Essays on Sovereign Debt Markets

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Chapter 1

Introduction

Sovereign debt crises have been part of the international financial landscape for a long time. Historians trace back the first sovereign defaults to the fourth century B.C. and in the last ten years we have witnessed eight major default episodes. The corresponding debt restructuring negotiations often turn out to be plagued with inefficiencies. Conceptually, the frequent incidence of sovereign default and the complexity of crisis resolution arise from the fact that there is no perfect enforcement mechanism in sovereign debt markets. Unlike the corporate world, the very concept of sovereignty poses a challenge to the existence of a court that would force the sovereign debtor to restructure its debt in a socially optimal way.

This thesis contains two essays addressing different dimensions of the sovereign risk problem. The first essay proposes a theoretical framework to evaluate the effects of two recent contractual innovations on the debt restructuring process. The second essay takes a close look at industrial performance around default times.

Chapter 2, titled "*The contractual approach to sovereign debt restructuring*", contributes to the debate on the optimal sovereign debt restructuring framework. Two initiatives are on the table: the so-called statutory and contractual approaches. The statutory approach calls for the creation of an international bankruptcy court akin to the institutions regulating domestic bankruptcy to address a number of inefficiencies in debt restructuring. Alternatively, the contractual approach proposes the introduction of new clauses in sovereign debt contracts. Two of its central innovations are Collective Action Clauses and Seniority Clauses.[1] The chapter analyzes these two clauses when: 1) repayment is endogenous and depends on creditor lobbying effort; 2) litigation for full repayment is purely redistributive. In this environment, there is a positive externality of effort that strongly interacts with asset distribution and contractual clauses. It follows from the model that individual litigation is not desirable from a social point of view since it weakens the incentives to exert effort. Collective Action Clauses have the ability to block litigation and maximize repayment. Regarding Seniority Clauses, the present framework shows that such clauses modify the incentives to exert effort and thus repayment. This effect can be positive or negative. In short, if creditors hold similar portfolios but the marginal loan being repaid is unevenly distributed among them, repayment falls. Finally, since effort decisions are influenced by asset distribution, the model also identifies and analyzes a novel role for secondary markets.

Chapter 3, titled "*The sectorial effects of sovereign default*" explores the linkage between sovereign debt crises and manufacturing industry growth. There is a sizeable literature discussing the association between sovereign defaults and aggregate output. In contrast, little is known about the behavior of sectorial output around default times. Using a difference-in-difference methodology, the chapter uncovers a

[1] A Collective Action Clause is a supermajority voting rule to change the payment terms of a contract. Seniority Clauses establish an absolute priority rule to repay debts in the event of default.

number of sectorial patterns. Industries facing tough import competition perform relatively better after a sovereign default. Export-oriented sectors grow more slowly around default times. These two facts are consistent with the theories stressing trade sanctions as the main cost of sovereign defaults. Industries characterized by high physical capital intensity and asset tangibility tend to suffer less from default episodes. One interpretation of these results is that private sector creditor-debtor relationships deteriorate after a sovereign default and, as a result, assets that are more easily appropriated by investors become essential to secure access to credit. Better access to credit boosts performance with respect to industries with fewer tangible assets. All these effects reach their maximum intensity two to four years after the default event.

Chapter 2

The contractual approach to sovereign debt restructuring

2.1 Introduction

Debt restructuring following default is a costly and complex process very often undermined by a host of inefficiencies in bargaining (see Rogoff and Zettelmeyer 2002). The recent Argentinian episode is a striking example: renegotiation involved a very diffuse base of creditors with a wide range of interests. The result was an expensive and slow restructuring process that went on for four years. As of today, approximately US$20 billion in bond capital remains in default.[1]

This evidence has led many to argue that there is a strong case for reforming the sovereign debt market. This desire for reform has yielded a proposal generically called the contractual approach which is the object of study of this chapter.[2] The contractual

[1] American Task Force Argentina, September 2007.

[2] The alternative is the so-called statutory approach that, in short, involves the creation of international laws and institutions akin to those regulating domestic bankruptcy (Hagan 2005, Krueger

approach addresses the inefficiencies by introducing new clauses in debt contracts. Two of its central innovations are Collective Action Clauses (henceforth CACs) and Seniority Clauses (henceforth SCs). In order to improve creditor coordination and avoid the holdout problem, CACs allow a contractually defined supermajority of creditors to impose decisions on a dissenting minority instead of waiting for unanimity. It is a choice of the debtor whether to include CACs in debt contracts. In recent years, almost every new issue featured CACs: 57% of outstanding sovereign debt includes CACs and in 2005, 95% of issues, in value, included CACs.[3] In order to prevent debt dilution,[4] SCs establish a schedule of repayment priorities in the event of default. In contrast with CACs, SCs have never been formally implemented in sovereign debt markets. Nevertheless, we do observe debtors granting *de facto* seniority to creditors such as the IMF.

The goal of this chapter is to provide an analytical debt renegotiation framework capable of evaluating the two proposals above and give guidelines on the shape of an optimal restructuring regime. This is not the first paper to address this question but the existing literature has researched the topic under the assumption that penalties are independent of creditor actions.[5] Instead, I propose a new theory of endogenous repayment in which incentives to increase penalties are shaped by asset distribution among creditors and contractual clauses. Penalties are the fruit of creditors' private lobbying and bargaining efforts but their provision carries a positive externality, which

2001). For a comprehensive discussion of both approaches see Roubini and Setser (2003), Bolton (2003), Taylor (2001), or Eichengreen (1999).

[3]Data as of January 23, 2006 from IMF Global Financial Stability Report (April 2006).

[4]Debt dilution occurs when new loans reduce the value of the outstanding stock of debt. The IMF World Economic Outlook, September 2003, reports evidence of such a failure in emerging economies. The use of principal reinstatement clauses, providing an automatic upward revision of principal in the event of default, reflects the concern about debt dilution.

[5]Papers such as Haldane et al. (2005a) and Eaton and Fernandez (1995) make penalties endogenous to the sovereign's fiscal effort but never to creditor actions.

parallels the well-known problem of public goods provision. Understanding how CACs and SCs affect this externality is important to assess their desirability in real world situations.

Consider first the use of CACs. The existing literature makes a case for CACs based on the need to force small creditors, who are not internalizing the effects of their actions on the debtor's incentives, to participate in debt forgiveness agreements.[6] Departing from this traditional view, I argue that CACs are also useful to address another type of free-rider behavior pursued by large agents which harms intra-creditor incentives. More precisely, I allow creditors to follow a holdout strategy by seeking full repayment through courts at the expense of a large fixed cost.[7] Litigation is modeled as a purely redistributive activity undesirable from a social point of view. In this setting, the redistribution of resources through litigation magnifies the externality of effort, undermines the incentives to lobby, and results in an endogenously low level of repayment. CACs are very powerful in this environment. Not only they are able to avoid the waste of legal costs, but they also ensure maximum repayment.

SCs have been typically studied under the implicit assumption that ex-post repayment is not sensitive to the shift from Pro-rata Clauses to SCs.[8] The literature supports the idea that SCs are unambiguously desirable since they are shown to prevent ex-ante overborrowing and assumed to be neutral ex-post. However, under endogenous repayment, this conclusion need not necessarily hold since pro-rata and SC contracts provide different incentives to exert lobbying effort. Following the adoption of SCs, ex-post repayment might fall under certain portfolio configurations. In

[6]Bolton and Jeanne (2005) and Weinschelbaum and Wynne (2005) are examples of papers modeling CACs as a device to achieve coordinated debt forgiveness.

[7]This strategy was relatively common in the recent case of Argentina: 140 lawsuits were filed against the sovereign.

[8]With Pro-rata Clauses, all loans have the same footing in the event of default.

turn, this would exacerbate the temptation to default thus making funds more expensive and borrowing constraints tighter. These two effects have a negative impact on welfare that could offset the gains derived from the prevention of overborrowing.

The introduction of secondary markets in this framework yields interesting results. Consistent with the empirical evidence, I find that, if CACs cannot be used to block legal actions, vulture funds engage in socially inefficient debt purchases and litigate for full repayment. However, if CACs are preventing such behavior, I uncover a new beneficial role of secondary markets. By trading debt, creditors can adjust the size of the effort externality so as to elicit full effort and maximize repayment both under pro-rata and SC contracts. Thus, secondary markets validate the simplifying assumption of no ex-post effects of SCs used in previous literature.

All the results in this paper rest on the assumption that penalties are endogenous to creditors' actions. It is therefore important to justify the plausibility of lobbying for higher repayment. Although it is difficult to provide hard evidence of such lobbying activities taking place, facts pointing to debt concentration devices and debt value increasing with creditor concentration lend support to the theory. First, Fernandez and Ozler (1999) and Ozler and Huizinga (1991) document that in the period 1986-1988, the secondary market value of developing country loans rose with the share of debt held by large international banks relative to small banks. This is consistent with the predictions of the model: large banks enjoy a large amount of lobbying power and, as their share in the debt issue increases, their incentive to exert lobbying effort strengthens. Since this increases the recovery rate in the event of default, the secondary market price of the loan will rise. Second, I would argue that organizations such as the Emerging Markets Creditors Association, the London

Club, or the historical Corporation of Foreign Bondholders[9] can be understood as lobbying devices to increase the leverage of creditors on a sovereign debtor. Also, a creditor committee can be interpreted as a device to share the lobbying costs among a number of creditors to make bargaining more affordable. For the pre-1914 period, Esteves (2007) finds that the presence of such bondholder committees is positively correlated with ex-post rates of return. This is consistent with the interpretation of creditor committees as lobbying devices.

The rest of the chapter is organized as follows. Section 2.2 lays out the basic setup. Section 2.3 considers the effects of CACs and SCs. The role of secondary markets is explored in section 2.4. At the end of each section I provide a summary of the results and relate them to the existing literature. Section 2.5 concludes. Appendix A contains extensions of the model and proofs.

2.2 A model of endogenous penalties

This section sets the core elements of the debt restructuring game. The sovereign has $J = 2$ outstanding loans of face values D_1 and D_2 held by I risk-neutral creditors.[10] Let $D \equiv D_1 + D_2$ denote the total outstanding debt. Without loss of generality, I normalize $D = 1$. α_i^j, $i \leq I$, $j \leq J$, denotes the share of loan j held by creditor i. $\alpha_i \equiv \frac{\alpha_i^1 D_1 + \alpha_i^2 D_2}{D}$ denotes the share of total face value held by creditor i. Every period the sovereign can default on its debt and trigger the sequence of events described in the model. I assume that inter-creditor equity is strictly respected and default must

[9] In the recent case of Argentina, several organizations of that sort arose (Task Force Argentina, Global Committee of Argentina Bondholders, and Argentine Bond Restructuring Agency to cite a few).

[10] All results generalize to $J > 2$ loans.

be on both loans.[11]

Following one of the main strands in the literature, I assume that there will be partial repayment P induced by the threat of suffering default penalties such as limited access to capital markets, trade sanctions or asset seizure. The debtor always repays exactly up to P and penalties are never actually imposed.[12]

The main novelty of the model is to make penalties endogenous to creditors. More specifically, all creditors simultaneously decide whether to exert a lobbying effort or not ($e_i = 0$ or $e_i = 1$). The individual cost of positive effort is $c > 0$. Contracts on effort cannot be written and enforced.[13] Contributions to penalties are aggregated according to the following function

$$P = \sum_{i=1}^{I} p_i e_i \tag{2.1}$$

where p_i is a non negative parameter that is meant to capture the fact that bargaining power might differ across creditors. The existing literature has implicitly set $c = 0$ by assuming that penalties are exogenous to creditors. However, this paper shows that this is not a neutral assumption. Let $\overline{P} \equiv \sum_{i=1}^{I} p_i$ denote the highest feasible penalties. I assume that full settlement is not possible, i.e., $\overline{P} < D$. Lobbying productivity and cost satisfy the following two properties.

Assumption 1. *Lobbying productivity and cost are such that $p_i > c$ for all $i \leq I$.*

Assumption 2. *Lobbying productivity and cost are such that there exist portfolios*

[11] Alternatively, the use of cross-default clauses by creditors also justifies the assumption.

[12] P can be thought of as an upfront cash payment or, more realistically, as a new bond with present value P.

[13] It is straightforward to show that if effort is contractible, repayment is invariant to any of the contracts considered in this paper.

$\{\alpha_i^1, \alpha_i^2\}_{i=1}^I$ *satisfying* $\alpha_i p_i \geq c$ *for all* $i \leq I$.

Assumption 1 assures that the net productivity of lobbying is positive and thus desirable from the creditors' standpoint. However, since effort is not contractible, assumption 1 is not enough to guarantee the feasibility of full effort. Note that lenders bear the full cost c but they might capture only a fraction of their contribution since P is shared according to contractual clauses and asset holdings. In other words, there is a positive externality of effort. Assumption 2 warrants that, for some portfolio configurations, all creditors will successfully internalize the effort externality and penalties will be maximized.

This model of endogenous penalties is the cornerstone of the paper and thus deserves some discussion. Traditionally, the sovereign debt literature has not put much emphasis on post-default events and exogenous penalties are the usual shortcut to summarize in a stylized way the bargaining process between the debtor, creditors, and international financial institutions leading to a certain level of partial repayment. Nevertheless, on-the-ground experience shows that sovereign debt restructuring is a complex and protracted process. Undoubtedly, an exogenous cost of default is an ill-suited modeling instrument to explore the consequences of imperfect ex-post bargaining. Effort in equation (2.1) should be interpreted in a broad sense. It can represent direct negotiations with the debtor but can also be interpreted as the cost of lobbying third parties such as governments, the IMF or banks providing trade credit to have them threaten the sovereign with further punishment if treatment to creditors is too harsh.

2.3 The contractual approach and creditor incentives

This section presents the main ideas of the paper by embedding the lobbying mechanism previously described into a game in which creditors can sue the sovereign for full repayment. Important interactions between litigation and the externality of effort arise and CACs are shown to play a central role in maximizing repayment. Moreover, the choice of pro-rata or SC contracts also interacts with the externality of effort. In short, two types of inefficiencies arise in this setting. First, even though the marginal productivity of effort p_i is larger than its marginal cost c, effort can be underprovided. Second, litigation costs are inefficiently spent on purely redistributive activities. To establish these results, let us first define every contractual clause and the timing of actions.

Debt contract

I shall consider two types of debt contracts specifying alternative rules to allocate repayment after default.

(i) *Pro-rata debt contracts*: both loans have the same priority in the event of default. Repayment is shared in proportion to the face value of loans. This means that loan D_1 recovers $\frac{D_1}{D}P$ and loan D_2 captures $\frac{D_2}{D}P$ where $D = D_1 + D_2$.

(ii) *Seniority Clauses*: debt contracts with SCs specify a repayment priority scheme in the event of default. Repayment is first allocated to the most senior loan and, once it has been fully serviced, the remaining resources (if any) accrue to the junior loan. In the model D_1 is the senior loan and D_2 the junior loan. Therefore, D_1 recoups $\min\{D_1, P\}$ and D_2 the remaining amount $\max\{0, P -$

$D_1\}$. Within a loan, payments are shared on a pro-rata basis.

For the time being, these contracts are not traded in the secondary market. In section 2.4 I relax this assumption.

Timing

The sequence of actions is the following.[14] At every stage all choices are made simultaneously.

1. *Lobbying stage*

Creditors decide whether to exert the lobbying effort already described in section 2.2 and P is determined. The game moves to the following stage.

2. *Restructuring stage*

Every creditor votes whether to change the payment terms of the debt contract or not. A favorable vote from creditor i is codified by $v_i = 1$ and a negative vote by $v_i = 0$. The result of the voting is summarized by the variable $V = \sum \alpha_i v_i$. If the contract is unchanged a creditor with share α_i is still entitled to recoup α_i. In the case of pro-rata contracts, restructuring involves setting a new face value of P so that repayment to creditor i is lowered from α_i to $\alpha_i P$. For SC contracts, restructuring translates into a binding agreement to distribute repayment according to contractual priorities. I allow for a voting rule of the type: the contract is rewritten if at least a fraction $\overline{v} \in (0, 1]$ of bondholders votes in favor. $\overline{v} = 1$ corresponds to the standard debt contract in which unanimity is needed. When CACs are in place a supermajority $\overline{v} < 1$ of voters can impose any decision on a dissenting minority.[15] If the contract

[14] Swapping stages one and two is qualitatively irrelevant since the key element of the model is the interaction between litigation and the externality of effort and not the specific timing.

[15] In real world cases, $\overline{v}$ is usually set in the range 0.75–0.85. See Haldane et al. (2005b) for a discussion on optimal thresholds.

is restructured, the game ends and P is distributed among creditors according to the original contractual clauses. Otherwise, the game moves to the next stage.

3. *Litigation stage*

At this point the original debt contract is still unaltered and every creditor has the right to enforce it by going to court. This action is represented by $l_i = 1$. The associated legal costs are $\phi > 0$. The contract explicitly specifies that repayment is $\alpha_i^j D_j$ and the court will recognize that. I assume that the resources available to the court are P, which means that the judicial system has no enforcement power on a sovereign. All that can be done by the judge is to redistribute the voluntary repayment P to litigators.[16] The setup is assuming that the sovereign does not hold assets in the court's jurisdiction that can be attached. Appendix A.3 relaxes the assumption of no attachable assets.[17] Creditors not litigating have lower priority and collect their corresponding part of the remaining resources after litigators are paid out and in some cases might receive nothing. To put it in different words, creditors can buy seniority at price ϕ.

Let $L^j \equiv D_j \sum_{i=1}^{I} \alpha_i^j l_i$, $j = 1, 2$, and $L \equiv L^1 + L^2$. Then, the payoff functions of player i with pro-rata contracts are

$$\pi_i(l_i = 0) = \begin{cases} \frac{\alpha_i}{1-L}(P - L) - ce_i & \text{if } P \geq L \\ -ce_i & \text{if } P < L \end{cases} \tag{2.2}$$

$$\pi_i(l_i = 1) = \begin{cases} \alpha_i - \phi - ce_i & \text{if } P \geq L \\ \frac{\alpha_i}{L}P - \phi - ce_i & \text{if } P < L \end{cases} \tag{2.3}$$

[16] Put differently, the judge only has access to the amount P once it enters the settlement system.

[17] For insightful discussions on sovereign debt litigation see chapter 3 in Sturzenegger and Zettelmeyer (2006) and Miller and Thomas (2007).

In the SCs case I assume that the judge enforces the original seniority structure within the class of litigators. Payoffs are

$$\pi_i(l_i = 0) = \begin{cases} \frac{\alpha_i^1}{1-L^1}\min\{D_1, P-L\}+ & \\ +\frac{\alpha_i^2}{1-L^2}\max\{0, P-D_1-L\} - ce_i & \text{if } P \geq L \\ -ce_i & \text{if } P < L \end{cases} \tag{2.4}$$

$$\pi_i(l_i = 1) = \begin{cases} \alpha_i - \phi - ce_i & \text{if } P \geq L \\ \alpha_i^1 D_1 + \frac{\alpha_i^2}{L^2}(P-L^1) - ce_i & \text{if } P \in (L^1, L) \\ \frac{\alpha_i^1}{L^1}P - ce_i & \text{if } P \leq L^1 \end{cases} \tag{2.5}$$

Note that litigation as described here is a redistributive activity not desirable from a social point of view since it carries a cost ϕ that is a pure loss. However, below I show that at the individual level it is sometimes optimal to seek full repayment through courts. The second stage of the game provides a coordination device that can get rid of the inefficiencies in the litigation stage.

