Sovereign Debt Contracts and Financial Stability in Emerging Market Economies

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Für meine Freunde

"The study of economics does not seem to require any specialised gifts of an unusually high order. Is it not, intellectually regarded, a very easy subject compared with the higher branches of philosophy and pure science? Yet good, or even competent, economists are the rarest of birds. An easy subject at which very few excel!"

John Maynard Keynes, 1883 - 1946

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Preface

Emerging market economies navigate rough waters. It seems that the path of development from a low income country is a pebbly one. These countries seem to suffer more often of more severe economic crises than first world countries. Often these problems emanate from the sovereigns ability to meet obligations to external creditors, or economic crises undermine the solvency of the sovereign and a debt crisis adds up on the crisis account. The vulnerability of emerging market financing has various reasons. For one thing since emerging market economies are less mature and resilient so that exogenous shocks cause more harm. Therefore government income may be very volatile. But there are additional amplifying effects that cause turmoil.

Emerging market sovereigns borrowing opportunities are typically limited. A key reason is that since emerging market economies are mostly capital scarce, the sovereign borrows from foreigners. Defaulting against external creditors is of course more beneficial for a sovereign than defaulting against agents in the same economic circuit. And since sovereigns are not subjugated to any judicial executive, the danger of default is immanent.

The desire of the creditors to protect their interest has the consequence that emerging market countries usually borrow in foreign currencies and under foreign jurisdictions. The latter is obvious because otherwise the sovereign could too easily use its legislation power to deteriorate its debt. For foreign currency denomination this argument is also true if the central banks independency is doubtful. But furthermore, even if the central banks reputation is established there is often simply no market for claims denominated in the domestic currency in the western worlds financial centers. The consequence of foreign currency denomination is that exchange rate fluctuations directly pass through to the sovereigns ability to repay.

Another stylized fact of emerging market sovereign borrowing, and together with foreign currency denomination often labeled the *original sin*, is maturity mismatch. While the borrowed money is widely used for long-run growth prospects like infrastructure and education financing mostly runs at shorter maturities. Maturity mismatch bears the risk of self-fulfilling debt crises because creditors have an incentive to secure there money before others do so first. Even though the creditors were collectively better off resolving matters orderly, individually the *run for the exit* is perfectly rational. This risk of creditor coordination failure has become extremely apparent as emerging market finance shifted more an more towards bonds in the 1990s.

In this thesis I address two important aspects associated with the financial stability of emerging market sovereign borrowing. One aspect is the coordination of creditors or for that matters sovereign bondholders. If inefficient sun-spot crises occur it is natural to ask whether this is an inevitable outcome as a second best due to other market imperfections or how something can be done about it. The second aspect is that most of the economic risks emerging market sovereigns face are also borne by them. I therefore ask if more contingency could be implemented to seize gains from international risk sharing.

In chapter 1 I analyze creditor coordination clauses. As a response to recurring roll-over crises of sovereign debtors the official sector had advocated the inclusion of these so called collective action clauses (CAC) into sovereign bond contracts. These clauses allow the financial terms of a bond contract to be changed by a specified fraction of bondholders while binding in dissenting creditors. Thereby they abrogate the coordination problem among bondholders that gives rise to self-fulfilling crises. However, it was also argued that CAC, by facilitating repudiation, render debtors without proper incentives to undertake policies directed to repay in full. In chapter 1 I present a model to address the effect of the specified approval quota on the debtor's behavior. The trade-off between inefficient roll-over crises and debtor moral hazard is formalized in a model with endogenous short-term debt. It is shown that higher thresholds tend to have a disciplining effect on the debtor. Some characteristics of the optimal contract are presented.

Chapter 2 concentrates on the pricing of these collective action clauses in the secondary market for sovereign debt. Historically bonds issued under English law have always included such clauses while they were uncommon in New York law. But recently, due to support from the official sector, CAC have become market standard under New York law as well. I extend the literature on the pricing of coordination clauses in bond contracts by allowing the effect of coordination clauses to vary with the amount of outstanding coordinated debt. This yields two important effects: first, the degree of coordination, determined by the fraction of CAC bonds is priced by both the CAC bondholders as well as the holders of uncoordinated bonds. The sign of the effect depends on whether moral hazard is seen as a concern. Second, holders of bonds with collective action clauses pay smaller spreads the more other bonds are coordinated. The interpretation of this effect is that the positive effect enhanced coordination has on financial stability increases with the degree of coordination. There is however the risk for CAC bondholders that their negotiation power is inferior to that of other bondholders and that they will therefore face larger writedowns in the event of a restructuring. So, a large fraction of CAC bondholders enjoys the benefits of increased financial stability, while small fractions perceive their claims as junior to other bonds without financial stability being improved much.

Chapter 3 analyzes potential measures for externally indebted sovereigns to smooth macroeconomic volatility. It focuses on financial instruments that allow for state contingent repayments to avoid outright defaults and stabilize fiscal policies. The theoretical part shows that collateralizing standard debt contracts with state contingent financial derivatives and indexing bonds are equivalent ways of establishing state contingency. Furthermore, it is shown that uncertainty over the judicial treatment of derivative instruments may keep countries from buying hedge contracts today. The empirical part analyzes the prospect of indexing contracts to external variables. While variables partly under control of the local authorities like GDP, debt ratios, and reserves have high predictive power of debt repayment difficulties, these bring along moral hazard concerns. In contrast, external factors like interest rates and commodity prices comprise no moral hazard and financial derivatives in these markets are well established.

All three chapters are self-contained and can be read independently.

Chapter 1

Collective Action Clause Thresholds in the Presence of Moral Hazard

1.1 Introduction

In the 1990's sovereign debtors, especially emerging market countries, have experienced numerous financial crises. These crises differed from the known repayment problems of sovereigns in the preceding era in two aspects: Firstly, bond financing had increased rapidly following the solution of the 1980's debt crisis with the Brady plan.[1] As a result, creditors were more anonymous and their number surged. This aggravated the coordination problems among creditors. Secondly, these crises were mostly perceived as problems of illiquidity rather than insolvency.[2] Accordingly, crises were not solely explained by unsound domestic budget policies.

One theoretical explanation is the existence of self-fulfilling crises in the presence of maturity mismatch, i.e. if a long-term project is financed by short-term debt. If a first-come-first-served constraint applies the rollover decision of each creditor depends on his beliefs about the other creditors' rollover decision. This leads to multiple equilibria where either all investors withdraw or roll over.[3]

As a response the IMF, the G10 and other international finance officials are now advocating the use of collective action clauses (CAC) in sovereign bond contracts and recently these have indeed been included in several issues.[4] Nevertheless, there is still concern that making CAC inclusion mandatory would cut off countries with unfavorable fundamentals from financial markets.[5] Collective Action Clauses stipulate that the terms of a bond contract can be changed by a prespecified majority of bondholders and that such a decision is binding for dissenting creditors as well. This solves the coordination problem among creditors. However, it can be shown that a contract with the risk of a crisis due to early liquidation is second best if debtor moral hazard is an issue.[6] In such models the threat of early liquidation disciplines the debtor. Contracts that allow for inefficient outcomes are implemented to cope with moral hazard. Following this line of argument, measures that prevent crises may as well lead to the breakdown of the market. This paper addresses the question how CAC interact with debtor moral hazard and how the choice of the quota in CAC affects this problem. It

[1] See Cline (2000).

[2] See Eaton and Gersovitz (1981) on this issue.

[3] This theory goes back to the classical work by Diamond and Dybvig (1983) on self-fulfilling banking crises. See also Cole and Kehoe (1996,2000) and Morris and Shin (2004).

[4] The first noteworthy mention was Eichengreen and Portes (1996). Official statements include the Rey Report by the Group of Ten (1996) and several IMF reports (2003). An overview of the current situation is in Galvis and Saas (2004).

[5] See for example Shleifer (2003).

[6] See Calomiris and Kahn, 1991 and Jeanne, 2003)

identifies a trade-off between stability and appropriate incentives.

In the model a capital scarce country finances a long term project with short term bonds. The allocation of final output to the debtor and creditor is determined by an initial policy choice of the debtor country. If the creditors realize that the debtor is trying to divert assets they can liquidate the project. This will mean a loss to creditors, but is more favorable to them than being cheated upon by the debtor.

After signing the contract the debtor learns about the prospect of the creditor-unfriendly policy and chooses whether to divert assets or not. Because this information is unknown to creditors they can not infer exactly which policy was chosen. Then, creditors receive a noisy signal on the countries policy choice and vote whether to roll over the claims. If they withdraw the project is liquidated and the limited funds are used to repay each creditor an equal fraction of her claim. Last, if the project is continued it terminates and payoffs are made.

In equilibrium the creditors play a threshold strategy conditional on their signals. Creditors receive heterogeneous signals so a higher quota implies that a creditor with a less favorable signal is pivotal. Consequentially, the conditional rollover probabilities are decreasing as the threshold rises. The paper shows that this has a disciplining effect on the debtor. This effect is linked to the private information of the country: By setting a higher quota the creditors know that the country will only pursue the bad policy if the prospect of the creditor-unfriendly policy was very good. However, disciplining the debtor by hampering coordination will also increase the chance of an unnecessary crisis.

The framework is taken from Jeanne (2003) where he endogenizes the role of short term debt for sovereign lending in the presence of moral hazard. Most importantly, heterogeneous creditors are introduced in order to focus on the role of collective action clause thresholds. The underlying incentives are also similar to the one developed in Calomiris and Kahn (1991) where they show that a demandable debt contract is optimal to discipline a potentially fraudulent banker. The model nests the same trade-off between moral hazard and inefficient contracting that is prevalent in Bolton and Scharfstein (1996). In their paper increasing the number of creditors complicates restructuring in the event of default. While this helps discouraging *strategic* defaults it affects the liquidation value negatively if a *liquidity* default occurs. Haldane et al (2004) also address the question of optimal collective action clause thresholds. In their model there is no debtor moral hazard. The tradeoff in their model is that a higher threshold decreases the debtors payoff in the event of a crisis, although raising it's probability.

The optimal choice of the threshold depends on the country's risk preference.

The paper is structured as follows. Section 2 introduces the framework of the model. In section 3 the equilibrium is derived. In section 4 the optimization problem of the country is analyzed and the optimal contract is characterized. Section 5 concludes.

1.2 The Model

1.2.1 Payoffs

In the model world sovereign debt is subject to severe enforcement problems. I assume that countries are only enforced to repay, because they face a disadvantage from being in default. If this default cost exceeds the outstanding debt the country repays, otherwise it will default. Default costs are commonly motivated by a disruption of international trade and by monetary turmoil, e.g. a devaluation of the domestic currency or inflation. Another explanation can also be reputational costs, i.e. the expected loss from difficulties in future borrowing due to limited market access or higher interest rates.[7] Default costs are assumed to be a fraction of output so this fraction, θ, is pledeagble. The country can invest in a profitable project. The project yields a save real return of one unit and demands an investment $I < 1$. The project is long-term, i.e. it lasts two periods. If the project is liquidated earlier the return is diminished severely, i.e. output is only equal to $\alpha < 1$. The bond contract specifies a repayment R and the country will actually repay $min\{\theta, R\}$.

