Sovereign Bond Restructuring Revisited

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Abstract

This paper revisits theoretical models of sovereign borrowing with renegotiation and reviews the basis for arguments for market-based contractual innovation in sovereign debt markets. It presents a tax-smoothing model of borrowing on international financial markets by a sovereign government that endogenizes the debt limit for the government. Debt repayments can be state contingent, but these are interpreted in terms of renegotiated conventional bond contracts. The main contribution of the model is to show how private debtor information can be used to motivate the implementation of borrowing through the issuance of conventional bonds that are renegotiated only in adverse states after debt has reached a sufficiently high level. The model is used as a benchmark for considering how opportunistic behavior by individual bondholders can lead to inefficient outcomes. This part of the paper recapitulates how coordination failures arise in theoretical models of sovereign debt from exogenous enforcement of creditor rights. It also discusses how costly delays due to bondholder rent seeking might be mitigated by contractual innovations that address collective action by bondholders using the simple payoffs for renegotiation games.

1. Introduction

The emerging market financial crises of the last decade prompted widespread concern about the adequacy of the present international financial architecture to maintain a stable international economy over a period of several years. Recently, attention shifted away from this policy debate with the adoption of a contractual innovation approach and the conclusion of the Argentine debt restructuring. However, a renewed research agenda reconsidering sovereign debt and default in the wake of Argentina's default reveals that our understanding of debt crises and their costs is very limited.[1] This paper revisits theoretical models of sovereign borrowing with renegotiation introducing a model of foreign lending to a sovereign government that motivates the use of conventional debt contracts and conforms to many of the empirical regularities found by economic historians and recent investigations using individual bond data. Attention is then turned to revisit the analysis of inefficiencies in sovereign debt renegotiation and the case for contractual innovation. This part of the paper concentrates on the basic elements for models of costly delays in debt renegotiation and restructurings that may arise from a lack of coordination and cooperation between creditors.

The first part of the paper reconsiders the constraints on national fiscal policies in an integrated financial market that derive from the absence of an international sovereign authority to define and enforce contractual obligations across borders. International public borrowing is possible to the extent that debt issuers restrain their exercise of sovereign immunity. While sovereign immunity may be waived with regard to debtor assets abroad, it is not waived with regard to domestic policy, legislation, and enforcement. Sovereign immunity protects a debtor government's power to tax sources of income and wealth within national borders. The enforcement of private contracts between parties subject to different national jurisdictions also requires the enlightened self-interest of sovereign governments.

Sovereign immunity serves as a fundamental assumption to derive intertemporal budget constraints for sovereign nations and their governments. The capacity to finance current aggregate consumption, investment, and government expenditures from global savings is determined endogenously given that a national government acts only in the interest of its constituents while recognizing the consequences of its actions for future transactions and international cooperation. Limits on public debt and deficits are derived in a tax-smoothing model by finding an efficient global equilibrium with international financial flows constrained by borrower sovereign immunity and the willing participation of private creditors. The securities issued by sovereigns are also endogenously determined; that is, the completeness or incompleteness of securities markets is determined in self-enforcing equilibria with and without restrictions on the information available to potential creditors.

Financial markets are incomplete in equilibrium. The model shows how contingent securities are required in international financial market equilibrium when all information about the government is public. By contrast, when shocks to the government's objective are not publicly observed, contingent repayments are only needed if outstanding government debt exceeds a threshold. A conclusion of the paper is that conventional bonds that are renegotiated with positive probability only as the government's debt limit is approached support an efficient outcome with private information. In the full information case, payments on conventional bonds would require renegotiation with positive probability every period for any debt level, but in the incomplete information model, bonds are renegotiated only when the debt limit is reached. This is consistent with the observation that renegotiations of emerging market debt denominated in foreign currency are infrequent and happen at high debt levels.

This model is then used as a basis for considering inefficiencies in debt renegotiation after a default occurs. The incentives of multiple competing creditors to collectively renegotiate a country's debt are portrayed without recourse to a specific model of negotiation. The idea is consider how creditor rights vis-a-vis each other leads to incentives for free-ridership in debt restructuring efforts and the exercise of strategies that delay the resolution of defaults. The simple framework allows illustration of the logic of arguments for contractual innovation that led to the adoption of collective action clauses for primary repayment terms in sovereign bond issues floated in the US.

The paper begins with the model presented in three sections. The first interprets the power of a sovereign to default and renegotiate its debts and motivates the public finance model of sovereign borrowing presented in Section 3. The third and fourth sections present a model of sovereign borrowing to smooth the welfare costs of distortionary taxation with complete information and with debtor private information, respectively. The fifth section reviews the recent policy debate and literature on debt restructurings, while the sixth discusses the implications of competition among bondholders with exogenously enforced bond covenants that can bind across creditors for collective action and delay in debt renegotiation in theory. The last section concludes.

2. Sovereign Borrowing and Renegotiation

A model of international financial transactions is analyzed in which national governments enjoy sovereign immunity. Sovereign immunity means that national authorities can regulate activities within their jurisdiction through legislation, administration, and judicial enforcement. Foreign governments cannot interfere with economic activities within sovereign boundaries and cannot enforce contractual relationships without the cooperation of national authorities. The enforcement of contracts between the domestic

private sector and foreigners within a country depends on the institutional and legal solution chosen by the sovereign government. Sophisticated legal systems may readily enforce contractual obligations of resident debtors on behalf of foreign creditors without being subject to the whims of current authorities. However, such institutions for domestic contract enforcement and the extension of its benefits to foreigners are chosen for the national benefit given incentives of international trade.

More specifically, a sovereign government chooses whether to honor its own obligations, whether to foreign or domestic creditors. The ability of a sovereign to borrow depends upon its willingness to repay. Following the literature on sovereign debt, fiscal authorities choose to repay if doing so is in the national interest, anticipating the consequences of failing to fulfill contractual obligations in equilibrium.[2] The model presented focuses on the financing of public sector budget deficits in an integrated international financial market. The focus on public finance is natural because it is important in international finance and because it encompasses all securities issued publicly or privately that enjoy explicit or implicit government guarantees. Implicit guarantees, in the view of this paper, include the enforcement of private contracts and the protection of domestic debtors by the sovereign's own legal system.

The analysis uses a simple model of a fiscal authority seeking to smooth distortionary taxes over time against random shocks to domestic demand, following Barro (1979). The shocks in the model are stochastic exogenous government expenditures for expositional convenience. These represent preference shocks reflected in the objective function of the sovereign policymaker but can be interpreted as any exogenous shocks to domestic absorption. In the model, fiscal authorities raise tax revenues to make transfers from the domestic private sector to creditors, domestic and foreign. More generally, taxation represents the capacity and willingness of the sovereign to ensure private and public debt repayments. Sovereign borrowing should be interpreted liberally to mean the issuing of any debt securities that can be held by foreign creditors by any debtor potentially protected by the sovereign.

