D_{02}^r only if there is no dilution and get nothing otherwise they are only willing to lend an amount:

$$g = D_{02}^r \int_{D_{02}^r/\rho}^{+\infty} f_2(y_2) dy_2. \tag{5}$$

Suppose that g is small enough that a solution $D_{02}^r(g)$ satisfying this equation exists. The country's ex-ante welfare is then given by:

$$U_0 = V(g) - g + E_0(y_1 + y_2) - \rho \int_0^{D_{02}^r(g)/\rho} y_2 f(y_2) dy_2. \tag{6}$$

The last term on the right-hand-side of (6) is the agency cost of debt.

[7] If y_2 were uncertain in period 1, the government would dilute when the probability of a default in period 2 conditional on no dilution exceeds a threshold.

Welfare is lower under discretion than under commitment, for any given level of g. Taking the difference of (10) and (6) shows that welfare is lower under discretion by an amount

$$\rho \int_{D_2^r(g)/\gamma}^{D_{02}^r(g)/\rho} y_2 f_2(y_2) dy_2.$$

This expression is positive for two reasons. First, if the risk premium on r-debt were the same under discretion as under commitment (i.e., if $D_{02}^r(g)$ were equal to $D_2^r(g)$), welfare would be lower under discretion because dilution implies more frequent defaults. Second, the risk premium is higher under discretion,

$$D_{02}^r(g) > D_2^r(g).$$

(compare (11) and (5)). The risk premium is larger under discretion because lenders have to be compensated for the risk of dilution. We summarize this discussion in the proposition below.

Proposition 4 *The level of period* 0 *borrowing and welfare under discretion are strictly below the levels of borrowing and welfare under a commitment not to dilute debt.*

Proof. See discussion above. ■

7 Non-renegotiable debt to forestall dilution

We now derive the optimal dynamic borrowing strategy $(D_{02}^r, D_{02}^n, D_{12}^r, D_{12}^n)$ when the government can issue both r-debt and n-debt in periods 0 and 1, and cannot commit not to dilute early lenders.

The analysis proceeds along the following steps. First, we highlight the comparative advantage 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 make some of its long-term debt nonrenegotiable as a way of forestalling dilution.

The sovereign makes its long-term debt nonrenegotiable to the extent that the benefit of forestalling dilution dominates the cost of higher deadweight losses of default in period 2. The optimal debt structure depends on the specification and the parameters of the model. We show in section 7.2 that under a fairly general condition on the stochastic distribution of y_2, it is optimal for the government to make its debt entirely nonrenegotiable. Section 7.3 then presents a counterexample where renegotiable debt may be optimal.

7.1 Dilution

It follows from Proposition 1 that non-renegotiable debt cannot be diluted, in the sense that it is impossible to transfer expected repayments from the n-creditors who have lent in period 0 to a new round of lenders in period 1. This is because when n-creditors are not fully repaid, no other creditors are. Thus, although the country can *hurt* n-creditors by issuing new debt, it cannot *dilute* them. By contrast, renegotiable debt can be diluted, either by renegotiable debt or by non-renegotiable debt.

Let us consider dilution by renegotiable debt. Dilution is possible in period 1 only if $D_{02}^n \leq \lambda y_2$ (if not, investors will not provide new loans since they know that there will be a full default with no repayment in period 2). If the government issues new r-debt D_{12}^r the representative resident's payoff is given by

$$\begin{aligned} U_1 &= y_1 + D_{12}^r + y_2 - (D_{02}^r + D_{12}^r + D_{02}^n) \quad \text{if } D_{02}^r + D_{12}^r + D_{02}^n \leq \gamma y_2, \\ &= y_1 + \frac{D_{12}^r}{D_{02}^r + D_{12}^r}(\lambda y_2 - D_{02}^n) + (1-\gamma) y_2 \quad \text{if } D_{02}^r + D_{12}^r + D_{02}^n > \gamma y_2. \end{aligned}$$

Given that $D_{02}^n \leq \lambda y_2$, the old n-debt will be fully repaid with certainty, and the only debt that can be diluted is the r-debt. The maximum benefit of dilution

is achieved by completely diluting the old r-debt, which yields a payoff $U_1 = y_1 + (\lambda y_2 - D_{02}^n) + (1-\gamma)y_2 = y_1 + (1-\rho)y_2 - D_{02}^n$. This is higher than the payoff under no dilution if and only if

$$y_2 < \frac{D_{02}^r}{\rho}.$$

This condition is the same as (4). Note that complete dilution of old r-debt could also be achieved by issuing an amount $\lambda y_2 - D_{02}^n$ of n-debt. The payoffs to creditors are the same in both cases: n-creditors receive all the pledgeable output and r-creditors receive nothing. Thus, r-debt and n-debt are perfect substitutable in diluting r-debt. To sum up, we have,

Proposition 5 *If the country has issued non-renegotiable debt D_{02}^n and renegotiable debt D_{02}^r in period 0, there is dilution in period 1 if and only if*

$$\frac{D_{02}^n}{\lambda} < y_2 < \frac{D_{02}^r}{\rho}. \tag{7}$$

Proof. See discussion above. ■

7.2 When nonrenegotiable debt dominates

The country can finance the first-best level of expenditure if g^* is lower than γy_2 with probability 1. For example, the government issues only n-debt, $D_{02}^n = g^*$, and never defaults on it. The government could also issue a mixture of n-debt and r-debt, provided that the level of r-debt stays low enough to prevent dilution. A pure r-debt structure is possible in the first-best if ρy_2 is larger than g^* with probability 1.

By contrast, if γy_2 falls below g^* with some probability, then default must occur in equilibrium, and the country will spend less than the first-best level because of the agency cost of debt. The government chooses the debt structure that minimizes the agency cost conditional on its level of expenditure g. This

choice involves a tradeoff between n-debt, which reduces the rate of dilution and the frequency of defaults, and r-debt, which entails a lower deadweight cost of default.

What is the optimal second-best debt structure? First, it is possible to show that the government issues a strictly positive amount of n-debt in equilibrium.