One key feature of the model is that the country can undertake two different types of policies: an investor-friendly and an investor-unfriendly. I assume that the country can determine the cost of default in the long run. If it undertakes a policy that keeps default costs high it can commit to a high repayment. Without commitment default costs and pledgeable output will be low. For example, an economy that is strongly

[7] Diamond (1989) shows that defaults will be punished with high interest rates and that reputation is an asset in this context. This does in a way extend the argument by Eaton and Gersovitz (1981) who assume that defaulting countries can not reaccess capital markets.
There is some debate on whether reputation can actually support foreign lending in the absence of direct sanctions. The idea of reputation based sovereign debt contracts is described in Eaton and Gersovitz (1981), Eaton, Gersovitz and Stiglitz (1986) and Grossman and Van Huyck (1988). Bulow and Rogoff (1989) argue that reputation alone can not support lending if the country can hold foreign assets to smooth its income path. Cole and Kehoe (1995,1998) challenge this argument by allowing for different institutions that affect a country's interaction with financial markets and show that reputation may be multidimensional in the sense that reputation in one dimension can spill over to another dimension. Both models allow for reputation to support foreign lending.

dependent on imports and exports will experience more severe economic decline due to default than one that is almost self-sustaining. Another example would be that a country could implement a regulatory scheme on domestic banks that makes them less vulnerable to a default on sovereign claims. In terms of the model this implies that default costs, i.e. the parameter θ can take different values. If θ is high the country commits to a higher repayment and is thus a more creditworthy borrower. I will label this investor-friendly policy simply the *good* policy. Consequentially, the policy that makes default less costly is the *bad* policy. So,

$$\theta = \begin{cases} \bar{\theta} & \text{if the policy is } \textit{good} \text{ and} \\ \underline{\theta} & \text{if the policy is } \textit{bad}. \end{cases}$$

At the outset the country is pursuing the good policy. In the initial period the country decides whether it sticks to the good policy or switches to the bad one. If the country decides to switch this will not be effective until the last period. So the impact of the bad policy comes with delay. The idea behind this is that a policy turnover is not effective over night. Following the examples I gave above, it is for example unrealistic for a country to overcome import dependence over night.

The policy can be thought of as an *asset diverting* policy, because it only affects the allocation of output, not its size. In the interim period the creditors can liquidate the project and evade a possible fraud. We assume that liquidating the project is profitable for the creditors if the bad policy was chosen, i.e. $\underline{\theta} < \alpha\bar{\theta}$. In addition, the liquidation value of the project is assumed to be insufficient to allow external financing, i.e. $I > \alpha\bar{\theta}$. It follows that $\alpha\bar{\theta} < R \leq \bar{\theta}$. So the creditors payoff U will be:

$$U = \begin{cases} R & \text{if the project is continued and the policy is } \textit{good} \text{ and} \\ \underline{\theta} & \text{if the project is continued and the policy is } \textit{bad} \text{ and} \\ \alpha\bar{\theta} & \text{if the project is liquidated.} \end{cases} \tag{1}$$

The debtor country will settle with the remainder of the project return:

$$X = \begin{cases} 1 - R & \text{if the project is continued and the policy is } \textit{good} \text{ and} \\ 1 - \underline{\theta} & \text{if the project is continued and the policy is } \textit{bad} \text{ and} \\ \alpha(1 - \bar{\theta}) & \text{if the project is liquidated.} \end{cases} \tag{2}$$

1.2.2 Timing, Information and Contracting

The model world lasts for four periods, $0, 1, 2, 3$. In period 0 the country can invest in the project that terminates in the last period. The country has no wealth so that it needs external financing. It offers a bond contract to a mass of risk neutral creditors. The risk-free world interest rate is normalized to zero. Bonds are assumed to be the only measure of external financing. We assumed that $I > \alpha\theta$ which implies that the project is long-term from the creditors point of view, i.e. it can not be financed if it is liquidated in the interim period for sure. This implies that a long-term contract is infeasible.

In the model the CAC will take the form of a roll-over clause.[8] It asks creditors to vote whether they accept to receive the repayment not until the final period. The contract also specifies a quota κ that determines the fraction of creditors required for the change in the financial terms of the contract. The specified repayment is R.

In period 1 the country learns it's type γ and thereafter decides whether it switches to the bad policy. The type is private information to the debtor and contains information on the relative prospect of both policies. The country will choose the good policy if

$$E[X_{good}] \geq E[X_{bad}] + \gamma \tag{3}$$

and the bad policy else. An interpretation of the type could for example be that the country receives news about the availability and prices of its imports and exports. In this example, if the country learns that it's future gains from trade are high it will be less likely to default. Alternatively, γ could also reflect political uncertainty. In this interpretation γ is simply an unforeseeable bias in the policymakers favor for either policy. The type γ is distributed with mean zero and variance σ_γ.

In period 2 short-term debt expires. The debtor will always desire to continue the project to maximize it's payoff. I assume that there are no other creditors supplying funds in the interim period. Accordingly, the country will exercise the CAC with certainty. This assumption incorporates the notion that old-established creditors do have a stronger incentive to engage into further financing of a struggling country.[9] Therefore the country will prefer to recontract with existing creditors in times of financial distress.

The debtors offer will then be voted upon by the creditors. In case the necessary

[8] See Buiter and Sibert (1999)
[9] See Bulow and Rogoff (1989)

quota for consent is met, the agreement will be binding for all creditors. If the offer is rejected the creditors will collectively sue the debtor country. They will extract all output pledgeable in that period and share it on a pro-rata basis. This embeds the fact that CAC usually provide a *sharing clause* so that no sequential service constraint applies.

In period 2, before casting her vote, each creditor receives a private signal. The signal contains noisy information of the policy that was undertaken, i.e.

$$z_i = \theta + \eta + \epsilon_i, \tag{4}$$

where ϵ_i represents some private noise term of creditor i and η is a common noise term, that reflects market uncertainty. Both types of noises are distributed normally with mean zero and variances σ_η and σ_ϵ respectively.

I assume that information efficiency does not hold, i.e. that information remains private after the signal is received. This restrictive assumption is necessary to implement a heterogeneous structure of the creditors that allows the analysis of the coordination problem. This is less of a problem since equation 4 can also be interpreted differently: all creditors receive the same public information but have a different perception of the consequences, or the signal has implications that are private information. For example some creditors may have other investment ongoing in the country that would be affected by the sovereign default. This would provide each creditor with an individual assessment of the situation. In the last period the project terminates and outstanding debt is settled.

The model setup defines a sequential game as in figure 1.1. In period 1 the country decides which policy action it chooses, $a \in \{good, bad\}$. In period 2 the creditors decide whether to roll over the countries claims or not, $v \in \{rollover(R), withdraw(W)\}$. With perfect information the efficient equilibrium $(good, R)$ is achieved. Without valuable information, i.e. if the signal is pure noise, the only equilibrium is (bad, W). In this case the game is equivalent to a simultaneous move game and *bad* is the dominant strategy for the debtor country because it yields at least the same payoff as *good* for either vote of the creditors.

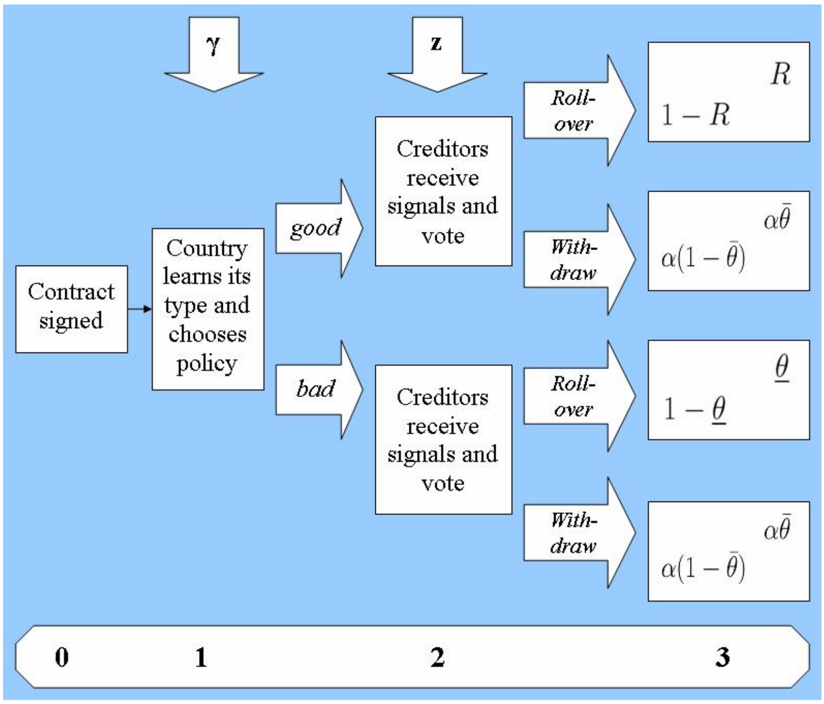

Figure 1.1: Sequential Game

The debt contract defines a sequential game: first, the country learns its type and decides upon the policy; second, the creditors receive a signal and decide collectively whether to roll-over the claims or not.

1.3 Solution

1.3.1 Individual Rational Voting

We proceed by solving backwards: In the final period all informational asymmetries are revealed and the payoffs are made. We begin our analysis in period 2 when the creditors make their roll-over decision. Each creditor will be asked to vote whether he agrees to a roll-over or not. In any case all creditors will receive the same pay-off so there is no room for strategic interaction.[10] Each creditor will vote for the action that maximizes his expected pay-off and will thereby also maximize the other creditors' expected payoff. Only, because creditors have heterogeneous private information there will be no unanimity.

The expression for each creditors expected payoff from rolling over the claims is:

[10]So the creditors do not play a global game a la Morris and Shin (1998,2000) and Carlsson van Damme (1993).

$$E[U^R] = P_i R + (1 - P_i)\underline{\theta}$$

where P_i is the probability that creditor i assesses to the event that the chosen policy is good, conditional on the signal z_i and her prior on the country's policy choice. The expected payoff from demanding immediate repayment is $\alpha\bar{\theta}$, so that we can claim that investor i will vote to roll over the claims if and only if:

$$P_i R + (1 - P_i)\underline{\theta} \geq \alpha\bar{\theta} \tag{5}$$

One can show that this implies that each individual creditor follows a threshold strategy around some z^*.

Proposition 1. INDIVIDUAL THRESHOLD STRATEGY: *Each individual creditor will vote in favor of the roll over if and only if $z_i \geq z^*$, i.e.*

$$v_i = \begin{cases} R & \text{if } z_i \geq z^* \\ W & \text{either.} \end{cases} \tag{6}$$

Proof of Proposition 1: A switching strategy implies that the left hand side of equation 5 is monotonically increasing in z_i and that the inequality holds in both directions for some values of z_i. Defining the expected payoff from rolling over as $E[U^R] = P_i R + (1 - P_i)\underline{\theta}$ we need:

$$\frac{\partial E[U^R]}{\partial z_i} \geq 0 \tag{7}$$

$$\lim_{z_i \to -\infty} E[U^R] \leq \alpha\bar{\theta} \tag{8}$$

$$\lim_{z_i \to \infty} E[U^R] \geq \alpha\bar{\theta} \tag{9}$$

where at least one inequality is strict. Let us now analyze how each creditor processes the information contained in the signal to get an expression for P_i. Bayesian updating implies:

$$Prob(\theta = \bar{\theta}) = \frac{Prob(\tilde{z}_i = z_i | \theta = \bar{\theta})P}{Prob(\tilde{z}_i = z_i | \theta = \bar{\theta})P + Prob(\tilde{z}_i = z_i | \theta = \underline{\theta})(1 - P)}$$

The probability that the signal z_i was sent, given the good policy was selected is:[11]

$$\begin{aligned} &Prob(\tilde{z}_i = z_i|\theta = \bar{\theta}) \\ =&Prob(z_i = \bar{\theta} + \eta + \epsilon_i) \\ =&Prob(\eta + \epsilon_i = z_i - \bar{\theta}) \end{aligned} \tag{10}$$

If η and ϵ_i are distributed normally the distribution of $\eta + \epsilon_i$ is also normal. Let us label the density of this common distribution f, then:

$$Prob(\theta = \bar{\theta}) = \frac{f(z_i - \bar{\theta})P}{f(z_i - \bar{\theta})P + f(z_i - \underline{\theta})(1-P)} = P_i$$

To see how the probability changes with different signals we can rearrange

$$P_i = \frac{1}{1 + \frac{f(z_i - \underline{\theta})(1-P)}{f(z_i - \bar{\theta})P}} \tag{11}$$

Let us now define the likelihood ratio of f:

$$l(z_i) = \frac{f(z_i - \bar{\theta})}{f(z_i - \underline{\theta})}$$

and recognize that by the normality of f it has the Monotone Likelihood Ratio Property. The Monotone Likelihood Ratio Property is a common assumption in principal-agent models with moral hazard. It states not only that higher ranked states become more likely as effort increases, but also that they become relatively more likely, i.e. that the likelihood ratio increases. For our purpose that implies:

$$\begin{aligned} \lim_{z_i \to -\infty} l(z_i) &= 0 \\ \lim_{z_i \to \infty} l(z_i) &= \infty \\ l'(z_i) &> 0 \end{aligned} \tag{12}$$

Then we can rewrite equation 11 as:

$$P_i = \frac{1}{1 + \frac{(1-P)}{P}\frac{1}{l(z_i)}}$$

[11]The analysis is symmetric for both policies.