The model allows for the integration of domestic financial markets with international financial markets. Private parties may be able to accumulate or issue internationally tradable debt or perfect substitutes. Government debt may be held by either domestic or foreign residents, allowing the sovereign to default on its contractual obligations to either or both. Implicitly, bonds are held anonymously so that the government cannot selectively default based on the debt holder's identity.

3. Sovereignty and International Debt with Complete Information

Sovereign borrowing and debt renegotiation are motivated in a simple model of tax smoothing in which distortionary taxes are required to raise government revenue to pay for public expenditures and make

debt service payments. Tax distortions are captured by assuming that output is a decreasing and concave function of tax revenues given by $Y(T)$. This function satisfies $Y(T) > 0$, $Y'(T) \leq 0$, $Y'(0) = 0$ and $Y''(T) \leq 0$ for $0 \leq T \leq \overline{T}$, where $\overline{T} > 0$ is an upper bound on tax revenues. Authorities seek to maximize the utility of a representative agent given by

$$U_t = u(c_t) + E_t \sum_{s=t+1}^{\infty} \beta^{s-t} u(c_s), \tag{1}$$

with respect to the consumption plan, where $c_t = y(T_t) = Y(T_t) - T_t$, subject to the need to finance an exogenous stream of government expenditures, g_t. This simple model should be interpreted as follows. Domestic residents seek to smooth their consumption over time, but households do not have access to internationally integrated financial markets. A portion of domestic consumption cannot be smoothed by the private sector, so the government smooths this consumption by issuing debt in the integrated financial market. Government expenditures can be interpreted as either government purchases of goods and services or transfer payments to households. The variable, g_t, may also be interpreted as a stochastic share of aggregate domestic demand for tradable goods that cannot be completely smoothed on international financial markets by households and firms. Government expenditures, g_t, are taken to be independently and identically distributed over a finite support for expositional simplicity. Substitution allows the government's objective to be written as

$$\widetilde{U}_t = v(T_t) + E_t \sum_{s=t+1}^{\infty} \beta^{s-t} v(T_s),$$

where $v(T) = u(Y(T) - T)$ displays negative and decreasing marginal utility in taxes.[3] The trade balance is given by

$$\tau_t = Y(T_t) - c_t - g_t = T_t - g_t.$$

The government issues securities on a global financial market to finance the primary deficit, $g_t - T_t$. The present value of all financial claims against the government is given by

$$w_t = T_t - g_t + E_t \sum_{s=t+1}^{\infty} \beta^{s-t} (T_s - g_s). \tag{2}$$

The government can issue new securities to finance current primary deficits or the repayment of retiring debt. Debt holders can trade existing securities on the international financial market. The value of securities issued by the government can be rewritten in the form

$$w_t = -(g_t - T_t) + \beta E_t w_{t+1}, \tag{3}$$

where w_{t+1} is the market value of outstanding debt conditional on the state in date $t+1$.

Any individual creditor purchases government securities willingly in any period. This assumption is

expressed by the participation constraints,

$$w_t \geq 0 \quad \text{and} \quad w_{t+1} \geq 0,$$

for all states and dates. That is, tradable securities can only have nonnegative market values. This rules out securities for which the expected present value can be negative in some future event, such as pure insurance contracts. The conditional expected present value of current and future primary surpluses of the government is restricted to be nonnegative at all dates. The government can only force involuntary payments to it by taxing economic activities within its sovereign domain. It can raise revenue on an integrated financial market by issuing securities that always have nonnegative market values.

Another set of participation constraints is introduced to represent national sovereignty. A sovereign authority can elect to refuse to honor government-issued debt. The capacity of the government to choose to repay only if doing so is in the national interest at the time payments are due is expressed by a participation constraint. At any time, the sovereign issuer can switch to financing public expenditures on a pay-as-you-go basis by defaulting on its current debt and never attempting to issue debt again. The sovereignty constraint is expressed for all dates and states as

$$v\left(T_t\right) + E_t \sum_{s=t+1}^{\infty} \beta^{s-t} v\left(T_s\right) \geq v\left(g_t\right) + E_t \sum_{s=t+1}^{\infty} \beta^{s-t} v\left(g_s\right). \tag{4}$$

An equilibrium with symmetric information between potential creditors and the authorities of the issuing government is characterized first. In equilibrium, securities will have state-contingent payments. In the case of complete state-contingent markets, only the single constraint,

$$w_0 = T_0 - g_0 + E_0 \sum_{t=1}^{\infty} \beta^t \left(T_t - g_t\right) \geq 0, \tag{5}$$

would need to be imposed. With self-enforcing contracts, the constraint, $w_t \geq 0$, is imposed for all dates and states.

The equilibrium is found by maximizing

$$\begin{aligned} V_t &= v\left(T_t\right) - v\left(g_t\right) + E_t \sum_{s=t+1}^{\infty} \beta^{s-t} \left(v\left(T_s\right) - v\left(g_s\right)\right) \\ &= v\left(T_t\right) - v\left(g_t\right) + \beta E_t V_{t+1}, \end{aligned} \tag{6}$$

with respect to the current tax revenue, T_t, and future repayments, w_{t+1}, for each state of nature, subject to the constraints,

$$T_t - g_t + \beta E_t w_{t+1} \geq w_t, \tag{7}$$

$$w_{t+1} \geq 0 \quad \text{and} \quad V_{t+1} \geq 0 \quad \text{for each state.} \tag{8}$$

The surplus for the government, V_t, is a function of the outstanding value of its debt, $V_t\left(w_t\right)$.[4]

The solution for a self-enforcing equilibrium is familiar from Thomas and Worrall (1988), Kocherlakota (1996), Kletzer and Wright (2000) and Kehoe and Perri (2002). For this tax-smoothing model, the first-order condition for tax revenues can be derived and is given by

$$v'(T_t) = v'(T_{t+1}) \quad \text{if} \quad w_{t+1} > 0 \quad \text{and} \quad V_{t+1}(w_{t+1}) > 0, \tag{9}$$

$$v'(T_t) < v'(T_{t+1}) < 0 \quad \text{if} \quad w_{t+1} = 0 \tag{10}$$

and

$$v'(T_t) > v'(T_{t+1}) < 0 \quad \text{if} \quad V_{t+1}(w_{t+1}) = 0. \tag{11a}$$

The solution for T_{t+1} depends on g_{t+1} and w_t (as does w_{t+1}) and can be written as

$$T_{t+1} = \theta(g_t, T_t),$$

since T_t conveys all information about w_t.