Proposition 6 *An optimal second-best debt structure involves a strictly positive amount of n-debt,*

$$g < g^* \Rightarrow D_{02}^n > 0.$$

Proof. See appendix. ■

The intuition is that by issuing a small (first-order) amount of n-debt that will almost always be fully repaid, the country can finance a first-order increase in g at the cost of a second-order increase in the agency cost of debt. The country, therefore, will issue *some* n-debt in period 0 in order to mitigate dilution.

The optimal share of n-debt is difficult to characterize in general, but can be explicitly determined under the following assumption.

Assumption A1. $h(x) \equiv \int_x^{+\infty} f_2(y)dy/(xf_2(x))$ is strictly decreasing with x in the domain of $f_2(\cdot)$.

This assumption holds for a number of well known distributions, including the normal, the exponential and the uniform distributions. If the distribution of output satisfies this assumption then we obtain the following result.

Proposition 7 *Under Assumption A1, a second-best debt structure is optimal if and only if*

$$\frac{D_{02}^n}{\lambda} \geq \frac{D_{02}^r}{\rho}. \tag{8}$$

The optimal debt structure is not uniquely determined. One optimal debt structure is pure n-debt ($D_{02}^r = 0$). For such debt structures there is no dilution in equilibrium

$$D_{12}^r = D_{12}^n = 0.$$

Proof. See appendix. ■

Under assumption A1, not only is n-debt present in equilibrium, but it completely crowds out r-debt. Assumption A1 is relatively weak but it is necessary for n-debt to unambiguously crowd out r-debt. We give in the appendix a counterexample where the distribution of y_2 does not satisfy A1 (it is binomial) and it may be optimal for the government to issue some r-debt in equilibrium.

The benefits of nonrenegotiable debt are illustrated in Figure 3a-c for a calibration of the model that satisfies assumption A1: $V(g) = \sqrt{g}$, $\rho = \lambda = 1/2$, $y_1 = 0$ and y_2 uniformly distributed in the interval $[0, 1]$. Figure 3a shows the equilibrium debt repayment D_2 on the y-axis as a function of the level of expenditure g on the x-axis under commitment, and under discretion with r-debt and with n-debt (the assumptions considered in sections 5, 6 and 7 respectively). Figure 3b shows the interest rate $(D_2 - g)/g$. We do not plot the curves beyond the point when an increase in g can no longer be financed by issuing more debt because the debt Laffer curve slopes downward. As figure 3b shows, under discretion the interest rate is lower on n-debt because the dilution premium on r-debt dominates the risk premium coming from the lower recovery value on n-debt. Figure 3c shows how ex ante welfare varies with g. Under discretion, issuing n-debt puts the economy pretty close to the commitment equilibrium: switching from r-debt to n-debt offsets 85 percent of the decrease in g and 91 percent of the welfare loss due to dilution.

8 Public Policy

Our analysis in the previous sections has shown that 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* in practice. In contrast to corporate debt, where courts generally enforce priority and seniority, there is no easy way of legally enforcing priority for sovereign debt.

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 response to the rapid growth of sovereign bond issues in the 1990s and following the proclaimed change in the *I.M.F.*'s policy towards reduced bailouts and more debt restructuring in debt crises, there has been a growing call for policy intervention to facilitate debt restructuring. There is, however, still an ongoing heated debate on how deep this policy intervention should be. Whether, as the IMF proposed, sovereign debt restructuring should be modeled on existing practice in corporate bankruptcy, or whether a more limited intervention that would facilitate debt-exchanges and/or introduce majority voting among bondholders in the form of a "collective action clause" (CAC) would be adequate. A consensus has emerged from this debate that at least a limited form of intervention, mainly in the form of CACs, would be desirable. Whether the *I.M.F.*'s more interventionist sovereign debt restructuring mechanism (SDRM) is called for, however, is still an open issue. Our analysis in this paper provides some simple answers to these complex policy questions.

8.1 The contractual approach

In the contractual approach, sovereigns are encouraged to make their debts easier to renegotiate using contractual features that facilitate the coordination of creditors in a crisis. These "collective action clauses" include collective representation clauses that allow the debtor to negotiate with a representative of the creditors, and majority enforcement and restructuring clauses that restrict

the rights of individual creditors to litigate before and after an agreement has been reached with a majority (Eichengreen, 2003). For example, UK law bonds, unlike those issued in New York, enable the holders of debt securities to call a bondholder assembly in which a majority of bondholders may change the bond's terms of repayment.[8]

The contractual approach has been endorsed by several academics and in some official reports (Eichengreen, 1999; Kenen, 2001; G-10, 1996; G-22, 1998). However, this apparent consensus on renegotiation-friendly clauses masks different views on how intrusive public policy should be in promoting their use. The official community has insisted that although educational efforts might be useful in advertising the merits of collective action clauses, their adoption by market participants should be purely voluntary. By contrast, some proponents of renegotiation-friendly clauses have suggested that their adoption should be subsidized, or even be made mandatory (Eichengreen, 1999; Kenen, 2001).[9]

If, coming back to our model, we interpret r-debt and n-debt as bonds respectively with, and without collective action clause, it is clear that the voluntary, market-led approach will not succeed in making debt structures more efficient ex ante. Propositions 6 and 7 say that sovereigns issue an excessive amount of bonds without collective action clauses even if they are fully aware of their benefits. This is our Gresham Law for sovereign debt: bad debt crowds out good debt in equilibrium.

However, the ex ante inefficiency of sovereign debt structures does not mean that a more intrusive approach based on taxes and subsidies would be efficient

[8] Most sovereign bonds are governed by either English or New York law. While traditional English law contract allows a supermajority of bond holders to amend the bond's financial terms, a traditional New York law contract requires the unanimous consent of all creditors.

[9] Eichengreen (1999) and Kenen (2001) argue that the IMF should provide an incentive for countries to adopt the clause by indicating that it is prepared to lend more generously to sovereigns that have included a collective action provision in their debts.

in our model. Let us assume that n-debt is taxed at rate τ and r-debt is subsidized at rate σ. A country that issues D_{02}^n and D_{02}^r must pay a tax τD_{02}^n to, and receives a subsidy σD_{02}^r from an international authority. The tax and the subsidy balance each other at the country level ($\tau D_{02}^n = \sigma D_{02}^r$), implying that the system involves no cross-country transfer, and its welfare impact comes purely from the effect of the tax and the subsidy on equilibrium debt structures. We then have the following result.

