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Restructuring the Sovereign Debt Restructuring Mechanism

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ABSTRACT

Sovereign defaults are time consuming and costly to resolve. But these costs also improve borrowing incentives ex ante. What is the optimal tradeoff between efficient borrowing ex ante and the costs of default ex post? What policy reforms, from collective action clauses to an international bankruptcy court, would attain this optimal tradeoff? Towards an answer to these questions, this paper presents an incomplete markets model of sovereign borrowing default coupled with an explicit model of the sovereign debt restructuring process in which delay arises due to both creditor holdout and free-riding on negotiation effort. We characterize the ex ante optimal amount of delay, and explore numerically the effects of various policy options on the amount of delay in renegotiations, and on the efficiency of capital flows.

*Very preliminary and incomplete. We thank ... for helpful comments. Further comments welcome.

1. Introduction

Sovereign defaults are time consuming to resolve. For example, the 1980's debt crisis took more than one decade and two US Treasury Plans before culminating in settlements under the Brady Plan. The recent default by Argentina took four years from initial default to exchange offer, and still lingers as creditors explore legal options. A number of studies (for example, Suter 1993) have shown that this pattern was also common in history, with the median time to settle defaults in excess of ten years. This delay is also costly. As shown in Figure One, sovereign capital flows to Argentina dropped to approximately zero following its default at the end of 2001, while Miller, Tomz and Wright (2005) document similar declines for a wide range of countries over a long period of history. That is, the sovereign governments of countries in default appear to be cut off from access to international capital markets.

As a result of these costs, it is hardly surprising that there has been a great deal of discussion in policy circles of potential changes to the workings of sovereign debt markets and restructuring negotiations with a view to reducing the costs of default. These potential changes to the so-called "sovereign debt restructuring mechanism" (SDRM) range from policies that de-emphasize the involvement of supra-national institutions focusing on private sector initiatives and changes to contract details including the addition of "collective action clauses" (Eichengreen 2002, Taylor 2001), to the re-introduction of the bondholder representative groups that mediated debt settlements at the turn of the 20th Century (Eichengreen and Portes 1995), all the way to the establishment of an international bankruptcy court (Krueger 2001, 2002).

But this policy effort faces a fundamental dilemma. Although negotiation protocols and contract structures that are complicated and time consuming to implement impose great costs on a defaulting country *ex post*, these same costs also give a country an incentive to avoid default, and to borrow efficiently *ex ante*. Indeed some authors, such as Dooley (2002), have argued that the difficulties that exist with regard to restructuring sovereign debt contracts are the deliberate response by both creditors and debtor countries to this incentive problem. In the light of this debate, this paper asks: What features of the current sovereign debt restructuring mechanism lead to slow and costly default resolution? What is the optimal trade-off between efficient borrowing ex ante and the costs of default ex post? and What policy reforms, by both international institutions and creditor country governments on one side, as well as by debtor countries themselves, are available to attain this optimal trade-off?

Towards an answer to these questions, this paper begins by reviewing recent experience with sovereign debt restructuring. We characterize the amount of delay observed, and review the debate on the causes of this delay. We then present an explicit model of the sovereign debt restructuring process designed to capture the features emphasized in the policy discussion. We make one key assumption – that creditors cannot commit to begin negotiations at any specific time – and study the amount of delay produced under a number of different assumptions on the bargaining process that are intended to capture features of the process that are currently in place, as well as a number of the policy proposals that are currently on the table. In negotiations, delay may arise because creditors hold out for better settlements or because they free ride on the negotiation effort of others. We then calibrate this model to match data on the restructuring process and find that the model does a good job matching restructuring outcomes.

We then embed this bargaining model in a simple model of sovereign borrowing. Countries borrow to finance profitable investments, and cannot commit to repay their debts, defaulting opportunistically whenever it is in their best interests. The only loan instruments are state non-contingent bonds, and so default can be socially desirable in some states of the world. We then use this model to characterize the optimal amount of delay, and to understand the effect of various policy options.

This paper draws on a number of related literatures concerning both sovereign debt and holdout in bargaining. The basic borrowing framework is an example of an incomplete contracting model of debt. The first to apply this framework to a study of sovereign debt were Eaton and Gersovitz (1983), who's work has since been extended by Arellano (2005), Aguiar and Gopinath (2006), Irani (2006) and many others. Unlike all of these papers, which assume that default is punished by an exogenous deterministic or stochastic process of exclusion from financial markets, we model the punishments to default as arising from an explicitly specified debt restructuring bargaining game. In a recent paper, Yue (2006) studies the effect of bargaining on default settlement on implied bond yields in a model that produces much less delay in bargaining, and hence also much shorter lengths of exclusion from financial markets, than is found in the historical record. In contrast, our model aims to explain the entire distribution of bargaining delays observed in the data, and then uses these results to examine the normative implications of different policy regimes.

In the restructuring model of the paper, creditors must decide when to enter into negotiations and, once in negotiations, their bargaining strategy. The decision to enter negotiations shares some features with simple timing games such as the war of attrition studied by Hendricks, Weiss and Wilson (1988) and many others. Once negotiations have begun, bargaining takes place using a modified version of the alternating offer model introduced by Rubinstein (1982) and extended by Binmore (1987) and many others. Although the model assumes complete information, delay is a feature of all symmetric equilibria. It is also worth noting that some bargaining games with incomplete information give rise to results which also echo the war of attrition (for example, Osbourne 1985 and Abreu and Gul 2000).

Finally, this paper is related to research on the welfare effects of changes in domestic bankruptcy systems such as Livshits, MacGee and Tertilt (2003). In contrast to their model which takes the bankruptcy system as a fixed set of parameters that change as a result of legislative reform, our model derives the form of debt restructuring as the equilibrium of a game that is then matched to observed restructuring outcomes. Policy is subsequently examined in terms of modifications on the parameters and structure of this game.

The rest of this paper is structured as follows. Section 2 describes our data on defaults and settlements and provides a survey of forces that would appear to be important in determining delay in restructuring negotiations in practice. Section 3 introduces our explicit model of the settlement bargaining process and shows how different assumptions on the number of creditors, the type of debt contracts, and different aspects of the bargaining environment translate into different amounts of delay in negotiations. Section 4 then outlines the borrowing environment and characterizes the results for welfare in terms of the features of the renegotiation process, while Section 5 concludes.

2. Sovereign Debt Restructuring in Practice

In this section, we survey restructuring negotiations of the past two centuries with a view to isolating factors that may contribute to delay.

A. Data on Sovereign Debt Restructuring

To begin, we examine data on the amount of time taken to conclude negotiations to resolve sovereign defaults. We follow standard practice in defining a sovereign default to have occurred if either a country fails to meet its contractual obligations, or if it restructures its debts on unfavorable terms. The latter may involve instances in which creditors appear to voluntarily exchange their bonds. We obtain dates for the beginning of a default according to this definition from Standard and Poors (Beers and Chambers 2004), who in turn rely on the historical work of Suter (1990, 1992). The data cover the entire period from the end of the Napoleonic wars to the present. A default is defined to have ended when a supermajority of creditors agrees to a restructuring. Once again we rely on Standard and Poors for providing end dates.

In some cases, the Standard and Poors dates may understate the length of a default. In particular, to the extent that a default is defined as an unfavorable restructuring, Standard and Poors dates the beginning of the default as the date of the restructuring which may ignore preceding negotiations. In addition, Standard and Poors reports only the year the default began and ended, and consequently the length of short defaults is typically truncated to zero. To rectify these problems, we examined a range of primary and secondary sources to obtain the month, and in some cases the day, in which defaults began or negotiations were terminated. Most notable amongst these sources were Duggan and Tomz (2006) for the historical data, while for the modern period we relied on the World Banks' *Global Development Finance,* the Institute for International Finance's *Surveys of Debt Restructuring*, and Cline (1996).[1]

[1] An alternative, and in some cases more preferable and more model consistent, approach would define the end of a default to have occurred when net borrowing by a sovereign becomes positive. Early efforts along these lines have been presented for the modern period in Miller, Tomz and Wright (2005) and Richmond (2007).

	Delay			
	num.	Mean	Std. Dev.	Skew
Whole sample	272	8.8	10.5	2.2
- ex. communist	267	8.1	9.1	1.9
	Defaults Ended During			
1824-1867	23	15.0	5.3	4.9
1868-1917	50	7.9	5.4	6.2
1918-1975	52	9.5	5.7	4.7
1976-2005	147	6.5	6.3	2.1
1981-2005	136	6.9	6.2	2.2
1991-2005	97	8.7	6.2	2.3

Some summary statistics on the lengths of defaults are presented in Table One. According to our measure, from 1824 to the present, there have been 272 defaults which on average lasted for just under nine years. If we exclude the communist defaults of the early Twentieth Century, which turned out to be especially long and arguably involve considerations outside of our analysis below, the average length of a default drops to just over eight years. There was also an extraordinary amount of variation in the length of time that it took for sovereign debts to be restructured, with a standard deviation in excess of nine years.