With the MLR property we can deduct the following properties for $P_i(z_i)$:

$$\lim_{z_i \to -\infty} P_i = 0 \tag{13}$$

$$\lim_{z_i \to \infty} P_i = 1 \tag{14}$$

$$\frac{\partial P_i}{\partial z_i} > 0 \tag{15}$$

It follows that we have that

$$\lim_{z_i \to -\infty} E[U] = \underline{\theta} < \alpha\bar{\theta} \tag{16}$$

$$\lim_{z_i \to \infty} E[U] = \bar{\theta} > \alpha\bar{\theta} \tag{17}$$

so that equation 8 and 9 hold. Finally, equation 15 implies that the condition imposed in equation 7 holds. □

Intuitively, with higher signals it becomes more likely that the good policy was undertaken. Hence, the expected payoff from rolling over the claim is increasing in the value of the signal. At some point z^* it exceeds the payoff from demanding immediate repayment. We will now proceed to characterize the switching point z^*. Since equation 5 holds with equality at z^* we know that

$$\frac{f(z^* - \bar{\theta})PR + f(z^* - \underline{\theta})(1-P)\underline{\theta}}{f(z^* - \bar{\theta})P + f(z^* - \underline{\theta})(1-P)} = \alpha\bar{\theta}$$

To characterize the effect of a change in the prior P on the switching point z^* it is convenient to solve for P.[12] One obtains

$$P = \frac{f(z^* - \underline{\theta})(\alpha\bar{\theta} - \underline{\theta})}{f(z^* - \bar{\theta})(R - \alpha\bar{\theta}) + f(z^* - \underline{\theta})(\alpha\bar{\theta} - \underline{\theta})}$$

Rearranging yields

$$P = \frac{1}{1 + l(z^*)\frac{R - \alpha\bar{\theta}}{\alpha\bar{\theta} - \underline{\theta}}} \tag{18}$$

We can conclude that P and z^* are inversely related in the optimal voting strategy of a creditor. So a better prior P leads to a lower threshold value z^*. Intuitively, this arises from the fact that the resulting assessment P_i given a specific signal z_i is better if the initial belief about the countries policy is better. A creditor is more likely to prolong the credit the better his prior belief in the countries creditworthiness is. Figure

[12] Although it is convenient to solve for $P(z^*)$ the causal dependency is the other way around here.

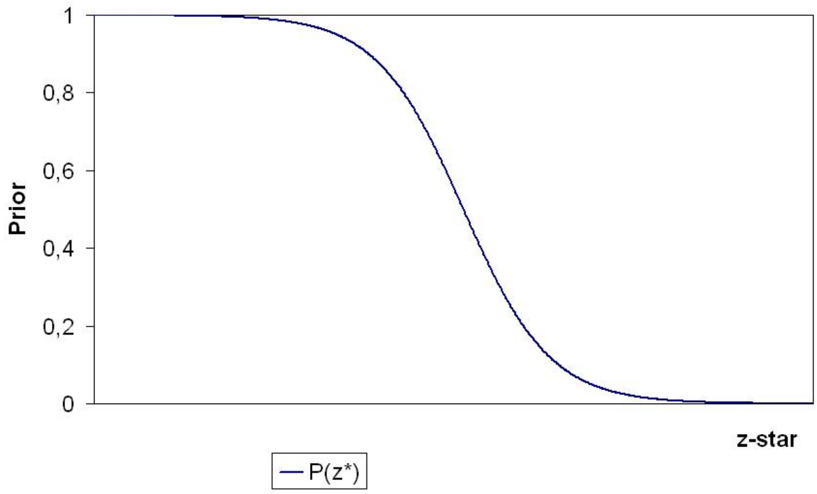

Figure 1.2: Threshold depending on the prior belief

1.2 illustrates this.

1.3.2 The Collective Vote

After assessing the voting decision of each individual creditor we shall now analyze the outcome of the voting. The decision making process is by assumption restricted to voting rules with a required approval to a roll over of $\kappa\%$. Since those creditors with the highest signals will vote in favor of a role over, this boils down to requiring that the creditor with the κth best signal favors the roll over. So the voting rule is:

$$v = v_\kappa$$

where v_κ is the pivotal creditor's vote. The signal the pivotal creditor received is $z_\kappa = \theta + \eta + \epsilon_\kappa$ where ϵ_κ satisfies

$$F_\epsilon(\epsilon_\kappa) = 1 - \kappa \tag{19}$$

So the debt will be rolled over if $z_\kappa = \theta + \eta + \epsilon_\kappa \geq z^*$. By equation 19 ϵ_κ is not random. This arises from the fact that the distribution of the private noise term is known, so that we can identify the private noise faced by the pivotal creditor. We recollect and define y to obtain a condition for a successful roll-over:

$$y = \theta + \eta \leq z^* - \epsilon_\kappa = y^* \tag{20}$$

Proposition 2. Creditor Collective Threshold Strategy: *The creditors will roll over the debt if and only if $y \geq y^*$, i.e.*

$$v = \begin{cases} R & \textit{if } y \geq y^* \\ W & \textit{either.} \end{cases} \tag{21}$$

To see how a change in the quota changes the roll-over regime we sub in $z^* = y^* + \epsilon_\kappa$ in equation 18 and get

$$P = \frac{1}{1 + l(y^* + \epsilon_\kappa)\frac{R - \alpha\bar{\theta}}{\alpha\bar{\theta} - \underline{\theta}}} = C(y^*, \kappa) \tag{22}$$

where we define the function $C(y^*, \kappa)$ for easy reference. According to equation 19 we see that a higher quota results in a lower private noise:

$$\frac{\partial \epsilon_\kappa}{\partial \kappa} < 0$$

Since $l'(\cdot) > 0$ an increase in κ also increases the value for P that is assigned to a value of y^*, so $\frac{\partial C}{\partial \kappa} > 0$. This implies that the same prior P will result in a higher y^*. The intuition is that though z^* stays the same it will be harder to send a signal of the required magnitude to the pivotal creditor when the quota is higher. This is illustrated in figure 1.3.

1.3.3 Debtor Policy Choice

The expected payoff for the country of choosing a policy a will in general be:

$$E[X_a] = Prob(R|a)X_a^R + Prob(W|a)X_a^W \tag{23}$$

where X_a^v is the payoff if the creditors decision is v and the chosen policy was a. Recall from equation 3 that the country will choose the *good* policy if

$$E[X_{good}] \geq E[X_{bad}] + \gamma \tag{24}$$

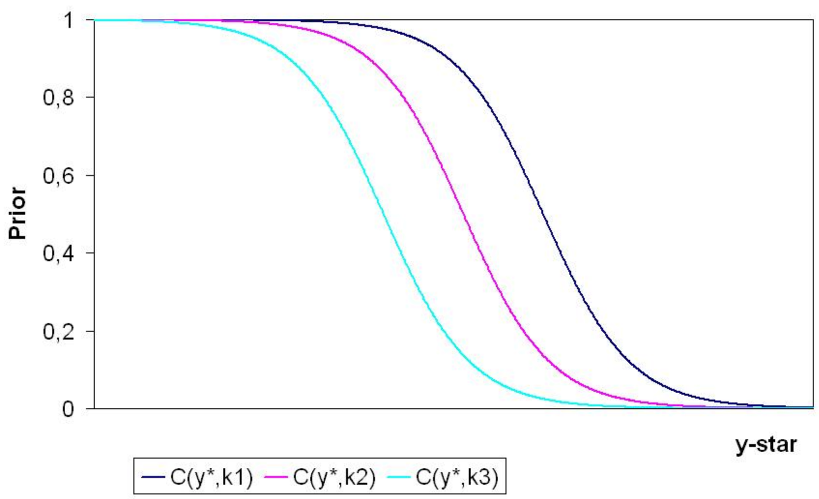

Figure 1.3: Roll-over regimes for different quotas with $\kappa_1 > \kappa_2 > \kappa_3$

where γ represents the type of the debtor that gets known to the country in period 1. Importantly, γ becomes known to the debtor right before the policy is chosen, but after the contract is signed. So in the moment the contract is signed, the country is unaware of it's policy preference. Or, to be more precise: the country's general preference for either policy in the model is summarized in the values of $\bar{\theta}$ and $\underline{\theta}$. The variable γ captures an unforeseen shock to this preference, that nevertheless may be crucial for the countries decision.

In principle, the collective threshold y^* determines the expected payoffs of both policies because they pin down the probability of a successful roll-over conditional on the policy chosen. Since the parameters of the model are common knowledge to all agents, the creditors know $E[X_{good}]$ and $E[X_{bad}]$ for each value of y^* that is implied by their rational voting strategies. But since γ is private information to the country they can not infer the policy choice of the country from the design of the contract.[13]

Nevertheless, creditors can precisely assess for which realizations of the shock the country will chose the good policy. Especially, from equation 3 the debtor will choose

[13]If that would be the case the game would not have an equilibrium. The only way to establish pure strategy equilibria in this game is to have the signal contain perfect information. Otherwise, a prior of $P = 1$ would imply that the creditors roll over the claims with probability one. This would result in the country choosing the bad policy for sure.

the good policy if

$$\begin{aligned} E[X_{good}] - E[X_{bad}] &\geq \gamma \\ \Delta_X &\geq \gamma \end{aligned} \tag{25}$$

where we define Δ_X as the difference between expected payoffs. Consequently, P can be derived explicitly from the expected debtor payoffs of both policies that depend on y^*.

$$\begin{aligned} P &= \Pr(a = good) \\ &= \Pr(\Delta_X \geq \gamma) \\ &= F_\gamma(\Delta_X) \end{aligned} \tag{26}$$

where F_γ is the normal cumulative density of γ. So the debtor will exercise the good policy with higher probability if the excess payoff of the good policy is higher. If both policies would yield the same expected payoff they will be chosen with equal probability, depending on the state of the world γ. If for example, the good policy would yield a higher expected payoff, only substantially positive values of γ would switch the policy decision to the bad policy. Since this is less likely, the good policy would be pursued with a probability greater than one half. For easy reference we define a function that maps y^* into the prior P:

$$P = F_\gamma(\Delta_X(y^*)) = D(y^*) \tag{27}$$

To analyze the function D we will first take a look at $\Delta_X(y^*)$. Since F_γ is just a positive monotone mapping into the $[0,1]$-interval we will be almost done then. The probability that the debt is rolled over successfully is just the probability that the pivotal creditor will vote in favor of a roll over. We know from the previous section that this will be the case if $y = \theta + \eta \geq y^*$. Then we can establish that the probability of a successful roll-over given that for example, the good policy was undertaken is

$$\begin{aligned} Prob(R|good) &= Prob(y = \bar{\theta} + \eta \geq y^*) \\ &= Prob(\eta > y^* - \bar{\theta}) \\ &= 1 - F_\eta(y^* - \bar{\theta}) \\ &= \Pi_{good}(y^*) \end{aligned} \tag{28}$$