I focus on subgame perfect equilibria. The formal definition of the equilibrium is

Definition 1. *A Subgame Perfect Equilibrium of the game is a set of strategies* $\{(e_i^*, v_i^*, l_i^*)\}_{i=1}^I$ *such that*

(i) If the litigation subgame is reached, no player wants to deviate from l_i^*

(ii) Given $\{l_i^*\}_{i=1}^I$*, no player wants to deviate from* v_i^*

(iii) Given $\{(l_i^*, v_i^*)\}_{i=1}^I$ *, no player wants to deviate from* e_i^* *in the lobbying game*

Having described all the elements in the model, I first study the interaction between CACs and litigation to then highlight the differences between pro-rata and SC contracts in terms of lobbying incentives.

Since pro-rata contracts are the norm in sovereign debt markets and CACs have been progressively introduced under this type of contract, I study in detail litigation and CACs in a pro-rata environment and relegate to appendix A.5 the analysis of litigation under SC contracts.

2.3.1 Collective Action Clauses

The mainstream argument to implement CACs in sovereign debt contracts is based on the observation that a small creditor does not voluntarily participate in an exchange offer since her individual debt forgiveness has a negligible impact on the debt overhang problem suffered by the sovereign. Put differently, debt forgiveness carries a positive externality that small creditors do not internalize. CACs are necessary to bind the mass of small creditors to agree to a haircut that optimally alleviates the debtor's repayment burden. The setup here presents a complementary mechanism relating CACs and creditor incentives. The analysis broadens the scope of CACs beyond debt overhang considerations: CACs also prevent negative externalities among creditors. The model shows that, in a framework with endogenous penalties, litigation is a harmful holdout opportunity pursued by large creditors that disrupts the incentives of small creditors to extract repayment. This is a new reason for large creditors to reject participation in exchange offers that CACs successfully prevent.

Turning to the model, let us first specify the main assumptions on creditors and debt issues. First, I assume that both loans have the same collective action threshold $\overline{v}$. Appendix A.1 discusses partial implementation of CACs. Then, the relative sizes of D_1 and D_2 are irrelevant since I focus on the pro-rata case and both contracts are identical. Second, to make the analysis tractable I deal with a specific but interesting portfolio configuration: the case of one large creditor and many small creditors.[18] This situation fits the actual pattern of bond issues held by a diffuse base of investors and a few vulture funds pursuing sophisticated legal strategies.[19] More specifically, let us assume that creditor one is large enough to litigate,[20]

$$\alpha_1(1-\alpha_1) > \phi \tag{2.6}$$

but the rest of creditors are small in the sense that they cannot afford the cost of seeking full repayment through court

$$\alpha_i < \phi \quad \text{for } i = 2, \ldots, I \tag{2.7}$$

Although this might seem a very arbitrary debt distribution, the main properties of the model also hold for more complicated configurations as long as there is an asymmetry in the opportunity of going to court. It is a robust result that litigators disincentivize effort by non-litigators.

I also place the following assumption on the lobbying abilities of creditors.

$$\alpha_i p_i \geq c \quad \forall i \tag{2.8}$$

In short, equations (2.6), (2.7), and (2.8) state that all creditors are relatively large with respect to the lobbying cost c, but that only creditor one is large with

[18] In appendix A.2 I also explore the symmetric creditors case in detail.

[19] Alternatively, the large player can be interpreted as a coalition of small creditors initiating a class action suit against the debtor.

[20] It follows from equations (2.2) and (2.3) that, for a given value of P, the large creditor only litigates if $P \in (P_1, P_2)$. In order to make litigation feasible we need $P_2 > P_1$ which holds if and only if (2.6) is satisfied.

respect to the legal cost ϕ. Relaxing assumption (2.8), i.e. allowing the lobbying cost to be relatively large, has important implications that I discuss below. With these three assumptions at hand, we obtain the following result.[21]

Result 1. *CACs with $\overline{v} < 1 - \alpha_1$ maximize repayment and minimize litigation costs. Contracts with $\overline{v} \geq 1 - \alpha_1$ are never restructured and there is litigation in equilibrium. The precise shape of the equilibrium is*

1. *If $\overline{v} < 1 - \alpha_1$, $P^* = \overline{P}$*
   If $\overline{v} \geq 1 - \alpha_1$, $P^* < \overline{P}$ is always an equilibrium

2. *$v_1^* = 0$; $v_i^* = 1$ for $i \geq 2$ so that $V^* = 1 - \alpha_1$*

3. *$l_1^* = 1$ if $P \in \left(\frac{\phi}{1-\alpha_1}, \frac{\alpha_1 - \phi}{\alpha_1} \right)$ and $l_1^* = 0$ otherwise. For $i \geq 2$, $l_i^* = 0 \quad \forall P$*

I next develop intuition of the equilibrium features. First of all, let us look at the incentives to sue the debtor if the contract has not been restructured. Small creditors cannot litigate since $\alpha_i < \phi$ for $i \geq 2$ but in contrast, creditor one is able to capture more resources than the rest of players by going to court. Only certain values of repayment make litigation attractive. Low levels of repayment relative to the cost ϕ render litigation unattractive and high values of P bring $\alpha_1 P$ close enough to face value α_1 to also disincentivize litigation. However, in the middle region litigation takes place and resources are transferred from the small players to the litigator. More formally, notice that the payoff described by equation (2.2), which always applies to the small players since they never litigate, is decreasing in L. The behavior of creditor one brings about the first inefficiency: ϕ is being spent on unproductive redistribution

[21] I also assume $\overline{P} \geq \frac{\phi}{1-\alpha_1}$. Otherwise, the game is uninteresting since penalties cannot reach the minimum level required to trigger litigation.

of repayment. Yet another inefficiency related to litigation will arise in the lobbying stage.

Figures 2.1 and 2.2 make clear that litigation has opposite effects on both types of creditors. The large player increases profits through courts at the expense of small creditors' repayment. As a result, at the time of voting the interests of the small and large creditor diverge. Creditor one benefits from litigation but small creditors are never interested in making it feasible. Therefore, $V^* = 1 - \alpha_1$ and CACs play a central role. If unanimity is required the contract is not restructured and ϕ is spent on legal costs. When CACs with threshold $\overline{v} < 1 - \alpha_1$ are written into the contract small creditors can impose their decision to the rogue creditor and block litigation.

So far, we have seen that in the absence of CACs resources are inefficiently allocated to redistributive litigation. I next show that if litigation is allowed, additional negative effects emerge in the lobbying stage.

If CACs can be used to restructure the contract, courts do not break the pro-rata clause and creditor i captures a fraction α_i of resources with certainty so that in the lobbying stage she just solves

$$\max_{e_i \in \{0,1\}} \quad \alpha_i \sum_{n=1}^{I} p_n e_n - c e_i \tag{2.9}$$

Optimal effort is

$$e_i^* = \begin{cases} 1 & \text{if } \alpha_i p_i \geq c \\ 0 & \text{if } \alpha_i p_i < c \end{cases} \tag{2.10}$$

which yields $e_i^* = 1$ for all creditors by the assumption in equation (2.8). Condition (2.10) states that a creditor contributes to penalties only if the combination of her power p_i and the share of repayment she captures is high enough relative to the cost

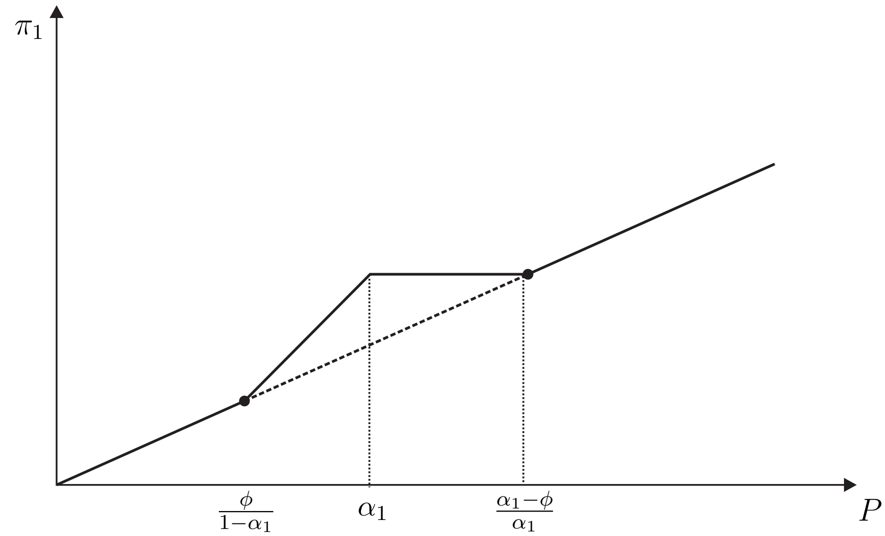

Figure 2.1: CACs, large creditor

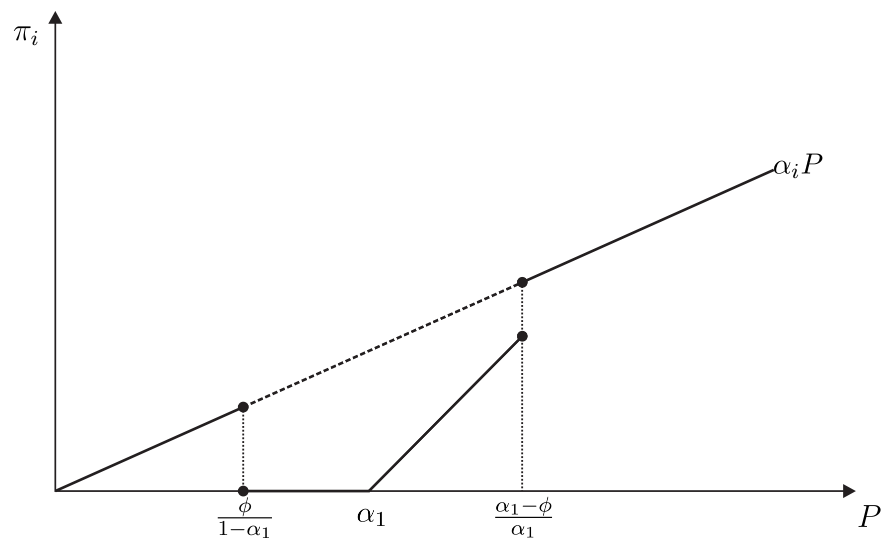

Figure 2.2: CACs, small creditor

of lobbying. Put differently, as the externality of effort grows, the incentive to bear the private cost of lobbying weakens. Note that litigation cannot cause any effort distortion since all creditors anticipate that the contract will be restructured in the voting stage. Thus, under CACs repayment is maximized.

In contrast, if CACs are absent, a new adverse effect of litigation stemming from the fact that courts exacerbate the externality of effort arises. $\alpha_i p_i \geq c$ is no longer a sufficient condition to maximize penalties. Equation (2.9) does not apply since the small creditor is not receiving a pro-rata share of repayment when creditor one is litigating. Since at $P = \frac{\phi}{1-\alpha_1}$ creditor one is exhausting resources through litigation, a marginal small creditor putting effort would face a zero marginal increase in her portfolio value but a positive marginal cost c (graphically, this corresponds to the flat region in figure 2.2). In other words, a hundred percent of the small creditor productivity would be an externality and, obviously, this rules out positive effort. Therefore, underprovision of effort is always an equilibrium outcome in the absence of CACs. I relegate to appendix A.7 the description of equilibrium penalty values since they depend intensively on parameter values but always satisfy the qualitative property $P^* < \overline{P}$. In short, litigation endogenously lowers penalties and CACs accomplish two goals: minimization of legal costs and maximization of repayment.

The relative values of the lobbying and legal cost play a central role in result 1. By assuming that all creditors are large relative to the lobbying cost c, we guarantee that penalties are maximized if CACs are ready to block litigation. By assuming that only one creditor is large enough to have access to courts, we magnify the externality of small creditors' effort so that being large with respect to the lobbying cost is no longer a sufficient condition to maximize penalties if CACs are absent. If we instead let the lobbying cost be large to the point that $\alpha_i p_i < c$ for all creditors but still assume $\alpha_1(1-\alpha_1) > \phi$ and $\alpha_i < \phi$ for $i \geq 2$, litigation cannot weaken the incentives to exert effort. In fact, the optimality of CACs can be reversed. If $p_1 \geq c + \phi$, litigation would allow the large creditor to fully internalize the benefit of her effort. However, if creditor one put effort under a CAC contract, small creditors would block litigation in the voting stage in order to capture their pro-rata share of p_1. Then, the large creditor would incur a net loss since $\alpha_1 p_1 < c$. Thus, $e_1 = 1$ is not a subgame perfect decision when $\overline{v} < 1 - \alpha_1$ and the equilibrium involves $P^* = 0$. Conversely, if $\overline{v} \geq 1 - \alpha_1$, the large creditor is free to litigate, successfully internalizes the effects of her effort, and $P^* = p_1$. In this particular setting, CACs do not maximize repayment and their ability to minimize legal costs is not desirable from an aggregate point of view.

Summarizing, litigation allows large creditors to appropriate a fraction of the resources generated by the rest of creditors. Then, legal strategies result not only in the waste of litigation costs but also in endogenously low repayment. CACs are able to prevent both effects. The next subsection assumes that CACs are always written into debt contracts to show that, despite the absence of litigation, the choice between pro-rata and SC contracts has effects on effort decisions too.

2.3.2 Seniority Clauses

As of today, pro-rata debt contracts are the standard in sovereign debt markets. However, contracts including SCs are a potential innovation in the sovereign debt arena that has recently attracted attention from both academic and policy circles.[22] Under

[22]SCs would implement *de jure* seniority. Appendix A.6 tailors the model to the case of *de facto* seniority in which the debtor treats a certain creditor (not loan) as implicitly senior.

the current regime, new loans impose a negative externality on existing creditors by shrinking the share of repayment that those creditors can claim in the event of default. Since the new lender does not suffer this loss, the externality is not priced into the new bond and overborrowing follows. The rationale to introduce an absolute priority rule is to subordinate the marginal lender in order to prevent a reduction in the value of the outstanding stock of debt. Missing in this argument is any potential ex-post effect of SCs. The present paper is silent on the ex-ante mechanisms just described to bring a number of ex-post considerations to the SCs debate. I uncover previously hidden consequences of the adoption of SCs that might make them undesirable under certain conditions.

Turning to the analytics of the model, I assume that CACs are effectively preventing litigation and focus on the lobbying incentives under both types of repayment rules.[23] To simplify the exposition, I assume that $I = 2$ creditors are the holders of the debt. Appendix A.4 shows that all results are robust to the general case with $I > 2$ creditors. Without loss of generality, I also assume that both creditors have the same lobbying abilities, i.e., $p_1 = p_2 = p$. No particular assumptions are placed on initial asset distributions or loan face values.

The goal of the section is to pin down the portfolios that maximize repayment for the cases of pro-rata and SC contracts and compare them. Let us first examine the case of pro-rata contracts. Since litigation is ruled out by CACs, creditor i solves

$$\max_{e_i \in \{0,1\}} \quad \pi_i = \alpha_i p(e_i + e_{-i}) - ce_i \tag{2.11}$$

[23]More precisely, the threshold $\overline{v}$ must satisfy $\overline{v} < 1 - \max\{\alpha_i : \alpha_i > \phi, i = 1, \ldots, I\}$ in order to successfully forestall litigation.

The equation governing effort is

$$e_i^* = 1 \text{ iff } \alpha_i \geq \frac{c}{p} \qquad i = 1, 2 \tag{2.12}$$

This condition is essentially identical to (2.10). A creditor only finds it profitable to exert effort if her stake in final repayment is high enough to cover the cost of lobbying. Put differently, if the lobbying externality $(1-\alpha_i)p$ is too large, the creditor fails to internalize the positive effect of individual effort and refuses to lobby. The following result summarizes the conditions leading to maximal penalties under pro-rata contracts.

Result 2. *With pro-rata debt contracts penalties are maximized ($P^* = 2p$) if portfolios satisfy*

$$\alpha_i \geq \frac{c}{p} \quad i = 1, 2 \tag{2.13}$$

Note that the weight of an individual loan in the portfolio is irrelevant since both loans have the same priority to recoup repayment; only total portfolio size conditions effort. This property breaks down under SCs with important implications on effort levels. I next show that this makes the choice of contractual clauses relevant to the level of repayment. With an absolute priority rule and no litigation the problem of creditor i is

$$\max_{e_i \in \{0,1\}} \quad \pi_i = \alpha_i^1 \min\{D_1, p(e_i + e_{-i})\} + \alpha_i^2 \max\{0, p(e_i + e_{-i}) - D_1\} - ce_i \tag{2.14}$$

Unlike the pro-rata case, effort choices exhibit interdependence and forces at work are better understood by summarizing the payoffs in the following table. The first line in every cell is the payoff to creditor one and the second is the payoff to creditor two.[24]

Table 2.1: Payoffs with SCs

	$e_2 = 0$	$e_2 = 1$
$e_1 = 0$	0 0	$\alpha_1^1 \min\{D_1, p\} + \alpha_1^2 \max\{0, p - D_1\}$ $\alpha_2^1 \min\{D_1, p\} + \alpha_2^2 \max\{0, p - D_1\} - c$
$e_1 = 1$	$\alpha_1^1 \min\{D_1, p\} + \alpha_1^2 \max\{0, p - D_1\} - c$ $\alpha_2^1 \min\{D_1, p\} + \alpha_2^2 \max\{0, p - D_1\}$	$\alpha_1^1 \min\{D_1, 2p\} + \alpha_1^2 \max\{0, 2p - D_1\} - c$ $\alpha_2^1 \min\{D_1, 2p\} + \alpha_2^2 \max\{0, 2p - D_1\} - c$

The description of the equilibria of the game for every possible parameter configuration is tedious but the properties of portfolios achieving maximal effort are intuitive. The next result characterizes such portfolios.

Result 3. *With SCs penalties are maximized ($P^* = 2p$) if portfolios satisfy the following conditions*

1. *In the case $D_1 < p$,*

$$\alpha_i^2 \geq \frac{c}{p} \quad i = 1, 2 \tag{2.15}$$

2. *In the case $D_1 \in [p, 2p]$,*

$$\alpha_i^1 (D_1 - p) + \alpha_i^2 (2p - D_1) \geq c \quad i = 1, 2 \tag{2.16}$$

3. *In the case $D_1 > 2p$,*

$$\alpha_i^1 \geq \frac{c}{p} \quad i = 1, 2 \tag{2.17}$$

[24] D_2 does not enter the payoff functions since I am assuming $2p < D_1 + D_2$.