Although there has been substantial variation in the lengths of defaults over time, these patterns are fairly consistent throughout history. Grouping defaults by the time period in which they ended (in an attempt to capture the different institutional arrangements that governed restructuring in different time periods) we find that the defaults of the first half of the 19th Century, before the formation of bondholder representative groups like the British Corporation of Foreign Bondholders (CFB), lasted more than twice as long as defaults in the modern period. Following the formation of the CFB in 1868 and up to the First World War, default lengths declined to about eight years on average. Defaults lengths then rose in the interwar period, driven by the long defaults following the Great Depression, before falling to six and one-half years in the modern period, which we define as beginning with the passage of the US Foreign Sovereign Immunities Act in 1976 which changed to legal basis of sovereign debt restructuring. Default lengths have stayed roughly constant during this period with the exception of a lengthening of defaults concluded in the 1990s which reflects the resolution of the debt crisis of the 1980s.

Strikingly, the standard deviation for default lengths remained large, and in the modern period was approximately equal to the mean default duration: there is, quite simply, an enormous amount of variation in the amount of time it takes to settle a default. The fact that the standard deviation of default durations is also approximately equal to the mean default duration also tells us something about the underlying process governing debt restructuring. In particular, this fact suggests that the distribution of delay may be well approximated by an exponential distribution, an observation which is further strengthened by noting that the skewness of the empirical distribution is approximately equal to two (which is a characteristic of the exponential). We will return to this observation below when we examine the empirical implications of our bargaining model.

B. Explaining the Delay in Bargaining

Delay in bargaining has been the subject of a substantial theoretical literature, with a great deal of effort devoted to the role of delay in signalling private information between parties. Arguably, the abundance of information about national economies suggests that private information is unlikely to be the main source of delay in bargaining over sovereign debt restructuring. In what follows, we examine some case studies of delays in sovereign debt restructuring for insights as to the causes of that delay which will then guide the development of our model.

Holdout and "Vulture Creditors"

The restructuring case that has garnered the most attention, and about which policy has been aimed, is the restructuring of Peru's debts in the mid 1990s under the Brady Plan following its default in 1983. The reason for this attention has been the actions of the "vulture creditors" Elliott Associates who at one point threatened to hold up the entire restructuring effort.

The brief story of this case begins in 1996 when Elliott Associates purchased, on secondary markets, a number of deeply discounted securitized bank loans. Court records show that Elliott Associates bought \$11.4m of Peruvian debt with a face value of \$20.7m, not including deferred interest. In 1997 Peru closed its Brady Exchange deal which received the support of more than 95% of its creditors. Of the creditors who did not settle, Elliott Associated was one of the largest. Elliott then proceeded through various legal avenues to force Peru to settle its outstanding debts at face value, plus deferred interest. In 1999, Elliott Associates obtained a judgment against Peru for the entire amount by which the debt was in arrears.

This was not in itself unusual: since the passage of the Foreign Sovereign Immunities Act in 1976, private citizens have been able to bring suit against a foreign sovereign government in the United States. Similar provisions were passed during the 1970s in most other countries with an English legal tradition. However, legal actions against sovereign countries have typically been fruitless as it has been extremely difficult to attach assets following a judgment. Typically courts have held that the assets of state owned corporations are immune from attachment, and, moreover, sovereign countries rarely hold other assets outside of their borders. Those assets that are held offshore, such as central bank reserves, are typically immune from seizure by international treaty.

Elliott Associates adopted the novel strategy of pursuing the interest payments on Peru's new debts under the Brady Plan. Specifically, it sought the attachment of the funds that were going to be used to pay coupons on the new Brady Bonds. In 2000, Elliott Associates obtained an injunction against Peru paying interest on the new debts. Coming just before a coupon payment was due, this forced Peru into the position of either having to settle with Elliott, or default on the interest payments on its new debts. As a result, Peru elected to settle for \$59m.

Although striking, the Elliott Associates case was not new. Other court cases had been pursued against defaulting sovereign countries in the 1980s and 1990s, including most notably the unsuccessful Allied Bank v. Costa Rica (1981) case, and the successful EM Ltd. v. Brazil case of 1995 which involved Kenneth Dart. There are also earlier historical episodes with a similar flavor in which creditors attempted to use the London Stock Exchange's prohibition against the listing of new securities issued by a country in default to force a settlement.[2] However, Elliott Associates was in many was the inspiration for new creditor efforts to extract funds and, indeed, Elliott Associates and EM Ltd. were at the forefront of the more than 140 court cases brought against Argentina during its new restructuring.[3]

The key feature of the Elliott case, as well as some other related cases, is that hold-out creditors appear able to disrupt a country's efforts to service new debts. This is important because, if creditors anticipate such efforts, they will not be prepared to issue new debts to a country until all of its remaining creditors have settled. Essentially, each creditor has veto power over a country's ability to re-access international financial markets. It is this de facto veto power that will be one feature of the model in the next section.

Free Riding on Negotiation Effort

Importantly, it is worth noting that despite the possible benefits to holding out in the manner of Elliott Associates, it is usual to see most creditors either settle on common terms (sometimes from a menu of options) or join a common holdout strategy. This is despite the fact that the veto power over market reaccess that underlies the success of vulture creditor strategies of itself imparts a strong incentive for all creditors to negotiate individually: no matter the amount that a country has settled for with other creditors, the last creditor to settle retains the veto and can extract better terms. This suggests that there must be substantial costs to negotiation that limit the incentives of small creditors to negotiate on their own. Such costs, in turn, can lead to an additional incentive to delay in order to free ride on the negotiation costs of others.

What little direct evidence we have suggests that the negotiation costs are substantial. The CFB, who's annual reports are public, typically charged bondholders a fee of one-half of one per cent of the face value of new securities to defray negotiation costs. This fee likely

[2] Perhaps the best known concern the rival Spanish bondholder committees who's disputes in the 1850s led indirectly to the formation of the Council (and later Corporation) of Foreign Bondholders in 1868.

[3] Although ongoing, these suits against Argentina have so far proven unsuccessful which in part may reflect the efforts of the US government in arguing that such holdout is undesirable. It should be noted that, for our purposes, all that is required to produce delay is the expectation of a higher return from legal action. Our model below will be used to question the wisdom of the US governments position.

understates the size of these costs: in most years, half of the expenses of the CFB were directly subsidized by the Bank of England, while expenses themselves tended to be understated due to the fact that all office holders donated their time and the fact that the CFB often made substantial use (without charge) of UK diplomatic and consular resources during negotiations with foreign sovereigns.

In the modern period, bank action committees may have been able to partially resolve this problem by requiring subscriptions from members and by negotiating for fees to be paid directly by the defaulting country, although the extent of the latter was presumably limited to costs that were verifiable. In the modern period, half a dozen or more bondholder representative bodies participated in discussions with the Argentine government, although most restricted membership to institutional investors who agreed to bear the negotiation costs.[4]

In the next section, we posit the existence of fixed costs of negotiation both as a source of delay (due to free riding) and as an explanation for the small number of different negotiation outcomes observed in practice.

3. Sovereign Debt Restructuring in Theory

In this section we introduce our bargaining framework and study how a number of institutional details of this bargaining framework produce different amounts of delay in equilibrium. We begin with a country that is in default on some past debts, and defer discussion of the original borrowing decision until a later section. Delay is produced by three key assumptions. The first is that creditors are unable to commit to begin negotiations with a defaulting country. As a result, creditors who settle later may be able to obtain different payoffs. Second, we assume that each creditor holds veto power over the country's ability to reaccess capital markets. Hence, a sovereign must settle with each creditor in order to reaccess capital markets. This gives the last creditor to settle special power, and delay results as creditors attempt to be that last creditor. Finally, we assume that a creditor can costlessly

[4] The Global Committee of Argentine Bondholders, which claimed to represent more than two-thirds of the outstanding value of the debt, represented consierably less than half of all bondholders by number despite the fact that it allowed individuals to join without charge as special non-voting members.

obtain the same settlement terms as any previous creditor to settle, but that it is costly to bargain anew. This leads to a further incentive for delay: to free ride on the negotiation costs of others. It also leads groups of creditors to form who all settle on the same terms.