Proposition 8 *Taxing n-debt and subsidizing r-debt induces a substitution of the former by the latter, but reduces the borrowing country's welfare.*

Proof. See appendix. ■

Increasing the cost of n-debt relative to that of r-debt does not address the underlying inefficiency. As the tax rate τ increases, sovereigns substitute r-debt for n-debt, which aggravates the dilution problem and leads to more frequent defaults. In the limit where $\tau = 1$—i.e., the case where r-debt is mandatory—the economy is in the same situation as in the dilutable r-debt case analyzed in section 6. The country's welfare is lower than when dilution is mitigated by n-debt (which is why the sovereign issues some n-debt in equilibrium).

Absent externalities, asymmetric information, or political agency problems, that would distort the sovereign choice of debt structure ex-ante, there is no benefit of a tax affecting this choice. Such a policy would not only result in credit rationing ex ante, as has been commonly argued, but also in excessive borrowing and default costs because of debt dilution, as our analysis highlights.[10]

[10] To be fair to the advocates of intervention to facilitate debt restructuring, there are likely to be political agency problems in reality, and the availability of *I.M.F.* programs *per se* induces even further distortions towards hard sovereign debt.

8.2 The statutory approach

The renegotiation of debt could also take place in the context of a new legal regime applying the bankruptcy reorganization principles to the resolution of sovereign debt crises.[11] The notion of a bankruptcy regime for sovereigns was endorsed by the IMF, with Anne Krueger's (2002) proposal of establishing a Sovereign Debt Restructuring Mechanism (SDRM). This project lost the support of the international community in 2003, after it had been criticized by the investor community and some scholars, on the ground that it was going to weaken creditor rights and dry up the market for sovereign debt ex ante (Institute of International Finance, 2002 ; Shleifer, 2003).

Our analysis provides some support for these concerns. If indeed the only purpose of the bankruptcy regime were to facilitate sovereign debt restructuring by coordinating creditors[12], then it would be equivalent, in our model, to making renegotiation-friendly clauses mandatory, which is welfare-reducing as we saw in the previous section.

However, a statutory bankruptcy regime *could* address the underlying inefficiency more effectively than the contractual approach. In order to do so it would have to replace the *de facto* seniority that prevails under laissez-faire by a *de jure* seniority based on the time of lending. In our model the following time-based priority rule would lead to a Pareto improvement: early lenders (who have lent in period 0) are senior to later lenders (who are lending in period 1). This means concretely that for a given aggregate debt $(D_2^r + \hat{D})$, with D_2^r denoting debt issued in period 0 and $\hat{D}$ debt issued in period 1, the holders of the debt

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

[12] This is how the case for the statutory approach has usually been made by its proponents. In particular, it was feared that the contractual approach would fail to coordinate creditors holding different bond issues, so that a statutory regime was necessary to achieve the required degree of coordination (see, e.g., Krueger, 2002).

claim $\hat{D}$ cannot recover any payment after default until the holders of the debt D_2^r are paid in full. Such a *de jure* priority rule would eliminate the sovereign's worst incentives to dilute outstanding debt and would eliminate the need for initial creditors to seek protection by insisting that their debt claim be difficult to restructure. In short, if priority can be enforced legally the sovereign can issue *undilutable* long-term r-debt in period 0, which puts the economy in the (commitment) first-best analyzed in section 5. We emphasize this conclusion in the proposition below:

Proposition 9 *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 difficult policy question, however, is: how can priority be legally enforced for sovereign debt? One way, proposed in Bolton and Skeel (2003), is to have a court enforce a first-in-time rule under an enlarged SDRM. This can be done, for example, by including a cram-down rule into the *I.M.F.*' s proposed plan, which would allow senior creditors to enforce priority payment. Another way, proposed by Zettelmeyer (2003) is to have courts enforce subordination clauses in sovereign debt issues. The idea is to give senior claim-holders the right to recover payment from junior claimholders, who have been able to extract a restructuring agreement which violates the priority ordering. The advantage of Zettelmeyer's proposal is that it can be implemented independently of the establishment of a statutory regime. One possible drawback, however, is that it imposes a potentially onerous monitoring requirement on creditors, who need to be aware of subordination clauses in pre-existing debt. In addition, the statutory solution allows more flexibility in the application of the seniority rule—a flexibility that might be desirable for reasons explained in the following section.

8.3 Optimal dilution

We have so far focused on the costs of dilution, and on the optimal policies or institutions to mitigate them. However, dilution might also entail some benefits: in particular, it might be useful way of relaxing a credit constraint when the sovereign needs to raise new funds.[13] Thus, it might be optimal, under some conditions, for the bankruptcy regime to infringe on the seniority of early lenders.

Let us assume that the sovereign can take a policy action that buffers the negative impact of a default on residents. This policy action requires an expenditure of αy_2 in period 1, and increases domestic welfare by $(\alpha + \beta)y_2$. This welfare increase is nonpecuniary and 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_2 in period 1.

If the bankruptcy court gives absolute priority to the period 0 lenders, then the sovereign cannot raise new funds in period 1. For the country to finance the welfare-enhancing expenditure in period 1, the court would have to suspend the seniority of early lenders. Let us assume that the sovereign can file for bankruptcy in period 1 after it has observed the level of period 2 output. We assume that the bankruptcy court grants its protection only to insolvent countries (with $\gamma y_2 < D_{02}^r$). In addition, the bankruptcy court allows the sovereign to dilute early lenders with new, senior debt so as to finance the expenditure αy_2.