In equilibrium, taxes are completely smoothed between dates if the participation constraints for neither the government nor its creditors are binding (as in equation (9)). Taxes rise with g_{t+1} if creditors' participation constraints bind (as in inequality (10)), and fall as g_{t+1} declines if the government's participation constraints bind as shown in equation (11a). For independently and identically distributed g_t, taxes and the primary surplus are non-decreasing with government expenditures. These are also increasing with the value of outstanding government obligations, w_t.

The value of financial claims against the government is state contingent in this equilibrium. As shown by Kletzer and Wright (2000) in the consumption-smoothing interpretation, this equilibrium can be implemented using single-period debt contracts with state-contingent, nonnegative repayments. The amount borrowed by the government at any date t is

$$\ell_t = w_t + g_t - T_t,$$

the sum of outstanding public-sector liabilities, w_t, at the beginning of period t and primary deficit for period t. Contingent repayments in period $t+1$ are given by setting

$$R_{t+1} = w_{t+1}.$$

An interpretation of the model is that equilibrium can be implemented through continual renegotiation of standard debt contracts with fixed contractual repayments equal to $\max\{w_{t+1}\}$. Renegotiation yields actual (*ex post*) repayments equal to w_{t+1}.[5]

The constraint on the government in the state-contingent economy differs from the conventional solvency constraint. By allowing for sovereign immunity, in the broad sense that foreign creditors can only indirectly influence the behavior of national executive, legislative, and judicial authorities by not

purchasing assets issued by the country, the country's intertemporal budget constraint is given by

$$w_t = -(g_t - T_t) + \beta E_t w_{t+1} \geq 0 \quad \text{and} \quad w_{t+1} \geq 0, \tag{12}$$

and not by the conventional solvency constraint given by

$$\lim_{s\to\infty} E_t \beta^{s-t} b_{s+1} \leq 0 \quad \text{for all } t, \text{ where} \quad \beta b_{s+1} = b_s + (g_s - T_s). \tag{13}$$

The difference is that the conventional solvency constraint requires that the expectation of the present value of the primary surplus be at least as great as the current outstanding debt at all dates,

$$w_t = T_t - g_t + E_t \sum_{s=t+1}^{\infty} \beta^{s-t} (T_s - g_s) \geq b_t, \tag{14}$$

while sovereign immunity imposes the weaker constraint on borrowing that w_t be greater or equal to zero at every date.

In equilibrium, the willingness of bondholders to purchase outstanding debt and accept new debt issues constrains the capacity of the government to smooth the distortionary cost of taxation. Incomplete smoothing arises because the participation constraints for the sovereign borrower can, and will, bind for some histories of realizations of the shock, g_t. Using this model to interpret debt renegotiation leads to the basic conclusion that renegotiation implements an implicit state-contingent contract guided by a simple explicit contract that ties a debtor to its creditors. Unfortunately, in the complete information economy, it implies that debt renegotiation is an everyday event, occurring in all but the lowest expenditure state of nature. Allowing asymmetric information about the government's willingness to repay debt can lead to incomplete state-contingent markets and motivate the use of conventional bond contracts without continuous renegotiation.

4. Incomplete Information and Bond Lending

The complete information case implies that we should observe a rich set of state-contingent securities or very frequent international debt renegotiation. Asymmetric information between debtors and creditors leads to an incomplete set of state-contingent securities. A simple assumption is that g_t is observed by national authorities but can never be observed by creditors. For example, the variable, g_t, can be reintroduced as an unobserved taste shock to the government's objective. A motivation for this interpretation is that national authorities are better informed of their capacity to transfer resources from the domestic private sector to creditors than are creditors themselves. Those who have achieved political power in a country are likely to know more about the willingness of residents to pay taxes for debt repayment than are individual bondholders or foreign authorities.

The assumption that shocks to expenditures are only observed by the borrowing government requires that equilibrium payments be incentive compatible for the government.[6] In an incentive-compatible equilibrium, the government will reveal the correct realization of g_t to creditors by its current choice of the primary deficit, $g_t - T_t$, which is observed by creditors. The separate components, g_t and T_t, are private information. The gains from tax smoothing suggest that higher reported expenditures should be associated with higher primary deficits. In the complete information case, current repayments and new borrowing can be conditioned separately on the publicly observable state, g_t. With incomplete information, incentive compatibility requires that the government cannot pay less when g_t is high without repaying more in the future. Otherwise, the government could falsely report high expenditures to lower the present value of its net repayments. In an incentive-compatible equilibrium, a favorable shock (lower g_t) should lead to a larger current net repayment (a larger primary surplus) and lower future repayments.

Under private information, an equilibrium is found by maximizing the expected value of government liabilities, $W_t = E_{t-1} w_t$, given a constraint set that includes the incentive-compatibility condition for the government. The expected future surplus for the government, $E_t V_{t+1}$, can be written as a function of the reported current state, denoted $\widehat{g}_t$, and the value of future repayments to creditors, W_{t+1}. Current taxes should also be a function of the reported state. The incentive-compatibility condition requires authorities to be at least as well off reporting the actual state, g_t, as reporting any other state. It is written as

$$V_t(g_t, g_t) \geq V_t(g_t, \widehat{g}_t), \tag{15}$$

for each state g_t and all possible $\widehat{g}_t$, where

$$V_t(g_t, \widehat{g}_t) \equiv v(T_t(\widehat{g}_t)) - v(g_t) + \beta E_t V_{t+1}(\widehat{g}_t).^{7} \tag{16}$$

The properties of incentive-compatible equilibrium with commitment on one or both sides of the market are well known (for the difficult one-sided commitment case, see Thomas and Worrall, 1990). While incentive-compatible solutions tend to be complicated, allowing a continuous and bounded support for the shock g_t simplifies things greatly.[8] Let the distribution of expenditure shocks have a continuous density over a fixed interval ($\left[g^{\min}, g^{\max}\right]$ where $0 < g^{\min} < g^{\max}$). In the case of full commitment (no participation constraints), the incentive-compatible equilibrium is supported by conventional, noncontingent bond contracts in the presence of borrower hidden saving (Cole and Kocherlakota, 2001). Without offering details, the cases with and without an unobservable storage opportunity for the borrower can be contrasted. The first-order approach to the principal-agent model can be applied to this model. Without a saving opportunity for the borrower, the inverse Euler condition,

$$\frac{1}{v'(T_t)} = E_t\left(\frac{1}{v'(T_{t+1})}\right),$$

characterizes the constrained optimum written here for non-binding participation constraints. This implies that

$$v'(T_t) < E_t v'(T_{t+1}),$$

suggesting a marginal rate of interest for government borrowing less than the common discount rate. It also characterizes an intermediate case between the complete information tax-smoothing case and the self-insurance model of tax-smoothing with noncontingent bonds as the only available financial instrument. In the first case, the value of the government, V_t, is fully smoothed (absent binding participation constraints) while the value for debt holders, w_t, is stochastic. In the second, the value for debt holders is non-stochastic and the government's objective is only partially smoothed. Adding the accumulation of other assets by the government to the model rules out the constrained optimum (Rogerson, 1985) because the conventional Euler condition holds.