A. The Model

Consider the problem of a debtor country that is in default. In later sections, we will model the borrowing decisions explicitly, but for now focus on the bargaining process by which debts in default are restructured. We consider a bargaining game with N creditors and one debtor. Time evolves continuously. The debtor begins in default, and upon reaccessing capital markets receives the value V at that date (V will be later determined endogenously when we discuss the borrowing decision). At the beginning of time, the debtor announces (costlessly) an initial settlement offer of P per creditor.

Each creditor chooses, at each instant of time, whether or not to settle. Once a creditor has decided to settle, they then decide whether or not to accept the settlement offer P, or whether to bargain with the debtor over a new settlement amount. The decision to bargain costs the creditor c (which we interpret as the cost of hiring a lawyer and a negotiating team, preparing restructuring documents, and lodging these with securities regulators). We assume that only one creditor can bargain with the country at a time, in order to abstract from the complexities of multiplayer bargaining problems. We assume that only one player can settle at any one instant in time, and that if two players were to attempt to settle at the same instant then one is randomly selected to settle[5].

Once the bargaining cost has been paid, the creditor and the debtor play a variant of Rubinstein's alternating offer bargaining game that works as follows. At the beginning, the creditor makes the first offer p to the debtor (we think of this as the counter offer to the initial offer P). The debtor may either accept or reject this offer. If the debtor accepts the offer, the

[5] As is common when considering timing games of this sort, the formal analysis of the game proceeds by taking a discrete time game and then taking limits as the the intervals of time become small. This facilitates the description of strategies and the analysis of the equilibrium. In this process, it is particularly important how one treats mass points (events in which multiple players decide to settle at the same time). The assumption that one creditor is randomly chosen to settle would appear to be necessary in ensuring the convergence of the analogous discrete time game to the continuous time game we describe in the text.

amount of resources p is transferred to the creditor and the debtor returns to a timing game exactly as above except for two changes: there are now $N-1$ creditors, and these creditors can now costlessly choose to accept the original settlement offer P or the new bargain p. Consequently, the state of the timing game consists of the number of creditors and the best previous settlement. If the offer is rejected, a unit of time of length Δ passes after which the creditor is randomly selected to make another offer with probability α while the debtor makes the offer with probability $1-\alpha$. Note that the assumption that the creditor makes the first offer serves to pin down deterministically the outcome of this bargaining game.

In the bargaining game, we take limits as the time between offers converges to zero yielding the result that the creditor obtains the fraction α of the remaining surplus of the debtor from the bargain. Obviously, this surplus is affected by expectations of future play, both in terms of the amount of resources to be paid to future creditors who settle, and in terms of the amount of delay before these settlements occur. We assume throughout that in the timing game, creditors play symmetric mixed strategies over the time at which they settle. This yields the familiar result that delay serves to exactly erode any surplus from settling at a later date.

Equilibria of this game can be constructed by backward induction on the number of players; that is, we start with the case of one creditor and the debtor, and move backwards to the case with N creditors. There exists the potential for multiple equilibria that depend upon expectations of future play by the debtor and any future creditor who settles. In particular, if the debtor and a creditor are negotiating today and they expect some future creditor will negotiate, then they believe the country has less surplus available today to bargain over. Hence, the result of any bargaining will be a smaller payment to the creditor. But this smaller payment in turn makes it more likely that a future creditor will want to bargain. Conversely, if the debtor and creditor expect future creditors to accept the outcome of the current bargain, there will be more surplus left for the country, the bargain will result in a higher payment, and future creditors will have an incentive to settle for this amount.

In the next subsection, we characterize in detail the equilibria that result when $N=2$ for different values of the bargaining cost c and the bargaining power α. This serves to provide intuition for the numerical results that follow. In the following subsection, we provide a general algorithm for computing equilibria of this game and discuss numerical results for different calibrations of the model. The final subsection presents some simplified versions of the model which serve to give intuition as to the numerical results.

B. The Two Creditor Game

In this subsection, we compute the set of equilibria of the two creditor version of the game in full detail, for all values of c and α, and for arbitrary initial choices of P. We then discuss the forces that affect the initial choice of P. The aim is the illustrate the underlying algorithm and to build intuition that will help in interpreting the results of the numerical solutions to follow.

The algorithm proceeds by backwards induction on the number of players. Suppose that there is only one creditor remaining to settle. The country will receive V once a settlement has been made. Consequently, if this last creditor were to bargain they would receive

$$P_1^* = \alpha V,$$

which yields payoffs to creditor and debtor country of

$$\begin{aligned} U_1 &= \alpha V - c, \\ V_1 &= (1 - \alpha) V. \end{aligned}$$

Therefore, the player will bargain iff the best settlement offer on the table P_1, which may be the debtors initial offer or the result of a bargain by the other creditor in the previous stage, satisfies

$$\alpha V - c > P_1.$$

Hence we have that

$$U_1 = \left\{ \begin{array}{ccc} \begin{array}{c} \alpha V - c \\ = P_1^* - c \end{array} & \text{if } P_1 < P_1^* - c & \begin{array}{c} (1-\alpha) V \\ = V - P_1^* \end{array} \\ & & \\ P_1 & \begin{array}{c} \text{if } P_1 \geq \alpha V - c \\ = P_1^* - c \end{array} & V - P_1 \end{array} \right\} = V_1$$

Obviously, there is no delay at this stage: with only one creditor, there is nothing to be gained from delay.

Now suppose we are in the subgame with two players, or $N = 2$. If the first player to settle was to bargain, they would receive some P_2^* where

$$P_2^* = \alpha V_1 \left(P_2^*\right).$$

There are three possible cases, in terms of fixed points, that refer to whether or not future players are expected to bargain.

Small Costs of Negotiation

If costs are small enough, where small enough is determined from

$$\alpha \left[(1-\alpha) V + c\right] < \alpha V - c,$$

or

$$c < \frac{\alpha^2}{1+\alpha} V,$$

the next creditor is expected to bargain and hence there is a unique fixed point that determines the bargain today to be only

$$P_2^* = \alpha (1-\alpha) V,$$

Hence, if the initial offer of the debtor P_2 is small, or

$$P_2 < P_2^* - c = \alpha\left(1-\alpha\right)V - c$$

both creditors will bargain. We can determine the cost of delay as that level which leaves the second creditor indifferent between playing the mixed strategy or settling immediately. Hence, delay must solve

$$\alpha\left(1-\alpha\right)V - c = \beta_a\left(2\right)\frac{\alpha\left(1-\alpha\right)V - c + \alpha V - c}{2},$$

or

$$\beta_a\left(2\right) = \frac{2\alpha\left(1-\alpha\right)V - 2c}{\alpha\left(2-\alpha\right)V - 2c}.$$

If the initial offer is a little bit larger, or

$$\alpha\left(1-\alpha\right)V - c \leq P_2 < \alpha V - c,$$

then the first creditor to settle will follow but last to settle will bargain, producing delay of

$$\beta_b\left(2\right) = \frac{2P_2}{P_2 + \alpha V - c} > \beta_a\left(2\right),$$

so there is less delay.

Finally, if the initial offer is large enough, or

$$\alpha V - c \leq P_2,$$

then both creditors will settle immediately and there is no delay

$$\beta_c\left(2\right) = 1.$$

Large Bargaining Costs

Similarly, if bargaining costs are very large, which is determined from

$$\alpha\left(1-\alpha\right)V \geq \alpha V - c,$$

or

$$c \geq \alpha^2 V,$$

the next creditor is expected to follow any bargain made today. Hence, the unique fixed point is the P_2^* that solves

$$P_2^* = \alpha\left(V - P_2^*\right),$$

or

$$P_2^* = \frac{\alpha}{1+\alpha}V.$$

Note that $1-\alpha < 1/\left(1+\alpha\right)$, which can be seen by multiplying across to get $1-\alpha^2 < 1$.

Hence, the range of possible outcomes, in terms of the initial offer, is given as follows. If the offer is sufficiently small, or

$$P_2 < P_2^* - c = \frac{\alpha}{1+\alpha}V - c,$$

the first to settle will bargain and the last to settle will follow this bargain yielding a delay determined by

$$\beta_b\left(2\right) = \frac{\frac{2\alpha}{1+\alpha}V - 2c}{\frac{2\alpha}{1+\alpha}V - c}.$$

If the initial offer is intermediate, or

$$\frac{\alpha}{1+\alpha}V - c \leq P_2 < \alpha V - c,$$

the second to settle accepts this offer while the last to settle bargains producing delay of

$$\beta_b(2) = \frac{2P_2}{P_2 + \alpha V - c}.$$

Finally, if the initial offer is high enough, or

$$\alpha V - c \leq P_2,$$

both will accept and there is no delay

$$\beta_c(2) = 1.$$

Intermediate Bargaining Costs

Finally, for intermediate levels of c

$$\alpha^2 V > c \geq \frac{\alpha^2}{1+\alpha} V,$$

the results of a bargain by the first creditor to settle will depend on expectations of the behavior of the last creditor to settle. Specifically, if it is expected that the next creditor will follow

$$P_2^* = \frac{\alpha}{1+\alpha} V,$$

while if it is expected that they will bargain

$$P_2^* = \alpha(1-\alpha) V.$$

The set of possible outcomes, as a function of P_2, is analogous to that above except that there are now multiple equilibria.