So we can express the expected payoffs of both policies as:

$$E[X_{good}] = \Pi_{good}(y^*)(1-R) + (1-\Pi_{good}(y^*))\alpha(1-\bar{\theta}) \quad (29)$$

$$E[X_{bad}] = \Pi_{bad}(y^*)(1-\underline{\theta}) + (1-\Pi_{bad}(y^*))\alpha(1-\bar{\theta}) \quad (30)$$

The difference between the payoffs of both policies is:

$$\begin{aligned}\Delta_X(y^*) =& \Pi_{good}(y^*)(1-R-\alpha(1-\bar{\theta})) \\ & -\Pi_{bad}(y^*)(1-\underline{\theta}-\alpha(1-\bar{\theta}))\end{aligned} \quad (31)$$

First, note that $\Delta_X(y^*)$ has the following properties.

$$\lim_{y^*\to-\infty} \Delta_X = \underline{\theta} - R$$

$$\lim_{y^*\to\infty} \Delta_X = 0$$

Second, it will be interesting to see how Δ_X changes with y^*. Therefore we will need the derivative of the conditional roll-over probability with respect to y^*. From equation 28 we can derive:

$$\frac{\partial \Pi_{good}}{\partial y^*} = -f_\eta(y^* - \bar{\theta})$$

Then we have that

$$\begin{aligned}\frac{\partial \Delta_X}{\partial y^*} =& -f_\eta(y^*-\bar{\theta})(1-R-\alpha(1-\bar{\theta})) \\ & +f_\eta(y^*-\underline{\theta})(1-\underline{\theta}-\alpha(1-\bar{\theta}))\end{aligned} \quad (32)$$

so that immediately follows that

$$\lim_{y^*\to-\infty} \frac{\partial \Delta_X}{\partial y^*} = 0$$

$$\lim_{y^*\to\infty} \frac{\partial \Delta_X}{\partial y^*} = 0$$

Rearranging equation 32 we see that this derivative is positive if

$$\frac{1-\underline{\theta}-\alpha(1-\bar{\theta})}{1-R-\alpha(1-\bar{\theta})} > \frac{f_\eta(y^*-\bar{\theta})}{f_\eta(y^*-\underline{\theta})} \quad (33)$$

Since the right side of equation 33 has the Monotone Likelihood Ration Property like the function $l(\cdot)$ used earlier in this section we know that this condition ceases to hold

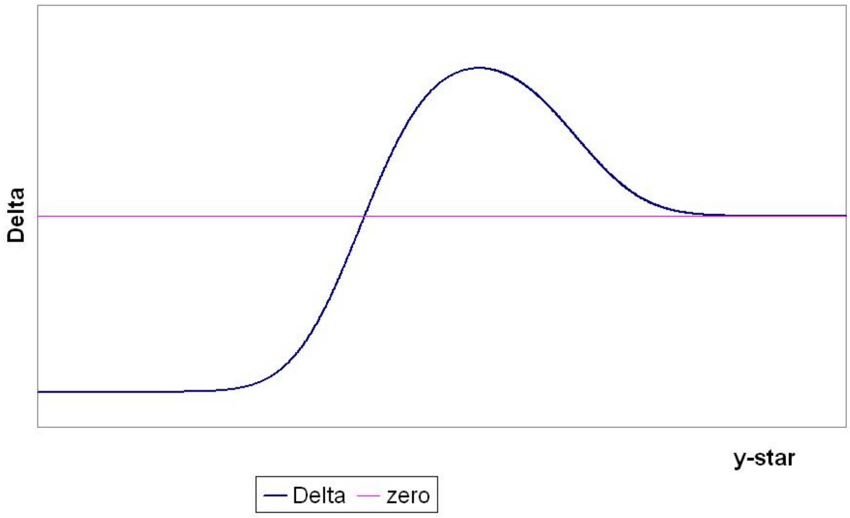

Figure 1.4: Excess payoff of the good policy

for large values of y^*. Thus we can conclude that the shape of Δ_X is humped with flat tails. The shape of $\Delta_X(y^*)$ is illustrated in figure 1.4.

Since the function F_γ is just a positive monotone transformation into the $[0, 1]$-space it is now straightforward to draw $P = D(y^*)$. If the variance of γ is large, deviations from $\Delta_X = 0$ will only result in moderate differences from $P = \frac{1}{2}$. As the variance of γ becomes small, these deviations become more substantial. For the limiting case where $\sigma_\gamma \to 0$ we are in the case where debtor heterogeneity plays no role. Figure 1.5 illustrates this. The variance of γ can be interpreted as a measure of policy predictability. It determines the degree to which the policy decision of the country is affected by a shock that is unobservable to the creditors. Or to put it in other words, how sensitive the debtor countries policy is to minor turbulences.

1.3.4 Equilibrium

In equilibrium the cutoff value of the creditors (y^*) implied by the prior (P) and the quota (κ) must render the debtor with expected payoffs such that the creditors prior is correct. This requires that $C(y^*) = D(y^*)$.

Proposition 3. Equilibrium: *There exists a unique*[14] *equilibrium* $(\hat{P}, \hat{y})$ *such that*

$$C(\hat{y}, \epsilon_\kappa) = D(\hat{y}) \tag{34}$$

[14] Numeric simulations show that this equilibrium is unique.

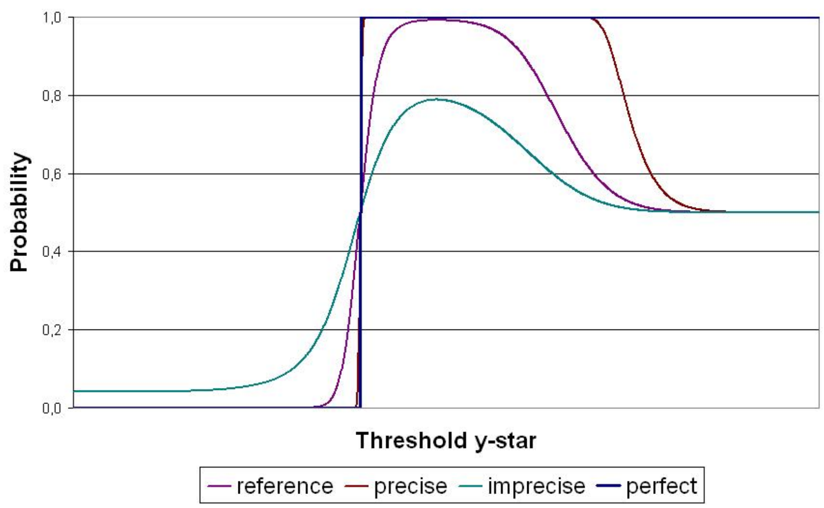

Figure 1.5: Resulting priors for different degrees of policy predictability

The equilibrium depends on the choice of the quota κ. As we have seen above a higher quota shifts the C-function to the right. The maximum of $D(y^*)$ marks the contract that maximizes the incentive for the debtor country. Let us label this point (P_{max}, y_{Pmax}). For all $y^* < y_{Pmax}$ a higher quota yields an equilibrium with a higher cutoff value y^*, i.e. a tighter roll-over regime, that is associated with a higher probability that the creditor chooses the good policy (see figure 1.6). In this area a higher quota has a positive incentive effect so that we can say that a higher quota has a disciplining effect on the debtor country. In this range the model embeds a trade-off where better incentives are associated with a loss in efficiency. For higher values of y^* there is no positive incentive effect. Intuitively, as a successful roll-over becomes very unlikely for both policies, the debtor is almost indifferent between policies.

1.4 Optimal Quota

We will now turn to characterize the optimal choice of the quota κ. The contract is designed by the country subject to the restriction that creditors have to buy the bonds. The country maximizes it's discounted cash-flow over all periods. For simplicity we assume that the discount factor is one. The discounted cash-flow is then simply the sum of all payments. In case the project is undertaken the country receives the loan of size L in period 0 of which it has to finance the project with I. Then depending on the roll over decision of the creditors it earns some part of the proceedings of the project

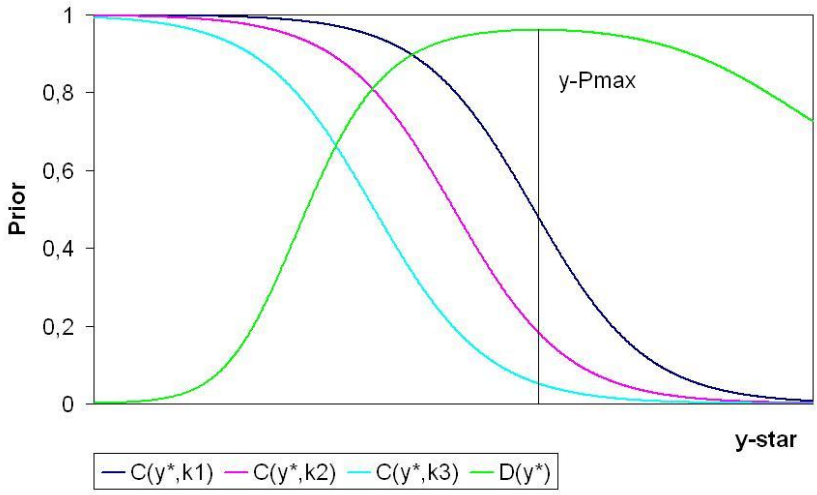

Figure 1.6: Equilibria for different values of κ

in period 2 or 3. These are in expectation worth $E[X]$. So the optimization problem is:[15]

$$\max_{\kappa,R} \; \Xi = +L - I + E[X]$$
$$s.t. \; I \leq L$$

Since creditors are risk neutral and the interest rate is normalized to zero we know that creditors will be willing to lend $L = E[U]$. The sum of $E[U] + E[X]$ is the expected return of the project. Since the project bears no risk in itself it is only depending on the chance of a successful roll-over. So the debtor's optimization problem can be rewritten:

$$\max_{\kappa,R} \; \Xi = \Pi + (1-\Pi)\alpha - I \tag{35}$$
$$s.t. \; I \leq E[U]$$

where Π is the unconditional roll-over probability, i.e.:

$$\Pi = \Pi_{good}P + \Pi_{bad}(1-P)$$

[15]The country will always desire to undertake the project if possible. Since it has no capital the gains from undertaking the project are never negative. Actually, since $\theta < 1$ the country always has a strictly positive payoff from undertaking the project.

It is convenient to describe the equilibrium in terms of (y^*, R) instead of (κ, R). Note that even though R influences y^* we can choose both variables independently because y^* can be adjusted freely via κ.