Following Cole and Kocherlakota, the holding of reserve assets by the sovereign is allowed although an adequate assumption is hypothesized to be that the government's holdings of these is unverifiable rather than unobservable. For example, reserve holdings are reported by sovereign states but can be readily changed or misreported. In the constrained optimum with no savings, interest payments will be conditioned on net government wealth with the gains from tax smoothing implying that interest rates fall with the amount borrowed. A portion of sovereign bond issues can be held back from sale amounting to an observable credit line on which interest rates cannot be conditioned. Therefore, the assumption is added that contracts cannot be conditioned on sovereign financial wealth.

Under this assumption, the expected present value of government liabilities,

$$W_t = T_t - g_t + \beta W_{t+1}, \tag{17}$$

does not depend on the current shock, g_t. This is the conventional budget identity for bond borrowing. Since the discounted level of the future debt, βW_{t+1}, varies one for one with the primary surplus, the government has no incentive to misrepresent its current state. The first-order condition for tax smoothing is

$$v'(T_t) = E_t v'(T_{t+1}). \tag{18}$$

The solution without participation constraints parallels equilibrium for self-insurance in the permanent income model.[9]

The participation constraints for bondholders and for the sovereign remain

$$w_{t+1} \geq 0 \quad \text{and} \quad V_{t+1} \geq 0,$$

respectively. If neither of these constraints binds in any possible state, g_{t+1}, then the first-order condition (18) holds. If the government's participation constraint binds for some states, then the first-order condition

becomes

$$v'(T_t) \leq E_t v'(T_{t+1}) < 0. \tag{19}$$

In this case, the government's primary surplus is constrained at time t in state g_t by its willingness to raise taxes to make repayments in some states at time $t+1$. When the participation constraints hold for the government's creditors, the first-order condition is given by

$$v'(T_t) \geq E_t v'(T_{t+1}). \tag{20}$$

In this case, the debt limit for the government is reached with positive probability.

The equilibrium when the sovereignty constraint for the government binds helps us to understand the renegotiation of conventional debt contracts issued by sovereigns. When participation constraints are not binding, equilibrium borrowing and repayment are implemented by conventional, noncontingent, single-period debt contracts. When the sovereignty constraint is binding with positive probability in the next period, the continuation surplus for the government, $E_t V_{t+1}$, equals its lowest possible value, which is zero. Therefore, in any state g_t that

$$v'(T_t) < E_t v'(T_{t+1}), \tag{21}$$

the government's continuation surplus must be zero. Otherwise, taxes could be smoothed more by reducing current taxes, T_t, and increasing the debt carried into the next period (that is, lowering the continuation surplus, $E_t V_{t+1}$). The present value of outstanding debt is maximized when the government's constraint binds. The debt limit equals the expected surplus for creditors, W_{t+1}, when the expected surplus for the government $E_t V_{t+1}$ equals zero. The debt limit is denoted $\overline{W}$.[10] Incentive compatibility requires that the primary deficit be the same for any state such that inequality (21) holds. If this were not true, then the government could increase its primary deficit without increasing its debt. Whenever the inequality (21) holds in a period, the value of outstanding debt is $\overline{W}$ in the next period.

At the debt limit, taxes are a function of the current state and, naturally, at their highest level in equilibrium. Let $\widehat{T}(g_t)$ be the maximum tax revenue collected in state g_t in equilibrium. At the debt limit, expected marginal utility, $E_{t-1} v'\left(\widehat{T}(g_t)\right)$, is a constant if shocks are independently and identically distributed. In this case, there must be a pivotal state, $\overline{g}$, such that inequality (21) holds for expenditure shocks greater than $\overline{g}$. In these states, the primary surplus will equal zero because the debt cannot rise above the limit so that taxes equal expenditures, $\widehat{T}(g_t) = g_t$, for $g_t \geq \overline{g}$. The pivotal state is determined by

$$v'(\overline{g}) = E v'\left(\widehat{T}(g_t)\right) \tag{22}$$

for $g^{\min} < \overline{g} < g^{\max}$. For expenditure states below $\overline{g}$, the government runs a primary surplus and its debt falls (so that it has an incentive to run a primary surplus).

As the government's debt rises to the debt limit, it follows the standard identity,

$$\beta W_{t+1} = W_t + (g_t - T_t), \tag{23}$$

until

$$v'(g^{\max}) < Ev'\left(\widehat{T}(g_t)\right)$$

(recall that $g^{\max}$ is the largest shock to expenditures). For shocks such that the inequality (21) holds, the primary deficit can be positive but must satisfy

$$\beta\overline{W} = W_t + (g_t - T_t).$$

In these circumstances, the primary deficit is independent of expenditures and current taxes are given by

$$T_t = W_t - \beta\overline{W} + g_t.$$

Therefore, debt rises from $W_t < \overline{W}$ to $\overline{W}$ in period $t+1$ if the shock at date t is equal to or greater than $\widehat{g}(W_t)$, which is determined by the condition

$$v'\left(W_t - \beta\overline{W} + \widehat{g}(W_t)\right) = Ev'\left(\widehat{T}(g_t)\right). \tag{24}$$

Another critical debt level, $\widetilde{W}$, can be defined using the first-order condition as

$$v'\left(\widetilde{W} - \beta\overline{W} + g^{\max}\right) = Ev'\left(\widehat{T}(g_t)\right). \tag{25}$$

If the current debt, W_t, is less than $\widetilde{W}$, then debt the next period, W_{t+1}, remains below the debt limit with certainty. But if the current debt is above the critical level, $\widetilde{W}$, then the debt limit will be reached in one period with the probability that $g_t \geq \widehat{g}(W_t)$. This probability rises with current outstanding debt in the interval, $\widetilde{W} \leq W_t \leq \overline{W}$, as $\widehat{g}(W_t)$ decreases from $g^{\max}$ to $\overline{g}$ as W_t increases. For $g_t \geq \widehat{g}(W_t)$, the primary deficit equals $\beta\overline{W} - W_t$. For $g_t < \widehat{g}(W_t)$, the primary deficit is decreasing in the expenditure shock and must be in surplus for low expenditure shocks.