Specifically, if the offer is large enough, or

$$\alpha V - c \leq P_2,$$

there is no delay as both accept it, or

$$\beta_c(2) = 1.$$

If the offer is intermediate, or

$$\frac{\alpha}{1+\alpha}V - c \leq P_2 < \alpha V - c,$$

the second to settle follows but last to settle bargains producing delay of

$$\beta_b(2) = \frac{2P_2}{P_2 + \alpha V - c}.$$

For lower P_2 we can get multiple equilibria. If

$$\alpha(1-\alpha)V - c \leq P_2 < \frac{\alpha}{1+\alpha}V - c,$$

we get one creditor following and one bargaining, with the identity determined by expectations (if I expect the last settler to follow, I bargain; if not, I follow and they bargain). Delay depends on each case.

$$\beta_b(2) = \frac{2P_2}{P_2 + \alpha V - c},$$

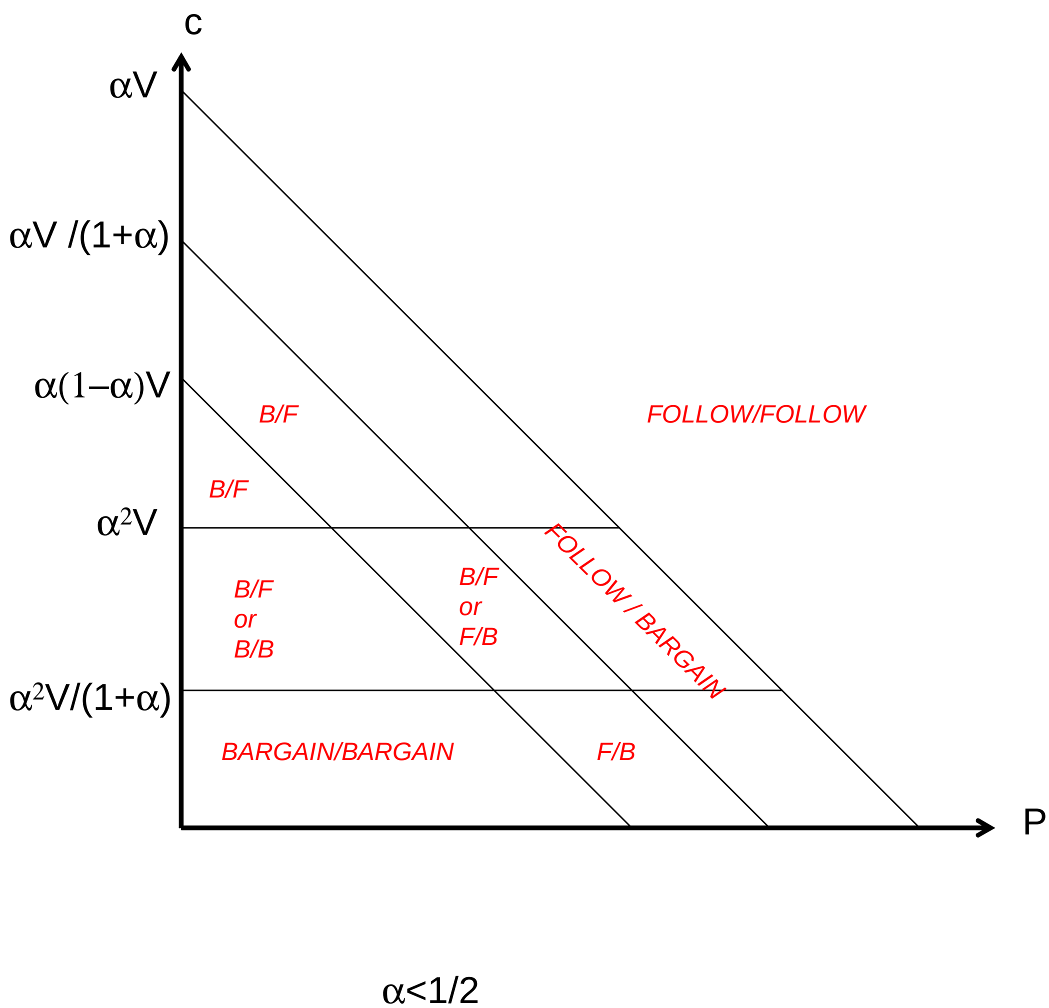
Finally, if

$$P_2 < \alpha(1-\alpha)V - c,$$

we once again get multiple equilibria. However, the second last to settle always bargains, while the second may or may not. Depending on expectations, the second last to settle may negotiate a bigger or smaller payment, which makes the expectations self enforcing.

The set of equilibria as a function of c, α and P is displayed in the following figure, which divides the parameter space for the case that $\alpha < 1/2$. A notation of B/F means that the first to settle bargains while the second to settle follows (or accepts the same bargain).

As shown, multiple equilibria only arise for intermediate cost levels.



What are the incentives for the country to make an initial offer P? Obviously, increasing P gives away surplus but, to the extent that it encourages creditors to settle, it means less delay and less negotiating effort, both of which are wasteful. Which incentive dominates? In the limit as costs get large, the country can make a small offer in the knowledge that it will be accepted.

To examine whether a debtor country might choose to make an offer knowing that some creditors would want to bargain, we examine the case in which costs are small in the sense that

$$c < \frac{\alpha^2}{1+\alpha}V.$$

Neglecting discounting for the moment (that is, computing payoffs conditional on the second last creditor settling) we have

$$V_2(P) = \begin{cases} (1-\alpha)^2 V & P < \alpha(1-\alpha)V - c \\ (1-\alpha)V - P & \alpha(1-\alpha)V - c \leq P < \alpha V - c \\ V - 2P & \alpha V - c \leq P \end{cases}$$

Note that

$$V_2(\alpha(1-\alpha)V - c) = (1-\alpha)^2 V + c > V_2(\alpha V - c) = (1-2\alpha)V + 2c.$$

Incorporating discounting we get a value function for the debtor of

$$\begin{aligned} EV_2(\alpha(1-\alpha)V - c) &= \beta_b\left[(1-\alpha)^2 V + c\right] = \frac{\left[(1-\alpha)^2 V + c\right]\left[2\alpha(1-\alpha)V - 2c\right]}{V(2-\alpha) - 2c} \\ EV_2(\alpha V - c) &= [(1-2\alpha)V + 2c] \end{aligned}$$

To find the maximum, we only need worry about choices of P_2 that correspond to the local peaks of this function. To see what may result, suppose we set $\alpha = 1/2$. Then

$$\begin{aligned} EV_2(\alpha(1-\alpha)V - c) &= \frac{[V/4 + c][V/2 - 2c]}{3V/2 - 2c} \\ EV_2(\alpha V - c) &= 2c \end{aligned}$$

Suppose we lower c keeping V constant. The first term stays positive, but the second approaches zero. Therefore, there must exist c small such that the function EV_2 reaches a maximum at $\alpha(1-\alpha)V - c$. That is, the country will choose an initial offer in the knowledge that the last creditor will bargain.

C. An Algorithm For Solving the N Player Game

Equilibria to the game with many players N can be computed using the following algorithm. At stage two, there may be multiple fixed points corresponding to different expectations about whether or not future creditors will bargain. The selection at this stage can have quite substantial effects on the resulting equilibrium. Note that existence of a solution is guaranteed by the fact that the sequence of value functions V_n are all continuous but for upward jumps.