Under these assumptions the country's budget constraint and ex ante welfare are given by,

$$g = (\lambda - \alpha) \int_0^{D_{02}^r/\gamma} f_2(y)dy + D_{02}^r \int_{D_{02}^r/\gamma}^{+\infty} f_2(y)dy,$$

$$U_0 = V(g) - g + E_0(y_1 + y_2) + (\beta - \rho) \int_0^{D_{02}^r/\gamma} y f_2(y)dy.$$

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

The cost of dilution comes from the term in α in the first equation: the government must issue a larger D_{02}^r to finance the same g. The expectation of dilution forces the sovereign to pay a higher interest rate, thus increasing the probability of default (for a given level of expenditure g). The second equation shows the welfare benefit of dilution (the term in β). If β is larger than ρ—i.e., if the period 1 expenditure more than offsets the deadweight cost of default—conditional dilution unambiguously increases the country's welfare. If β is smaller than ρ, the welfare impact of conditional dilution is ambiguous, but remains positive if α is sufficiently small relative to β.

Proposition 10 *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 of dilution given to the court can be interpreted as the analog of 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, in general, be implemented in a contractual way by coordinating creditors ex post. The court must be granted the discretionary power of deviating from the absolute priority rule. Conditional dilution, therefore, provides one more argument for a statutory regime as opposed to the contractual approach.

9 Concluding Comments

This paper presents a model of sovereign debt crises which, although stylized, is versatile enough to lend itself to the analysis of a number of questions that have been discussed in the recent debates on the international financial architecture. The endogeneity of the debt structure implies that the normative analysis has

to go beyond statements that debt workouts should be made more orderly and sovereign creditors coordinated in a crisis. These statements are correct in an ex post sense, but from an ex ante perspective dangerous liability structures arise for a reason.

At the same time, our analysis does not support a Panglossian view that sovereign debt contracts are efficient ex ante and that there is no scope for welfare-improving reforms. We do find that sovereign debt might be excessively difficult to restructure under laissez-faire (even from an ex ante point of view), and that public intervention is warranted. Our model points to a sovereign debt restructuring mechanism that shares many features with corporate bankruptcy regimes. In particular, it should not *only* solve the classical common pool problem between creditors but *also* establish a seniority structure between the pre-default lenders, and enjoy some discretion in granting super-seniority to post-default lenders.

This model abstracted from a number of issues that may be quite relevant in the real world. One such issue is debt maturity. Short-term debt is another way of forestalling dilution: it allows creditors to price any dilution in the rate at which they refinance their claims, or punish the sovereign by a debt rollover crisis when dilution becomes too large. However, short-term debt could make sovereigns excessively vulnerable to debt rollover crises (Jeanne, 2004). Our model suggests that if the maturity of sovereign debt were excessively short because of the nonexclusivity problem, then this inefficiency could be taken care of by a statutory bankruptcy mechanism granting some seniority to long-term creditors. The normative implications, thus, would be close to those we have obtained here (a conjecture that we plan to explore further in future work).

The analysis could be extended to take other agency problems than those between debtors and creditors into consideration, in particular political agency

problems between citizens and their governments. In this paper it was unambiguously optimal to relax the credit constraints in the international debt market because governments were assumed to be benevolent. The welfare analysis would be very different if decisions were taken by self-interested policymakers who do not maximize domestic welfare. Rationing policymakers, then, could increase the welfare of their citizens.

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APPENDIX

Proof of Proposition 2

We assume that condition (1) is satisfied (the proof is easy to extend to the case where it is not). Then creditors as a whole receive $D_2 = D_2^r + D_2^n$ under full repayment (case (i) of Proposition 1), λy_2 under partial repayment (case (ii)), and zero repayment if there is a full default (case (iii)). The lenders' binding participation constraint implies that the expected debt repayment be equal to g

$$g = \int_{D_2^n/\lambda}^{D_2/\gamma} \lambda y_2 f_2(y_2) dy_2 + \int_{D_2/\gamma}^{+\infty} D_2 f_2(y_2) dy_2. \tag{9}$$

The deadweight cost of default is equal to ρy_2 if the default is partial, to which one must add λy_2 if the default is full. Thus the expected deadweight loss of default is

$$E_0(\ell) = \int_0^{D_2/\gamma} \rho y_2 f_2(y_2) dy_2 + \int_0^{D_2^n/\lambda} \lambda y_2 f_2(y_2) dy_2.$$

Substituting r-debt for n-debt keeping the total constant—that is reducing D_2^n and increasing D_2^r while keeping their sum D_2 constant—is optimal since it has the effect of increasing g *and* reducing ℓ. Thus the optimal debt structure has $D_2^n = 0$.

Given that the sovereign issues r-debt, it chooses g to maximize

$$U_0 = V(g) - g + E_0(y_1 + y_2) - \rho \int_0^{D_2^r(g)/\gamma} y_2 f_2(y_2) dy_2, \tag{10}$$

where $D_2^r(g)$ is the solution to (9) in which D_2^n has been set to zero[14]

$$g = \int_0^{D_2^r(g)/\gamma} \lambda y_2 f_2(y_2) dy_2 + \int_{D_2^r(g)/\gamma}^{+\infty} D_2^r(g) f_2(y_2) dy_2. \tag{11}$$

The sovereign underborrows, as

$$\frac{d[\int_0^{D_2^r(g)/\gamma} y_2 f_2(y_2) dy_2]}{dg} > 0.$$

[14] Such equations can have multiple solutions, in which case the economically relevant solution is the lowest one.

Proof of Proposition 6

If $D_{02}^n/\lambda < D_{02}^r/\rho$, then by Propositions 1 and 3, D_{02}^n is repaid if it is smaller than λy_2 and D_{02}^r is repaid if it is smaller than ρy_2. When $D_{02}^r > \rho y_2$ it is completely diluted. Hence the zero-profit condition for lenders is

$$g = D_{02}^n \int_{D_{02}^n/\lambda}^{+\infty} f_2(y)dy + D_{02}^r \int_{D_{02}^r/\rho}^{+\infty} f_2(y)dy. \tag{12}$$

The deadweight loss amounts to ρy_2 if $y_2 < D_{02}^r/\rho$, to which one must add λy_2 if $y_2 < D_{02}^n/\lambda$. Hence the expected deadweight loss is

$$E_0(\ell) = \rho \int_0^{D_{02}^r/\rho} y f_2(y)dy + \lambda \int_0^{D_{02}^n/\lambda} y f_2(y)dy. \tag{13}$$

Assume that the country issues some r-debt and no n-debt, $D_{02}^n = 0$. Then a first-order increase in n-debt, dD_{02}^n, would imply $dg = dD_{02}^n > 0$ and $dE_0(\ell) = 0$.That is, the country could marginally increase the expenditure g without increasing the deadweight loss. This implies that issuing no n-debt cannot be optimal.