If the debt is below the critical level, $\widetilde{W}$, public debt follows conventional debt dynamics and repayments are not state contingent. The ex post value of the debt, w_t, is the same as the ex ante expected value, W_t. The real rate of interest on single-period bonds is equal to the riskless rate equal to the discount rate, $\rho = (1-\beta)/\beta$. When the debt level exceeds the critical level, the present value of outstanding bonds varies with the expenditure shock. The return to single-period bonds is risky. Past the critical level, the present value of public debt satisfies

$$W_t = E_{t-1}\left[(T_t - g_t) + \beta W_{t+1}\right], \tag{26}$$

rather than

$$W_t = (T_t - g_t) + \beta W_{t+1}$$

because the *ex post* value of debt claims, $w_t = (T_t - g_t) + \beta W_{t+1}$, is state dependent. The single-period

budget identity can be rewritten as

$$W_{t+1} = (1 + r_{t+1}) [W_t + (g_t - T_t)] , \tag{27}$$

where r_{t+1} is the *ex post* yield, which is stochastic if debt exceeds the critical level and equal to ρ if debt is below the critical level. For example, if the debt limit has already been reached, the rate of return is zero for adverse shocks because

$$\overline{W} = (1 + r_{t+1}) \left[\overline{W} + (g_t - T_t)\right] = (1 + r_{t+1}) \overline{W} \quad \text{for } g_t > \overline{g}. \tag{28}$$

For g_t less than $\overline{g}$, the yield is positive and falls with higher expenditures. Combining equations (26) and (27) leads to

$$\rho (W_t + E_{t-1} (g_t - T_t)) = W_t E_{t-1} r_t + E_{t-1} [r_{t+1} (g_t - T_t)] , \tag{29}$$

implying that the actual return exceeds the discount rate for low expenditure shocks.

This equilibrium under incomplete information is implemented by one-period contracts that are only state contingent when the present value of outstanding government obligations is above a threshold. It could be implemented using standard one-period debt contracts if these can be costlessly renegotiated in some events. Renegotiation will only take place with positive probability after the debt level exceeds the critical level. Under short-term bonds subject to renegotiated repayments, the interest premium on public debt rises above the discount rate after the debt reaches the critical threshold. In the model, creditors are risk neutral or, equivalently, renegotiation risk is uncorrelated with global market risk. Extending the model to allow for risk-averse creditors would yield a risk premium on short-maturity debt that only turns positive when the critical level is attained.

The lowest single-period ex post net yield on bonds is zero. At the debt limit, bondholders lose net interest with an adverse shock but not bond principal. This contrasts with the complete information case in which the gross return to creditors is zero in the worst state when tax smoothing is incomplete.[11] Renegotiation is also an infrequent event in the bond lending case.

The debt limit derived for the tax-smoothing model under sovereign immunity is not the same as the conventional debt limit imposed in most models of government borrowing. In the model with private information, government securities have noncontingent repayments unless the sovereignty constraints can bind with positive probability before maturity. The natural interpretation is that equilibrium borrowing and lending follow an implicit contract guided by standard, noncontingent debt instruments. Contingent repayments are made through renegotiation of the net interest on conventional bonds issued at interest rates that include a positive risk premium when debt outstanding exceeds the critical level. Alternatively, an explicit state-contingent contract would specify contingent repayments only when the debt is above the

same threshold. That is, the contract would depend on the state of nature, g_t, and the state variable, W_t.

Imposing a conventional solvency constraint on bond borrowing does not allow constrained efficient equilibrium tax smoothing in the presence of sovereign immunity. The conventional approach, for example as followed by Aiyagari (1994) and others, will set an upper bound on outstanding public debt, b_t, for this economy given by

$$\left(\beta^{-1}-1\right) b_t \leq \widehat{T}\left(g^{\max}\right) - g^{\max}, \tag{30}$$

where the right-hand side of this inequality is the largest primary surplus sustainable in equilibrium in all states. This ensures that noncontingent debt can be repaid in all events. An equilibrium for the tax-smoothing model could be derived after adding the restriction that only noncontingent securities can be issued by the borrower.[12] Restricting contracts to be noncontingent in all events reduces the set of securities that can be used in equilibrium for the tax-smoothing model under private information, since it eliminates securities that were needed to implement an efficient solution. Doing so must lead to a lower debt limit than the limit, $\overline{W}$, derived above and to less smoothing of taxes. In the model of this paper, sovereign immunity is taken as a fundamental and the set of securities is endogenous while in the conventional model the nature of securities and contract enforcement are taken as exogenous.

5. Enforcement of Seniority Rights and Renegotiation

The model of constrained efficient equilibrium with asymmetric information implies that debt renegotiation is not an everyday phenomenon as in the complete information model used by Kletzer and Wright (2000) or Grossman and van Huyck (1988). Debt renegotiation occurs only after debt, W_t, has passed the threshold level, $\widetilde{W}$, and in states of nature such that expenditures exceed $\widehat{g}\left(W_t\right)$. Efficient renegotiation requires that net interest be forgiven in these events. In the equilibrium, no new lender would pay more than the upper bound on the present value of expected repayments, $\overline{W}$, for the stock of outstanding debt claims against the sovereign. Therefore, debt rollovers are no longer possible in these states without the realization of losses by current bondholders. Current bondholders could exchange their claims for a debt rollover that incorporates unpaid interest on paper, but the present value of these assets must remain below the debt limit, $\overline{W}$.

Implementation of the constrained efficient equilibrium requires costless forgiveness of unpaid interest by existing bond holders in the events that default occurs. This might be done by simple acceptance of the equilibrium repayment by the sovereign since it bears the reputational cost of deviating from the incentive compatible equilibrium with nonverifiable saving. By paying net interest on maturing single-period bonds, the sovereign acts as required given the publicly observed market value of the debt in the implicit

contract. It would avoid sanctions and be able to issue new bonds in the amount $\overline{W}$. In the next period, these bonds would be renegotiated in high expenditure states and repaid on net in low expenditure states leading to a decrease in the size of the subsequent new bond issue. The complete information version of the consumption-smoothing model of sovereign debt of Kletzer and Wright (2000) demonstrates that an equilibrium in state-contingent loans can be enforced by market participants in the absence of any outside means of contract enforcement.[13] The proof that credit markets are sustainable in the presence of two-sided participation constraints can be extended readily to the tax-smoothing model with asymmetric information. under anarchy.