Proposition 4. NO EXCESS BORROWING: *In equilibrium the country borrows exactly the amount of money that is required to finance the project, i.e.:*

$$L = I \tag{36}$$

Proof. The partial derivative of the expected creditor utility with respect to the repayment is:

$$\frac{\partial E[U]}{\partial R} = \frac{\partial P}{\partial R}\Delta_U + P(1 - F(y - \bar{\theta})) \tag{37}$$

where $\frac{\partial P}{\partial R}$ is the incentive effect of a change in R and $\Delta_U = E[U|good] - E[U|bad]$ is the payoff difference for the creditors between the two states. The incentive effect of increasing R is negative, because it makes the roll-over state less attractive for the country. Formally,

$$\frac{\partial P}{\partial R} = -f_\gamma(\Delta_X)(1 - F(y^* - \bar{\theta})) < 0 \tag{38}$$

Therefore the sign of 37 is ambiguous. However, since the incentive effect of increasing R is negative we know that $\frac{\partial \Xi}{\partial R} < 0$. The intuition is that increasing R results in no social profits, but only shifts payoffs to the creditors. So in equilibrium $\frac{\partial E[U]}{\partial R}$ must be positive and the constraint 37 holds binding. Otherwise reducing R marginally would allow for larger social surplus while not violating the constraint. □

The Lagrangian of the optimization problem 35 yields two conditions:

$$\frac{\frac{\partial \Pi}{\partial y}}{\frac{\partial \Pi}{\partial R}} = \frac{\frac{\partial E[U]}{\partial y}}{\frac{\partial E[U]}{\partial R}} \tag{39}$$

$$E[U] = I \tag{40}$$

While the intuition for equation 40 has been discussed and is straightforward, equation 39 does not deliver an enlightening intuition. It is useful to first examine the signs of the four terms involved. As we have just argued, $\frac{\partial E[U]}{\partial R}$ is positive in equilibrium and

$\frac{\partial\Pi}{\partial R}$ is always negative because the incentive effect of increasing R is unambiguously negative. To analyze the two remaining components lets claim two propositions:

Proposition 5. $E[U]$ SINGLE-HUMPEDNESS: *The expected return of the creditors has one unique maximum in y.*

Proposition 6. ORDER OF LOCAL MAXIMA: *If there exists a local maximum of the unconditional roll-over probability Π this occurs for smaller values of y^* than the maximum of $E[U]$.*

$$\underset{y^*}{\operatorname{argmax}}\, E[U] = y^{EU}_{max} > y^{\Pi}_{max} = \underset{y^*}{\operatorname{argmax}}\, \Pi \tag{41}$$

Proofs. The proofs of these propositions can not be derived analytically. They can be proven by numerical simulation. The simulation procedure is commented on in the appendix.

Since $\frac{\partial\Pi}{\partial y}$ and $\frac{\partial E[U]}{\partial y}$ must have opposite signs in equilibrium the optimal contract must include $y \in (y^{\Pi}_{max}, y^{EU}_{max})$ if y^{Π}_{max} exists. The latter is not self-evident. It may be that $\frac{\partial\Pi}{\partial y} < 0$ throughout. Note that:

$$\begin{aligned}\frac{\partial\Pi}{\partial y^*} =& \frac{\partial P}{\partial y^*}(\Pi_{good} - \Pi_{bad}) + P\frac{\partial\Pi_{good}}{\partial y^*} + (1-P)\frac{\partial\Pi_{bad}}{\partial y^*}\\ =& \frac{\partial P}{\partial y^*}(F(y^* - \underline{\theta}) - F(y^* - \bar{\theta})) - f(y^* - \bar{\theta})P - f(y^* - \underline{\theta})(1-P)\end{aligned} \tag{42}$$

There are two effects from changing the collective threshold y^* that affect the unconditional roll-over probability. The first term captures the incentive effect, that the good policy will be chosen with higher probability (at least in a certain value range) if the threshold is higher and that the good policy makes successful roll-over more likely. The rest mirrors the fact that the conditional roll-over policies are of course decreasing in y^*. So Π is either monotonically decreasing or it has two locally stable points, a minimum and a maximum. For $y^* \to 0$ it is approaching one and for $y^* \to \infty$ we have that Π is approaching zero. Π will only have a local maximum if $\frac{\partial P}{\partial y}$ takes substantially positive values for some y. This is the case when policy predictability is high, i.e. the variance of γ is low. Intuitively, the incentive effect must be large enough.

Depending on whether there is a sizeable incentive effect or not we can draw two characteristic pictures. In figure 1.7 the incentive effect is large enough to allow for an inner maximum of the unconditional roll-over probability. The equilibrium is then in the narrow range between y^{Π}_{max} and y^{EU}_{max}. In this equilibrium both the unconditional

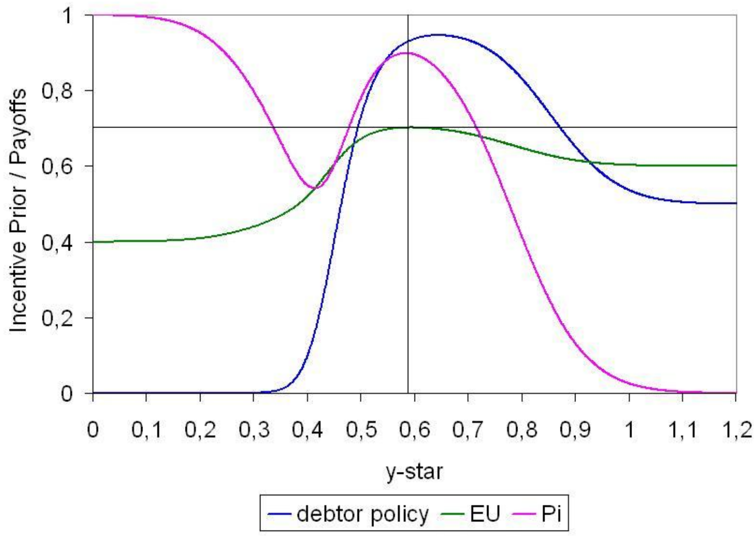

Figure 1.7: Incentive Contract
Typical contract for relatively high policy predictability. The equilibrium is inbetween the local maxima of $E[U]$ and Π.

roll-over probability which is the measure of financial stability in this model (purple line) and the countries incentives (blue line) are relatively high. In figure 1.8 the incentive effect is small. Borrowing can still be supported, but only a lower level. The country chooses both policies with almost the same probability and will be hit by a crisis with a high probability.

The figures also give an idea of the comparative statics with respect to the degree of policy predictability. Higher y tends to imply a higher threshold, i.e. a more disciplining contract. So the contract with the politically stabler country is more disciplining. The reason why this is so is that the benefit from disciplining is larger for countries with higher policy precision.

The marginal effect from a change in σ_γ can not be derived analytically. But since $y \in (y^{\Pi}_{max}, y^{EU}_{max})$ and this interval is very small for incentive solutions we might get an insight from taking a look at the unconditional roll-over probability. For $\frac{\partial \Pi}{\partial y^*}$ we can derive the effect of marginal changes in σ_γ if we impose a few restrictions on the equilibrium. This effect is that the local maximum is for rather lower values of y^* if policy precision decreases. If we consider the first order condition $\frac{\partial \kappa}{\partial \sigma_\gamma} < 0$ should imply that the local maximum of Π moves left if σ_γ increases. This implies that a marginal

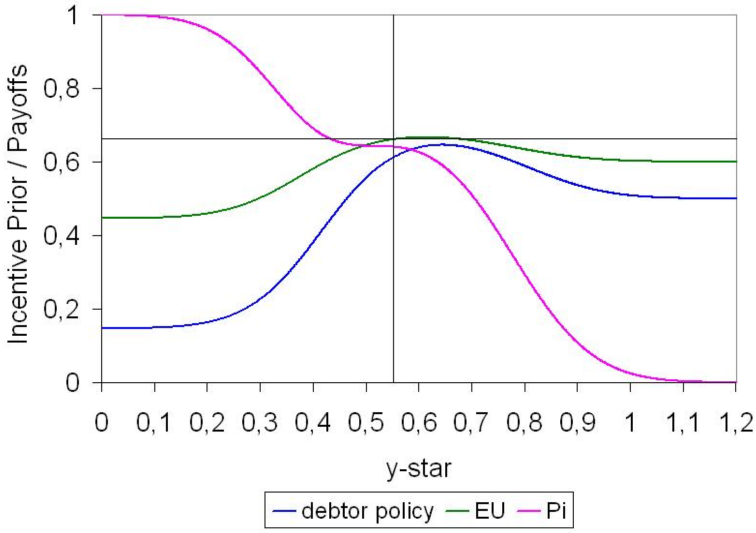

Figure 1.8: No-Incentive Contract
Typical contract for relatively low policy predictability. The equilibrium is to the left of the local maximum of $E[U]$.

increase in σ_γ decreases the first derivative of Π with respect to y^*.

$$\frac{\partial \Pi}{\partial y^* \partial \sigma_\gamma} = \frac{\partial P}{\partial \sigma_\gamma}(-f_\eta(y^* - \bar{\theta}) + f_\eta(y^* - \underline{\theta})) + \frac{\partial P}{\partial y^* \partial \sigma_\gamma}(\Pi_{good} - \Pi_{bad}) < 0 \tag{43}$$

The condition we have to impose to know that the condition in 43 holds unambiguously is that $y^* > \frac{\bar{\theta}+\underline{\theta}}{2}$ and that P lies in the interval $[0.5, \Phi(1) \approx 0.841]$. The latter value is the standard cumulative density evaluated at its standard deviation. We know that $\frac{\partial P}{\partial \sigma_\gamma}$ is negative if $P > 0.5$ because the incentive effect is weakened. Furthermore, $\frac{\partial P}{\partial y^* \partial \sigma_\gamma} = \frac{\partial f_\sigma(\Delta)}{\partial \sigma_\gamma}$ is also negative if we are in the σ_γ surrounding of $\Delta = 0$ and this is the case if $P < \Phi(1)$. It remains to show that both terms in brackets are positive. The second is always positive since the conditional roll-over probability of the good policy is always higher than of the bad policy. Finally, $f_\eta(y^* - \bar{\theta}) > f_\eta(y^* - \underline{\theta})$ is positive if $y^* > \frac{\bar{\theta}+\underline{\theta}}{2}$ which we assumed above.

On one hand these restrictions are restrictive. On the other hand they incorporate two features that are not that far fetched: first, that the information contained in the cut-off signal suggests that the good policy was undertaken and second, that the country is disciplined such that the prior is in an upper area. Also, one should keep in mind, that missing out on these restrictions does not reverse the effect but renders us in an area of ambiguity. The restrictions for $\frac{\partial \kappa}{\partial \sigma_\gamma} > 0$ would be that $y^* < \frac{\bar{\theta}+\underline{\theta}}{2}$ and that $P > \Phi(1)$. This is unlikely, since $y_{Pmax} > \frac{\bar{\theta}+\underline{\theta}}{2}$. Nevertheless, this can be the case if σ_γ

is very small.

However, numeric simulation of the equilibrium delivers the opposite pattern for many parameter constellations, namely that decreased policy predictability is indeed punished by higher quota in equilibrium. So the evidence on how policy predictability affects the choice of the optimal quota remains elusive.

Another interesting parameter to look at is the signal precision σ_η. For example one would like to identify a trade-off between transparency and the tightness of the roll-over regime: a country that is delivering better information would be able to borrow with a lower quota κ. However, results of this kind cannot be derived within the framework presented here. One reason is that due to the normality of certain distributions the partial derivative of the density with respect to the variance is ambiguous. In the model this implies that the effect on the marginal conditional roll-over probabilities is ambiguous as well. In addition, if we analyze a change in the variance of the signal, we are not done by calculating $\frac{\partial y^*}{\partial \sigma}$ to analyze resulting changes in κ. A change in σ_η does not only influence y^* but also z^*, the individual optimal cutoff signal. An increase in the variance of the signal will unambiguously increase z^*. So even if we find conditions such that a higher variance of the signal results in an equilibrium with increased y^*, we do not know the consequences on the choice of κ. One can say that each creditor tightens the screws individually if the signal precision declines. This ambiguity is also confirmed by a simulation of equilibria for different values of signal precision. It remains elusive whether the optimal κ changes systematically.