The algorithm works backwards as follows:

1. Begin with $V_0(P) = V$.
2. For any value function capturing the surplus to the debtor from future play with n creditors, $V_n(P)$, compute the set of outcomes that would result were the $n+1$ creditor to bargain, P_{n+1}, as the set of values such that

$$P_{n+1} = \alpha V_n(P_{n+1}).$$

   When there are multiple fixed points, choose largest (or any other rule).
3. Compute the value to the creditor at the time the $n+1$ creditor bargains, $\hat{V}_{n+1}(P)$, as:

$$\hat{V}_{n+1}(P) = \begin{cases} V_n(P_{n+1}) - P_{n+1} & P_{n+1} > P + c \\ V_n(P) - P & P_{n+1} \leq P + c \end{cases},$$

   and record the outcome of negotiations

$$\hat{P}_{n+1}(P) = \begin{cases} P_{n+1} & P_{n+1} > P + c \\ P & P_{n+1} \leq P + c \end{cases}$$

   and the payoffs to the $n+1$ creditor who settles as of this point in time

$$\hat{U}_{n+1}(P) = \begin{cases} P_{n+1} - c & P_{n+1} > P + c \\ P & P_{n+1} \leq P + c \end{cases}$$

4. Incorporate discounting to find the cost of delay in determining the identity of the $n+1$ creditor as

$$\beta_{n+1}(P) = \frac{(n+1)\hat{U}_{n+1}(P)}{\hat{U}_{n+1}(P) + n\hat{U}_n\left(\hat{P}_{n+1}(P)\right)},$$

and the surplus to the debtor at the beginning of the $n+1$ subgame as

$$V_{n+1}(P) = \beta_{n+1}(P)\,\hat{V}_{n+1}(P).$$

5. Iterate on steps 2 through 5 until $n = N-1$.
6. Choose P_0 to maximize $V_N(P)$.

Given the solution to this algorithm, the sequence of settlement payments $\{P_n\}_{n=1}^{N}$ can be obtained by iterating from P_0 with the sequence of functions $\left\{\hat{P}_n\right\}_{n=1}^{N}$, while the total cost of delay from negotiations can be computed by multiplying the costs of delay at each stage. Expected payoffs to the creditors are given as the payoff to the first creditor to settle, as delay serves to erode any surplus gained by waiting.

D. Calibration

To examine the quantitative implications of our bargaining model, it is necessary that we take a stand on three main parameters: the bargaining power of the creditors α, the cost of bargaining c and the number of creditors N. We will attempt to measure the bargaining cost parameterand bargaining power directly and will then experiment with a number of different values for N to examine the implications of the model for the distribution of default durations.

We begin with the bargaining cost. Inspection of the annual reports of the CFB indicates that the CFB typically charged bondholders a fee of one-half of one percent of the face value of any new securities issued in exchange for the old defaulted bonds. However, this figure probably understates the size of the costs incurred by the CFB as the main office holders of the Corporation were unremunerated while the CFB also made use of the consular and diplomatic services of the UK government. Finally, for many years the expenses of the CFB were directly subsidized by the Bank of England and, under some coercion, by groups of private banks. Based on these figures, we calibrate an individuals bargaining costs to be one and one half per-cent of the total value of the settlement, but also experiment with costs of bargaining as low as one per cent and a large as two per-cent of the value of the settlement.

We calibrate our estimates of bargaining power to the differences in settlements received by holdouts as opposed to those received by creditors who accepted the exchange offer. Singh (2003) studies sovereign restructuring negotiations in the 1990s and finds that, when attention is restricted to debts that were quite liquid and were traded on secondary markets, holdouts averaged returns one and one-half times as large as creditors who accepted an exchange offer. This is also the figure estimated by Sturzenegger and Zettelmeyer (2005) in their study of sovereign debt negotiations, and is the figure most commonly attributed to the excess return earned by holdouts in US corporate restructurings. However, Singh also finds that relative returns on illiquid debts ranged as high as four times larger than the values obtained by creditors who accepted the creditors offer. Consequently, we aim to set α to match a figure of 1.5, but experiment with some larger values.

The final parameter to be calibrated is the number of creditors. This is by far and away the hardest parameter to calibrate because what is relevant for the model is not the number of creditors per se, but the effective number in terms of negotiations. The two can be quite different particularly when bondholdings are quite unequal amongst creditors. There is also a great deal of dispersion in bondholding levels across recently restructured bonds. During the 1980's, bank action committees ranged from having roughly 20 members all the way up to committees with membership of close to one hundred banks and financial institutions. During the 1990s, some bond restructurings have been conducted with a small number of institutional investors, while others have involved hundreds of thousands of small retail investors (in some cases, such as Ukraine, different bonds in the restructuring were held very differently).

To get around this problem, we choose N to approximate as closely as possible the mean length of delay observed in the data and then examine higher moments of the data on delay to assess the predictions of the model. Due to the fact that N must be an integer, we are not always able to hit the target for N exactly. In some cases, we are also not able to hit our targets for α exactly. In these cases, we choose values for α and N to minimize the sum of squared differences from these targets.

Finally, it is important to remember that our model makes no direct predictions for delay. It only makes predictions for the cost of delay, so that we have a free parameter – the opportunity cost of funds – that allows us to match delay. In what follows, we assume an instantaneous interest rate of 4.5% and bear in mind the fact that a higher or lower choice of this interest rate would produce lower or higher delay.

	Data	Modern Data	c=0.015 α to 1.5	c=0.01 α to 1.5	c=0.015 α to 2	c=0.015 α to 4	c=0.02 α to 4	c=0
Mean	8.1	6.5	5.5	4.1	7.6	7.3	7.7	16.5
Std Dev	9.1	6.3	5.5	3.0	6.1	4.9	7.6	8.0
Skew.	1.9	2.1	2.0	1.5	1.8	1.5	1.8	1.1
alpha			0.08	0.17	0.20	0.08	2.0	0.08
N			14	5	5	18	13	14

Results are presented in Table 2, which compares the implications of the model for several sets of parameter values with those from the data. For our benchmark parameter ($c = 0.015$ and $c = 0.01$) a group of creditors constituting almost 75 per-cent of creditors immediately accepts the initial debtors offer, after which there is a delay of roughly five and one-half years as creditors wait to free ride on the negotiation effort of increasing the offer which is eventually accepted by a further 25 per-cent of creditors. The fact that there is only one group of holdouts means that delay is characterized precisely by an exponential distribution: the mean level of delay equals the standard deviation and the measure of skewness is two.

A lower level of bargaining costs requires a higher bargaining power parameter to match the data on holdout returns and implies less delay in equilibrium. Increasing the return to holding out increases delay to over seven and one half years, although at the cost of moving away from the exponential distribution. Further increases in returns to holding out have only small effects on overall delay although, when accompanied by increases in bargaining costs also lead to a distribution of delay quite close to the exponential. Zeroing out bargaining costs (the last column) produces more delay and,. as each creditor negotiates on their own, produces a distribution along way form the exponential.

From the above we conclude that the model has the potential to produce delays in restructuring close to those observed in the data for reasonable parameter values. The bargaining cost is important in ensuring that not too many creditors bargain on their own, which would push the observed distribution too far away from the exponential. Focusing on our benchmark case of $c = 0.015$ and α to match a holdout payoff 1.5 times higher than that earned by accepting the exchange offer, we can see that holdout is responsible for more than eighty per-cent of the observed delay. Below we consider the effect of introducing a collective action clause to reduce holdout, and find that it produces smaller declines in delay as a result of an intensification of the free rider problem.

E. Intuition for the Results

The results for the first two sets of parameter values, which correspond to our preferred specifications, are broadly in line with the distribution of delay observed in the data. In this subsection, we use a simplified version of the timing game to provide intuition for the observed amount of delay.

There are two main forces governing delay: an incentive to free ride on the negotiation costs incurred by others; and, an incentive to hold out in the hope of using later veto power to extract a higher settlement. To understand the quantitative effects of free riding, suppose that there are N creditors and that the first to settle receives the settlement payment P but must incur costs c while all other creditors receive the payment P alone. In that case, the equilibrium of the timing game with symmetric mixed strategies must imply enough delay so as to make creditors indifferent between following this strategy or settling immediately. That is, the cost of delay β must satisfy

$$U - c = \beta \frac{U - c + (N-1)\,U}{N},$$

which can be rearranged to get

$$\beta = \frac{N\,(U - c)}{U - c + (N-1)\,U}.$$

If we set $c = \tilde{c}NU$ and rearrange we get

$$\beta = \frac{1 - \tilde{c}N}{1 - \tilde{c}}.$$

For our benchmark parameter $\tilde{c} = 0.01$, with twenty creditors, this implies a level for β of about 0.8 which in turn, for standard interest rates, is consistent with a delay of about four and one-half years.

To understand the effects of holdout on delay, suppose that the first player to settle receives P while the second group receive P'. In this case, the cost of delay from hold out must satisfy

$$\beta = \frac{MP}{P + (M-1)\, P'} = \frac{M}{1 + (M-1)\, P'/P}.$$

If we set $P'/P = 1.5$, consistent with out findings on the returns to hold out discussed above, and set $M = 2$ (so that only one player, or about 3 per-cent of creditors, are holdouts) the implied delay is also on the order of about four and one half years.

Added together, these simple calculations suggest that the forces emphasized above are capable of producing delays of similar magnitude to those observed in the data. The content of the bargaining model above is that it determines which of these forces are operative, and how many creditors are affected.