Unfortunately, debt renegotiation has not be a smooth process carried out without the potential enforcement of creditor rights vis-a-vis each other by governments. Instead, debtors suffer sudden capital account reversals followed by sharp drops in output growth and consumption. Creditors endure delays to complete debt restructurings and receive partial payments in a costly process of negotiation. The model still helps us frame what is renegotiated when creditors can assert contractual rights against each other or against subsequent lenders. In this case, the social losses to delays to agreement are seen in the loss of tax smoothing by the sovereign borrower for a period of time and the reduction in the present value of bond repayments bounded from above through the postponement of repayment. An informationally thrifty way to implement a constrained efficient equilibrium is through the exogenous enforcement of seniority privileges between creditors. With fully state-contingent contracts subject to the self-enforcement constraints, simple seniority rights can support an efficient perfect equilibrium. Seniority privileges, however, can be problematic when accompanied by restrictions on the renegotiation of conventional bond contracts.

The remainder of this paper considers restrictions on the renegotiation of debt contracts created by bond covenants binding between creditors and enforced by creditor country governments. Specifically, it considers how the enforcement of seniority rights across creditors and the use of collective action clauses can affect the outcomes of renegotiation. Although there are many ways to model bargaining between the borrower and lenders during renegotiation, any renegotiation equilibrium will be in the set of all self-enforcing equilibria. The strategy used is to identify some characteristics of possible perfect equilibria under alternative institutions that govern debt renegotiation. Rather than study specific bargaining models, the approach is to show whether bond covenants can allow a constrained efficient equilibrium outcome.

A simple stylized case with one-period loan contracts and a seniority privilege is used. The seniority privilege ensures that if the sovereign reneges on debt repayment, current lenders can interfere with future payments to subsequent lenders. A conventional seniority privilege holders of any bond in default can

attach payments made to any new bond issue. This reduces, or eliminates, returns to the new lenders, so that a new loan cannot be offered that implements the continuation of an efficient equilibrium. Part or all of the surplus that could be realized in the continuation of the tax-smoothing equilibrium has already been taken by the existing creditors who do not need to provide any new net financing to claim a positive share of the continuation equilibrium surplus. A new lender can only realize a gain equal to the additional surplus in equilibrium past what is already owed to existing creditors.

Consider the case in which the debt limit has been reached so that a new bond issue will only cover the principal of the expiring issue net of the accumulated contractual interest. The present value of the maturing bonds is given by $\overline{W}$ and the lost interest by $\left(\beta^{-1}-1\right)\overline{W}=r\overline{W}$. New bonds are worthless in the presence of the (*de jure* or *de facto*) seniority privilege of existing bondholders until the old bondholders restructure their claims to absorb the loss of net interest. Renegotiation now concerns the acceptance of a debt write down.

With seniority clauses enforced between creditors, a single lender can provide accumulated interest write downs as necessary to implement the constrained efficient equilibrium for sovereign borrowing with the asymmetric information that motivates conventional bond contracts. This suggests that bond issues held in trust by a single financial intermediary that pays dividends to shareholders could implement the equilibrium in absence exogenous creditor country government restriction. Similarly, it suggests that efficient renegotiation might be possible with a bondholder representative with the authority to restructure bond issues on behalf of its members if it controls all outstanding debt. With autonomous holders of bonds, renegotiation depends crucially on the details of bond contracts.

To study renegotiation with many bondholders who choose whether and when to accept a debt restructuring, first consider the case of two lenders, A and B, with total claims, R_A and R_B, respectively, that exceed $\overline{W}$ in sum. While seniority privileges can solve a problem of lender entry in the event of default, it now creates a problem of lender exit for this economy. A successful renegotiation pays the two lenders together $\overline{W}$ financed by a new debt issue in the same amount in a high expenditure state. The two lenders need to coordinate in renegotiating the maturing debt to allow continued tax smoothing for the sovereign debtor.

Begin with the borrower's response to a refusal to renegotiate by both lenders. The borrower can refuse to pay either lender or pay one and not the other. By satisfying the debt claim of one lender, say lender A, the borrower still needs to settle the remaining (and now senior) claim of lender B which has a face value greater than $\overline{W}$ minus the amount paid, R_A. The residual claim of lender B reduces the amount that new lenders would pay for a new debt issue to $\overline{W}-R_B$. This means that the debtor effectively paid the sum

R_A plus R_B to issue new debt in the amount $\overline{W}$ which is less than $R = R_A + R_B$, so that the borrower realizes negative surplus from settling any debt independently of all other outstanding claims. This is just a straightforward consequence of seniority restrictions imposed by various bond convenants. The point extends to the case in which lender A offers to accept a pro rata share, R_A/R of the maximum payment $\overline{W}$; the borrower still faces a senior claim against new financing held by lender B.[14] Therefore, whenever the sovereign is better off self-financing public expenditures to repaying contractual interest on outstanding public debt, it should not selectively repay individual loans or bond issues leaving the rest to renegotiate later.[15]

Next, consider the case in which the borrower agrees only to a restructuring offer made by both lenders. Since delay is costly, lender B can hold out against accepting an offer by lender A to share the surplus $\overline{W}$ on a pro rata basis. This equilibrium yields the returns, $(1-x)\overline{W}$ and $x\overline{W}$, to lenders A and B, respectively, where the share $x = R_B/R$. In this case, lender B can guarantee lender A the amount $(1-x)\overline{W}$ after a delay of one period. This gives lender A the return in present value, $\beta(1-x)\overline{W}$, allowing lender B to ensure itself the payoff,

$$(1-\beta(1-x))\overline{W} > x\overline{W}.$$

However, lender A has the same opportunity so that an unique solution can be found for the two players in the extensive form Nash bargaining game. With seniority rights enforced exogenously by creditor country governments, each lender has an outside option equal to R_A and R_B, respectively, so that a sufficiently small lender can successfully hold out for full buyout of its debt at the contractual value by the larger lender. This might characterize bank loan renegotiation with sovereign debtors, but it does not explain how holdouts induce costly delays in bond restructurings.