Proof of Proposition 7

First, let us show that condition (8) is necessary. Assume that it is not satisfied, i.e.

$$0 < \frac{D_{02}^n}{\lambda} < \frac{D_{02}^r}{\rho}.$$

Then the optimal debt structure (D_{02}^n, D_{02}^r) is an interior solution of the problem,

$$\begin{cases} \max g \\ E_0(\ell) \leq \ell^*, \end{cases}$$

where ℓ^* is the optimal agency cost and g and $E_0(\ell)$ are respectively given by (12) and (13). The Lagrangian of this problem is $\pounds = g - \mu E_0(\ell)$, and the first-order conditions

$$\frac{d\pounds}{dD_{02}^n} = \frac{d\pounds}{dD_{02}^r} = 0,$$

imply (using (12) and (13)),

$$1+\mu = h\left(\frac{D_{02}^n}{\lambda}\right) = h\left(\frac{D_{02}^r}{\rho}\right), \tag{14}$$

which is impossible if (A1) is true. This proves that condition (8) is necessary.

Suppose now that (8) is satisfied. Then repayment occurs if and only if $D_{02}^n + D_{02}^r$ is smaller than γy_2. If $D_{02}^n + D_{02}^r$ is strictly larger than γy_2, there is a default in which the deadweight loss is equal to γy_2. Thus one has

$$g = (D_{02}^n + D_{02}^r)\int_{(D_{02}^n+D_{02}^r)/\gamma}^{+\infty} f_2(y)dy,$$

$$E_0(\ell) = \gamma\int_0^{(D_{02}^n+D_{02}^r)/\gamma} y f_2(y)dy.$$

Both g and $E_0(\ell)$ depend on the sum $D_2 \equiv D_{02}^n + D_{02}^r$. This sum is uniquely determined in equilibrium, not the components D_{02}^n and D_{02}^r, which can be chosen arbitrarily subject to the zero-profit condition for lenders. One particular solution is $D_{02}^n = D_2$, $D_{02}^r = 0$, i.e. pure n-debt. This proves the proposition.

A counterexample

We now highlight that if the distribution of y_2 does not satisfy assumption A1, it may be optimal for the government to issue some r-debt in equilibrium. We consider the situation where $y_1 = 0$ and y_2 has the binomial distribution:

$$\begin{cases} y_2 = y_L \text{ with probability } p_L \\ \\ y_2 = y_H \text{ with probability } p_H. \end{cases}$$

In this example the sovereign is obviously indifferent between any combination of r-debt and n-debt as long as the debt remains default-free. That is, for any amount g raised that is less than or equal to ρy_L the optimal debt structure is indeterminate. For

$$\rho y_L < g \leq \gamma y_L$$

the sovereign strictly prefers n-debt over r-debt, as n-debt is safe and has face value $D^n = g$, while r-debt is either risky or not sustainable. Indeed, for $g > \rho y_L$ r-debt leads to a default and full dilution in state y_L. The face value of the risky r-debt is then given by $D^r(g) = \frac{g}{p_H}$ when it is sustainable (r-debt is sustainable if and only if $\frac{g}{p_H} \leq \rho y_H$).

However, for $\gamma y_L < g \leq \rho p_H y_H$ r-debt is preferred to n-debt since both forms of debt are now risky and both lead to default in state y_L, but n-debt involves the higher expected deadweight cost of default of $p_L \gamma y_L$. In this situation the cost of borrowing g under respectively r-debt and n-debt (in terms of expected foregone future consumption) is given by $C^r(g) = p_L \rho y_L + g$ and $C^n(g) = p_L \gamma y_L + g$. As can be easily verified, the sovereign is indifferent between borrowing all its debt in the form or r-debt here, or borrowing any amount up to λy_L in safe n-debt and the remainder $g - \lambda y_L$ in r-debt. However, if g is raised entirely with r-debt, this debt is sustainable as only if $\frac{g}{p_H} \leq \rho y_H$. On the other hand, if only $(g - \lambda y_L)$ is raised with r-debt then the total debt is sustainable if

$$\lambda y_L + \frac{g - \lambda y_L}{p_H} \leq \gamma y_H$$

or,

$$p_H \lambda y_L + g - \lambda y_L \leq \gamma p_H y_H$$

Notice that since the RHS of this inequality is higher and the LHS lower than in the inequality $g \leq \rho p_H y_H$, the sovereign may have to borrow with a mix of n-debt and r-debt even if it does not have a strict preference for mixed debt over pure r-debt. In other words, when $\gamma y_L \leq \rho p_H y_H < g$ and $g \leq p_H \gamma y_H + (1 - p_H)\lambda y_L$ then it is strictly optimal for the sovreign to borrow with a mixture of r-debt and n-debt.

Finally, for $p_H \gamma y_H + (1 - p_H)\lambda y_L < g \leq \gamma y_H$ only n-debt is sustainable and is therefore preferred (any borrowing requirement $g > \gamma y_H$ cannot be funded with either form of debt in this example).

In short, this example illustrates how for low borrowing requirements n-debt may weakly dominate r-debt, for intermediate g the ranking between the two forms of debt is reversed, while for high borrowing requirements it is again n-debt that is preferable.

Proof of Proposition 8

Equation (12) is replaced by,

$$g = D_{02}^n \left(\int_{D_{02}^n/\lambda}^{+\infty} f_2(y)dy - \tau \right) + D_{02}^r \left(\int_{D_{02}^r/\rho}^{+\infty} f_2(y)dy + \sigma \right), \qquad (15)$$

and equation (13) remains the same. As long as τ is strictly smaller than 1, sovereigns strictly gain from issuing some n-debt since starting from $D_{02}^n = 0$, one has $dg = (1-\tau)dD_{02}^n > 0$ and $dE_0(\ell) = 0$. So Proposition 6 remains true if $\tau < 1$.