The portfolios achieving maximal penalties differ from the pro-rata case and merit a detailed explanation. Intuitively, effort decisions are not based on total portfolio size but on the weight of the marginal loan being repaid when effort increases. Depending on the relative size of D_1 and p, individual effort deviations can affect only the market value of the junior loan, only the senior's value or both. Thus, we must distinguish three cases. When the senior loan is very small, $D_1 < p$, deviations from full effort cannot affect its market value since the effort of only one creditor already covers D_1 in full. Then, in a penalty maximizing equilibrium both creditors must hold a high enough share of the junior loan to prevent deviations. A parallel argument applies if $D_1 > 2p$. In this case ownership of the junior loan is irrelevant since it will never recoup any repayment and decisions boil down to an evaluation of the senior loan's weight in the portfolio. Finally, in the middle region $D_1 \in [p, 2p]$, both loans are affected by deviations from full effort. The deviation spares the creditor the lobbying cost c but yields a drop in her portfolio's value since the junior loan loses $(2p - D_1)$ and the senior loan loses $(D_1 - p)$. Ruling out the deviation requires the combined loss arising from both loans to be large enough compared to the lobbying cost.

An important policy question arises from the last two results. Since effort incentives vary with contractual clauses, would the introduction of SCs raise or lower repayment? No assertive answer can be given as I next show through simple examples.

Example 1. ***(SCs lower repayment)*** *Consider the following parameter values*

(i) Portfolios are $\alpha_1^1 = \alpha_2^2 = 1$ *and* $\alpha_1^2 = \alpha_2^1 = 0$

(ii) Loans satisfy $D_1 = D_2 < p$

In words, assumption (i) says that creditor one holds the whole debt issue D_1

and creditor two is the sole owner of loan D_2.[25] Therefore, it is clear that, under this debt distribution, the marginal loan being repaid with SCs is not present in one of the portfolios. As a result, repayment is not maximized under SCs (specifically, condition (2.15) fails to hold for creditor one). In contrast, if contracts are pro-rata, only total portfolio mass matters. Since both loans have the same face value it immediately follows that every creditor holds half of the total face value and condition (2.13) for penalty maximization under pro-rata contracts is satisfied.

Example 2. ***(SCs do not alter repayment)*** *Consider the following parameter values*

(i) Portfolios are $\alpha_i^j = \frac{1}{2}$ *for* $i = 1, 2,\ j = 1, 2$

(ii) Loans satisfy $D_1 = D_2$

In this particular example, substitution of assumption (i) into (2.11) and (2.14) proves that the payoffs are identical under both types of clauses and that only total portfolio mass affects effort even under SCs. Since every creditor holds half of the debt their stake in final repayment is high enough to support maximum effort both under pro-rata and SC contracts.

Example 3. ***(SCs raise repayment)*** *Consider the following parameter values*

(i) Initial portfolios are $\alpha_i^1 = \frac{1}{2}$ *for* $i = 1, 2$. $\alpha_1^2 = 0$ *and* $\alpha_2^2 = 1$

(ii) Loans satisfy $D_1 = 2p$ *and* $D_2 > \frac{p/2 - c}{c} D_1$

[25]This can be justified on the grounds that creditor two did not have income when loan D_1 was floated and that creditor one did not have wealth at the time D_2 was issued.

In this case, the marginal loan being repaid under SCs is D_1 and it turns out to be properly allocated to maximize repayment by assumption (i). However, D_2, which is entirely owned by creditor two, is large enough to yield a divergence in total portfolio sizes that results in suboptimal repayment in the case of pro-rata contracts (the stake of creditor one is too small for her to put effort).

In short, these examples warn that, under endogenous penalties, it is not granted that repayment stays constant after the adoption of SCs. However, the existing literature implicitly assumes an invariant repayment to derive the welfare implication of SCs. The next subsection further discusses the policy implications of this finding.

2.3.3 Summary and relation to the literature

This section has studied the interaction between the level of endogenous penalties and contractual innovations in sovereign debt contracts.

The option of seeking full repayment through courts disrupts penalties since large creditors are able to extract resources from the small creditors. When courts interfere the externality of effort becomes too large and small creditors stop contributing to penalties. In this setting CACs are more powerful than one could expect. Not only they save legal costs but also optimize the use of lobbying opportunities to extract repayment.

It is worth stressing that the results differ from the typical source of renegotiation conflicts: it is usually argued that large agents are able to internalize bargaining inefficiencies while small agents have the incentive to be opportunistic and hold out for full repayment. Absent any coordination device, the debt overhang problem is not corrected and the debtor's fiscal incentives are misaligned. Instead, I claim that filing suit against a sovereign is an expensive option that only creditors holding a significant share of a bond issue can afford and that such actions distort the incentives of other creditors. Regarding policy recommendations, this paper shows that CACs are not only a useful tool in debt forgiveness environments but also in litigation prone renegotiations.

The few papers pursuing an analytical approach to debt restructuring with CACs focus on debtor incentives in a debt overhang framework.[26] Weinschelbaum and Wynne (2005) analyze the interaction between CACs and government's fiscal incentives. They point to a trade-off between positive ex-post effects of debt reduction and negative ex-ante incentives to trigger a default that is cheaper when CACs allow ex-post forgiveness. Haldane et al. (2005a) is the closest paper to my work. They develop a model where litigation interferes with the debtor's incentives to generate repayment resources. CACs solve the inefficiencies by inducing the optimal debtor's effort and discouraging litigation. In the present framework a parallel mechanism is at work on the creditors' side: litigation distorts the incentives of creditors to extract repayment from the debtor but CACs are able to optimize creditors' effort. Finally, Kletzer (2004) addresses the collective action problem in a framework based on risk-sharing arguments. In his model CACs guarantee efficiency by ruling out war of attrition games.[27]

Regarding SCs, contributors to the ongoing debate such as Bolton and Jeanne (2005), Bolton and Skeel (2004), Borensztein et al. (2004) or Roubini and Setser

[26]See also Cohen and Portes (2004) that, despite not modeling an explicit voting rule, highlight the importance of CACs to prevent self-fulfilling crises. Yue (2005) and Ghosal and Miller (2003) also provide insightful discussions on debt restructuring.

[27]The environment in which the holdout problem was first identified is the market for corporate control. Grossman and Hart (1980) is the seminal contribution in this literature.

(2004), recommend the implementation of explicit seniority in sovereign debt contracts based on its desirable ex-ante effects. I show that SCs also have ex-post effects in a setting with endogenous penalties.[28] Taking into account ex-post considerations, the welfare effects of SCs are unclear. Preventing ex-ante debt dilution is clearly welfare improving. However, I show that ex-post repayment can either increase or decrease with the adoption of SCs. If repayment actually falls, there is also a negative welfare effect in the form of higher interest rates and tighter borrowing constraints.

2.4 The role of secondary markets

The previous section studied the contractual approach under the assumption of no secondary markets for sovereign debt. CACs were shown to maximize penalties and the introduction of SCs could have effects on repayment going in either direction. Importantly, these effects were shaped by the asset distribution among creditors. Then, it is natural to think that the possibility of trading claims in the secondary market has implications on the results presented so far. While the lack of explicitly modeled secondary markets is a common feature in the literature,[29] I next show that they play a meaningful role in a model of endogenous penalties.

Regarding the timing of secondary market transactions, I assume that in stage one creditors simultaneously trade in a frictionless secondary market and choose their lobbying effort. After that, the voting and litigation stage follow.

[28] The corporate finance literature has dealt with the parallel question of the interaction between seniority and monitoring incentives. See for instance Park (2000) and Rajan (1992). Also in the corporate context, Bris and Welch (2005) derive the optimal number of creditors with an endogenous recovery rate but do not tackle the issue of voting rules, SCs or secondary markets. Moreover, there are a number of interpretive between the case of firms and sovereigns.

[29] Broner et al. (2006) is the exception.

The first important result is that secondary markets can be used by vulture funds to achieve the critical mass necessary to litigate if CACs are not in place.[30] Since a full characterization of the litigation game with secondary markets is beyond the scope of this paper, I make the point clear through a simple example.

Example 4. ***(Secondary markets foster litigation without CACs)*** *Consider the case of pro-rata contracts with no CACs. I creditors hold the debt and lobbying power is such that $p_1 = p > 0$ and $p_i = 0$ for $i \geq 2$. The initial asset distribution satisfies*

(i) $\alpha_i < \phi \quad i = 1, \ldots, I$

(ii) $\alpha_1 = \frac{c}{p}$

Condition (i) assures that no litigation takes place in the absence of secondary markets since the portfolio's face value is lower than the legal cost of claiming it for all creditors. Condition (ii) guarantees that there is a creditor who exerts lobbying effort if courts do not interfere. Therefore, the equilibrium with no secondary markets is $P^* = p$, $L^* = 0$ with $\pi_1^* = c$ and $\pi_i^* = \alpha_i p$ for $i \geq 2$. Is this equilibrium always robust to opening a secondary market? in general, no. I next describe a deviation by purchasing claims in the secondary market to litigate which is profitable for a range of litigation costs. Variables with hats denote the deviation. Suppose that creditor one buys $\hat{\gamma}$ claims (face value) in the secondary market. Assuming that available

[30] A real world example of such behavior is the case of Elliot Associates v. Peru. In 1995, Elliot purchased US$20.7 million (face value) of Peruvian debt at a distressed price of US$11.4 million with the sole intention of litigating. The final judgment was favorable and Elliot recovered the sum of US$55.6 million.

resources are high enough to pay the holdout in full,[31] the deviation is profitable if

$$\hat{\pi}_1 = \alpha_1 + \hat{\gamma} - \phi - c - \hat{\gamma}p > \pi_1^* = c \tag{2.18}$$

The term $\hat{\gamma}p$ on the LHS is the price paid by creditor one in the secondary market (assuming that sellers break even). Given that the cost of litigation is fixed, creditor one maximizes her profit by purchasing a portfolio that results in her appropriating repayment in full through litigation. This is achieved by setting $\hat{\gamma} = p - \frac{c}{p}$. This profit maximizing strategy is feasible if legal costs are such that

$$\phi < p(1-p) \tag{2.19}$$

Then, in the range $\phi \in \left(\frac{c}{p}, p(1-p)\right)$ litigation is not feasible without secondary markets but becomes profitable if trading is allowed.

We have seen that the introduction of secondary markets in environments where litigation is allowed is bound to have negative effects since trading can be used to achieve the share of debt consistent with profitable litigation. An entirely different conclusion arises if contracts feature CACs to block litigation. In this case secondary markets play the unambiguously positive role of maximizing repayment. I next state the result formally and derive its policy implications. For the sake of simplicity, I present the case of $I = 2$ creditors. Appendix A.4 shows that the result also holds in the general case.

Result 4. *Under perfect secondary markets and CACs, repayment is always maximized ($P^* = 2p$) both under pro-rata and SC contracts. The equilibrium portfolios*

[31] This is the case if and only if $p \geq \frac{c}{p} + \hat{\gamma}$.

are those already described in results 2 and 3.[32]

Proof: see appendix A.8

Intuitively, starting from a situation in which portfolios do not induce full effort, trades that increase total repayment are always executed since such exchanges generate a positive net surplus in the form of higher penalties. Denoting by e_i^0 the effort levels before trading, the expression for this surplus is $(p - c)(2 - e_1^0 - e_1^0) > 0$. Then, there always exists a way of sharing these additional resources such that both creditors earn a strictly higher profit.

In terms of the externality, the power of secondary markets stems from the fact that the size of the externality becomes endogenous to creditors' trading decisions. Therefore, creditors choose to minimize the negative impact of the externality by choosing portfolios that successfully internalize the effects of effort.

To conclude, this section has shown that the combination of CACs with secondary markets is a very powerful policy measure. No litigation takes place, repayment is maximized, and the introduction of SCs is neutral.

2.4.1 Summary and relation to the literature

Secondary markets for sovereign debt play a significant role in a model of endogenous penalties since the asset distribution among creditors is a key determinant of effort and litigation decisions.

Without CACs, secondary markets are found to foster litigation and its associated negative effects. Opposite conclusions arise when secondary markets are combined with CACs. In this case, a novel reason for observing secondary market trading after

[32] I do not report equilibrium secondary market prices since the expressions are cumbersome and irrelevant to the central results regarding the level of default penalties.

default emerges: secondary markets are used to maximize penalties. Importantly, the level of repayment with secondary markets is the same both under pro-rata and SC contracts. The existing literature has established welfare implications of SCs assuming no haircut variation following their introduction. I claim that the assumption is still valid under endogenous repayment if debt is traded in frictionless secondary markets. In this particular case, SCs will prevent overborrowing with no ex-post impact.

The only paper linking secondary markets with debt enforcement is Broner et al. (2006) where it is shown that, even in the absence of penalties, secondary markets ensure enforcement by transferring claims to domestic agents to whom the debtor does not want to default on. Alternatively, in the endogenous penalties framework secondary markets transfer claims to the agents most able to sanction the debtor. It is worth emphasizing that this result only holds conditional on the presence of CACs. If holdouts are not deterred, secondary markets no longer play a positive role.

2.5 Conclusion

This paper evaluates the contractual approach to sovereign debt crisis resolution under the novel assumption of endogenous penalties as a function of creditor effort. There is a positive externality of effort that sharply reacts to changes in bond clauses and portfolio configuration. In the context of purely redistributive litigation, holdouts exacerbate the externality of effort yielding low endogenous repayment.

I find that CACs play a twofold role when blocking litigation: they prevent the waste of legal costs and assure that repayment is maximized. Once CACs are forestalling litigation, it is shown that pro-rata and SC contracts do not necessarily yield the same level of repayment. Depending on asset distribution, the adoption of SCs can depress or raise repayment. Secondary markets have an adverse effect in the absence of CACs since they promote holdout behavior. Conversely, if CACs are ready to deter litigation, secondary markets maximize repayment and render the introduction of SCs irrelevant to the incentives to exert effort.

The reader should bear in mind that the present analysis is entirely positive. A precise welfare assessment of the impact of CACs, SCs and secondary markets requires an examination of ex-ante events.[33] Cases can be made for and against high repayment. For instance, in a setup like Eaton and Fernandez (1995) where penalties are random and there is no other source of uncertainty, it is optimal to maximize repayment since then the contractual interest rate is lower and the debtor can raise more funds. In contrast, the opposite recommendation can arise from risk-sharing considerations since low output realizations call for low repayment in order to smooth consumption.

Of special interest is the trade-off between the ex-ante and ex-post effects of SCs when no secondary markets are available. On the one hand, SCs have the well-known property of preventing overborrowing ex-ante. But on the other hand, this paper warns that SCs might lower ex-post repayment which, in turn, would result in a tight ex-ante borrowing constraint. If this effect is strong enough, the sovereign would go into an underborrowing situation by introducing SCs. Whether the actual outcome will be underborrowing or full efficiency is unclear and promises to be a fruitful avenue of research.

[33] Pitchford and Wright (2007) jointly analyze the ex-ante and ex-post effects of sovereign debt restructuring mechanisms.

Chapter 3

The sectorial effects of sovereign default

3.1 Introduction

There is an ongoing debate on whether sovereign defaults are associated with output declines. Borensztein and Panizza (2006a) and Sturzenegger (2004) suggest that output falls by around 0.6 percentage points per year in the aftermath of a default. De Paoli and Hoggarth (2006) and Sturzenegger and Zettelmeyer (2006) among others also back the idea that sovereign defaults have a negative impact on domestic output. Nevertheless, in recent work Tomz and Wright (2007) challenge this conclusion by showing that the correlation between output and default over the last two centuries is negative but weak. These calculations are carried out using annual GDP data, thus making it impossible to assess whether some sectors suffer the effects of default more intensely than others. A notable exception is Borensztein and Panizza (2006b) who show that output growth in export-oriented industries is slower following a default.

The present paper seeks to fill the gap by analyzing the performance of different industrial sectors around default times. The econometric analysis points to a number of industry characteristics relevant at explaining sector-level growth after a sovereign debt crisis. Such an exercise is useful along two dimensions. First, evidence of heterogeneous industry performance could shed light on the specific form that the costs of default take. For instance, poor performance of an export industry would be consistent with the existence of trade sanctions as a default punishment. Second, a deeper understanding of what domestic constituencies are particularly affected by sovereign debt crises could help us draft guidelines for policymakers considering or implementing a default.

Methodologically, I follow the lead of Rajan and Zingales (1998) in applying the difference-in-difference approach to study industrial growth. Using a panel of manufacturing sectors in developing countries, I specify an interaction between sovereign default (a country characteristic) and a variety of industry characteristics. A preview of the main results is as follows.

- Sectors that on average face tough import competition perform relatively better in the aftermath of a default. The most significant effects appear two and three years after the default event. An industry in the 75th percentile of the import penetration distribution grows around 5 percentage points faster than an industry in the 25th percentile.

- Export-oriented industries suffer a deeper growth slowdown. This negative effect hits exporters one year after the default and lasts around three years. The annual growth rate of a sector in the 75th percentile of the export orientation distribution is 2 percentage points lower than that of a sector in the 25th percentile.

- Industries characterized by high asset tangibility and capital intensity are less affected by sovereign defaults. The most significant impact is concentrated 2–4 years after the default event. An industry in the 75th percentile of the asset tangibility distribution grows one percentage point faster than an industry in the 25th percentile.

The first two findings are consistent with the existence of default punishments in the form of trade sanctions and exclusion from trade credit markets. Reduced imports should boost the performance of domestic producers which faced strong foreign competition before the default. Conversely, exporters are hurt by a loss of access to foreign markets and unavailability of export-linked credits. The links between asset tangibility and post-default performance do not have a clear counterpart in the literature discussing the costs of default. I hypothesize that sovereign defaults result in a deterioration of private credit relationships. Those who are able to offer more collateral can partially offset the adverse effect, preserve access to credit, and thus grow faster than average.

This paper relates to a literature documenting empirical evidence on the costs of default. Apart from the output studies mentioned above, Rose (2005) and Rose and Spiegel (2004) highlight the negative impact of default on international trade. Regarding market access, Sandleris et al. (2004) find that defaulters are excluded from international capital markets for an average of four years in the 80s and very short exclusions in the 90s. Long lasting effects of default on the cost of borrowing have also been identified by the literature (Dell'Ariccia et al. 2006), although others such as Ades et al. (2000) find that the effect is not significant. Finally, Arteta and

Hale (2008) study credit to domestic private firms around default times and find a systematic decline in foreign credit.[1]

The rest of the chapter is organized as follows. Section 3.2 discusses the econometric methodology and data sources. Estimation results are presented in section 3.3. Section 3.4 describes various robustness checks and extensions of the main specification. Finally, section 3.5 concludes.

3.2 Methodology and data

The main goal of this paper is to explore the links between industry characteristics and industrial growth during and after sovereign default episodes. Even though the number of potentially relevant industry characteristics is bewildering, existing sovereign debt models point to some specific variables as a feasible starting point. In particular, one strand of the literature argues that potential trade sanctions imposed by creditors are central to explain the existence of sovereign debt. If this channel is effectively at work, international trade should significantly diminish after a default. Rose (2005) shows that this is actually the case, but the effects of reduced imports and exports on domestic producers remain unexplored. I hypothesize that we should observe two sectorial effects of default related to international trade. On the one hand, sectors that faced strong import competition before a default should perform relatively better in the aftermath of a debt crisis since imports are falling. On the other hand, exporters should suffer relatively more because their access to foreign

[1] Using a similar methodology to mine, Dell'Ariccia et al. (2008) and Kroszner et al. (2007) study the growth impact of banking crises on industries with different levels of dependence on external finance.

markets is impaired. As I discuss below in more detail, loss of access to trade finance could also harm exporters disproportionately more in the event of a default. In section 3.4, I further expand the specification to account for aspects other than international trade related variables.