1.5 Conclusion

This paper offers a framework to analyze the choice of the majority action quota in sovereign bond contracts with collective action clauses. The core argument is that debtor moral hazard can be ameliorated by choosing an appropriate quota.

The paper shows that, around the equilibrium, increasing the quota has a disciplining effect on the debtor. It then shows that the optimal contract will be slightly overdisciplining with respect to financial stability. However the amount of disciplining is most likely lower than the most disciplining contract would allow.

The comparative statics of the model mostly bear ambiguous results. It is analyzed how a change in either the predictability of the debtor country's policy or the precision of the signal affect the optimal quota. The degree of policy predictability appears to have a positive effect on the quota: there may be a situation where a country with a less transparent and predictive policy decision process tends to sign contracts with lower quotas. This seemingly odd result arises because the incentive effect from raising the quota depends on the country's predictable reaction. If the debtor does not react to a tighter contract with an increased probability to choose the good policy there is no use in making a roll-over more difficult.

A change in the signal precision is not associated with a systematic change of the optimal quota. Declining precision of the signal will lead each creditor individually to assess the roll-over decision more critically. It can however not be shown how the optimal choice of the quota is affected.

The model predicts that country specific parameters like transparency and political stability should not contribute to a large variation in the quotas specified in debt contracts with collective action clauses. This is consistent with real world experience where the quota has mostly been set around 75%. Another reason why this sort of standardisation is perceived in sovereign debt markets could lie outside of the model presented here. If the debtor has private information on some country specific factors at the time the contract is signed adverse selection becomes an issue. One could imagine that a standardization of quotas arises as a pooling equilibrium in this context.

Appendix

Numerical Simulations

Three propositions in this chapter can not be derived analytically. I therefore test these predictions by numerical simulation. For the payoff relevant parameters α,$\bar{\theta}$,$\underline{\theta}$ and R the intervals that are simulated are the universe of parameter values allowed by the model structure. So $\bar{\theta}$ and α run form 0 to 1 in the simulation. For $\underline{\theta}$ possible values are taken form the interval $(0, \alpha\bar{\theta})$. R is simulated with values in $(\alpha\bar{\theta}, \bar{\theta})$. For the variances of ϵ,η and γ I choose reasonable upper and lower bounds. The software I use is MATLAB®.

The propositions have proven to be valid for all constellations. I therefore claim that they are generally true.

Chapter 2

Coordination, Aggregation and Seniority in the Pricing of Sovereign Debt

2.1 Introduction

The financial crises of the 1990s have provoked a sizeable debate on what is referred to as the international financial architecture. After the resolution of the 1980s debt crisis with the Brady plan in the early 1990s it only took until 1994 when Mexico slit into the so called Tequila crisis. The surge of bond financing in emerging market economies led to financial crises of a new form. Creditor countries mostly borrowed at short maturities and had to roll over their claims frequently. If this coincided with a time of general market sentiment or if country fundamentals declined, the markets were unwilling to provide new money. Since the new money was needed to satisfy the outstanding debt the country experienced a roll-over crisis.

It was commonly understood that the problems arose because individual agents faced an incentive to *run for the exit* first, and thereby destabilized financial systems and aggravated matters. These first come first serve constraints were not only at work when sovereign debtors ran into liquidity based debt crises but also in balance of payments crises, currency crises, banking crises and combinations of these.[1] For the case of sovereign debt crises the discussion focused on the absence of any bankruptcy-like procedures for sovereign debtors and asked for measures to provide more orderly workouts for sovereigns in financial distress.[2]

The two main ideas discussed for reform of the international financial architecture were the contractual approach and the statutory approach. The contractual approach suggested that so called collective action clauses (CAC) should be embedded in sovereign bond contracts to overcome creditor coordination problems. These clauses stipulate that all proceeds a creditor receives from suing the debtor shall be split evenly among creditors (*sharing clause*), that only a prespecified threshold of creditors is needed to start litigation against the country (*non-acceleration clause*), and that the financial terms of the bond contract can be changed by a qualified majority of outstanding debt and that such an agreement is binding for dissenting creditors as well (*majority action clause*). While the latter solves hold out problems and facilitates restructuring the first two clauses are important to break the first come first serve constraint. The statutory approach consisted of the SDRM proposal by the IMF.[3] The

[1] There is ample literature on what I touch here in a few words. Overview on the East Asian Crisis in 1997 is found in Corsetti, Pesenti and Roubini (1999) and in Radelet and Sachs (1998), for self-fulfilling balance of payments and currency crisis see for example Obstfeld (1986,1996) and for banking and balance of payments *twin crises* see Kaminsky and Reinhard (1999).

[2] An initiating role can be attributed to Eichengreen and Portes (1995) and Sachs (1995).

[3] See Krueger (2002). The IMF also supported collective action clauses, see IMF (2002).

SDRM would oversee sovereign restructurings similar to a domestic bankruptcy court. Both proposals drew heavy criticism. Coordination clauses were seen as undermining creditor rights and possibly putting the existing of the sovereign debt market at risk and the SDRM proposal was viewed as a rigid, bureaucratic international organization with doubtful legitimation.

Financial markets were wary towards the introduction of coordination clauses in sovereign bond contracts. On the creditor side there seemed not to be much consciousness on problems related to uncoordinated creditors. In contrast, a common opinion used to be that the status quo in sovereign debt restructuring, especially bond exchanges, allowed for sufficient renegotiation of stark claims.[4] Apparently fears of loosing bargaining power against emerging market borrowers preponderated discontent about problems with hold-out creditors or lengthy restructuring procedures. It is a common appraisal that the IMF's pressure towards a statutory mechanism strongly helped overcoming the resistance, as the private sector felt it had to opt quickly for the lesser of two evils.

In February 2003, Mexico was the first emerging market borrower to issue bonds including CAC under New York law. In the consecutive years many other countries have followed. This of course enables us to analyze whether sovereign debtors pay a premium for the option of facilitated restructuring. In the present analysis of secondary bond market spreads I disentangle this question into three effects:

- **Seniority Effect**
  How are bonds with and without CAC by the same issuer with similar characteristics priced?
- **Coordination Effect**
  How does the fraction of bonds by an issuer that includes CAC affect the price of outstanding bonds, i.e. how does the market perceive the effect facilitated restructuring?
- **Aggregation Effect**
  Does the pricing of CAC depend on whether only a small or a large share of debt is coordinated?

While the first question has been addressed frequently, I believe that the other two deserve special attention as well. The commonly cited positive and negative effects

[4] See for example the remarks of Chamberlin (2002), executive director of the EMTA, at a conference of the Institute of International Finance, where he sums up views from the creditor side.

of collective action clauses are unlikely to depend on one single bond containing CAC or not. The positive effect, increased financial stability, assumes that a restructuring is faster and more equitable and efficient if creditors are coordinated. It seems straightforward to assume that this effect depends on the amount of debt that is easy to restructure. The negative effect, moral hazard, implies that a country will tend to run reckless policies if the penalty in form of a crisis is less severe. Again, it seems natural to assume that the amount of coordinated debt determines the cost of the restructuring and hence the degree to which moral hazard is a concern. Both of these effects may very well apply for the holders of uncoordinated bonds as well. For the positive case those bondholders could possibly *freeride* on the agreement the CAC bondholders reach with the country.[5] In the case of increased moral hazard holders of bonds without CAC will face the consequence of unduly macro policies just as much as the CAC bondholders. Being aware of these interactions, the holders of sovereign bonds with CAC should be happy to see other creditors holding claims that are easy to restructure as well, because as mentioned above, the potential gains would otherwise partly accrue to creditors, who do not *pay* for such benefits by giving away some of their bargaining power.

The empirical analysis supports this view. I find evidence that bonds with collective action clauses are priced as if they were slightly junior to non CAC bonds. This penalty for holding instruments that are easy to restructure and therefore at higher risk of facing a writedown is more prominent for bonds with a higher probability of default, i.e. higher spreads. Evidence for the coordination effect is mixed. The results can however be explained that moral hazard reverses this effect for bad borrowers. The aggregation effect that CAC bondholders value the overall degree of coordination higher than other bondholders is very robust in the data.

The next section reviews the empirical literature on the pricing of collective action clauses. In section 2.3 I build a model to clarify my argumentation on the interaction of uncoordinated and coordinated bonds. The key argument is that CAC reduce the inefficiency arising from default, but worsen the negotiation position of CAC bondholders so that situations can arise were CAC bondholders face a larger haircut than other creditors do. I then address the question empirically. In section 2.4 and 2.5 I introduce the methodology and data. Section 2.6 contains the results and section 2.7 concludes.

[5] Holders of uncoordinated bonds could make their consent more expensive and thereby share some of the rents due to increased efficiency.

2.2 Overview of Existing Studies

Since the proposal on collective action clauses was tabled in the mid 1990s quite a few scholars have addressed the question on how the inclusion of such clauses into sovereign bond contracts would affect the market for sovereign debt. A fruitful coincidence for this task has been that bonds issued under English law traditionally include collective action clauses, while bonds issued under New York Law don't.

Eichengreen and Mody (2000) undertake an analysis of the spreads paid by emerging market issuers 1991-1998. Their analysis includes sovereign and corporate borrowers and they use UK governing law as a proxy for CAC inclusion. Since they examine launch spreads they have to control for endogeneity by running a first-stage regression explaining the choice of the governing law. Their main finding is that collective action clauses are priced differently depending on the quality of the borrower. When splitting their sample according to the credit rating they find that CAC reduce borrowing costs for more credit-worthy borrowers. Less credit-worthy creditors pay significantly higher spreads on their issues. They argue that while facilitated restructuring generates a benefit for all countries this is outweighed by moral hazard concerns for creditors with bad credit ratings.

Becker, Richards and Thaicharoen (2003) analyze primary market data as well as secondary market spreads. They find no evidence that CAC increase borrowing costs for creditors, independent of the creditworthiness of the borrower.[6] A lot of the results for the English law dummy are insignificant, no matter whether primary or secondary market spreads are analyzed. They see their results in line with anecdotal evidence that CAC inclusion seems to be no critical factor in financial circles when explaining variation of bond spreads. Accordingly, Becker, Richards and Thaicharoen (2003) conclude: "In summary, we consider it unlikely that governing law and the presence of CACs could have an impact [...] without market participants being acutely aware of this effect." (p. 26)[7]

Richards and Gugiatti (2003) examine primary as well as secondary market spreads. For the latter they find no significant effect of the inclusion of CACs. In their analysis

[6] Actually, Becker, Richards and Thaicharoen (2003) find the opposite effect to Eichengreen and Mody (2000) for some specifications: for comparatively bad borrowers CAC seem to have a positive effect, suggesting that the benefits of orderly restructuring are valued higher if this event is indeed more likely.