F. Policy Options To Reduce Delay

Much of the recent debate in policy circles has centered on the proposal to introduce collective action clauses into sovereign bond contracts. This debate appears to have successfully influenced the practice of sovereign lending beginning with Mexico's 2003 issue of sovereign bonds which were amongst the first to be issued under New York Law with collective action clauses. Over time as the stock of debt is increasingly dominated by debt containing these clauses, policy makers hope that the length of sovereign bond restructuring negotiations will decrease. We defer a discussion of the welfare effects of this change until the next section, when we can consider the effect of these changes on ex ante borrowing. For now we ask: Will this delay? And if so, by how much will delay fall?

In this section we report on the effect of introducing a collective action clause into the above model, as well as on some other potential policy options. The idea of a collective action clause is that if a suitably defined majority of creditors agrees to a restructuring, all other creditors can be bound to accept the same terms. Intuitively, this should reduce delay through two effects. First, any incentive to holdout for a higher future settlement should be removed. Second, because future creditors must follow any agreement made today, if early creditors were to bargain they would be able to negotiate a larger settlement, which in turn reduces the importance of the costs of negotiating in inducing free riding.

The key issues are: how large the required majority is set to be, and whether it refers to a majority of bonds outstanding at the time the settlement is negotiated, or to a majority of all bonds including those already redeemed. For example, in all of the above computed examples, the group of creditor who accepted the debtors' initial offer was less than a majority of bondholders, while in some cases the second group constituted more than two thirds of the remaining bonds (that is, after those who accepted the initial offer are removed).

When a simple majority action clause of all bonds is added to the above model, in the first two cases the debtor responds by making a slightly better initial offer which is enough to ensure that all creditors immediately accept. Thus a simple majority action clause eliminates delay entirely.

However, if the clause is designed as a supermajority action clause of remaining bondholders (which appears to be the criterion envisaged by the drafters of new bonds), the effect is only to eliminate the second stage of holdout in the first example. In this case, delay is decreased by around half, despite the fact that holdout accounted for substantially more than half of the delay in this case. The reason is that, with the collective action clause, the creditors who renegotiate a settlement do better leading to more holdout at the earlier stage.

These results are obviously very preliminary. However, they suggest that for the most commonly used specifications, collective action clauses may serve to reduce delay by as much as half. In some cases, delay may be eliminated, despite the fact that CACs have no direct effect on the incentive to free ride. This results from the indirect effect of encouraging the debtor to make a more attractive initial offer.

Alternative policy options are available. One option that received a lot of attention during Argentina's recent restructuring are the so called "most favored creditor clauses". In principle, these clauses entitle creditors who have settled at an earlier stage to receive any more favorable payment that is negotiated at a later stage. In the case of Argentina, the language of the clause appeared to explicitly exclude settlement offers of this sort. However, there appears to be no reason in principle why clauses could have been written to include settlements. In this case, the details of the majority and how it is determined are irrelevant. Delay may not be eliminated, however, if the debtors initial offer is not high enough to deter all renegotiation.

Finally, one can imagine schemes in which the costs of negotiations are shared amongst all creditors thus removing the incentive to free ride. One such scheme would be the reintroduction of bondholder representative groups such as the CFB. If CFB agreements were considered to be binding on all creditors, holdout would also be eliminated, and hence all delay could be avoided. Whether or not this would be a desirable outcome depends upon the effects of eliminating or reducing the default penalty on the ability of the debtor country to borrow in normal times. To address this question directly, we turn to a model of borrowing in the next section.

4. Borrowing Environment

In this section, we outline the main aspects of our economic environment. A sovereign country borrows from competitive international financial intermediaries to finance a periodically recurring investment project. The sovereign cannot commit to repay these borrowings and may default on what is otherwise a state non-contingent debt contract. The consequences of default are a period of lost access to international financial markets, and a financial settlement. In this section, we treat both the period of lost access and the size of the financial settlement as parameters. In the next section, we go on to endogenize these variables as the result of the explicit bargaining game studied above.

A. The Basic Model

Time evolves continuously and last forever. However, investment projects take discrete amounts of time which give the model the flavor of a discrete time model. At any point in time t in which a sovereign country is not engaged in an investment project, the sovereign country has access to a production opportunity that requires foreign capital. We assume that the project requires capital from abroad. Both the sovereign country, and all international creditors are risk neutral, and both discounts the future at the world interest rate r^W. Note that the only motive for borrowing is to finance the investment opportunity; both the creditors and the sovereign borrower are risk neutral and discount the future identically[6]. It will be convenient to denote by δ the discount factor that applies to points in time one unit apart

$$\delta = \frac{1}{R^W} = e^{-r^w t} dt.$$

After capital has been borrowed, a discrete unit of time passes, which we normalize to one unit, before the sovereign debtor observes the productivity level of the project that period θ. This is the only source of uncertainty in the model. At this point, the sovereign debtor may decide whether or not to default. If the debtor does not default, the capital is committed to the project and the country receives any output plus undepreciated capital of $\theta f(k) + (1-d)k$ net of any interest payments contracted on the debt Rk, where $f(k)$ is a standard neoclassical production function and $R > R^W$ is the gross rate of interest on a state non-contingent sovereign bond which is determined endogenously as shown below. In addition, if the country repays its debts, it is free to borrow again next period.

Should the country decide to default, they are able to appropriate the undepreciated capital stock $(1-d)k$ and do not have to pay back any interest on the loan this period. Next period, however, they will have to enter renegotiations with creditors[7]. For the entirety of this section, we model the outcome of this renegotiation process in a reduced form fashion summarized by three parameters β, P and λ that serve to capture any delay in negotiations, as well as the size of any settlement payment made by the debtor at the time of the settlement, and any resources used up in negotiations. More explicitly, the parameter β serves to capture the expected cost of delay resulting form the renegotiation process that defers the point at which the country is able to re-access capital markets. Similarly, the parameter P captures

[6] The assumption that the country is risk neutral reduces the benefits of default by eliminating any sense in which default provides insurance against consumpiton fluctuations. Default *does* provide insurance against low realizations of the productivity shock in production.

[7] We use the term "enter negotiations" to signify that the debtor moves into the renegotiation game. Of course, one possible outcome of this game is that the debtor and creditors do not begin negotiations immediately.

the expected level of the settlement payment made by the debtor at this future date, while λP is the amount received by the creditor. We assume that the discounted value of a settlement is less than what would have been earned has the capital been invested in the risk free security

$$\beta\lambda P < R^W k.$$

If we let V' denote the value to the country from re-accessing capital markets in the future, then it is easy to see that the country will default whenever

$$\theta f(k) + (1 - d - R)k + \delta V' < (1 - d)k + \delta\beta V' - \beta P.$$

This can be rearranged to show that a country will default whenever the productivity shock is sufficiently low, or

$$\theta < \frac{Rk - (1 - \beta)\delta V' + \beta P}{f(k)} \equiv \theta^*(k).$$

That is, the productivity shock must drop lower than the interest rate on sovereign loans by an amount at least as large as the discounted future costs of default. This has two components: a pure cost of delay which reduces the value of future credit market access by a factor of $(1 - \beta)$; and, any future settlement payments that occur at a later date. We let the probability of default be denoted by

$$\pi(k) = \Pr\{\theta < \theta^*(k)\}.$$

International creditors are risk neutral and competitive expecting to earn zero profits in equilibrium. This requires that the weighted average of returns with and without a default be equal to the world interest rate, or

$$\left(1 + r^W\right)k = (1 - \pi)Rk + \pi\beta\lambda P,$$

which can be rearranged to give an expression for the interest rate on sovereign bonds of

$$R = \frac{1 + r^W - \pi\beta\lambda P/k}{1 - \pi}.$$

As creditors make zero profits, world welfare in this economy is given purely by the welfare of the country, which in expected value terms is given by

$$\begin{aligned} V &= (1-\pi)\left[E\left[\theta|\theta \geq \theta^*(k)\right] f(k) + (1-d)k - Rk + \delta V'\right] + \pi\left[(1-d)k + \beta\left(\delta V' - P\right)\right] \\ &= (1-\pi) E\left[\theta|\theta \geq \theta^*(k)\right] f(k) + (1-d)k - R^W k + \left[1 - \pi(1-\beta)\right]\delta V' - \pi\beta(1-\lambda)P. \end{aligned}$$

This can be contrasted with a world in which sovereign debtors could commit to honoring contracts (but are constrained to have the same future value of access to capital markets).

$$V^C = \left(E[\theta] f(k^c) + (1-d)k^c - R^W\right)k + \delta V',$$

where we have used k^c to denote the fact that the level of capital chosen in this full commitment environment will typically differ from that chosen when a country can default. Note that

$$\begin{aligned} V - V^C &= \left[(1-\pi) E\left[\theta|\theta \geq \theta^*(k)\right] f(k) - E[\theta] f(k^c)\right] \\ &\quad + \left[1 - d - R^W\right](k - k^c) - \pi(1-\beta)\delta V' - \pi\beta(1-\lambda)P. \end{aligned}$$

Approximating $f(k^c)$ around k, we get

$$\begin{aligned} V - V^C &\simeq \left[(1-\pi) E\left[\theta|\theta \geq \theta^*(k)\right] - E[\theta]\right] f(k) \\ &\quad + \left[E[\theta] f'(k) - \left(d + r^W\right)\right](k - k^c) \\ &\quad - \pi\left[(1-\beta)\delta V' - \beta(1-\lambda)P\right]. \end{aligned}$$

The first term represents the loss of output that occurs when the country diverts capital. Note that this may be negative (and hence default has the potential to be welfare improving) if low enough realizations of the productivity shock are allowed; it is in this sense that allowing default completes markets and allows the world to minimize risk. A decrease in default penalties has the potential to either increase or decrease this term.