In order to test the existence of significant interactions between industry exposure to international trade and default, I use the methodology developed in Rajan and Zingales (1998). The baseline specification is

$$\begin{aligned} VAGR_{ijt} = \alpha_{ij} + \alpha_{it} + \alpha_{jt} + \beta_1 SHVA_{ij,t-1} + \\ + \sum_{\tau=0}^{K} (\gamma_{\tau M} MPNTR_{ij} + \gamma_{\tau X} XORNT_{ij}) DEF_{j,t-\tau} + \epsilon_{ijt} \end{aligned} \tag{3.1}$$

$VAGR_{ijt}$ denotes real value added growth for industry i in country j at time t. α_{ij} is a set of industry-country fixed effects, α_{it} a set of industry-year fixed effects, and α_{jt} a set of country-year fixed effects. These sets of fixed effects are meant to mitigate the omitted-variable problem by capturing most of the shocks not explicitly modeled. $SHVA_{ij,t-1}$ is the lagged share of industry i in total manufacturing value added in the country where it is located. This term is included to control for reversion to the mean and the coefficient β_1 is expected to be negative. The last set of variables are the central part of the specification. $MPNTR_{ij}$ is a time-invariant measure of import penetration at the industry-country level. Higher values of $MPNTR_{ij}$ should be interpreted as tougher competition from foreign producers (see the formal definition of the variable in the data sources subsection below). Similarly, $XORNT_{ij}$ is a measure of export orientation, also at the industry-country level. These two indexes are interacted with the default indicators $DEF_{j,t-\tau}$ which take a value of one if country

j defaulted τ years ago. Up to K lags are included in the regression. In the main tables K is set to 4. Longer lags and alternative default indicators are explored in section 3.4. If the international trade effects of sovereign default are strong, the coefficients $\gamma_{\tau M}$ are expected to be positive and significant reflecting diminished competition from imported goods. Conversely, export-oriented industries should display poorer relative performance, i.e., we should obtain negative and significant $\gamma_{\tau X}$ coefficients.

Since real exchange rate fluctuations are correlated with defaults and importer/exporter performance, in a second specification I allow for interactions between the two trade variables and the real bilateral exchange rate with respect to the U.S. The augmented equation is

$$VAGR_{ijt} = \alpha_{ij} + \alpha_{jt} + \alpha_{it} + \beta_1 SHVA_{ij,t-1} + (\beta_2 MPNTR_{ij} + \beta_3 XORNT_{ij}) RERGR_{jt} + \\ + \sum_{\tau=0}^{K} (\gamma_{\tau M} MPNTR_{ij} + \gamma_{\tau X} XORNT_{ij}) DEF_{j,t-\tau} + \epsilon_{ijt} \tag{3.2}$$

Where $RERGR_{jt}$ is the real bilateral exchange rate growth. The coefficients β_2 and β_3 are expected to be positive as real depreciations favor the competitiveness of the export sector and make imported goods more expensive.

Before going into data details, a comment on endogeneity issues is in order. It could well be the case that poor industrial performance is the main factor driving the default decision. In that case, equations (3.1) and (3.2) would suffer from reverse causality problems thus invalidating any statistical inference based on them. An instrumental variable approach is the natural solution to this situation but, unfortunately, it is extremely difficult to find a valid instrument for default. The reverse causality problem is nonetheless attenuated by the fact that my dependent variable is industry-level growth instead of a more aggregated measure. Therefore, a contraction of a single industry is less likely to trigger a sovereign default than a generalized GDP slump. In short, it is important to interpret the estimates I report as conditional correlations rather than causal effects.

Having specified and discussed the two basic functional forms, I next turn to a description of the data used to estimate the model.

3.2.1 Data sources

Industry-level data for 28 manufacturing sectors (3-digit ISIC Revision 2) is used in this paper. Table 3.8 contains a short description of each sector. Data on value added for each industry in each country is obtained from UNIDO Industrial Statistics Database (2006 CD-ROM). The database covers the period 1963-2004 but little information is available for developing countries that defaulted on their debts before 1980. Value added is corrected for inflation using CPI data from the IMF International Financial Statistics. After calculating industry-level value added growth, the top and bottom 2-percent of the distribution is excluded. The main source for trade data is Nicita and Olarreaga (2007) where imports, exports and output are documented for the 28 manufacturing sectors.

I measure the degree of import competition with an import penetration rate that is country-industry specific but time invariant. The formal definition of the variable is as in Trefler (1993)

$$MPNTR_{ij} = \frac{1}{T} \sum_{t=2004-T}^{2004} \frac{IMPORTS_{ijt}}{OUTPUT_{ijt} + IMPORTS_{ijt} - EXPORTS_{ijt}} \tag{3.3}$$

In words, $MPNTR$ is the average share of domestic demand that is satisfied by imports.

I follow a similar approach to capture the export orientation of industry i in country j. $XORNT_{ij}$ is computed as the average ratio of exports over total sales.

$$XORNT_{ij} = \frac{1}{T} \sum_{t=2004-T}^{2004} \frac{EXPORTS_{ijt}}{OUTPUT_{ijt}} \tag{3.4}$$

Since there are abundant breaks in the series, the maximum value of T is 22.[2] Note that the data do not allow us to distinguish final-good imports from imported inputs. This is relevant in the current context since a reduction in each type of imports is bound to have opposite effects on sectorial growth. Less competition from foreign producers in the final goods market clearly benefits domestic firms but a shortage of imported inputs is likely to weaken value added growth. As I discuss in the next section, the estimation results allow me to argue that the former effect is statistically significant even though the measure in (3.3) embodies both types of imports.

Default episodes are taken from Beers and Chambers (2006), which is the most widely used listing of sovereign default episodes. The authors provide a list of all sovereign defaults on domestic currency debt, foreign currency debt, and foreign currency bank loans for the period 1975-2006.[3] The default indicators $DEF_{j,t-\tau}$ are constructed to capture the three types of default.

Finally, the real exchange rate between the domestic currency and the US dollar is calculated from data in the IMF International Financial Statistics.

These data sources yield an unbalanced panel of 42 countries, a total of 13,220

[2]The top and bottom 2-percent observations of the $IMPORTS/(OUTPUT + IMPORTS - EXPORTS)$ and $EXPORTS/OUTPUT$ distributions are dropped to calculate the averages.

[3]Two defaults on oil warrants by Nigeria and Venezuela are also included in the sample.

observations, and 49 default episodes. Table 3.1 presents summary statistics of the main regression variables and table 3.9 lists the default episodes in the sample.[4]

3.3 Estimation results

Table 3.2 reports the estimated coefficients for the baseline specifications while figure 3.1 summarizes the coefficients of interest.[5] As expected, the convergence term is negative and statistically significant. Real depreciations significantly favor industries where import penetration is high. The interaction between depreciation and export orientation has the predicted sign but is not significant. As it becomes clear by comparing columns one and two, the inclusion of the real exchange rate does not change the qualitative nature of the results.

Turning to the interaction between import penetration and sovereign default, the regressions suggest that its effects are significant. As the bottom rows show, an F test indicates that the five interaction terms are jointly significant. The immediate effect is negative, i.e. sectors facing strong import competition perform poorly when default strikes, but as I show in the next section the coefficient is not robust to the inclusion of other variables. Interestingly, two and three years after the default there is a very significant boost in the performance of industries in which average import penetration is high. Moving from the 25th to the 75th percentile of the import penetration distribution increases value added growth by around 8 percentage points. However, in the next section I show that this magnitude falls considerably

[4] Three of the most recent bond defaults cannot be included in the sample due to data limitations (Ukraine, Pakistan, and Dominican Republic).

[5] More specifically, figure 3.1 depicts the coefficients and confidence intervals in column (2) of table 3.2

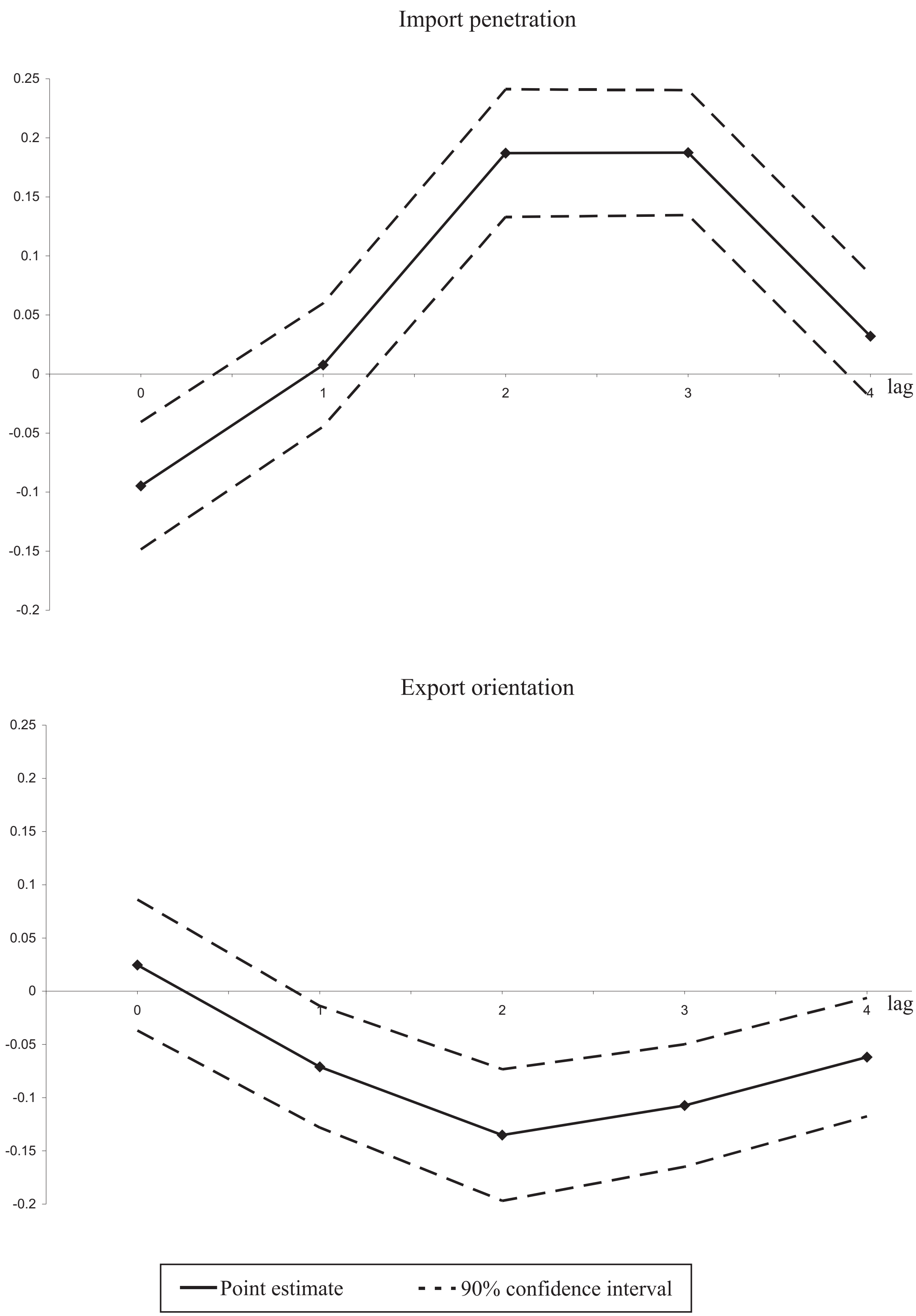

Figure 3.1: Baseline regression

when other industry characteristics are accounted for. In the fourth year the effect is still positive but not significant. These patterns can be interpreted as the sectorial equivalent of the findings in Rose (2005): the decline in aggregate bilateral trade translates into a relatively stronger performance of import-competing sectors. There is however a discrepancy in the persistence of Rose's effects and mine. While the decline in aggregate bilateral trade lasts for around 15 years, the impact on domestic producers is short lived (I later confirm the finding by exploring other lag structures). This suggests than individual firms are successful at adapting their business model to a low-international-trade environment.

Going back to the input imports issue raised in the previous section, the positive and significant coefficients on the import penetration variables allow me to claim that if reduced input imports have a negative effect on growth, it is more than offset by the decline in final goods imports.

Similarly to Borensztein and Panizza (2006b), export orientation also turns out to be a relevant factor to explain post-default industry performance. The F test shows that all the export interaction terms are jointly significant at the 1% level. Save for the effect on the default year, all lags have the expected sign and are individually significant. Exporters underperform the rest of sectors for at least four years after the default, with the strongest effect being felt two years after the default (an industry in the 75th percentile of the export-orientation distribution would see its growth drop by 2.2 percentage points relative to an industry in the 25th percentile). Compared to the import-related effects, exporters experience the consequences of default earlier (the first lag is already significant) and for a longer period (the fourth lag is also significant). Two explanations for weak exporter performance can be put forward. First, the drop in bilateral trade mentioned earlier could be the driving force: export sectors face lower demand when excluded from foreign markets and value added growth falls as a consequence. The second explanation relates to the workings of financial markets. It has been argued elsewhere that trade finance is essential for export activities and anecdotal evidence points to a sharp decline in the availability of trade finance around default times.[6] Part of my estimated effects can be interpreted as the negative consequences of trade finance disruptions. Obviously, the present methodology does not allow me to disentangle the relative importance of both channels.

In short, the two baseline regressions suggest that industries exposed to import competition or oriented towards foreign markets display a significantly different behavior following a default event.

3.4 Robustness

In this section I discuss additional factors that explain industrial growth around default times and check that the results are robust to alternative definitions of the default indicators.

3.4.1 Other industry characteristics

Both import penetration and export orientation might be significantly correlated with other industry characteristics that also explain value added growth. Omitting these additional factors leads to biased estimators of the international trade effects. The goal of this subsection is twofold. By including additional variables, I intend to both check the robustness of the import/export variables and study the role of these new

[6]See Auboin and Meier-Ewert (2003) for more details.

regressors. The exercise is severely constrained by data availability issues, especially when trying to incorporate measures that are both country and sector specific. Three additional variables could be collected, all of them significantly correlated with import penetration and export orientation. I next present the new variables and discuss their potential links with sovereign default and sectorial growth.

The first additional variable ED_j is a measure of dependence on external finance developed by Rajan and Zingales (1998). Their index is constructed using data for US firms and is a valid way to identify the extent of external dependence of an industry elsewhere in the world assuming that there are technological reasons why some industries depend more than others on external finance, and that these differences persist across countries. Dependence on external finance could interact with default and industrial growth in the following way. If credit to the private sector declines in the aftermath of a default as Arteta and Hale (2008) suggest, we would expect highly dependent sectors to experience slower growth after default due to the disruption in capital markets.[7]

Secondly, I construct an indicator of the physical capital intensity of an industry $KINT_{ij}$. This is the only measure in this section that can be constructed from data in UNIDO. Following the growth literature, I proxy for capital intensity by calculating the capital share in value added assuming a Cobb-Douglas production function at the sectorial level.[8] Very similar results follow from using the capital intensity measure in Braun (2003) which is backed out from US data which is therefore not country

[7] The inclusion of dependence on external finance is also motivated by the fact that it plays a role in explaining sectorial growth during banking crises (Dell'Ariccia et al. 2008).

[8] More specifically, I calculate $KINT_{ij} = 1 - (1/T)\sum_{t=2004-T}^{2004} \frac{TotalPayroll_{ijt}}{ValueAdded_{ijt}}$ after trimming the bottom and top 2% of the $TotalPayroll/ValueAdded$ distribution.

specific.[9] A measure of asset tangibility (TNG_j) taken from Braun (2003), turns out to be very colinear with physical capital intensity.[10] Tangibility is defined as net property, plant, and equipment divided by book value of assets and is calculated using American data. As in the case of dependence on external finance, the validity of this country-invariant measure requires that the ranking among industry tangibility remains relatively stable across countries. Assuming that default is associated with credit market distress, we would expect sectors that are naturally high in hard assets to be in a better position to put up collateral. This would relatively mitigate tight credit conditions, thus leading to better performance in default times.

All these new variables enter the regression as interactions with the default indicators. Table 3.3 and figure 3.4.1 present the results of the augmented regressions.[11] The first three columns separately incorporate dependence on external finance, capital intensity, and asset tangibility to the regression. Column four includes both dependence on external finance and capital intensity. In the last column dependence on external finance and asset tangibility are added to the regression.[12]

Dependence on external finance appears not to have any significant interaction with default. Most of the interaction coefficients are negative but they are far from being individually or jointly significant. The variable is still irrelevant when capital intensity or asset tangibility is included.

Regarding the second set of variables, I find some interesting results. Looking at

[9] The correlation of both measures is close to one and highly significant.

[10] The same happens if one calculates average establishment size at the country-industry level using data in UNIDO (defined as the ratio of output to number of establishments in constant PPP dollars).

[11] Dependence on external finance is omitted in figure 3.4.1 since it is never statistically significant. The import penetration, export orientation, and capital intensity panels plot the coefficients in column (4). The tangibility panel is constructed from column (5).

[12] The number of observations drops below 13,202 because the additional measures are not available for some of the manufacturing sectors.