[7] Becker, Richards and Thaicharoen (2003) also question the magnitude of the effects Eichengreen and Mody (2000) claim. Their effects are in the order of 5-25 basis points while Eichengreen and Mody find effects of more than 100 basis points.

on launch spreads they specifically analyze how a new issue was priced, not only given the inclusion of CAC, but also given the historical issue custom of the country. They argue that if CACs were indeed valued negatively by the market, a change from issuing uncoordinated debt to issuing with CAC should increase returns and a cessation of the use of CAC should reduce the spread. Since they find no evidence for these effects they join Becker, Richards and Thaicharoen (2003) in claiming that coordination clauses are likely to be a dispensable factor in sovereign bond pricing. However, Richards and Gugiatti (2003) themselves question their event study on primary spreads. With 204 bonds issued between 1991 and 2001 by 10 countries it seems likely that switches between issues with and without CAC solely represent the conformance to market customs of borrowers seeking finance in London as well as New York.[8]

The effect of aggregation, i.e. the composition of the outstanding bond debt has so far been addressed by Eichengreen and Mody (2003). However, they do not specifically focus on bonds with and without creditor coordination clauses. In an econometric assessment of launch spreads they analyze the effect of the number of bonds the debtor has already outstanding in the market. They find that the more outstanding bonds result in marginally higher spreads. This supports the view that aggregation is priced in the market and that creditors are well aware of the fact that more issues will be more difficult to rearrange if necessary. Also, Eichengreen, Kletzer and Mody (2003) augment the dataset by Eichengreen and Mody (2000) by controlling for the amount of outstanding coordinated debt. Their results are insignificant, but when they split their sample according to creditor quality, they find that borrowers with unfavorable credit worthiness pay higher spreads on new CAC issues if they already have a lot of coordinated debt outstanding.

2.3 Theoretical Background

2.3.1 An Ex-Post Model of Debt Prices

The following model illustrates the interaction of bonds with and without coordination clauses in the secondary market for sovereign bonds. The model takes the composition of outstanding debt as given, i.e. the decision to issue bonds with or without collective action clauses is not modeled.

[8] Further studies include Tsatsaronis (1999), Dixon and Wall (2000) and Petas and Rahman (1999). All these find that CAC do not raise borrowing costs significantly.

The total debt of the country outstanding is normalized to one. Of this a fraction γ is supposed to include collective action clauses. All bonds mature in the same period. The country enjoys full sovereign immunity, so that its repayment decision is voluntary. However, if the country does not honor its debt, creditors can impose a default pain on the country. If the country repays the creditors a fraction of the original debt and in turn the creditors lift the default pain, I call this arrangement a debt restructuring, which is a Pareto improvement. I do not analyze the negotiation process that leads up to this agreement but claim that by the threat of the default claim a fraction (θ) of output (y) is *pledgeable*.[9] Formally the country will repay up to θy.

The negotiation of a sovereign debt restructuring is costly in the model. Due to the prolonged state of uncertainty until an agreement is reached during which the country suffers the consequences of default, a fraction of output is lost. The literature usually motivates this with difficulties in international trade and domestic economic stress arising from a sovereign default. However, I assume that for bonds with collective action clauses these effects do not apply. If the country sticks to the rules defined in the bond contract, the country never defaults on outstanding claims. For example the exercise of a majority vote upon a rescheduling, does not allow creditors to sue the country.[10] In the model the use of collective action clauses for restructuring is costless, while restructuring claims without CAC bears a loss of output α. The cost of restructuring is of course proportional to the amount of uncoordinated debt outstanding. So disposable income is:

$$\tilde{y} = (1 - (1 - \gamma)\alpha)y \tag{1}$$

If the country arrives in the repayment period it has to decide whether to repay or to seek a restructuring. The country can also decide to restructure only one type of claim. The returns from either decision can be summarized in the following table 2.1:

Decision	Payoff
repay all	$y - 1$
restructure just CAC bonds	$y - \gamma R_1 - (1 - \gamma)$
restructure just no-CAC bonds	$(1 - \alpha(1 - \gamma))y - \gamma - (1 - \gamma)R_2$
restructure all	$(1 - \alpha(1 - \gamma))y - R_3$

Table 2.1: Country Payoffs

To make a useful comparison of the payoffs we have to clarify how high the re-

[9] See Fernandez and Rosenthal (1990) on the negotiation process with limited enforcement.
[10] The procedure of suing is fruitless for the creditor, but essential in making the default costly.

structured repayment R_i is. Therefore we use the fact that the pledgeable output is $\theta(1-(1-\gamma)\alpha)y$. It follows that $R_3 = \theta(1-(1-\gamma)\alpha)y$. How much will the country offer in a restructuring to a fraction of bondholders? Just the same amount. While a higher amount makes no sense from the debtors point of view, a lower offer would be rejected by the creditors, because they know they can get more by rejecting and forcing the country into a full restructuring. With $R_1 = R_2 = R_3 = R$ it is straightforward to see that the country will never seek a restructuring just with the holders of uncoordinated bonds. The loss of output is the same if all debt is reduced. However, seeking agreement on a debt reduction only with the holders of CAC bonds makes sense. The fact that restructuring bears no cost makes these creditors easy prey of a country unwilling to repay. If they are offered a reduced claim R, they have no means to ask for more. Forcing the country into default does not promise any excess payments. The resulting payoffs for the country are summarized in table 2.2. For simplicity it is convenient to write the effect of a restructuring on output as $\beta = 1-(1-\gamma)\alpha$.

Decision	Payoff
repay all *(repay)*	$y-1$
restructure just CAC bonds *(cac)*	$(1-\gamma\theta\beta)y-(1-\gamma)$
restructure all *(default)*	$(1-\theta)\beta y$

Table 2.2: Country Payoffs

Let output be distributed randomly with a support of $[0,\infty]$ and some general density $f(y)$. Then we can derive decisions for the country depending on the realization of y. First, it is easy to see that the country will restructure all debt if $y \to 0$. Also, we can derive that for $y \to \infty$ the country will repay the claims of both types of creditors. To see that there is an intermediate zone in which the country only restructures the bonds that include coordination clauses, first note that the slope of the equation describing the payoff from restructuring only the CAC bonds is inbetween the other two (*repay,default*). Firstly, $1-\gamma\theta\beta < 1$, so that repaying all bonds becomes more attractive than restructuring just the CAC bonds for some y. Also, it can be shown that a separate restructuring of CAC bonds is better than restructuring all debt for some y:

$$1-\gamma\theta\beta > (1-\theta)\beta \qquad (2)$$

$$\Leftrightarrow \theta\beta(1-\gamma) > 0 \qquad (3)$$

In order to prove the existence of a range for y where restructuring just the CAC bonds is optimal, we have to prove that the intersection of the $default$ and the cac line is for smaller values of y than the intersection between the cac and the $repay$ line. Let us define the intersections:

$$y_1 := (1-\theta)\beta y_1 = (1-\gamma\theta\beta)y_1 - (1-\gamma) \tag{4}$$

$$y_2 := (1-\gamma\theta\beta)y_1 - (1-\gamma) = y_1 - 1 \tag{5}$$

We solve for these intersections and see that there exists a range for y such that restructuring only CAC claims is optimal.

$$y_1 = \frac{1}{\alpha + \beta\theta} < \frac{1}{\theta\beta} = y_2 \tag{6}$$

Since α is positive $y_2 > y_1$ holds unambiguously. These findings are illustrated in figure 2.3.1. Let us know analyze how the different types of bonds will be priced in

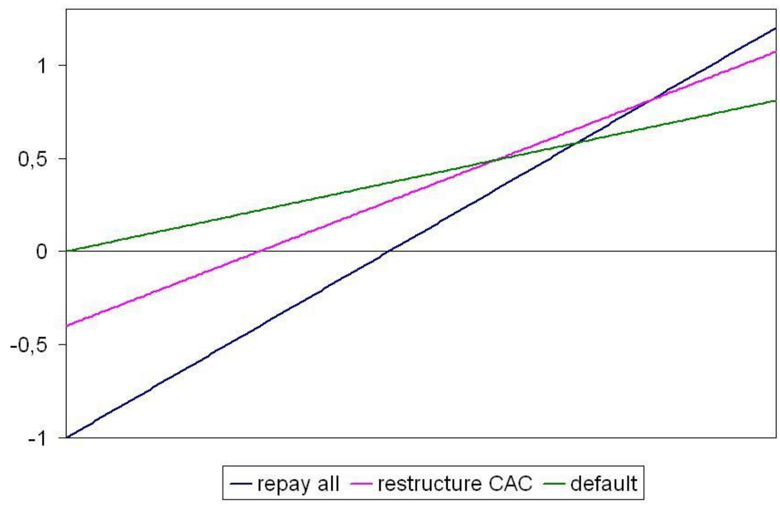

Figure 2.1: Debtor Payoffs

the secondary market. I assume that the benchmark interest rate is normalized to zero. So a risk-free bond in the model, that promises a return equal to one, will be priced exactly with one. The interest rate of the sovereign bonds is the fraction of the contracted repayment over the current price minus one. Since the discount factor is one, the current price equals the expected return. And since the risk-free interest rate is zero, the interest rate and the spread are analogous. With s_{CAC} I denote the interest rate differential of bonds including CAC to uncoordinated bonds.

$$i_{CAC} = \frac{1}{P_{CAC}} - 1 \tag{7}$$

$$i_{NO} = \frac{1}{P_{NO}} - 1 \tag{8}$$

$$s_{CAC} = i_{CAC} - i_{NO} = \frac{1}{P_{CAC}} - \frac{1}{P_{NO}} \tag{9}$$

The price of each bond is just its expected return. These are given by:

$$P_{CAC} = \int_0^{y_2} \beta\theta y f(y)dy + \int_{y_2}^{\infty} f(y)dy \tag{10}$$

$$P_{NO} = \int_0^{y_1} \beta\theta y f(y)dy + \int_{y_1}^{\infty} f(y)dy \tag{11}$$

Since $\beta\theta y < 1$ and $y_1 < y_2$ we can immediately propose that:

Proposition 1. *The spreads of the sovereign bonds over a risk-free asset are strictly positive. Collective action clause bonds are priced with a higher spread than uncoordinated bonds.*

$$i_{CAC} > 0, \; i_{NO} > 0 \tag{12}$$

$$s_{CAC} > 0 \tag{13}$$

Our next task is to analyze how a variation in the amount of coordinated debt affects the spreads of the uncoordinated as well as the coordinated sovereign bonds.

$$\frac{\partial i_{CAC}}{\partial \gamma} = -\left(\frac{1}{P_{CAC}}\right)^2 \frac{\partial P_{CAC}}{\partial \gamma} \tag{14}$$

$$\frac{\partial i_{NO}}{\partial \gamma} = -\left(\frac{1}{P_{NO}}\right)^2 \frac{\partial P_{NO}}{\partial \gamma} \tag{15}$$

The partial derivatives of the prices are:

$$\begin{aligned}
\frac{\partial P_{CAC}}{\partial \gamma} &= \frac{\partial y_2}{\partial \gamma}\beta\theta y_2 f(y_2) + \int_0^{y_2} \frac{\partial \beta}{\partial \gamma}\theta y f(y)dy - \frac{\partial y_2}{\partial \gamma} f(y_2) \\
&= -\frac{\partial y_2}{\partial \gamma} f(y_2)(1-\beta\theta y_2) + \int_0^{y_2} \frac{\partial \beta}{\partial \gamma}\theta y f(y)dy \\
&= \int_0^{y_2} \frac{\partial \beta}{\partial \gamma}\theta y f(y)dy \qquad (16)\\
\frac{\partial P_{NO}}{\partial \gamma} &= \frac{\partial y_1}{\partial \gamma}\beta\theta y_1 f(y_1) + \int_0^{y_1} \frac{\partial \beta}{\partial \gamma}\theta y f(y)dy - \frac{\partial y_1}{\partial \gamma} f(y_1) \\
&= -\frac{\partial y_1}{\partial \gamma} f(y_1)(1-\beta\theta y_1) + \int_0^{y_1} \frac{\partial \beta}{\partial \gamma}\theta y f(y)dy \qquad (17)
\end{aligned}$$

For the analysis of the partial derivatives of the intersections with respect to γ we have:

$$\delta_1 = \frac{\partial y_1}{\partial \gamma} = -\frac{\alpha\theta}{(\alpha + (1-\alpha(1-\gamma))\theta)^2} = -\frac{\alpha\theta}{(\alpha+\beta\theta)^2} \qquad (18)$$

$$\delta_2 = \frac{\partial y_2}{\partial \gamma} = -\frac{\alpha}{\theta(1-\alpha(1-\gamma))^2} = -\frac{\alpha}{(\beta\theta)^2} \qquad (19)$$

Since α and θ are within the interval $(0, 1)$, the partial derivatives of the intersections with respect to the fraction of CAC bonds (δ_1, δ_2) are negative and we can state another proposition.