Going through the same steps as in the proof of Proposition 7, one can show that the first-order condition (14) is replaced by,

$$h\left(\frac{D_{02}^n}{\lambda}\right)\left(1 - \frac{\tau}{1 - F_2\left(D_{02}^n/\lambda\right)}\right) = h\left(\frac{D_{02}^r}{\rho}\right)\left(1 + \frac{\tau D_{02}^n}{D_{02}^r\left(1 - F_2\left(D_{02}^r/\rho\right)\right)}\right), \qquad (16)$$

where $F_2(\cdot)$ is the cdf of y_2, and σ was substituted out from the right-hand-side using $\tau D_{02}^n = \sigma D_{02}^r$. This relationship defines an upward sloping locus in the space (D_{02}^r, D_{02}^n) (see Figure 4). To see why the locus is upward-sloping, note that an increase in D_{02}^n reduces the left-hand side and raises the right-hand side of (16), and that an increase in D_{02}^r is required to restore equality ($D_{02}^r\left(1 - F_2\left(D_{02}^r/\rho\right)\right)$ is increasing with D_{02}^r in an efficient debt structure). For a given g, the equilibrium debt structure is at the intersection of locus (16) and locus (15). It is uniquely determined because the second locus is downward-sloping.

An increase in the tax rate on n-debt, τ, shifts the locus (16) downward. (Holding D_{02}^r constant, an increase in τ lowers the left-hand side of 16) and

increases the right-hand side; the equality is restored by decreasing D_{02}^n.) It follows that an increase in τ reduces the amount of n-debt and increases that of r-debt.

In equilibrium, the sovereign's budget constraint is still given by (12) since the tax and the subsidy cancel each other. The appropriate first-order condition of the sovereign's problem, therefore, is (14) and not (16). The tax increases the agency cost of debt $E_0(\ell)$ for any given level of g, or equivalently reduces the level of g that can be achieved by for a given agency cost $E_0(\ell)$. It follows that the tax reduces domestic welfare in equilibrium.

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Figure 1. Structure of External Public Debt: Bonds versus Loans