The second term captures the effect of changing default risk on the amount of capital borrowed. If under default risk, less capital is borrowed than with full commitment, the first part of this term is positive while the second is negative, reflecting the fact that the world loses when less than the optimal amount of capital is borrowed. Decreasing default penalties will make this term more negative.

The third term corresponds to the fact that default occurs in equilibrium and is costly in terms of delay and resource usage: with probability π, the country loses the fraction $(1-\beta)$ of future value $\delta V'$ through delay, and loses the $(1-\lambda)\,P$ of resources in the future. Decreasing these costs will raise world welfare as long as the probability of default does not rise too fast.

Note that the overall term is not obviously positive or negative: default may produce a benefit in terms of being able to truncate the distribution of shocks to production; however, this comes at the cost of placing positive probabilities on the occurrence of costly defaults which also implies a higher interest rate. Similarly, policy reforms that facilitate debt restructurings and lower delay (raise β) may either raise or lower welfare. Essentially, as β rises, delay falls. But this will lead to an increased default probability, and further truncation of the distribution of realized productivity shocks.

Obviously, if full commitment dominated default, this effect will be magnified through the value of future interactions in this environment. However, the resulting welfare comparison consists of the same components as the expression derived above, with some elements magnified because of the fact that they are incurred every period with positive probability.

B. Solution Algorithm

We solve the model numerically using recursive methods. One algorithm that works first reformulates the model in terms of the price of debt $q = 1/R$ and an amount of bonds b where qb is the total amount of funds borrowed and invested in capital. Under our assumptions, q is bounded below by zero, and above by $1/R^W$, unlike R which may be unbounded above; this is important for the convergence of the algorithm.

The algorithm proceeds by iterating on two operations or mappings. The first operation, takes as given the function q of b, say $q_n(b)$, and is used to compute the corresponding value to the country V_n as a fixed point. We denote this mapping by T_n^V where the n serves to denote that the mapping is defined for q_n as given

$$T_n^V(V) = \max_{b\in\{0,k/q_n\}} E\left\{\max\left\{\theta f\left(q_n(b)\,b\right) + (1-d)\,q_n(b)\,b - b + \delta V, (1-d)\,q_n(b)\,b + \beta(\delta V - P)\right\}\right\}.$$

It is straightforward to see that this is a contraction mapping on the real numbers. Let the fixed point of this mapping be denoted by V_n.

The second operation acts on the interest rate by first updating the probability of default given the fixed point of the first mapping

$$\pi_{n+1}(b) = \Pr\left\{\theta < \frac{b-(1-\beta)\,\delta V' + \beta P}{f\left(q_n(b)\,b\right)}\right\},$$

which leads then to a new bond price function

$$q_{n+1}(b) = \frac{1-\pi_{n+1}(b) + \pi_{n+1}(b)\,\beta\lambda P/b}{R^W}.$$

We let this mapping on the bond prices q be denoted by T^q. We can then show that this iteration of mappings produces a monotone sequence for the bond prices.

Proposition 1. *If $q' \leq q$ then $T^q(q') \leq T^q(q)$.*

Proof. Let $q' \leq q$. Then the fixed point of T^V for q' is weakly smaller than the one for q, or $V' \leq V$, because the period return function is smaller. But then

$$\begin{aligned}
\pi'(b) &= \Pr\left\{\theta < \frac{b-(1-\beta)\,\delta V' + \beta P}{f\left(q'(b)\,b\right)}\right\} \\
&\geq \Pr\left\{\theta < \frac{b-(1-\beta)\,\delta V + \beta P}{f\left(q'(b)\,b\right)}\right\} \\
&\geq \Pr\left\{\theta < \frac{b-(1-\beta)\,\delta V + \beta P}{f\left(q(b)\,b\right)}\right\} = \pi(b),
\end{aligned}$$

which implies that

$$T^q(q') \leq T^q(q),$$

under our assumption on the size of settlements $\beta\lambda P$. ∎

As q is bounded below, this implies that an equilibrium exists. We do not know that it is unique. Intuitively, a higher interest rate makes default more likely which can justify a higher interest rate in equilibrium, so that the possibility for multiple equilibria exist. We explore this possibility in related work.

C. Numerical Results

In this subsection, we explore the implications of introducing CACs to our benchmark bargaining model, and then introducing this change to our model of borrowing.

Most of the parameters for the model are set to standard values. The annual world interest rate is set to 5%, with depreciation at 8.5%. The production function is assumed to have an output elasticity of one third. One of the more important magnitudes involves the "shape" and "location" of the productivity shock distribution. We use data from Tomz and Wright (2007) covering 175 countries at annual frequencies for up to 180 years on the evolution of output in both default and non-default years to construct an empirical density for the level of productivity shocks. This gives us the shape of the distribution. The mean of the distribution, and a scale factor governing its standard deviation are then set to match two parameters: a default probability of 2% in the benchmark model, and a mean output cost of 2% as estimated by Chuhan and Sturzenegger (2005).

We begin with the benchmark model and examine the introduction of collective action clauses, which we saw above had the effect of reducing delay by about half from just under seven years to about 3.5 years. The model finds that this has the effect of increasing welfare by about six hundredths of one per-cent of GDP per year. This is a tiny amount.

To get a handle on why this is the estimated benefit, note that in the benchmark model a country defaults on average twice per century and when it does, it loses two per-cent of GDP per year for about 7 years. Roughly speaking, it loses about 0.28% of GDP of annual GDP. When CACs are introduced, a country now loses only 2% of GDP for about 3,5 years, but it now does so about 25% more often, defaulting on average 2.5 times per century. That is, it now loses about 0.2% of annual GDP from defaults. However, this gain is offset by the fact that the country now pays a higher interest rate in normal times, which leads it to borrow about 3% less on average. Given an output elasticity of 1/3, this implies 1% less output from foreign borrowing per year for about 90 years in every century. The result is a net increase in output of only 6 hundredths of one per-cent of GDP.

Obviously, these results depend on the estimated shape of the productivity distribution which determines the change in the probability of default. This is something about which we have only limited confidence. To put it another way, one can ask: how large would the increase in default probabilities have to be eliminate any welfare increase at all? One can reverse engineer the model to show that default probabilities would have to rise to a level implying 3.5 defaults every century. This seems like an implausibly large number, which leads us to be confidence in the direction of the change: the introduction of CACs should increase welfare.

What about the quantitative magnitudes? This result seems startlingly small relative to some of the proposed claims of benefits from reform of the SDRM. It is also, no doubt, sensitive to the exact specification of the borrowing model. Nonetheless, the basic logic would seem to be robust: since defaults are rare events, they will have only a small effect on welfare.

Obviously, our conclusions change if we condition upon being in a default, if we increase the estimate of the output cost of default (for example, Eichengreen 2002 examines estimates four to five times larger than the one we consider) or consider changes with transfer bargaining power to creditors thus increasing the incentives of countries to repay while also substantially reducing social waste. Preliminary estimates suggest that the benefit of introducing a veto option proposal as outlines above suggest a welfare gain of about one half of one percent of annual GDP. We intend to refine this estimate in future work.

5. Conclusion

This paper has presented a theory of the process by which sovereign countries in default restructure their debts with private creditors. We have found that the observed delay in restructuring negotiations can plausibly be explained by a combination of free riding on negotiation effort with an incentive to holdout to obtain better settlement terms. These findings imply that current options aimed at reducing delay, such as collective action clauses, have the potential to reduce but not eliminate the observed delays in debt restructuring.