Figure 3.2: Additional industry characteristics

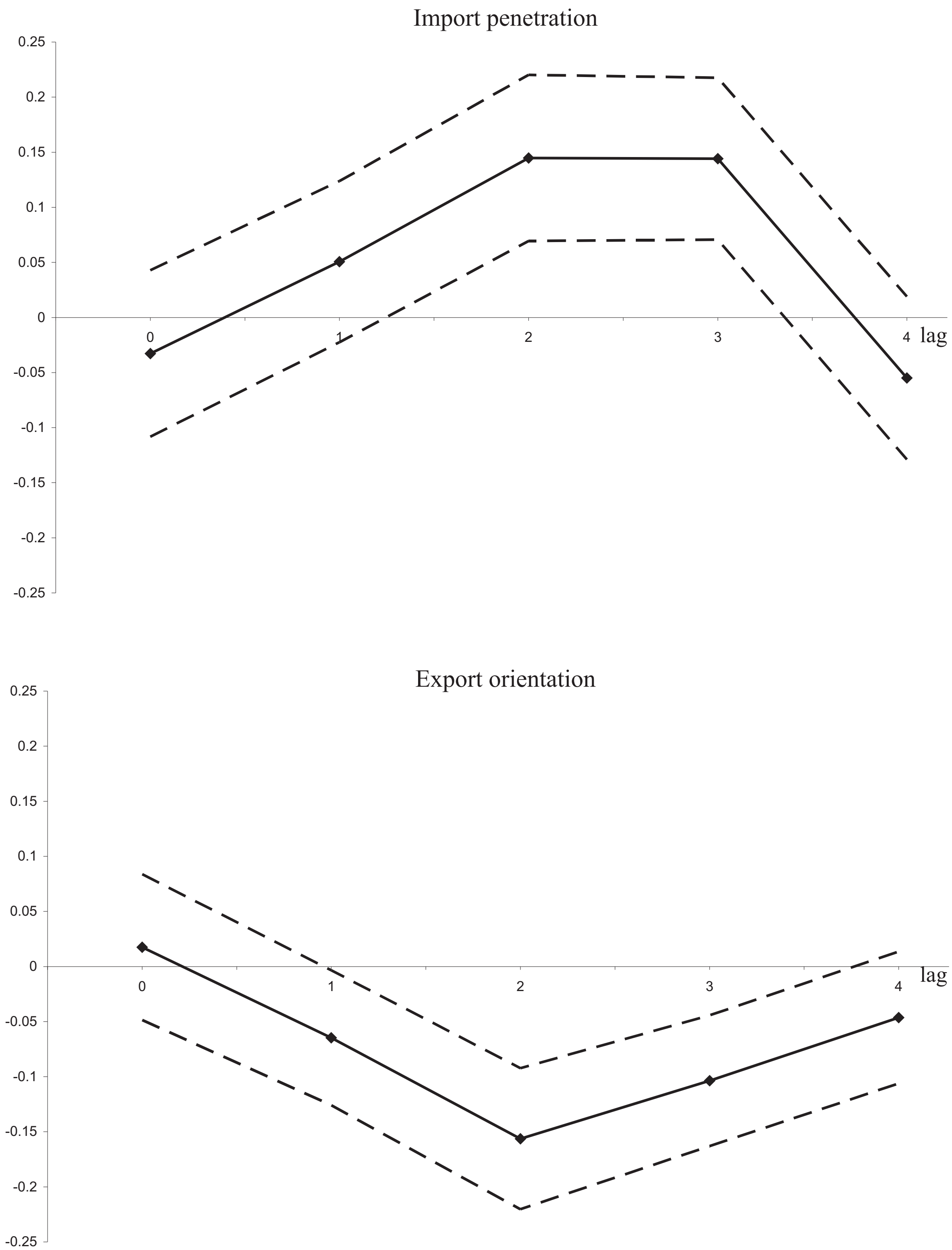

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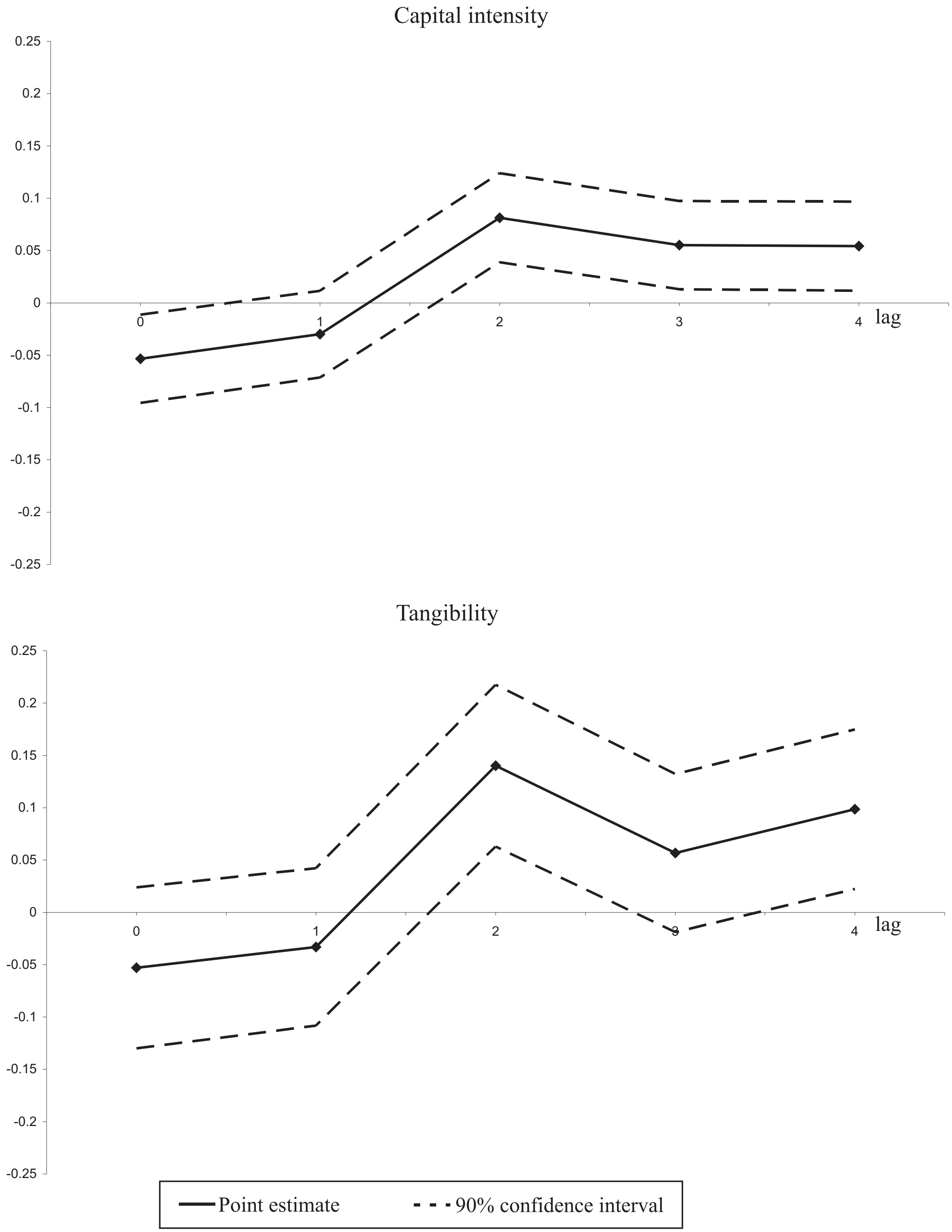
Figure 3.2: Additional industry characteristics (continued)



physical capital intensity, the five coefficients are jointly significant under all specifications (see the F tests in the bottom rows). We observe an immediate slowdown of capital intensive industries ($DEF_0 \times KINT$ coefficient significant at the 5% level). In contrast, the performance of these industries is significantly higher than average from the second to the fourth year after the default event. More specifically, an industry in the 75th percentile of the capital intensity distribution is growing one percentage point faster than an industry in the 25th percentile. The finding is independent of the inclusion of the external dependence variable. The interaction between default and asset tangibility displays a similar qualitative behavior. The five interactions are jointly significant. As I found with capital intensity, sectors characterized by high asset tangibility are particularly affected immediately after the default but the finding is no longer statistically significant. The effect is reversed two years after the default, when high asset tangibility results in higher than average industrial performance. Moving from the 25th to the 75th percentile of the asset tangibility distribution increases value added growth by 1.6 percentage points. The effect persists until the fourth year after the default event, albeit the significance is weaker than the capital intensity interactions. One interpretation of these results is that private sector creditor-debtor relationships deteriorate after a sovereign default and, as a result, assets that are more easily appropriated by investors become essential to secure access to credit. Better access to credit boosts performance with respect to industries with fewer tangible assets.

Let us now reexamine the effects of import penetration and export orientation. The first noticeable fact is that the negative interaction between import penetration and the first default indicator is not robust to the inclusion of capital intensity or asset tangibility. The coefficient is negative but no longer individually significant. The rest of findings in the previous section remain robust to the inclusion of the new variables: two and three years after the default industries that face tough import competition grow faster than average and exporters especially suffer the effects of the default (although the effects on the fourth year after the default are less significant than before). Quantitatively, the import penetration effects are weaker. An industry in the 75th percentile of the import distribution is growing around 5 percentage points faster than an industry in the 25th percentile. Regarding export orientation, there are no quantitatively remarkable variations in the coefficients.

3.4.2 Alternative default indicators

In this subsection I explore the possibility of long-lasting effects of defaults and check the robustness of the results to alternative default variable definitions.

The most straightforward option to test for long-lasting effects of sovereign defaults is to include longer lags of the variable $DEF_{j,t-\tau}$ interacted with industry characteristics. Table 3.4 reproduces the regressions in the previous subsection with $K = 7$ lags. A clear picture emerges from this table. The effects of sovereign defaults on sectorial growth vanish five years after the default. Roughly speaking, the most intense effects are concentrated around the second and third year after the default. This evidence points to the fact that, even if default punishments are very persistent as Rose (2005) suggests, the most affected firms find ways to adapt to the new environment.

Tables 3.5, 3.6, and 3.7 experiment with different lag structures. In table 3.5, the $K+1$ default dummies are substituted by a single default variable $DEFB_{jt}$ that takes the value of one on the default year and four more years. Compared to the baseline specification, this model estimates effects that are constrained to be constant over five years. All coefficients retain the expected signs but significance is generally lower. According to these results, the poor performance of exporters around default times is the most robust finding that arises from the analysis since the interaction of default and export orientation is significant for the 6 sets of variables. Capital intensity is no longer relevant under the alternative default indicator but asset tangibility retains its significance.[13]

In the regressions presented so far, the lagged default variables take the value of one regardless of whether the sovereign has settled the default with its creditors. By doing so, I am potentially capturing the effects of default punishments that persist beyond the settlement date. The strategy seems reasonable since the literature has found long-lasting effects of sovereign default on international trade and the cost of borrowing. As a robustness check, table 3.6 replicates the results using a set of default variables $\{DEFC_{j,t-\tau}\}_{\tau=0}^{4}$ that take the value of one if and only if the sovereign defaulted τ years ago and the debt still remains in default. Under this specification, no new results emerge. The significance and magnitude of the import penetration and export orientation variables drop but their signs remain stable. The effects of capital intensity are slightly larger but there is no clear pattern of variation in the asset tangibility interactions.

In a similar exercise, I interact each industry characteristic with a single default indicator $DEFD_{jt}$ that takes the value of one for every year in which a country is in default according to Standard&Poor's. Since most bank debt defaults in the

[13]Quantitatively, the growth effect of moving from the lower to the upper quartile of the export orientation distribution drops to 1.2 percentage points. Regarding tangibility, an industry in the upper quartile grows 0.9 percentage points faster than an industry in the lower quartile.

sample last for a decade, this specification is effectively testing for long-lasting effects of sovereign default. As table 3.7 shows, none of the interactions presented so far is clearly statistically significant under these default indicators. The regression results confirm that the effects of sovereign default on sectorial growth are not extremely persistent.

In a nutshell, all default indicator structures point to the same qualitative patterns of industrial growth around crisis times. There are relatively short-lived effects related to import competition, export orientation, and capital intensity.

3.5 Conclusion

This paper explores the growth patterns of different manufacturing sectors around sovereign default episodes using the methodology originally proposed by Rajan and Zingales (1998). There are a number of industry characteristics that affect sectorial performance after a default. Industries that on average face strong import competition grow relatively faster after a default. In contrast, export-oriented sectors suffer disproportionately more from sovereign debt crises. Both effects appear with a lag and vanish five years after the default. These two facts are consistent with a strand of literature arguing that trade sanctions and denial of trade credit are relevant costs of a sovereign default. I also find that industries characterized by high physical capital intensity and abundant tangible assets fare relatively better in the aftermath of a default. I hypothesize that this could be evidence of a deterioration of private credit relationships following a sovereign default. Firms with a large pool of tangible assets would be in a better position to offer collateral, thus mitigating the adverse effects of capital market disruptions on industry growth.

The analysis presented here opens a number of questions. On the empirical plane, a similar exercise at the firm-level could offer deeper insights on which industry characteristics display the most interesting interactions with sovereign default (possibly at the cost of covering less crisis episodes). The fact that different domestic constituencies suffer the effects of sovereign defaults unevenly, suggests that political economy considerations could play an important role in understanding default decisions. For instance, an economy in which exporters exert a strong influence on government would be more reluctant to default than an economy in which import competing industries enjoy high lobbying power. Also, the present findings could contribute to understand in more detail the composition of economic activity. Sectors that are more resilient to sovereign defaults should be proportionally larger in crisis-prone economies.

3.6 Tables

Table 3.1: Descriptive statistics

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**Obs.**
VAGR	-0.006	0.299	-1.158	1.061	13202
SHVA	0.042	0.061	5.7e-13	0.75	13202
MPNTR	0.344	0.272	2.6e-4	0.99	1005
XORNT	0.275	0.373	6.8e-5	0.98	1005
RERGR	0.012	0.203	-0.729	2.799	608

Table 3.2: Baseline regressions

	(1) VAGR	(2) VAGR
SHVA	-2.073***	-2.073***
	(0.117)	(0.120)
RERGR*MPNTR		0.146***
		(0.0519)
RERGR*XORNT		0.0576
		(0.0620)
DEF_0*MPNTR	-0.0762**	-0.0947***
	(0.0319)	(0.0328)
DEF_1*MPNTR	-0.0075	0.0076
	(0.0314)	(0.0317)
DEF_2*MPNTR	0.191***	0.187***
	(0.0325)	(0.0328)
DEF_3*MPNTR	0.193***	0.187***
	(0.0316)	(0.0321)
DEF_4*MPNTR	0.0444	0.0320
	(0.0312)	(0.0317)
DEF_0*XORNT	0.0461	0.0246
	(0.0356)	(0.0374)
DEF_1*XORNT	-0.0649*	-0.0710**
	(0.0343)	(0.0347)
DEF_2*XORNT	-0.141***	-0.135***
	(0.0370)	(0.0376)
DEF_3*XORNT	-0.0969***	-0.107***
	(0.0343)	(0.0350)
DEF_4*XORNT	-0.0602*	-0.0619*
	(0.0334)	(0.0338)
Observations	13220	13220
R^2	0.085	0.089
F tests (p-values):		
all DEF*MPNTR=0	[0.000]	[0.000]
all DEF*XORNT=0	[0.000]	[0.000]

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.3: Additional industry characteristics

	(1) VAGR	(2) VAGR	(3) VAGR	(4) VAGR	(5) VAGR
SHVA	-2.090***	-2.063***	-2.078***	-2.079***	-2.079***
	(0.124)	(0.120)	(0.124)	(0.125)	(0.124)
RERGR*MPNTR	0.0886*	0.150***	0.0853	0.0903*	0.0841
	(0.0537)	(0.0521)	(0.0536)	(0.0539)	(0.0537)
RERGR*XORNT	0.0760	0.0573	0.0838	0.0769	0.0844
	(0.0631)	(0.0627)	(0.0631)	(0.0638)	(0.0632)
DEF_0MPNTR	-0.0746*	-0.0426	-0.0533	-0.0335	-0.0534
	(0.0406)	(0.0412)	(0.0407)	(0.0459)	(0.0440)
DEF_1*MPNTR	0.0204	0.0493	0.0189	0.0494	0.0333
	(0.0394)	(0.0397)	(0.0393)	(0.0445)	(0.0428)
DEF_2*MPNTR	0.211***	0.121***	0.131***	0.145***	0.159***
	(0.0408)	(0.0408)	(0.0406)	(0.0458)	(0.0443)
DEF_3*MPNTR	0.184***	0.135***	0.162***	0.144***	0.164***
	(0.0396)	(0.0401)	(0.0396)	(0.0446)	(0.0430)
DEF_4*MPNTR	-0.0081	-0.0294	-0.0262	-0.0559	-0.0445
	(0.0396)	(0.0401)	(0.0393)	(0.0449)	(0.0430)
DEF_0*XORNT	0.0148	0.0219	0.0128	0.0173	0.0140
	(0.0389)	(0.0389)	(0.0387)	(0.0403)	(0.0389)
DEF_1*XORNT	-0.0621*	-0.0732**	-0.0585	-0.0647*	-0.0613*
	(0.0360)	(0.0361)	(0.0358)	(0.0373)	(0.0360)
DEF_2*XORNT	-0.153***	-0.135***	-0.147***	-0.156***	-0.155***
	(0.0388)	(0.0376)	(0.0385)	(0.0389)	(0.0388)
DEF_3*XORNT	-0.101***	-0.109***	-0.0995***	-0.104***	-0.0996***
	(0.0360)	(0.0351)	(0.0359)	(0.0361)	(0.0360)

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Table 3.3: (continued)

DEF_4*XORNT	-0.0486	-0.0605*	-0.0517	-0.0464	-0.0467
	(0.0351)	(0.0353)	(0.0348)	(0.0364)	(0.0351)
DEF_0*ED	-0.0100			0.0087	-0.0014
	(0.0348)			(0.0358)	(0.0358)
DEF_1*ED	-0.0357			-0.0291	-0.0304
	(0.0341)			(0.0351)	(0.0351)
DEF_2*ED	-0.0316			-0.0561	-0.0565
	(0.0352)			(0.0360)	(0.0361)
DEF_3*ED	0.0059			-0.0147	-0.0050
	(0.0344)			(0.0353)	(0.0354)
DEF_4*ED	0.0517			0.0358	0.0344
	(0.0348)			(0.0358)	(0.0357)
DEF_0*KINT		-0.0501**		-0.0523**	
		(0.0245)		(0.0256)	
DEF_1*KINT		-0.0377		-0.0283	
		(0.0240)		(0.0251)	
DEF_2*KINT		0.0664***		0.0809***	
		(0.0247)		(0.0258)	
DEF_3*KINT		0.0558**		0.0558**	
		(0.0245)		(0.0256)	
DEF_4*KINT		0.0615**		0.0557**	
		(0.0247)		(0.0258)	
DEF_0*TNG			-0.0531		-0.0530
			(0.0454)		(0.0467)
DEF_1*TNG			-0.0421		-0.0330
			(0.0445)		(0.0458)

(continues on next page)

Table 3.3: (continued)

DEF_2*TNG			0.124***		0.140***
			(0.0457)		(0.0470)
DEF_3*TNG			0.0551		0.0567
			(0.0447)		(0.0460)
DEF_4*TNG			0.108**		0.0986**
			(0.0451)		(0.0464)
Observations	12221	13033	12221	12045	12221
R^2	0.090	0.091	0.090	0.091	0.091
F tests (p-values):					
All DEF*MPNTR=0	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
All DEF*XORNT=0	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
All DEF*ED=0	[0.521]			[0.481]	[0.522]
All DEF*KINT=0		[0.000]		[0.000]	
All DEF*TNG=0			[0.009]		[0.009]

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3.4: Long-lasting effects of sovereign default ($K = 7$)

	(1) VAGR	(2) VAGR	(3) VAGR	(4) VAGR	(5) VAGR	(6) VAGR
SHVA	-2.072***	-2.088***	-2.065***	-2.076***	-2.080***	-2.076***
	(0.120)	(0.124)	(0.120)	(0.124)	(0.125)	(0.124)
DEF_1*MPNTR	0.00621	0.0194	0.0481	0.0173	0.0474	0.0323
	(0.0319)	(0.0396)	(0.0399)	(0.0395)	(0.0447)	(0.0430)
DEF_2*MPNTR	0.186***	0.213***	0.122***	0.129***	0.147***	0.160***
	(0.0330)	(0.0410)	(0.0410)	(0.0408)	(0.0460)	(0.0444)
DEF_3*MPNTR	0.183***	0.180***	0.129***	0.157***	0.139***	0.159***
	(0.0323)	(0.0397)	(0.0402)	(0.0399)	(0.0448)	(0.0431)
DEF_4*MPNTR	0.0189	-0.0217	-0.0425	-0.0378	-0.0682	-0.0575
	(0.0324)	(0.0403)	(0.0408)	(0.0401)	(0.0457)	(0.0438)
DEF_5*MPNTR	-0.0509	-0.0581	-0.0657	-0.0500	-0.0592	-0.0584
	(0.0342)	(0.0423)	(0.0424)	(0.0420)	(0.0474)	(0.0458)
DEF_6*MPNTR	-0.0494	-0.0413	-0.0390	-0.0411	-0.0404	-0.0377
	(0.0339)	(0.0420)	(0.0424)	(0.0416)	(0.0472)	(0.0454)
DEF_7*MPNTR	-0.00703	0.0310	0.0169	0.000663	0.0372	0.0237
	(0.0332)	(0.0416)	(0.0417)	(0.0413)	(0.0467)	(0.0451)
DEF_0*MPNTR	-0.100***	-0.0802**	-0.0480	-0.0584	-0.0381	-0.0586
	(0.0329)	(0.0407)	(0.0414)	(0.0408)	(0.0461)	(0.0442)
DEF_1*XORNT	-0.0732**	-0.0640*	-0.0725**	-0.0606*	-0.0644*	-0.0634*
	(0.0349)	(0.0362)	(0.0363)	(0.0360)	(0.0374)	(0.0362)
DEF_2*XORNT	-0.137***	-0.156***	-0.137***	-0.150***	-0.160***	-0.159***
	(0.0378)	(0.0390)	(0.0379)	(0.0387)	(0.0391)	(0.0390)
DEF_3*XORNT	-0.103***	-0.0966***	-0.104***	-0.0951***	-0.0998***	-0.0956***
	(0.0351)	(0.0362)	(0.0352)	(0.0360)	(0.0363)	(0.0362)