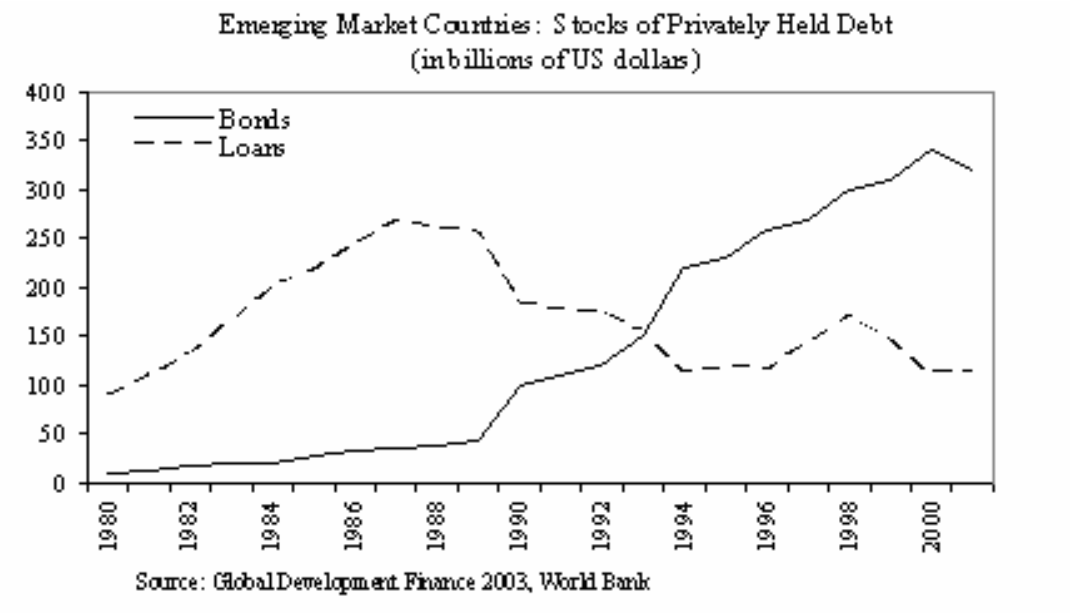


Figure 2. Sequence of actions

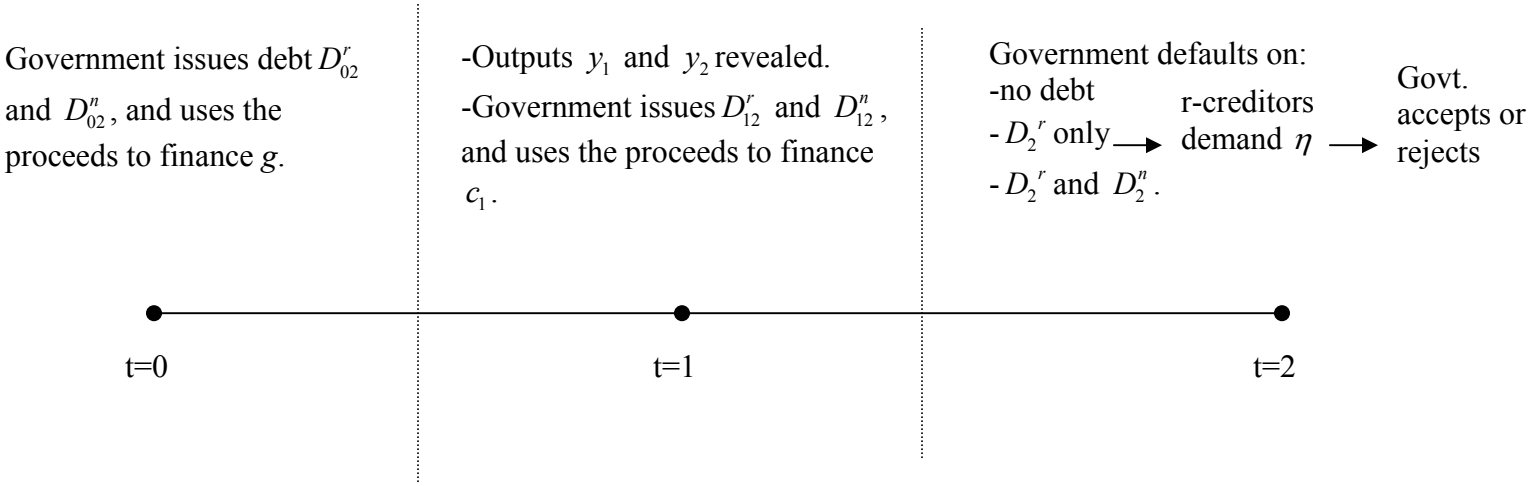


Figure 3a. Debt Due

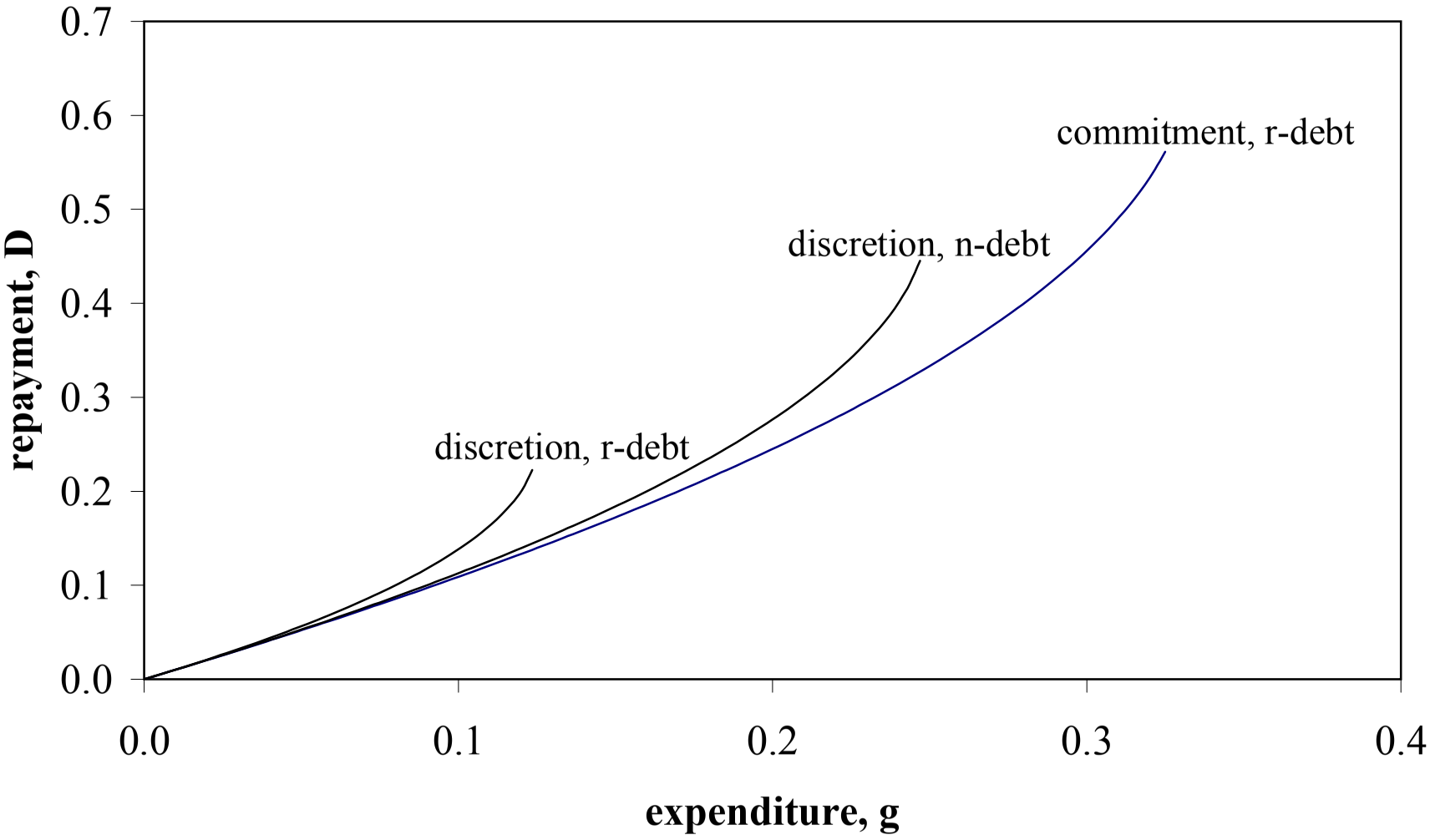