This *positive* model of the bargaining process was then combined with a model of sovereign borrowing to examine the *normative* question of whether or not these reductions in delays are welfare improving. We find they are not, and further that the optimal level of delay would plausibly involve an increase over current levels. The logic seems robust to various changes in the modeling framework: essentially, defaults are sufficiently rare events that the benefits from reducing the costs of a default ex post are small relative to the gains associated with reducing borrowing costs, and thus increasing borrowing levels, in normal times.

The model and analysis of this paper could usefully be extended in a number of directions. Empirically, our examination of default duration has focused on the amount of time between the beginning of a default and its end defined as the time at which a majority of creditors agree to a settlement. In practice, as well as in the context of our model, a more appropriate definition would involve defining the end of the default as the first date at which a country is able to reaccess international capital markets. Work on this question for the modern period, relying on data on gross capital flows, has been conducted by Gelos, Sahay and Sandleris (2004), and using data on net capital flows by Miller, Tomz and Wright (2005) and Richmond (2007).

Theoretically, our model points to some subtle incentives facing countries and creditor with respect to the design of debt contracts. On the one hand, a country gains ex ante by designing contracts so that they are costly to restructure ex post. On the other, increasing the costs of bargaining directly can perversely lead to a reduction in the costs of restructuring debts, as higher costs bind future creditors to accept settlements negotiated by creditors that have settled earlier in the restructuring process, leading to shorter delays and higher returns to the country. Consequently, reducing the costs of bargaining by making debts easier to restructure, can somewhat surprisingly lead to more diversity amongst settlements and more delay as creditors sort themselves into different settlement groups.

Our model also emphasizes that the most efficient way to deter default is to increase the bargaining power of creditors in the event of a default restructuring. Such increases reduce the incentives of a country to default without wasting social surplus. Some modest changes to the debt restructuring process present themselves. One possibility is to design what we refer to as a veto option proposal in which the first creditor to negotiate offers the debtor an option to buy its outstanding debt (that creditors veto power) that only vests if all creditors simultaneously sell similar options. If this offer is rejected, negotiations would resume in the old debt restructuring regime. The costs of the first creditor to negotiate would be fully subsidized by the IMF. In such a world, there would be no delay and hence little social surplus wasted, while the country would continue to receive the same payoffs as in the old regime and hence facing the same incentives to repay. Indeed, and somewhat surprisingly, the outcome of this veto option proposal would be further strengthened if the old regime was modified to further *increase* delays and hence further lower debtor country payoffs.

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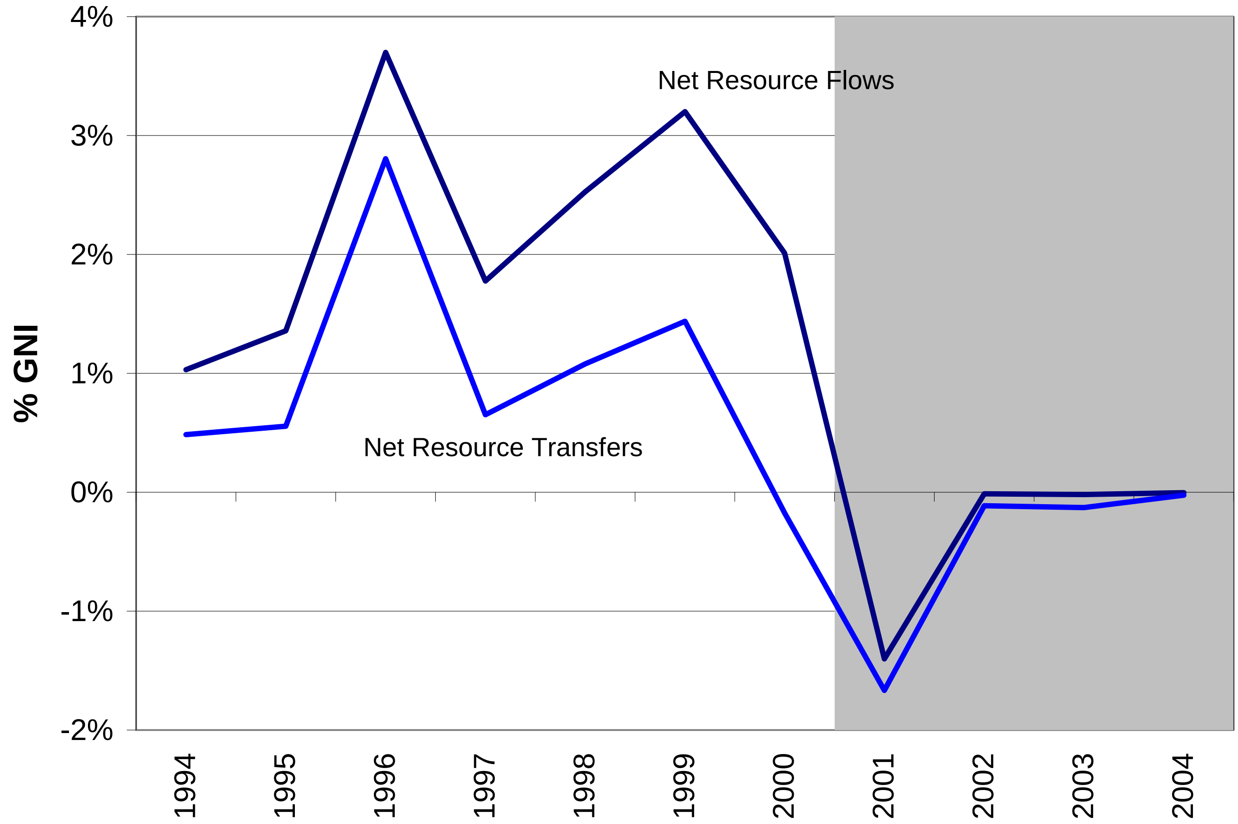
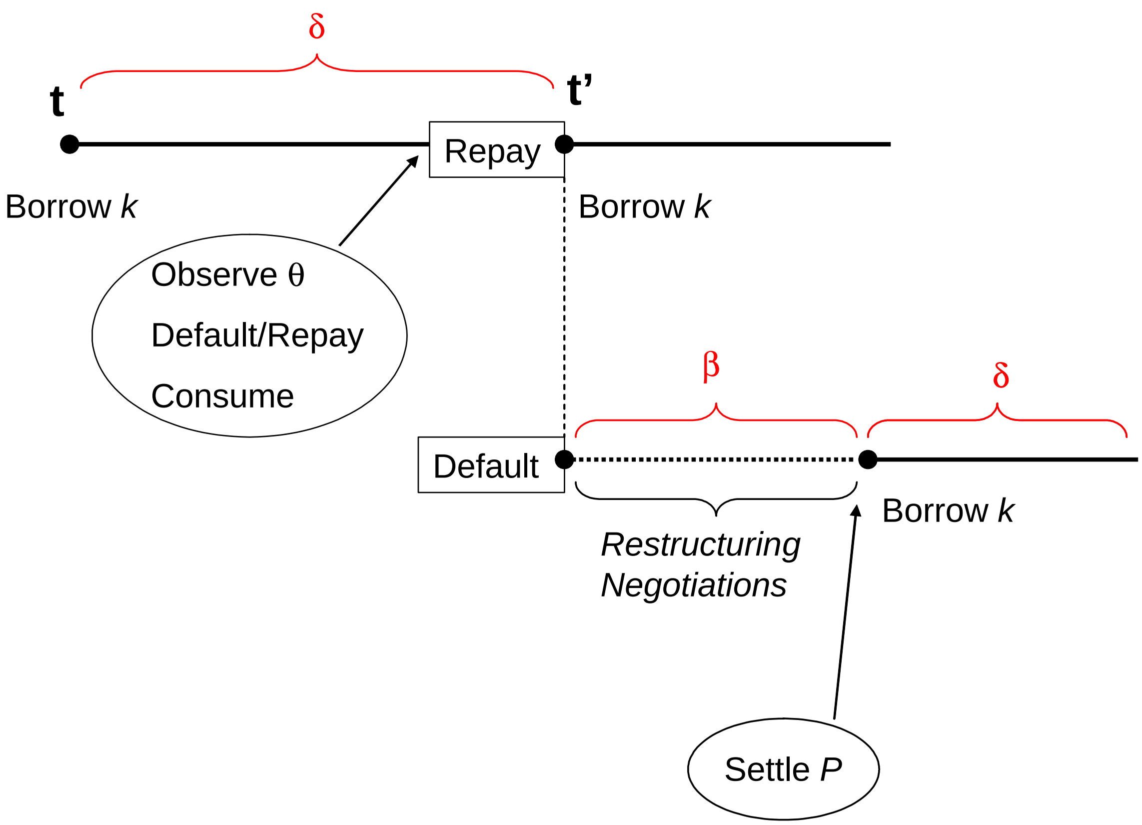


Argentine Sovereign Capital Flows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