DEF_4*XORNT	-0.0457	-0.0348	-0.0480	-0.0378	-0.0358	-0.0322
	(0.0348)	(0.0360)	(0.0359)	(0.0358)	(0.0371)	(0.0360)
DEF_5*XORNT	0.0632*	0.0589	0.0658*	0.0588	0.0593	0.0618*
	(0.0352)	(0.0364)	(0.0361)	(0.0361)	(0.0372)	(0.0364)
DEF_6*XORNT	0.0328	0.0193	0.0287	0.0208	0.0160	0.0198
	(0.0354)	(0.0364)	(0.0359)	(0.0361)	(0.0368)	(0.0364)
DEF_7*XORNT	-0.00479	-0.0187	-0.00466	-0.0111	-0.0169	-0.0173
	(0.0355)	(0.0367)	(0.0360)	(0.0364)	(0.0372)	(0.0367)
DEF_0*XORNT	0.0322	0.0211	0.0264	0.0188	0.0209	0.0200
	(0.0377)	(0.0391)	(0.0390)	(0.0389)	(0.0404)	(0.0392)
RER*MPNTR	0.144***	0.0883	0.149***	0.0846	0.0898*	0.0835
	(0.0520)	(0.0538)	(0.0522)	(0.0538)	(0.0541)	(0.0538)
RER*XORNT	0.0600	0.0773	0.0611	0.0861	0.0793	0.0863
	(0.0621)	(0.0632)	(0.0628)	(0.0633)	(0.0640)	(0.0633)
DEF_1*ED		-0.0366			-0.0295	-0.0315
		(0.0342)			(0.0352)	(0.0352)
DEF_2*ED		-0.0345			-0.0584	-0.0601*
		(0.0352)			(0.0361)	(0.0362)
DEF_3*ED		0.0059			-0.0150	-0.0053
		(0.0346)			(0.0355)	(0.0356)
DEF_4*ED		0.0531			0.0367	0.0360
		(0.0355)			(0.0365)	(0.0365)
DEF_5*ED		0.0143			0.0090	0.0146
		(0.0369)			(0.0381)	(0.0380)
DEF_6*ED		-0.0088			-0.0032	-0.0066
		(0.0361)			(0.0375)	(0.0373)
DEF_7*ED		-0.0407			-0.0320	-0.0452
		(0.0358)			(0.0372)	(0.0369)
DEF_0*ED		-0.0084			0.0095	0.0003

	(0.0348)			(0.0358)	(0.0359)
DEF_1*KINT		-0.0389		-0.0286	
		(0.0240)		(0.0252)	
DEF_2*KINT		0.0651***		0.0808***	
		(0.0248)		(0.0259)	
DEF_3*KINT		0.0569**		0.0566**	
		(0.0247)		(0.0258)	
DEF_4*KINT		0.0641**		0.0573**	
		(0.0253)		(0.0265)	
DEF_5*KINT		0.0181		0.0083	
		(0.0256)		(0.0268)	
DEF_6*KINT		-0.0055		0.0006	
		(0.0256)		(0.0268)	
DEF_7*KINT		-0.0233		-0.0111	
		(0.0252)		(0.0264)	
DEF_0*KINT		-0.0482**		-0.0509**	
		(0.0245)		(0.0256)	
DEF_1*TNG			-0.0421		-0.0326
			(0.0446)		(0.0459)
DEF_2*TNG			0.125***		0.143***
			(0.0459)		(0.0472)
DEF_3*TNG			0.0560		0.0579
			(0.0449)		(0.0463)
DEF_4*TNG			0.107**		0.0968**
			(0.0461)		(0.0474)
DEF_5*TNG			0.0017		-0.0016
			(0.0469)		(0.0483)
DEF_6*TNG			-0.0123		-0.0092
			(0.0458)		(0.0474)

DEF_7*TNG				0.0060		0.0202
				(0.0457)		(0.0470)
DEF_0*TNG				-0.0525		-0.0531
				(0.0455)		(0.0469)
Observations	13220	12221	13033	12221	12045	12221
R^2	0.090	0.090	0.091	0.091	0.092	0.091
F tests (p-values):						
All DEF*MPNTR=0	[0.000]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]
All DEF*XORNT=0	[0.000]	[0.001]	[0.000]	[0.002]	[0.000]	[0.001]
All DEF*ED=0		[0.678]			[0.721]	[0.647]
All DEF*KINT=0			[0.002]		[0.004]	
All DEF*TNG=0				[0.053]		[0.048]

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3.5: Alternative default indicators (I)

	(1)	(2)	(3)	(4)	(5)	(6)
	VAGR	VAGR	VAGR	VAGR	VAGR	VAGR
SHVA	-2.074***	-2.090***	-2.069***	-2.092***	-2.086***	-2.093***
	(0.120)	(0.124)	(0.121)	(0.124)	(0.125)	(0.124)
RERGR*MPNTR	0.0964*	0.0401	0.0977*	0.0411	0.0403	0.0395
	(0.0518)	(0.0535)	(0.0520)	(0.0535)	(0.0538)	(0.0535)
RERGR*XORNT	0.0794	0.0970	0.0740	0.0968	0.0928	0.0976
	(0.0603)	(0.0613)	(0.0609)	(0.0612)	(0.0619)	(0.0612)
DEFB*MPNTR	0.0564**	0.0621**	0.0342	0.0290	0.0431	0.0400
	(0.0224)	(0.0278)	(0.0278)	(0.0279)	(0.0311)	(0.0301)
DEFB*XORNT	-0.0517**	-0.0483*	-0.0515**	-0.0457*	-0.0488*	-0.0482*
	(0.0250)	(0.0258)	(0.0250)	(0.0257)	(0.0259)	(0.0258)
DEFB*ED		-0.0121			-0.0206	-0.0236
		(0.0237)			(0.0244)	(0.0244)
DEFB*KINT			0.0220		0.0234	
			(0.0164)		(0.0173)	
DEFB*TNG				0.0530*		0.0606*
				(0.0308)		(0.0318)
Observations	13220	12221	13033	12221	12045	12221
R^2	0.083	0.083	0.082	0.083	0.083	0.083

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3.6: Alternative default indicators (II)

	(1) VAGR	(2) VAGR	(3) VAGR	(4) VAGR	(5) VAGR	(6) VAGR
SHVA	-2.083***	-2.096***	-2.074***	-2.089***	-2.088***	-2.089***
	(0.120)	(0.124)	(0.120)	(0.124)	(0.125)	(0.124)
RERGR*MPNTR	0.130**	0.0716	0.130**	0.0656	0.0699	0.0645
	(0.0520)	(0.0537)	(0.0522)	(0.0537)	(0.0540)	(0.0537)
RERGR*XORNT	0.0614	0.0828	0.0669	0.0940	0.0888	0.0948
	(0.0622)	(0.0633)	(0.0629)	(0.0634)	(0.0641)	(0.0634)
$DEFC_0$*MPNTR	-0.118***	-0.1000**	-0.0510	-0.0688*	-0.0457	-0.0716
	(0.0326)	(0.0404)	(0.0413)	(0.0406)	(0.0460)	(0.0439)
$DEFC_1$*MPNTR	-0.0604	-0.0673	0.0203	-0.0187	-0.00057	-0.0214
	(0.0368)	(0.0454)	(0.0466)	(0.0465)	(0.0518)	(0.0502)
$DEFC_2$*MPNTR	0.144***	0.158***	0.0640	0.0483	0.0762	0.0775
	(0.0383)	(0.0470)	(0.0480)	(0.0481)	(0.0535)	(0.0518)
$DEFC_3$*MPNTR	0.148***	0.142***	0.0541	0.0990**	0.0647	0.105**
	(0.0386)	(0.0478)	(0.0496)	(0.0495)	(0.0552)	(0.0535)
$DEFC_4$*MPNTR	0.0026	-0.0188	-0.0498	-0.0259	-0.0580	-0.0397
	(0.0362)	(0.0450)	(0.0460)	(0.0454)	(0.0514)	(0.0494)
$DEFC_0$*XORNT	0.0559	0.0435	0.0436	0.0379	0.0386	0.0394
	(0.0371)	(0.0387)	(0.0391)	(0.0385)	(0.0404)	(0.0387)
$DEFC_1$*XORNT	0.0085	0.0264	0.0045	0.0205	0.0247	0.0215
	(0.0413)	(0.0425)	(0.0413)	(0.0423)	(0.0425)	(0.0425)
$DEFC_2$*XORNT	-0.131***	-0.141***	-0.128***	-0.130***	-0.140***	-0.137***
	(0.0417)	(0.0430)	(0.0418)	(0.0428)	(0.0430)	(0.0430)
$DEFC_3$*XORNT	-0.0896**	-0.0678	-0.0831*	-0.0608	-0.0632	-0.0621
	(0.0423)	(0.0434)	(0.0424)	(0.0434)	(0.0435)	(0.0436)

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Table 3.6: (continued)

$DEFC_4$*XORNT	-0.0480	-0.0444	-0.0527	-0.0441	-0.0447	-0.0407
	(0.0380)	(0.0394)	(0.0400)	(0.0392)	(0.0412)	(0.0394)
$DEFC_0$*ED		-0.0065			0.0163	0.0045
		(0.0347)			(0.0357)	(0.0357)
$DEFC_1$*ED		-0.0128			0.0105	0.0054
		(0.0406)			(0.0416)	(0.0416)
$DEFC_2$*ED		-0.0291			-0.0534	-0.0640
		(0.0421)			(0.0431)	(0.0432)
$DEFC_3$*ED		0.0028			-0.0228	-0.0134
		(0.0432)			(0.0441)	(0.0442)
$DEFC_4$*ED		0.0347			0.0247	0.0257
		(0.0392)			(0.0402)	(0.0401)
$DEFC_0$*KINT			-0.0626**		-0.0657**	
			(0.0245)		(0.0256)	
$DEFC_1$*KINT			-0.0592		-0.0588	
			(0.0420)		(0.0417)	
$DEFC_2$*KINT			0.0802***		0.0952***	
			(0.0298)		(0.0310)	
$DEFC_3$*KINT			0.0923***		0.0902***	
			(0.0309)		(0.0322)	
$DEFC_4$*KINT			0.0531*		0.0419	
			(0.0286)		(0.0298)	
$DEFC_0$*TNG				-0.0671		-0.0685
				(0.0453)		(0.0466)
$DEFC_1$*TNG				-0.113**		-0.115**
				(0.0537)		(0.0551)

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Table 3.6: (continued)

$DEFC_2$*TNG				0.189***		0.208***
				(0.0552)		(0.0566)
$DEFC_3$*TNG				0.0899		0.0941
				(0.0569)		(0.0582)
$DEFC_4$*TNG				0.0583		0.0517
				(0.0516)		(0.0529)
Observations	13220	12221	13044	12221	12056	12221
R^2	0.087	0.087	0.089	0.088	0.089	0.089
F tests (p-values):						
All DEFC*MPNTR=0	[0.000]	[0.000]	[0.301]	[0.126]	[0.312]	[0.078]
All DEFC*XORNT=0	[0.010]	[0.014]	[0.019]	[0.035]	[0.019]	[0.025]
All DEFC*ED=0		[0.929]			[0.753]	[0.713]
All DEFC*KINT=0			[0.000]		[0.000]	
All DEFC*TNG=0				[0.001]		[0.000]

Standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 3.7: Alternative default indicators (III)

	(1) VAGR	(2) VAGR	(3) VAGR	(4) VAGR	(5) VAGR	(6) VAGR
SHVA	-2.073***	-2.088***	-2.068***	-2.088***	-2.085***	-2.088***
	(0.120)	(0.124)	(0.121)	(0.124)	(0.125)	(0.124)
RERGR*MPNTR	0.121**	0.0641	0.123**	0.0644	0.0660	0.0640
	(0.0515)	(0.0532)	(0.0518)	(0.0532)	(0.0535)	(0.0532)
RERGR*XORNT	0.0630	0.0811	0.0553	0.0810	0.0746	0.0812
	(0.0597)	(0.0607)	(0.0603)	(0.0607)	(0.0613)	(0.0607)
DEFD*MPNTR	-0.0435**	-0.0352	-0.0414	-0.0437	-0.0366	-0.0361
	(0.0220)	(0.0269)	(0.0272)	(0.0272)	(0.0301)	(0.0291)
DEFD*XORNT	-0.0135	-0.0109	-0.0150	-0.0092	-0.0104	-0.0107
	(0.0223)	(0.0231)	(0.0228)	(0.0231)	(0.0236)	(0.0232)
DEFD*ED		-0.0172			-0.0165	-0.0178
		(0.0232)			(0.0241)	(0.0241)
DEFD*KINT			-0.0026		-0.0005	
			(0.0158)		(0.0168)	
DEFD*TNG				-0.0035		0.0025
				(0.0296)		(0.0308)
Observations	13220	12221	13033	12221	12045	12221
R^2	0.083	0.083	0.083	0.083	0.083	0.083

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3.8: Sector descriptions

ISIC	Description
311	Food products
313	Beverages
314	Tobacco
321	Textiles
322	Wearing apparel, except footwear
323	Leather products
324	Footwear, except rubber or plastic
331	Wood products, except furniture
332	Furniture, except metal
341	Paper and products
342	Printing and publishing
351	Industrial chemicals
352	Other chemicals
353	Petroleum refineries
354	Misc. petroleum and coal products
355	Rubber products
356	Plastic products
361	Pottery, china, earthenware
362	Glass and products
369	Other non-metallic products
371	Iron and steel
372	Non-ferrous metals
381	Fabricated metal products
382	Machinery, except electrical
383	Machinery, electric
384	Transport equipment
385	Prof and scient equipment
390	Other manufactured products

Table 3.9: Default episodes in the sample

Country	Default years
Algeria	1991
Argentina	1989,2001
Bolivia	1986
Chile	1983
Costa Rica	1981,1984
Ecuador	1982,1999
Ethiopia	1991
Guatemala	1986
Indonesia	1998,2000,2002
Jordan	1989
Kenya	1994,2000
Kuwait	1990
Malawi	1982,1988
Mexico	1982
Moldova	2002
Morocco	1986
Myanmar	1997
Nigeria	1982,1992
Panama	1983,1987
Philippines	1983
Poland	1981
Russia	1998
Senegal	1981,1990,1992
Slovenia	1981
South Africa	1985,1989,1993
Tanzania	1984
Trinidad and Tobago	1988
Turkey	1982
Uruguay	1983,1987,1990
Venezuela	1983,1990,1995,1998

Appendix A

Extensions and proofs

This appendix contains extensions and proofs related to the debt restructuring model presented in chapter 2.

A.1 Partial implementation of Collective Action Clauses

The analysis of CACs presented so far assumed that both loans had the same collective action threshold. The main result was that CACs maximized the value of debt. Both the threshold assumption and the result on penalty maximization are at odds with empirical observations. First, virtually every country has an outstanding debt stock of debt mixing bonds with and without CACs. Second, Becker et al. (2003) and Gugiatti and Richards (2003) find that the inclusion of CACs has no significant impact on bond yields. It is clear that, if CACs actually maximize the value of a bond in the event of default, its primary and secondary market yield should be lower.

A straightforward modification of the model to incorporate bond-specific thresholds reconciles the theoretical predictions with the empirical regularities.

A slight variation in the voting stage is enough to capture the effects of multiple thresholds. Let $\overline{v}_j \in (0,1]$ denote the collective action threshold of loan j and assume that $\overline{v}_1 < 1$ but $\overline{v}_2 = 1$. In words, loan one includes CACs, but loan two does not. Since the two loans are no longer identical, every creditor votes twice. $v_i^j \in \{0,1\}$ codifies the vote of creditor i on the amendment of loan j. $V_j \equiv \sum_{i=1}^{I} \alpha_i^j v_i^j$, $j = 1, 2$, summarizes the result of each voting. If $V_1 < \overline{v}_1$ or $V_2 < 1$ the game moves to the litigation stage.

As in the main text, I consider the case of one large creditor and many small ones. If the large creditor holds the loan with CACs, it is still the case that CACs maximize repayment and deter litigation. However, if the large creditor has a stake in the loan without CACs, new insights arise. More specifically, assume the following.

$$\alpha_1^1 = 0 \text{ and } \alpha_1^2(1-\alpha_1^2)D_2 > \phi \tag{A.1}$$

The remaining claims are held by small creditors

$$\alpha_i < \phi \quad i = 2, \ldots, I \tag{A.2}$$

Finally, the lobbying cost is relatively small

$$\alpha_i p_i \geq c \quad \forall i \tag{A.3}$$

In this setting, the power of CACs vanishes.

Result 5. *Partial implementation of CACs ($\overline{v}_1 < 1$ but $\overline{v}_2 = 1$) is irrelevant if the large creditor holds the debt issue without CACs. In this case, the equilibrium for all $\overline{v}_1 \in (0, 1)$ is*

1. $P^* < \overline{P}$

2. $v_1^2 = 0$. *For* $i \geq 2$, $v_i^j = 1$, $j = 1, 2$ *so that* $V_1^* = 1$ *and* $V_2^* = 1 - \alpha_1^2$

3. $l_1^* = 1$ *if* $P \in \left(\frac{\phi}{1-\alpha_1^2 D_2}, \frac{\alpha_1^2 D_2 - \phi}{\alpha_1^2 D_2}\right)$ *and* $l_1^* = 0$ *otherwise. For* $i \geq 2$, $l_i^* = 0 \; \forall P$

This result rationalizes the empirical finding that CACs do not affect bond yields. Penalties remain unaltered following a partial adoption of CACs because unanimity is required for the bond the litigator is holding. As a result, the externality of effort is not reduced by the introduction of partial CACs and the market value of the loans cannot vary.

A.2 Collective Action Clauses with symmetric creditors

Throughout chapter 2, I have studied CACs under a particular but interesting portfolio configuration that features asymmetric creditor sizes. In this appendix I show that if one assumes the asymmetry away, CACs become an irrelevant dimension of the debt contract.

Let the $I \geq 2$ creditors hold symmetric portfolios

$$\alpha_i = \frac{1}{I} \quad \forall i \leq I \tag{A.4}$$

Lobbying power is not restricted to be homogeneous but is large with respect to the lobbying cost for all creditors[1]

$$\alpha_i p_i \geq c \quad \forall i \tag{A.5}$$

Finally, I restrict the legal cost to be such that $\phi < \frac{1}{I^2}$.[2]

Under these assumptions the following result obtains.