Figure 3b. Interest Rate

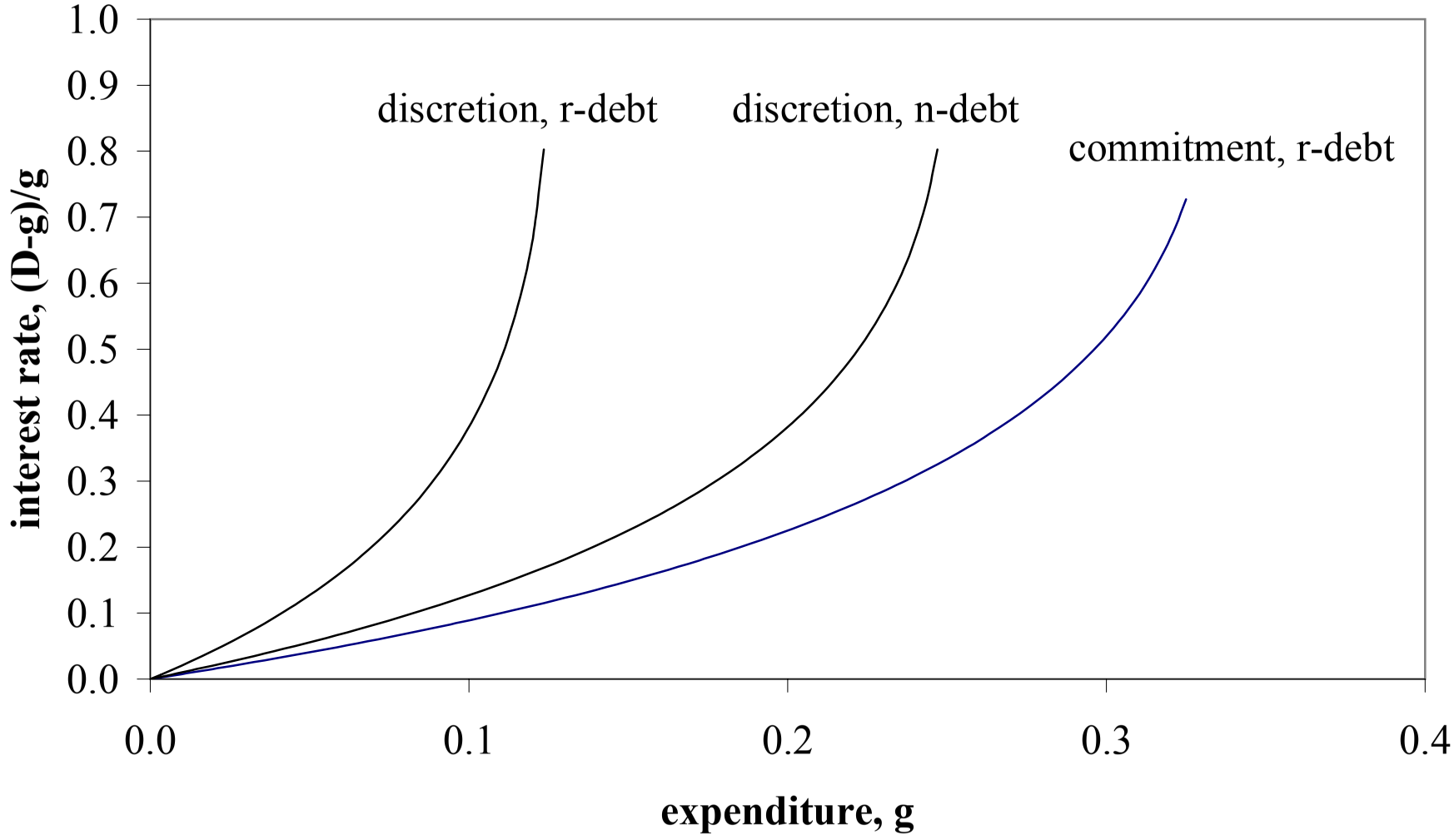
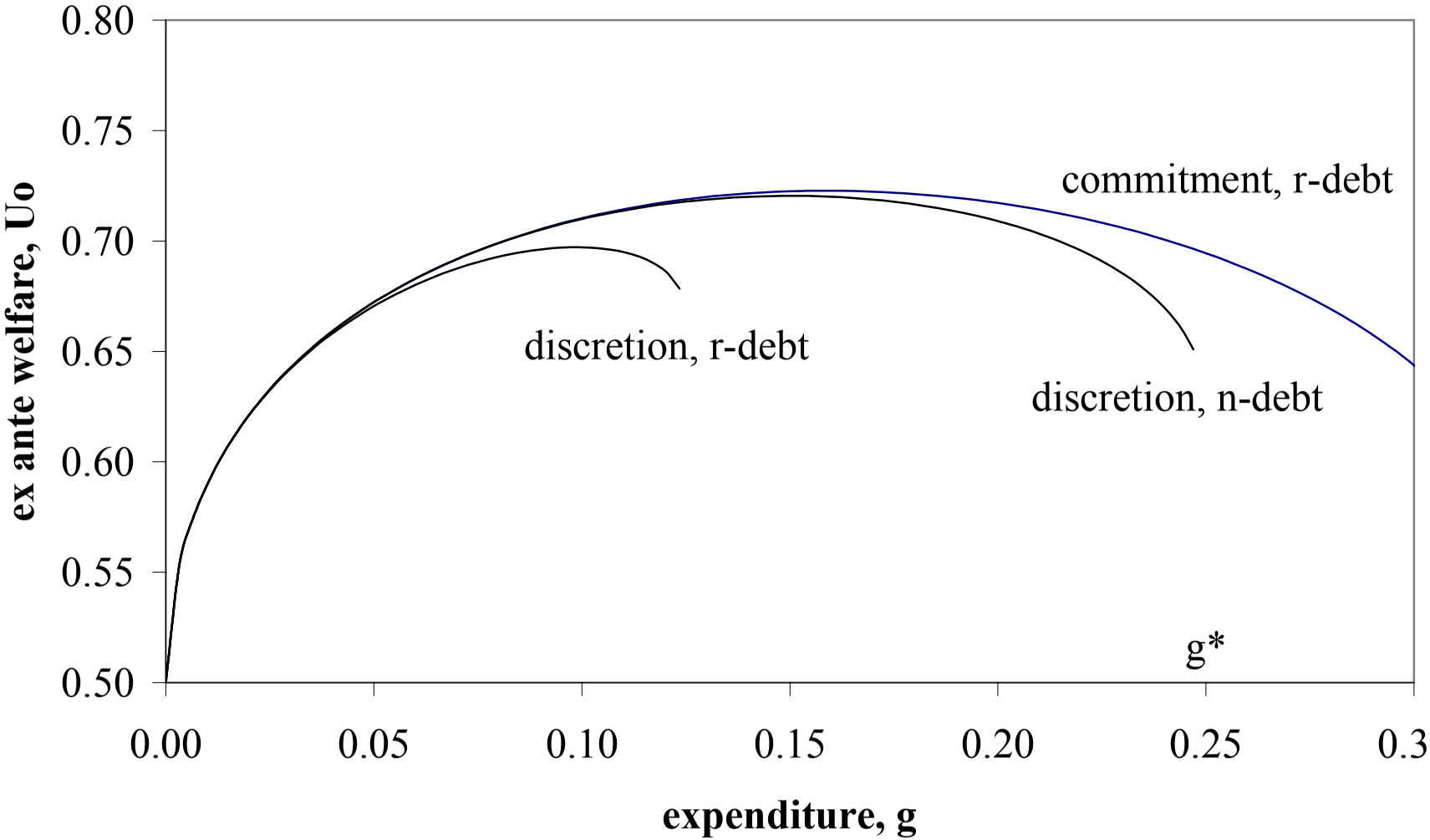


Figure 3c. Welfare



<u>Figure 4.</u> Proof of Proposition 8