This argument applies with modification to the case of a large number of holders of identical bonds. An intuitive extension of the two lender example is to consider funds that purchase bonds on financial markets. The size of these funds is endogenous. If one of two funds seek agreement to a pro rata reduction in debt repayments, then it realizes the payoff, $(1-x)\overline{W}$, where the size of the fund, x, is to be determined. The return to the other fund if it delays agreement is as before, $(1-\beta(1-x))\overline{W}$. Now, any individual bondholder can purchase bonds, so that entry by funds is possible. The net return to imposing a delay,

$$(1-\beta(1-x))\overline{W} - x\overline{W} = \frac{r}{1+r}\overline{W}(1-x),$$

where $r = \beta^{-1} - 1$, is decreasing in the share of bonds held, x. If a small fund can commit to holding out (for example, by litigating its claim imposing costs on the debtor and other creditors), the other bondholders should be willing to pay up to this amount to avoid delay to agreement to accept repayment or new bonds in the amount $\overline{W}$. Note that the holdout gains as rent the opportunity interest on the ultimate settlement for

all other bondholders. With free entry by other bondholders in litigation, a third fund would choose to enter if its maximal gain is positive. This is given by

$$\max_z \left\{ z\frac{r}{1+r}\overline{W}\left(1-x-z\right)-c \right\},$$

where c is a hypothesized fixed cost of litigation. The optimal size of the entrant fund is $z=\left(1-x\right)/2$, and a little algebra leads to the solution for the equilibrium total number of bonds held by such vulture funds,

$$\left(\frac{1-x}{2}\right)^2 \frac{r}{1+r}\overline{W}=c,$$

if

$$\frac{r}{1+r}\overline{W}>c.$$

Without considering the artifice of commitment, nothing restricts the number of recalcitrant bondholders. Since any holdout will gain if all others capitulate, this model fits extensive form games of the war of attrition. The argument above sets out the payoff structure for a war of attrition in which each bondholder can seek to wait out the others. There are typically many inefficient perfect equilibria for this game (see Fudenberg and Tirole, 1990) so that this set up generates an argument for inefficient renegotiation of bond issues in the presence of access to litigation to enforce bondholder seniority rights. It the case of bank lending, it suggests strategies for coordinating initial lending and assigning an agent (such as the lead bank) to negotiate on behalf of a consortium.

6. Contractual Innovation and Sovereign Debt Restructuring

We begin with a brief review of the recent policy debate is useful and its analysis. Prolonged and costly sovereign debt renegotiations are widely taken as evidence of inefficiencies in international financial markets. The possibility that these result from the inability of various creditors to cooperate effectively in debt restructurings has been a concern for many years in many debt crises. Over the years, market participants, researchers and policy makers have offered a variety of explanations and proposed solutions for collective action failures between lenders in the resolution of sovereign debt problems.

The most recent debates reinvigorated the argument that international bankruptcy procedures might be needed to coordinate the actions of creditors with diverse interests and information to restructure debts and achieve the timely resolution of debt crises. Proposals by Haldane and Kruger (2001) and by Krueger (2002) suggested that the IMF play a prominent role in the reorganization of sovereign debt obligations. The restructuring of sovereign debt under such proceedings would require the aggregation of debt claims in parallel with corporate reorganization under Chapter 11 of the United States Bankruptcy Code. Similar proposals to apply bankruptcy reorganization procedures to sovereign debt were made by Schwarcz (2000)

and Miller and Stiglitz (1999). The primary counter proposal, which was successful, came from the US Treasury (Taylor, 2002) and argued that market-based contractual innovation through the adoption of collective action clauses should take precedence.[16]

The case for collective action clauses argues that bonds issued under UK governing law, which include collective representation, sharing and majority action clauses, are more readily restructured to the mutual advantage of creditors and debtors than are bonds issued under in the United States under the State of New York law governing corporate bonds (see Eichengreen and Portes (1995) and by Eichengreen (1999)). Collective action clauses allow bondholder trustees (for example, a bondholder assembly) to modify the repayment terms of bonds subject the approval of a qualified majority of bondholders (typically, those holding a supermajority of the outstanding debt). By contrast, the unanimous consent of all bondholders is required to revise the terms of repayment (amounts and timing) of a corporate bond issued in the United States. This allows an opportunity for "vulture funds" to seek a privately favorable outcome by holding a bond restructuring hostage.

Several authors have discussed the implications of collective action clauses and capacity of strategic behavior by small bond funds to gain under unanimous consent rules.[17] Bonds issued under New York governing law can include covenants that are modifiable by a qualified majority of bondholders and have financial value to bondholders but do not directly concern the terms of repayment. Using such covenants, a majority can accept an exchange of new bonds for the old bonds after rewriting provisions that do directly affect the amount and timing of repayments. Such exit consents can reduce the secondary market value of the bonds held by bondholders that do not participate in the exchange and were used, for example, in the restructuring of Ecuadorian Brady bonds. Buchheit and Gulati (2000) explain how exit consents can be used for restructuring sovereign bonds issued under US governing law. Roubini (2000), for example, argues that collective action clauses are unnecessary because bond exchanges in recent cases (Ecuador, Ukraine and Pakistan) allowed restructuring by a supermajority of bondholders.

A few papers, Eichengreen and Mody (2000), Eichengreen, Kletzer and Mody (2004) and Becker, Richards and Thaicharoen (2001), consider whether collective action clauses matter empirically as evidenced by their effects on the interest spreads on sovereign bonds. The first two papers find significant empirical evidence that these clauses do affect interest differentials using primary market spreads, while the second shows contradictory findings using secondary market yields. The estimated effects of Eichengreen, Kletzer and Mody (2004) are modest but fit the launch spreads for new issues in the US that incorporate collective action repayment clauses. The remainder of this section recapitulates the arguments and analysis of Kletzer (2004) and of Eichengreen, Kletzer and Mody (2004) on collective action problems in sovereign

debt renegotiation in terms of the general model of debt renegotiation.

The legal rights of creditors in financial centers can both allow implementation of an implicit contracting solution for sovereign borrowing and create opportunities for individual creditors to seek rents in renegotiation at a social cost. The simple approach of setting up the payoffs in renegotiation games between uncooperative lenders admits war of attrition types of games helps explain how bond covenants enforceable between bond holders can lead to welfare losses for sovereign debtors when taken into account *ex ante* by lenders. Bond covenants address some of these issues in both sovereign and domestic corporate borrowing originating in the major financial centers.

The problem of the free rider portrayed above that allows the payoffs leading to the possibility of prolonged costly delay in sovereign debt restructurings arises because individual bond holders can hold out for full repayment against the majority of bond holders. If the majority can force a settlement on the minority, this problem is mitigated. The possibility arises under bonds issued with unanimous consent repayment clauses replicating the convenants of US corporate bond issues in the form of qualified majority requirements for modifying other clauses, such as subordination and acceleration clauses. A qualified majority of bondholders can swap existing debt for new issues with principal equal to the actual present value of the mature bonds after rewriting clauses that allow the consent of a qualified, but non-unanimous, majority of bond holders for revising. Such exit consents can be and have been used in bond exchanges by a majority of bondholders that reduce the value of the remaining bonds held by a minority of bondholders who do not agree to the exchange.