Result 6. *With symmetric creditors, penalties are always maximized and legal costs minimized regardless of the inclusion of CACs. The equilibrium is*

1. $e_i^* = 1 \quad \forall i,\ P^* = \overline{P}$

2. $v_i^* = 1 \quad \forall i,\ V^* = 1$

3. *The litigation game depends on P in the following way*

   If $P \leq \frac{\phi}{1-1/I},\ L^* = 0$

   If $P \in \left(\frac{\phi}{1-1/I}, I\right],\ L^* = \frac{P}{\phi I}$

   If $P \in (\phi I, 1 - \phi I],\ L^* = 1$

   If $P \in \left(1 - \phi I, 1 - \frac{\phi I}{I-1}\right]$, *both* $L^* = 0$ *and* $L^* = 1$ *are equilibria*

   If $P > 1 - \frac{\phi I}{I-1},\ L^* = 0$

To understand the qualitative nature of the result, note that the payoff functions are completely symmetric if one assumes $\alpha_i = 1/I\ \forall i$. Therefore, litigation harms all players evenly. Every time ϕ is spent on legal costs everyone's profit falls and it is

[1] I also assume $\overline{P} \geq \frac{\phi}{1-1/I}$. Otherwise, the game is uninteresting since penalties cannot reach the minimum level required to trigger litigation.

[2] There are two more cases, $\phi \in \left(\frac{1}{I^2}, \frac{1}{2I}\right]$ and $\phi \in \left(\frac{1}{2I}, \frac{1}{I} - \frac{1}{I^2}\right]$, that deliver slightly different breaking points between regions. The qualitative results of the model are unaffected by the changes. For costs above $\frac{1}{I} - \frac{1}{I^2}$ litigation never takes place and debt restructuring is a straightforward process.

not possible to do better than average by litigating. At the voting stage, creditors anticipate the negative effects of litigation and perfectly coordinate to rewrite the contract. The voting rule is irrelevant since no individual holdout can earn a higher than average return. Figure A.1 illustrates the point graphically. A restructured contract assures a payoff P/I while a nonrestructured contract brought to court always delivers a weakly lower payoff.

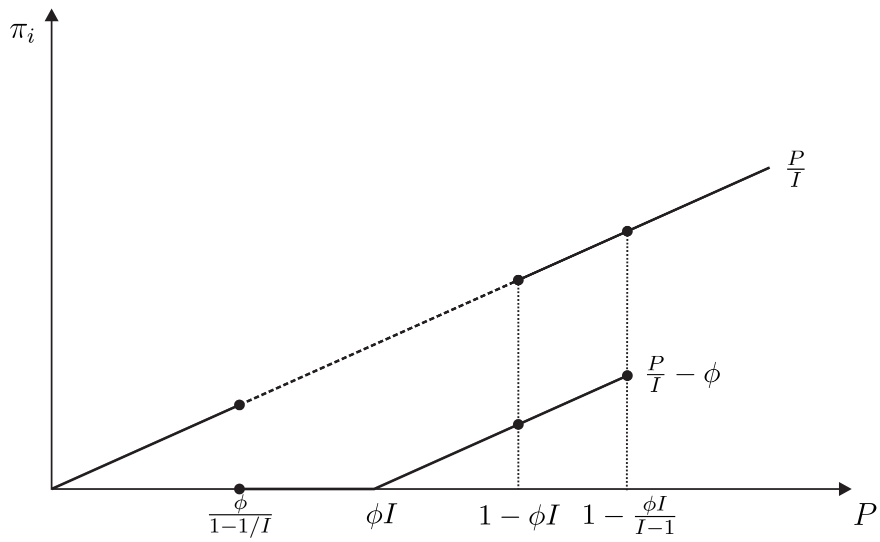

Figure A.1: CACs, symmetric creditors

Summing up, asymmetric creditor sizes are critical to generate a meaningful role for CACs. This could partly explain why creditor coordination failures were less of a central issue in the syndicated loan era. It is reasonable to argue that, however limited the information on the composition of the investor base might be, the syndicates extending loans in the 80s were a far more symmetric group than nowadays bond investors.

A.3 Collective Action Clauses with attachable assets

So far I have assumed that the court cannot seize any debtor's assets to satisfy demands of full repayment. This is likely to be the case since it is easy to circumvent attachment in the court's jurisdiction by transferring assets to the embassies or similar strategies. However, if assets with total value S are available to the court the game displays some new features.

As in the main text, I assume pro-rata contracts. The judicial process when the court has further power than the pure redistribution already modelled is as follows. In first place, sovereign's assets are attached to pay the litigators with no redistribution of P. When the total size of litigators surpasses the value of attachable assets, $L > S$, the judge resorts again to the redistribution of P described in section 2.3.1. I still assume that there is no way of recouping the face value of the claims: $S + \overline{P} < 1$. The rules for the first two stages and the timing remain the same. Then, the third stage is fully described by

$$\pi_i(l_i = 0) = \begin{cases} \alpha_i P - ce_i & \text{if } L \leq S \\ \frac{\alpha_i}{1-L}(S + P - L) - ce_i & \text{if } S < L \leq S + P \\ -ce_i & \text{if } L > S + P \end{cases} \tag{A.6}$$

$$\pi_i(l_i = 1) = \begin{cases} \alpha_i - \phi - ce_i & \text{if } L \leq S + P \\ \frac{\alpha_i}{L}(P + S) - \phi - ce_i & \text{if } L > S + P \end{cases} \tag{A.7}$$

Litigation as it is described here is a productive activity that increases repayment by S in contrast with the previous setup where it was just a costly redistribution. A direct implication is that it is not so clear that banning litigation is an efficient choice. On the one hand, legal costs ϕ are saved but on the other hand access to additional resources S is lost. I next explore this trade-off in detail.

As in the main text, I deal with the case of one large creditor and many small ones. I impose $\alpha_1(1-\alpha_1) > \phi$ and $\alpha_i < \phi$ for $i \geq 2$. The lobbying cost is such that $\alpha_i p_i \geq c$ for all creditors.[3] The upshot of this case is that the guarantee that CACs maximize total net repayment is broken under some conditions. Before showing the result formally, I provide some intuition of it. First of all, note that as long as $S > \phi$ it is optimal from an aggregate point of view to attach assets. If S is large enough to pay the large creditor in full, $S > \alpha_1$, the small players are happy to allow litigation since the large creditor demands are fully financed by seizing assets. Nevertheless, opposite interests arise in the region $\phi < S < \alpha_1$. Although it is efficient to attach assets, small creditors do not agree since part of P is used to pay the litigator. Then, if the contract features CACs, the small creditors will block litigation even though total net repayment is lowered.

To make the point clear I focus on the case $\phi < S < \alpha_1$. A short comment is enough for the remaining two cases. When $S < \phi$ the game is qualitatively identical to the case in section 2.3.1. Small players always choose to block litigation and endogenous penalties are maximized. From an aggregate standpoint it is optimal to have no litigation since the value of assets is low. The case $S > \alpha_1$ does not generate any disagreement among players since P goes in full to small creditors and S is high enough to repay player one in full. Litigation is allowed and total net repayment is maximized.

In the case $S \in (\phi, \alpha_1)$, the properties of the equilibrium are

[3] I also assume that individual p_i's are small: $p_1 < \alpha_1 - S$ and $p_i < \alpha_1 - S - p_1 \ \forall i \geq 2$.

Result 7. *Contracts with* $\overline{v} < 1 - \alpha_1$ *are always restructured. Contracts with* $\overline{v} \geq 1 - \alpha_1$ *are never restructured and there is litigation in equilibrium. Restructuring the contract reduces total net repayment under the conditions in equation* (A.10) *below. The precise shape of the equilibrium is*

1. *If* $\overline{v} < 1 - \alpha_1,\ P^* = \overline{P}$

   If $\overline{v} \geq 1 - \alpha_1,\ P^* < \overline{P}$

2. $v_1^* = 0$*;* $v_i^* = 1$ *for* $i \geq 2$ *so that* $V^* = 1 - \alpha_1$*.*

3. $l_1^* = 1$ *if* $P \in \left[0, \frac{\alpha_1 - \phi}{\alpha_1}\right)$ *and* $l_1^* = 0$ *otherwise. Small creditors never litigate.*

Figures A.2 and A.3 depict payoff functions for both types of players. In the presence of an asset seizure technology, it is still the case that the large creditor earns a higher profit by allowing litigation. More specifically, these two conditions hold

$$\pi_1^r = \alpha_1 \overline{P} - c < \pi_1^{nr} = p_1 + S - \phi - c \qquad \text{(A.8)}$$

$$\pi_i^r = \alpha_i \overline{P} - c > \pi_i^{nr} = 0 \qquad i = 2, \ldots, I \qquad \text{(A.9)}$$

where r denotes a restructured contract and nr a non-restructured one. (A.8) and (A.9) result in a non unanimous voting $V^* = 1 - \alpha_1$. In the initial stage, the flat region of small players' payoff precludes contributions for a nonrestructured contract. Only the large player finds it profitable to increase repayment since she claims it through courts in the third stage. Therefore, penalties are endogenously low when CACs are not available. With CACs the contract is restructured and assets are not attached. The properties of the equilibrium discussed so far are common to the case of no attachable assets. However, there is a new trade-off in terms of total net repayment

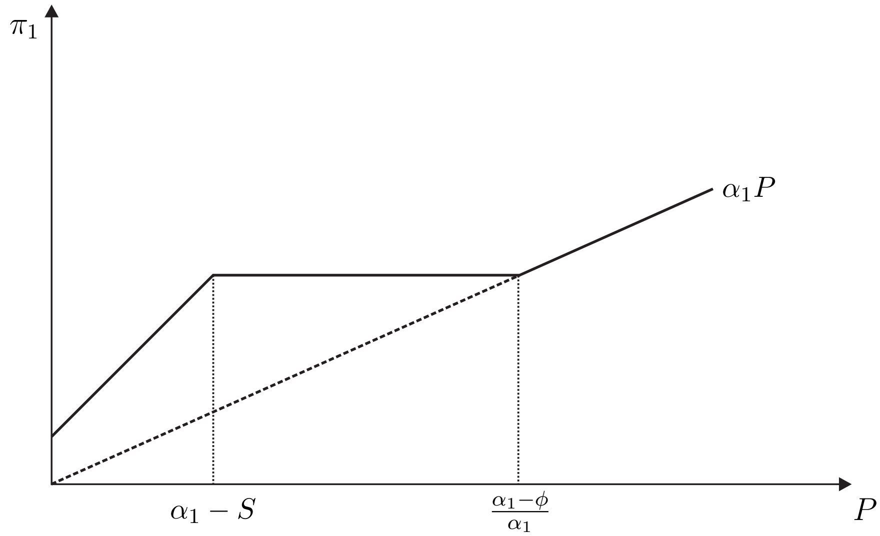

Figure A.2: Attachable assets, large creditor

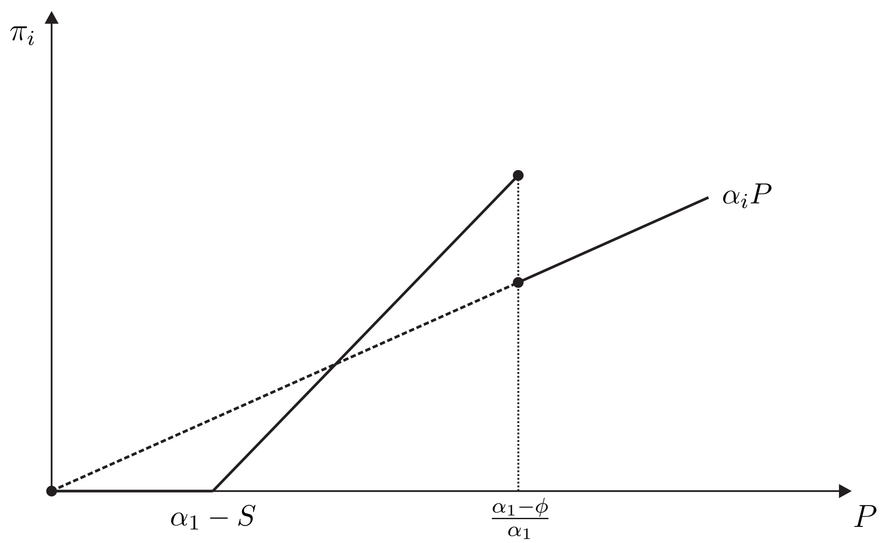

Figure A.3: Attachable assets, small creditor when using CACs: with CACs endogenous penalties are maximized but S is lost. Conversely, when player one is free to litigate, S is attached but endogenous penalties drop to p_1. The following condition determines parameter values that combined with CACs depress aggregate repayment.

$$\sum_{i=2}^{I}(p_i - c) < S - \phi \tag{A.10}$$

In words, if the abilities of lobbyists are low relative to the net value of assets maximizing the use of lobbying at the expense of asset seizure is not globally optimal. However, it is individually optimal to block litigation from the small creditors' standpoint since they suffer a loss in terms of P and do not capture S.

In contrast with the no attachable assets case, protecting the small creditors does not imply repayment maximization if condition (A.10) holds. This property of the model follows from the fact that litigation is productive but small creditors still suffer a loss when the sovereign is sued.

A.4 Seniority Clauses with I creditors

This appendix generalizes the SC analysis of sections 2.3.2 and 2.4 to the case of $I > 2$ creditors. I still assume that CACs are precluding litigation and $p_i = p$ for all $i \leq I$. I state the results skipping the intuitive discussion since it is identical to that presented in the main text.

When no secondary markets exist, the problem of creditor i with pro-rata contracts is

$$\max_{e_i \in \{0,1\}} \quad \pi_i = \alpha_i p \sum_{n=1}^{I} e_n - c e_i \tag{A.11}$$

The first-order condition of this problem immediately yields the following result.

Result 8. *With pro-rata debt contracts penalties are maximized ($P^* = Ip$) if portfolios satisfy*

$$\alpha_i \geq \frac{c}{p} \quad i = 1, \dots, I \tag{A.12}$$

For the case of SCs, creditor i solves

$$\max_{e_i \in \{0,1\}} \quad \pi_i = \alpha_i^1 \min\{D_1, p\sum_{n=1}^{I} e_n\} + \alpha_i^2 \max\{0, p\sum_{n=1}^{I} e_n - D_1\} - ce_i \tag{A.13}$$

As before, penalty maximizing portfolios are those containing the marginal loan being repaid.

Result 9. *With SCs penalties are maximized ($P^* = Ip$) if portfolios satisfy the following conditions*

1. *In the case $D_1 < (I-1)p$,*

$$\alpha_i^{2^*} \geq \frac{c}{p} \quad i = 1, \dots, I \tag{A.14}$$

2. *In the case $D_1 \in [(I-1)p, Ip]$,*

$$\alpha_i^{1^*}(D_1 - (I-1)p) + \alpha_i^{2^*}(Ip - D_1) \geq c \quad i = 1, \dots, I \tag{A.15}$$

3. *In the case $D_1 > Ip$,*

$$\alpha_i^{1^*} \geq \frac{c}{p} \quad i = 1, \dots, I \tag{A.16}$$

Qualitatively identical parameter configurations to those in examples 1–3 yield again the result that the introduction of SCs might lower or raise repayment. For the sake of brevity, I omit the equivalent examples with $I > 2$ creditors.

Introducing secondary markets together with CACs yields again the result that penalties are maximized irrespective of the existence of SCs.

Result 10. *Under perfect secondary markets and CACs, repayment is always maximized ($P^* = Ip$) both under pro-rata and SC contracts. The equilibrium portfolios are those already described in results 8 and 9.*

Proof: straightforward modification of the proof in appendix A.8

Summing up, the properties of the model do not hinge on the assumption $I = 2$.

A.5 Litigation with Seniority Clauses

This appendix argues that the interaction between litigation and effort with SC contracts is qualitatively identical to the pro-rata case already discussed in detail. Since closed-form solutions to this case are beyond the scope of the paper, I just show that litigation still disincetivizes effort in the setting with one large creditor in front of many small ones. The specific assumptions on creditor sizes are $\phi < 1 - \alpha_1^2 - (\alpha_1^1 - \alpha_1^2)D_1$ and $\phi > \alpha_i$ for $i \geq 2$.[4]

For the sake of simplicity, let us assume $p_i = p \; \forall i$ and take the case $D_1 < (I-1)p$, which implies that the marginal loan being repaid is D_2.[5] According to the payoff functions in equations (2.4) and (2.5) creditor one will litigate if the third stage is

[4]The steps to derive the restriction on the large creditor's size are qualitatively identical to those described in footnote 20.

[5]Parallel arguments apply to the cases $D_1 \in [(I-1)p, Ip]$ and $D_1 > Ip$.

reached as long as penalties satisfy

$$\alpha_1^1 D_1 + \alpha_1^2 D_2 - \phi > \alpha_1^1 D_1 + \alpha_1^2 (P - D_1) \tag{A.17}$$

$$P - \phi > \alpha_1^1 D_1 + \alpha_1^2 (P - D_1) \tag{A.18}$$

which yields $l_1^* = 1$ iff $P \in \left(\frac{(\alpha_1^1 - \alpha_1^2) D_1 + \phi}{1 - \alpha_1^2}, 1 \right)$. This condition is qualitatively identical to the litigation rule described in result 1.

Having seen that the large creditor litigates for certain values of penalties, let us look at the voting stage. As it was the case with pro-rata contracts, the payoff of a small creditor is decreasing in L (see equation 2.4). Therefore, voting decisions diverge. Without CACs the large creditor will deter any attempt to restructure the contract. CACs bind the large creditor and assure that legal costs are not inefficiently incurred.

Finally, it is also possible to show that, in the lobbying stage, incentives to exert effort are weakened if creditors anticipate litigation. To see it, let us compare the conditions leading to maximal repayment in the cases $L = 0$ and $L = \alpha_1$. In the former situation effort decisions are governed by case (i) in result 9:

$$e_i^* = 1 \text{ iff } \alpha_i^2 \geq \frac{c}{p} \quad \forall i \tag{A.19}$$

In contrast, two conditions are required to elicit effort if $L = \alpha_1$

$$\alpha_1 < \overline{P} - D_1 \tag{A.20}$$

and

$$\alpha_i^2 \geq \frac{c}{p} \quad \forall i \tag{A.21}$$

which immediately yields that conditions for maximizing penalties are more restrictive when contracts allow litigation. Intuitively, (A.20) is required since the litigator is reducing the resources available to repay the marginal loan D_2. Thus, if the mass of the litigator is sufficiently high, nothing is left for the junior loan and small creditors stop putting effort since a hundred percent of their effort productivity is an externality to the litigator. In a nutshell, in the absence of CACs litigation also distorts effort incentives under SCs. CACs prevent low endogenous repayment and inefficient expenditure on litigation costs just as they did in the pro-rata case.

A.6 Implicit seniority

The core model of the paper has dealt with the case of *de jure* seniority, that is, with an absolute priority rule explicitly stated in the debt contract. Despite the absence of explicit seniority in sovereign debt contracts, Bolton and Jeanne (2005), Roubini and Setser (2004), and Gelpern (2004) note that debtors seem to treat particular creditors as implicitly junior or senior. For instance, Paris Club debt tends to be junior to bonded debt and multilateral agencies senior to the rest of lenders. In these cases, seniority is attached to the creditor and not to the instrument itself. Another remarkable property of bilateral and multilateral loans is that they are not traded in secondary markets.

The model can be easily tailored to explore the implications of these facts on default penalties. Taking the case of Paris Club debt versus bonded debt, let creditor one holding D_1 be a private creditor and creditor two holding D_2 be the Paris Club. To simplify, I assume that no litigation can take place in this setting.[6]

Finding the equilibrium penalties boils down to solving (2.14) for the particular case $\alpha_1^1 = \alpha_2^2 = 1$ and $\alpha_1^2 = \alpha_2^1 = 0$. The equilibrium of this game is relatively simple. The notation used to describe mixed strategy equilibria is $\sigma_1^* = \Pr[e_1^* = 1]$ and $\sigma_2^* = \Pr[e_2^* = 1]$.

Result 11. *With implicit seniority effort choices in the parameter regions depicted in figure A.4 are*

(a) $e_1^* = 0,\ e_2^* = 1;\ P^* = p$

(b) $\sigma_1^* = \frac{D_1+c-p}{D_1};\ \sigma_2^* = \frac{D_1-c}{D_1}.\ E\{P^*\} = p\left(2 - \frac{p}{D_1}\right) < 2p$

(c) $\sigma_1^* = \frac{c}{2p-D_1};\ \sigma_2^* = \frac{p-c}{2p-D_1}.\ E\{P^*\} = \frac{p^2}{2p-1} < 2p$

(d) $e_1^* = e_2^* = 1;\ P^* = 2p$

(e) $e_1^* = 1,\ e_2^* = 0;\ P^* = p$

Summarizing, full effort is only an equilibrium under very specific conditions. The reason is that under the initial portfolios creditor one is effectively senior to creditor two and the externalities of effort are large under a variety of parameter values. When lobbying power p is very large relative to D_1 – region (a) in the figure – creditor one would always deviate from $e_1 = 1$ because she knows that the junior's effort is very productive (p is high) and $P^* = p$ is high enough to fully repay D_1 and still leave enough repayment to creditor two to make up for the lobbying cost associated with $e_2^* = 1$. Conversely, when p is small compared to D_1 – region (e) – creditor two will

[6] I impose $p \geq 2c$ to make penalty maximization feasible if a secondary market opens.

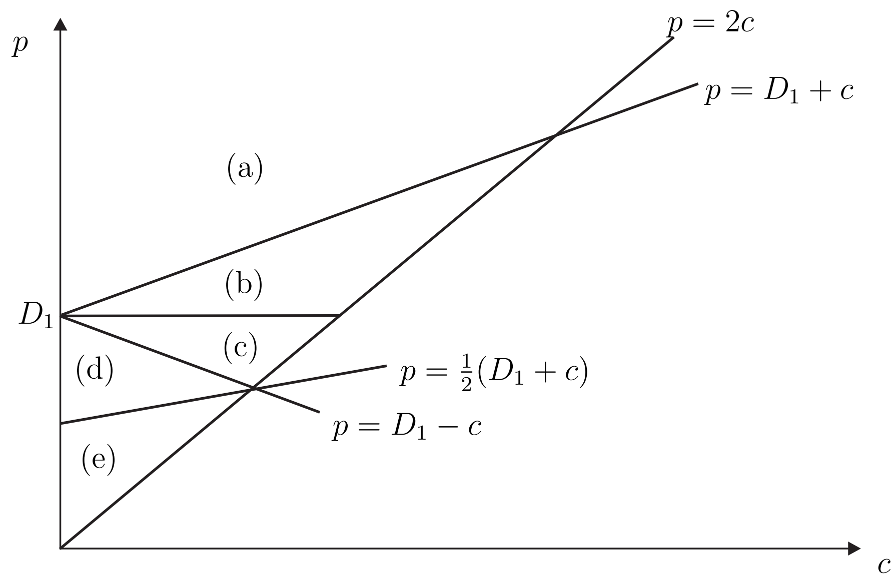

Figure A.4: Implicit seniority, penalties as a function of p and c

never exert effort in equilibrium since she would bear the cost c but the full value of penalties would be spent to cover the value of the large senior loan D_1 which is held by creditor one. As p takes less extreme values, the effects outlined above weaken and the equilibrium is in mixed strategies in regions (b) and (c). Finally, in region (d) parameter values strike a balance to sustain full effort as an equilibrium: creditor one does not deviate because p is not large enough relative to D_1 to free-ride on the other's effort and creditor two, despite being junior, can cover the cost c since p is high enough.

The disruption caused by implicit seniority could be neutralized if the Paris Club were allowed to trade with private creditors. In that context, purchases by the Paris Club decrease the amount of outstanding senior debt while sales to private creditors increase the amount of senior debt. Let X denote the, possibly negative, face value sold by Paris Club. Q denotes the price of the debt. Then, the optimization problem of the private creditor is

$$\max_{e_1 \in \{0,1\}} \quad \pi_1 = \min\{D_1 + X, p(e_1 + e_2)\} - ce_1 - QX \tag{A.22}$$

Paris Club solves

$$\max_{e_2 \in \{0,1\}} \quad \pi_2 = \max\{0, p(e_1 + e_2) - D_1 - X\} - ce_2 + QX \tag{A.23}$$

With this secondary market in place, there exists a trading strategy $X^* = p+c-D_1$ such that penalties are maximized. Note that when D_1 is large purchases by Paris Club are needed. The reason is that initially the amount of effectively senior debt is too large for the junior Paris Club to put effort. The opposite argument applies when D_1 is small, i.e., when too much junior debt exists. The private creditor has to buy debt from the Paris Club to strengthen her incentive to exert effort. Both creditors are interested in the exchange since it generates a net positive surplus.

To sum up, I collect in the following result the effects and policy implications of implicit seniority patterns.

Result 12. *The observed patterns of implicit seniority between bilateral lenders, multilateral agencies and private lenders might distort the incentives of the parties to contribute to penalties. Trading bilateral and multilateral loans in the secondary market would assure that penalties are maximized even in the presence of implicit seniority.*

A.7 Details of result 1

This appendix details the equilibrium effort choices in result 1 for all parameter values that are compatible with assumptions (2.6), (2.7), and (2.8).[7]

Result 1b. *If $\overline{v} \geq 1-\alpha_1$, equilibrium effort levels depend on parameter values in the following way.*

1. *If $\overline{P} \in \left[\frac{\phi}{1-\alpha_1}, \alpha_1\right)$, $P^* = \frac{\phi}{1-\alpha_1}$*
2. *If $\overline{P} \in [\alpha_1, \alpha_1 + p_1)$, there is multiple equilibria: $P^* = \frac{\phi}{1-\alpha_1}$ or $P^* = \overline{P}$*
3. *If $\overline{P} \in \left[\alpha_1 + p_1, \frac{\alpha_1-\phi}{\alpha_1}\right)$, there is multiple equilibria: $P^* = \frac{\phi}{1-\alpha_1}$ or $P^* = \overline{P} - p_1$*
4. *If $\overline{P} \geq \frac{\alpha_1-\phi}{\alpha_1}$, there is multiple equilibria: $P^* = \frac{\phi}{1-\alpha_1}$ or $P^* = \overline{P}$*

When $P^* = \frac{\phi}{1-\alpha_1}$, efforts are $e_i^* = 1$ for $i = 1, \ldots, \iota$ and $e_i^* = 0$ for $i = \iota+1, \ldots, I$ where ι is implicitly defined by $\sum_{n=1}^{\iota} p_n = \frac{\phi}{1-\alpha_1}$

The decisions in the voting and litigation stage do not depend on specific parameter values.

A.8 Proof of result 4

The result in the main text can be restated as follows in order to make the proof clearer.

Result 13. *Under perfect secondary markets and CACs, if portfolios such that $e_1^* = e_2^* = 1$ exist, they are the equilibrium portfolios. Any debt allocation with $e_1^* \neq 1$ or $e_2^* \neq 1$ cannot be an equilibrium since mutually profitable trades can be carried out.*

[7] I also assume that individual p_i's are small: $p_1 < \frac{\phi}{1-\alpha_1}$ and $p_i < \alpha_1 - \frac{\phi}{1-\alpha_1}$ for $i \geq 2$.

Proof. The following identity always holds true

$$\pi_1 + \pi_2 = (p - c)(e_1 + e_2) \tag{A.24}$$

Note that the sum of profits is maximized when effort is maximal. I first show that no trades take place when portfolios $\{\alpha_i^1, \alpha_i^2\}_{i=1}^2$ are such that $e_1^* = e_2^* = 1$ and $\pi_1^* + \pi_2^* = 2(p - c)$. Suppose that creditors deviate to portfolios $\{\hat{\alpha}_i^1, \hat{\alpha}_i^2\}_{i=1}^2$. Then, for the deviation to be profitable it must be the case that

$$\hat{\pi}_1 \geq \pi_1^* \text{ and } \hat{\pi}_2 \geq \pi_2^* \tag{A.25}$$

If following the deviation $\hat{e}_1 = \hat{e}_2 = 1$, then $\hat{\pi}_1 + \hat{\pi}_2 = \pi_1^* + \pi_2^*$ and (A.25) can only be satisfied with a transaction price such that both inequalities bind. Since creditors are thus indifferent I assume that trading volume is minimized and deviations leading to $\hat{e}_1 = \hat{e}_2 = 1$ are never observed.

If following the deviation $\hat{e}_1 \neq 1$ or $\hat{e}_2 \neq 1$ or both, $\hat{\pi}_1 + \hat{\pi}_2 < \pi_1^* + \pi_2^*$. It is trivial to see that this inequality is incompatible with (A.25). If overall profits are strictly lower after trade, one of the creditors must earn a strictly lower profit and that rules out the deviation.

Any debt allocation with $e_1^* \neq 1$ or $e_2^* \neq 1$ is neither an equilibrium if there exist alternative portfolios $\{\hat{\alpha}_i^1, \hat{\alpha}_i^2\}_{i=1}^2$ leading to $\hat{e}_1 = \hat{e}_2 = 1$. Since effort is not the highest, $\pi_1^* + \pi_2^* < 2(p - c)$ whereas $\hat{\pi}_1 + \hat{\pi}_2 = 2(p - c)$. Then, a debt price Q (or range of prices) that satisfies both inequalities in (A.25) must exist since the aggregate profit has risen with the deviation.

Finally, I show that the restrictions that parameters p and c must satisfy in order to make penalty maximization feasible are the same under pro-rata and SC contracts. Clearly, the restrictions $\alpha_1^j + \alpha_2^j = 1$, $j = 1, 2$, must hold at all times. Thus, in the case of pro-rata contracts, $2\frac{c}{p} \leq 1 \Leftrightarrow p \geq 2c$ is needed to satisfy (2.13) for both creditors at a time. Under SCs, it is immediate to see that the same condition applies to equations (2.15) and (2.17). To show that $p \geq 2c$ is also required in the remaining case (2.16), let us rewrite the inequalities in the following way

$$(1-\alpha_2^1)(D_1 - p) + (1-\alpha_2^2)(2p - D_1) \geq c \tag{A.26}$$

$$\alpha_2^1(D_1 - p) + \alpha_2^2(2p - D_1) \geq c \tag{A.27}$$

then suppose (A.26) is binding and add it to (A.27) to yield

$$(D_1 - p) + (2p - D_1) \geq 2c \tag{A.28}$$

which simplifies to $p \geq 2c$. □

Bibliography

Ades, A., Kaune, F., Leme, P., Masih, R. and Tenenguazer, D.: 2000, Introducing GS-ESS: a new framework for assessing fair value in emerging markets hard currency debt. Global Economics Paper No. 45, Goldman Sachs.

Arteta, C. and Hale, G.: 2008, Sovereign debt crises and credit to the private sector, *Journal of International Economics* **74**, 53–69.

Auboin, M. and Meier-Ewert, M.: 2003, Improving the availability of trade finance during financial crises. WTO Discussion Papers.

Becker, T., Richards, A. and Thaicharoen, Y.: 2003, Bond restructuring and moral hazard: are collective action clauses costly?, *Journal of International Economics* **61**(1), 127–161.

Beers, D. T. and Chambers, J.: 2006, Sovereign defaults at 26-year low, to show little change in 2007. Standard and Poor's RatingsDirect.

Bolton, P.: 2003, Towards a statutory approach to sovereign debt restructuring: Lessons from corporate bankruptcy practice around the world. IMF working paper No. 03/13.

Bolton, P. and Jeanne, O.: 2005, Structuring and restructuring sovereign debt: The role of seniority. CEPR Discussion Paper No. 4901.

Bolton, P. and Skeel, D.: 2004, Inside the black box: How should a sovereign bankruptcy framework be structured?, *Emory Law Journal* **53**, 763–822.

Borensztein, E., Chamon, M., Jeanne, O., Mauro, P. and Zettelmeyer, J.: 2004, Sovereign debt structure for crisis prevention. IMF Occasional Paper 237.

Borensztein, E. and Panizza, U.: 2006a, The cost of default. Inter-American Development Bank.

Borensztein, E. and Panizza, U.: 2006b, Do sovereign defaults hurt exporters? Research Department Working Paper no. 553, Inter-American Development Bank.

Braun, M.: 2003, Financial contractibility and asset hardness. Harvard University manuscript.

Bris, A. and Welch, I.: 2005, The optimal concentration of creditors, *Journal of Finance* **60**, 2193–2212.

Broner, F., Martín, A. and Ventura, J.: 2006, Sovereign risk and secondary markets. mimeo CREI.

Cohen, D. and Portes, R.: 2004, Towards a lender of first resort. CEPR Discussion Paper No. 4615.

De Paoli, B. and Hoggarth, G.: 2006, Costs of sovereign default, *Bank of England Quarterly Bulletin* .

Dell'Ariccia, G., Detragiache, E. and Rajan, R.: 2008, The real effect of banking crises, *Journal of Financial Intermediation* **17**, 89–112.

Dell'Ariccia, G., Schnabel, I. and Zettelmeyer, J.: 2006, How do official bailouts affect the risk of investing in emerging markets?, *Journal of Money, Credit and Banking* **38**(7), 1689–1714.

Eaton, J. and Fernandez, R.: 1995, Sovereign debt, *in* G. Grossman and K. Rogoff (eds), *Handbook of International Economics*, Vol. 3, Elsevier.

Eichengreen, B.: 1999, Toward a new international financial architecture: A practical post-Asia agenda. Washington: Institute for International Economics.

Esteves, R. P.: 2007, Quis custodiet quem? sovereign debt and bondholders' protection before 1914. University of Oxford Economics Series Working Papers No. 323.

Fernandez, R. and Ozler, S.: 1999, Debt concentration and bargaining power: Large banks, small banks, and secondary market prices, *International Economic Review* **40**(2), 333–355.

Gelpern, A.: 2004, Building a better seating chart for sovereign restructurings, *Emory Law Journal* **53**, 1115–1158.

Ghosal, S. and Miller, M.: 2003, Co-ordination failure, moral hazard and sovereign bankruptcy procedures, *The Economic Journal* **113**, 276–304.

Grossman, S. J. and Hart, O. D.: 1980, Takeover bids, the free-rider problem, and the theory of the corporation, *The Bell Journal of Economics* **11**(1), 42–64.

Gugiatti, M. and Richards, A.: 2003, Do collective action clauses influence bond yields? new evidence from emerging markets, *Rba research discussion papers*, Reserve Bank of Australia.

Hagan, S.: 2005, Designing a legal framework to restructure sovereign debt, *Georgetown Journal of International Law* **36**(2), 299–402.

Haldane, A. G., Penalver, A., Saporta, V. and Shin, H. S.: 2005a, Analytics of sovereign debt restructuring, *Journal of International Economics* **65**, 315–333.

Haldane, A. G., Penalver, A., Saporta, V. and Shin, H. S.: 2005b, Optimal collective action clause thresholds. Bank of England Working Paper No. 249.

Kletzer, K. M.: 2004, Sovereign bond restructuring: Collective action clauses and official crisis intervention, *in* A. Haldane (ed.), *Fixing Financial Crises in the 21st Century*, Routledge, chapter 13, pp. 230–253.

Kroszner, R. S., Laeven, L. and Klingebiel, D.: 2007, Banking crises, financial dependence, and growth, *Journal of Finance* **84**, 187–228.

Krueger, A.: 2001, International financial architecture for 2002: A new approach to sovereign debt restructuring. International Monetary Fund mimeo.

Miller, M. and Thomas, D.: 2007, Sovereign debt restructuring: The judge, the vultures and creditor rights, *The World Economy* **30**(10), 1491–1509.

Nicita, A. and Olarreaga, M.: 2007, Trade, production and protection 1976-2004, *World Bank Economic Review* **21**, 165–171.

Ozler, S. and Huizinga, H.: 1991, Debt concentration and secondary market prices: A theoretical and empirical analysis. NBER working paper 3654.

Park, C.: 2000, Monitoring and structure of debt contracts, *Journal of Finance* **55**(5), 2157–2195.

Pitchford, R. and Wright, M. L. J.: 2007, Restructuring the sovereign debt restructuring mechanism.

Rajan, R. G.: 1992, Insiders and outsiders: The choice between informed and arm's-length debt, *Journal of Finance* **47**(4), 1367–400.

Rajan, R. G. and Zingales, L.: 1998, Financial dependence and growth, *American Economic Review* **88**(3), 559–86.

Rogoff, K. and Zettelmeyer, J.: 2002, Bankruptcy proceedings for sovereigns: a history of ideas, 1976-2001. IMF working paper No. 02/133.

Rose, A. K.: 2005, One reason countries pay their debts: renegotiation and international trade, *Journal of Development Economics* **77**, 189–206.

Rose, A. K. and Spiegel, M. M.: 2004, A gravity model of sovereign lending: trade, default, and credit. IMF Staff Papers 51, Special Issue: 50-63.

Roubini, N. and Setser, B.: 2003, Improving the sovereign debt restructuring process: Problems in restructuring, proposed solutions, and a roadmap for reform. Paper prepared for the conference on "Improving the Sovereign Debt Restructuring Process".

Roubini, N. and Setser, B.: 2004, *Bailouts or Bail-ins? Responding to Financial Crises in Emerging Economies*, Institute for International Economics, Washington DC.

Sandleris, G., Gelos, G. R. and Sahay, R.: 2004, Sovereign borrowing by developing countries: What determines market access? IMF working paper 04/221.

Sturzenegger, F.: 2004, Toolkit for the analysis of debt problems, *Journal of Restructuring Finance* **1**(1), 201–230.

Sturzenegger, F. and Zettelmeyer, J.: 2006, *Debt Defaults and Lessons from a Decade of Crises*, The MIT Press.

Taylor, J. B.: 2001, Sovereign debt restructuring: A U.S. perspective. Speech at the Conference "Sovereign Debt Workouts: Hopes and Hazards?".

Tomz, M. and Wright, M. L. J.: 2007, Do countries "default in bad times?", *Journal of the European Economic Association* **5**(2-3), 352–360.

Trefler, D.: 1993, Trade liberalization and the theory of endogenous protection: An econometric study of U.S. import policy, *Journal of Political Economy* **101**(1), 138–60.

Weinschelbaum, F. and Wynne, J.: 2005, Renegotiation, collective action clauses and sovereign debt markets, *Journal of International Economics* **67**, 47–72.

Yue, V. Z.: 2005, Sovereign default and debt renegotiation. University of Pennsylvania mimeo.