The extension of collective action clauses to primary repayment clauses (which specify the amount and timing of payments) increases the strategies available to the holders of a majority of an outstanding bond issue in default. These simply work if the solution to the free entry condition,

$$\left(\frac{1-x}{2}\right)^2 \frac{r}{1+r}\overline{W} = c,$$

for $1-x$ is at least as great as the qualified majority under the bond contract. The holdout will simply hold either disfigured bonds (in the case of exit consents) or bonds that are worthless unless swapped for the new issue or its market value. This condition yields an minimal size for qualified majorities in collective action clauses needed to rule out delay gains in renegotiation. A qualification is in order here. The baseline for renegotiation assumes no costs of renegotiating or of forming a sufficient coalition of bond holders when diversification is a goal or creditors themselves can be liquidity constrained (so that a single creditor can hold the majority of bonds). Debt restructuring can still be costly but collective action clauses can eliminate a source of persistent delays evidenced by the threat of litigation by small bond holders.

An important problem for sovereign debt restructuring cannot be addressed by adding collective action

clauses alone in individual bond issues. Implicit to any analysis of renegotiation that begins with the basic models outlined above is that all maturing debt is renegotiated. This includes debt that was to come due in the future because of acceleration clauses. It is in the debtor's best interest in theory to restructure all debt at once, and this certainly has been the practice. The large number of international bond issues to Argentina at the time of the most recent default exceeded eighty. Aggregation of outstanding claims is an essential and central step in all debt restructurings. As suggested by Eichengreen and Portes (1995) and others, bondholder committees consisting of representatives of the qualified majorities of each bond issue can be formed, or established as a standing body, can implement aggregation under collective action clauses. In the sketch of negotiations between creditors, if none of the bond issues comprises so small a fraction of the total debt that its holders can unilaterally hold out, then constrained efficient debt restructurings could be achieved with bondholder committees. With a large number of bond issues, such a condition could be violated, or might be endogenously violated in a richer model of overlapping issues. Super-collective action clauses that allow restructuring of all bond issues when a qualified majority of a sufficiently large majority of outstanding issues address this.

7. Conclusion

A model of sovereign borrowing to finance public spending in the presence of exogenous shocks and distortionary taxation is used to motivate sovereign debt renegotiation. The debt limit for the government is determined endogenously given information asymmetries that motivate conventional bond contracts. The model shows that the interpretation of debt renegotiation as the playing out of an implicit contract with state contingent repayments that is guided by noncontingent bond contracts implies continuous renegotiation under complete information. With private information, renegotiation only occurs when the debt level exceeds a sufficiently high threshold and domestic shocks are adverse. As a consequence, sovereign risk premiums should only rise above the opportunity cost for foreign creditors after the debt threshold is reached for single-period maturity bonds. This conclusion is consistent with the nonlinear effect of debt on bond spreads found empirically (for example, by Eichengreen, Kletzer and Mody (2004)). Further, the model shows that creditor losses in default are bounded by the flow of net interest accruing during periods of distress, consistent with historical empirical studies.

This benchmark model is used to discuss the effects of exogenously enforced rights of creditors vis-a-vis other creditors on debt renegotiation. These seniority rights represent the ability of bondholders to assert their contractual rights against infringement by other bondholders, either holders of the same issues or subsequent lenders. The inclusion of seniority privileges also introduces a role for provisions with

non-contingent debt contracts that enable or inhibit debt renegotiation. The model allows a comparison of the potential effects of US and UK corporate governing law for sovereign bond issues on debt restructuring with these simple explicit restrictions on loan contracts for welfare. The barren model does not incorporate any additional or implicit institutional assumptions that influence resource allocation but does allow a demonstration of the elements of game theoretic models of the costs and consequences of coordination failures among creditors.

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Endnotes

[1]See, for example, Yue (2006) and Arellano (2004).

[2]Models of sovereign debt based on willingness to pay begin with Eaton and Gersovitz (1981). A still timely and thorough review of country risk is given by Eaton, Gersovitz and Stiglitz (1986).

[3]The replacement of a tax-smoothing objective for a consumption-smoothing objective for the representative household is demonstrated in Zhu (1992).

[4]For the stochastic g_t following a Markov chain (including independently and identically distributed g), this surplus can be written as $V(w_t, g_t)$. The model extends immediately to the case in which g_t follows a Markov chain.

[5]This interpretation of debt renegotiation as the implementation of an implicit contract was suggested by Grossman and van Huyck (1988).

[6]Atkeson (1991) introduces asymmetric information in a repeated moral hazard model of sovereign debt with one-sided commitment. Kletzer (2005) discusses bond contracts with no observability of debtor income in a model with two-sided noncommitment.

[7]The time subscripts on the functions reflects dependence on ex ante surplus, $E_{t-1}V_t$.

[8]The demonstration that standard debt contracts with bankruptcy are optimal incentive compatible contracts is due to Townsend (1979). In that model and others, debtor income is observable at a cost. Cole and Kocherlakota (2001) implicitly demonstrate bond contracting with no observability in a model with hidden savings and no self-enforcement constraints.

[9]The model implicitly assumes no global constraints, and this first-order condition implies convergence toward a steady state in which taxes are zero and the interest on government credit covers the upper bound for expenditures. With risk-averse counterparts, the steady-state gross interest rate, R, would be smaller than β^{-1} and the first-order condition would become $v'(T_t) = R\beta E_t v'(T_{t+1})$.

[10]The debt limit $\overline{W}$ is determined endogenously by the condition,

$$v\left(\widehat{T}(g_t)\right) - v(g_t) + \beta E_t V_{t+1} = 0,$$

and the inequality (21), which holds with equality for $E_t V_{t+1} > 0$.

[11]This is equivalent to the incomplete consumption smoothing case in Thomas and Worrall (1988), Kocherlakota (1996) and Kletzer and Wright (2000).

[12]Two papers that endogenize the debt limit but place exogenous constraints on contracts are Aiyagari (1995) and Aiyagari and others (2002).

[13]Kletzer and Wright (2000) prove that a coalition-proof equilibrium exists. Wright (2001) proves that the result carries over when creditors can commit but are oligopolistic for a less strict definition of coalition-proofness.

[14]For an elaboration, see Kletzer (2004).

[15]With various bond maturities, cross default or acceleration clauses allow creditors to gain comparable seniority in the event the debtor defaults.

[16]Other policy proposals include universal debt rollover options (Buiter and Sibert (1999)), standstills (for example, Haldane and Kruger (2001)) and official guarantees, contingent credits, lending into arrears and so forth. Papers that analyze standstills and other interventions to avoid financial and currency crises in emerging market economies include Chui, Gai, and Haldane (2000), Gai, Hayes and Shin (2001) and Miller and Zhang (2000).

[17]A very useful overview of collective action clauses is given in Bank of England [2000], pages 142-151.