Proposition 2. *The spread a holder of a sovereign bond demands in relation to a risk-free bond is decreasing in the fraction of sovereign debt endowed with collective action clauses. This effect arises for both the uncoordinated bonds and the bonds including collective action clauses themselves.*

$$\frac{\partial i_{CAC}}{\partial \gamma} < 0 \qquad (20)$$

$$\frac{\partial i_{NO}}{\partial \gamma} < 0 \qquad (21)$$

Furthermore, we might be interested in knowing whether the two types of bonds are affected differently by a variation in the amount of debt that can be restructured easily. Therefore we have to compute the partial derivative of s_{CAC} with respect to γ.

$$\frac{\partial s_{CAC}}{\partial \gamma} = -\left(\frac{1}{P_{CAC}}\right)^2 \frac{\partial P_{CAC}}{\partial \gamma} + \left(\frac{1}{P_{NO}}\right)^2 \frac{\partial P_{NO}}{\partial \gamma} \qquad (22)$$

If we make a general assumption on the distribution of y we can unambiguously state:

Proposition 3. *If $f(y)$ describes a single humped distribution and the maximum density is for $y > y_2$, the spread between sovereign bonds by the same issuer with and without collective action clauses is declining when the fraction of bonds with coordination clauses rises.*

$$\frac{\partial s_{CAC}}{\partial \gamma} < 0 \tag{23}$$

For symmetric distributions of y the assumption made implies that the probability of a restructuring must be below 50%. Depending on the expected loss in the event of a restructuring this requires that spreads must be very high to fall short of this assumption. For example for an expected haircut of 50% the assumption is valid for spreads below 2500 basis points.

Proof. If we make use of the fact that $P_{NO} > P_{CAC}$ we have to show that:

$$\frac{\partial P_{CAC}}{\partial \gamma} > \frac{\partial P_{NO}}{\partial \gamma} \tag{24}$$

Substituting in yields:

$$\begin{aligned}\int_{y_1}^{y_2} \frac{\partial \beta}{\partial \gamma}\theta y f(y)dy &> -\frac{\partial y_1}{\partial \gamma} f(y_1)(1-\beta\theta y_1)\\ \int_{y_1}^{y_2} \alpha\theta y f(y)dy &> \frac{\alpha\theta}{(\alpha+\beta\theta)^2} f(y_1)(1-\frac{\beta\theta}{\alpha+\beta\theta})\\ \int_{y_1}^{y_2} y f(y)dy &> \frac{1}{(\alpha+\beta\theta)^2} f(y_1)\frac{\alpha}{\alpha+\beta\theta}\end{aligned} \tag{25}$$

Since $f(y)$ is single-humped with its maximum for $y > y_2$ we know that $f(y_1) \leq f(y)$ for all $y \in [y_1, y_2]$. Therefore we can conclude that inequality 25 will always hold if:

$$f(y_1)\int_{y_1}^{y_2} y dy > \frac{\alpha}{(\alpha+\beta\theta)^3} f(y_1) \tag{26}$$

Solving for the integral we get:

$$\begin{aligned}\frac{1}{2}\left[\frac{\alpha^2+2\alpha\beta\theta}{\beta^2\theta^2(\alpha+\beta\theta)^2}\right] &> \frac{\alpha}{(\alpha+\beta\theta)^3}\\ \frac{1}{2}\left[\frac{\alpha+2\beta\theta}{\beta^2\theta^2}\right] &> \frac{1}{\alpha+\beta\theta}\end{aligned} \tag{27}$$

Since α is positive inequality 27 will surely hold if:

$$\frac{1}{2}\left[\frac{\alpha+2\beta\theta}{\beta^2\theta^2}\right] > \frac{1}{\beta\theta}$$
$$\frac{1}{2}\left[\frac{\alpha+2\beta\theta}{\beta\theta}\right] > 1$$
$$1+\frac{\alpha}{2\beta\theta} > 1$$

□

Next we address the question whether the effects identified so far vary systematically with the overall quality of the debtor. A meaningful way to distinguish between good and bad debtors in the model is the distribution of y. I assume that good countries' output is distributed according to the density $f(y)$, whereas bad debtors' output is distributed with a density $\tilde{f}(y)$. I assume that $\tilde{F}(y_2) > F(y_2)$ which implies that it is more likely that a bad country refuses to honor its debt. Furthermore, I assume that $\tilde{f}(y) > f(y)$ for all $y \in (0, y_2)$ so that every single state where the country dishonors the debt is more likely for bad debtors. For single-humped distributions a squeezing of the density towards smaller values is included as long as the maximum density is for $y > y_2$.

Proposition 4. *The premium creditors pay for uncoordinated bonds is higher for comparatively bad debtors.*

$$s_{CAC}|\tilde{f}(y) > s_{CAC}|f(y) \tag{28}$$

Proof. From equation 9 we know that the spread is proportional to the difference between the prices of the two bonds. From equations 10 and 11 the difference between bondprices is:

$$\int_{y_1}^{y_2}(1-\beta\theta y)f(y)dy \tag{29}$$

Since $\tilde{f}(y) > f(y)$ for $y \in [y_1, y_2]$ the difference between prices is larger for worse debtors. Henceforth, the spread s_{CAC} of bonds with CAC over other bonds by the same issuer is also larger. □

Proposition 5. *The sensitivity of the spread of a sovereign bond over a riskless bond* *with respect to the degree of coordination γ is higher for comparatively bad debtors.*

$$\left.\frac{\partial i_j}{\partial \gamma}\right| \tilde{f}(y) > \left.\frac{\partial i_j}{\partial \gamma}\right| f(y) \ , \qquad j \in (CAC, NO) \tag{30}$$

Proof. Since the prices are smaller for worse debtors we have to proof that the derivatives are larger, i.e.:

$$\left.\frac{\partial P_j}{\partial \gamma}\right| \tilde{f}(y) > \left.\frac{\partial P_j}{\partial \gamma}\right| f(y) \ , \qquad j \in (CAC, NO) \tag{31}$$

We have from equations 16 and 17:

$$\begin{aligned}\frac{\partial P_{CAC}}{\partial \gamma} &= \int_0^{y_2} \alpha\theta y f(y) dy \\ \frac{\partial P_{NO}}{\partial \gamma} &= -\delta_1 f(y_1)(1-\beta\theta y_1) + \int_0^{y_1} \alpha\theta y f(y) dy\end{aligned}$$

Since $\tilde{f}(y) > f(y)$ for $y < y_2$ the derivatives of the prices with respect to the degree of coordination are larger for bad debtors. □

To set out for a proposition on the behavior of proposition 3 for bad debtors we have to make an extra assumption:

$$\begin{aligned} g(y) &:= \tilde{f}(y) - f(y) \\ g(y_1) &\leq g(y) \ , \quad \text{for } y \in (y_1, y_2) \end{aligned} \tag{32}$$

To grasp the intuition for this assumption recall from equations 16 and 17 how a change of γ affects the prices of the two types of bonds. For the CAC bonds a change in γ raises β so that recovery is better for all default states $y < y_2$. The marginal effect cancels out, because $\theta\beta y_2 = 1$. For bonds without CAC the effect of γ on default states is smaller simply because there are less default states. However, the marginal change of y_1 has a positive effect because the return jumps from $\frac{\beta\theta}{\alpha+\beta\theta}$ to 1. For this effect at y_1 not to outweigh the accumulated effects between y_1 and y_2 we needed that the density at y_1 is smaller than for $y \in (y_1, y_2)$. A similar assumption about the change of the density has to be made for proposition 6.[11]

[11] Two things can be said on the restrictiveness of this assumption. Firstly, if the density of a normal distribution is shifted to the left, assumption 32 holds for default probabilities below 50% and well beyond. In so far the assumption includes what one could have in mind as a benchmark example. Secondly, imagine the situation in real world financial markets. With some uncertainty about the parameter values, the point density $f(y_1)$ seems to loose weight towards the area $\int_{y_1}^{y_2} f(y)dy$. For the

Proposition 6. *The sensitivity of the spread of a sovereign bond with CAC over a sovereign bond without CAC with respect to the degree of coordination γ is higher for comparatively bad debtors.*

$$s_{CAC}|\tilde{f}(y) < s_{CAC}|f(y) \tag{33}$$

Proof. Recall the definition of $\frac{\partial s_{CAC}}{\partial \gamma}$ from equation 22:

$$\frac{\partial s_{CAC}}{\partial \gamma} = -\left(\frac{1}{P_{CAC}}\right)^2 \frac{\partial P_{CAC}}{\partial \gamma} + \left(\frac{1}{P_{NO}}\right)^2 \frac{\partial P_{NO}}{\partial \gamma}$$

From Proposition 4 we know that the difference between prices increases when the countries' prospect worsens. So we are left to show:

$$\left(\frac{\partial P_{CAC}}{\partial \gamma} - \frac{\partial P_{NO}}{\partial \gamma}\right)\Bigg| \tilde{f}(y) > \left(\frac{\partial P_{CAC}}{\partial \gamma} - \frac{\partial P_{NO}}{\partial \gamma}\right)\Bigg| f(y) \tag{34}$$

From equation 25 we can write $\frac{\partial P_{CAC}}{\partial \gamma} - \frac{\partial P_{NO}}{\partial \gamma}$ as:

$$\int_{y_1}^{y_2} \alpha\theta y g(y) dy + \frac{\partial y_1}{\partial \gamma} g(y_1)(1 - \beta\theta y_1) > 0$$

This is the same equation as in 25 with $g(y)$ instead of $f(y)$. With the assumption made on $g(y)$ the proof of proposition 3 holds here as well. □

The model just presented delivers three testable predictions about the pricing of sovereign bonds with and without collective action:

- Seniority Effect: Bonds that include collective action clauses have a positive spread over equivalent bonds without these clauses. This effect arises because facilitated restructuring will make a writedown in debt more likely for these bonds.
- Coordination Effect: Sovereign bond spreads are lower if the fraction of coordinated debt is larger. This stems from the fact that a restructuring is more orderly if more debt includes collective action clauses.

marginal effect that the assumption in equation 32 disarms to be effective, creditors had to know that exactly the density at the switching point from defaulting on both types of claims to restructuring only CAC bonds, would increase more than the probability that only CAC bonds be restructured. If one assumes that real financial markets act with some blurriness this is a seemingly far fetched idea.

- Aggregation Effect: The spread between bonds with and without coordination clauses is decreasing in the fraction of outstanding debt that is coordinated. Since the likelihood of a restructuring is higher for the bonds with facilitated restructuring, the holders of these bonds benefit comparatively more from more efficient workouts.

Furthermore all three effects are shown to be larger in magnitude for debtor countries with a comparatively worse distribution of pledgeable output.

2.3.2 Moral Hazard

The model presented in the previous subsection takes the distribution of output as given. However, the theory on the borrowing of sovereign debtors puts a lot of emphasis on the policy decision of the debtor and the associated incentives. This moral hazard concern highlights that the debt contract has to be disciplining enough to secure repayment to the creditors. In the context of creditor coordination clauses it has been argued that facilitating restructuring by improving creditor coordination will increase the likelihood of default. This could eventually lead to a breakdown of the market for sovereign debt because creditors would be unwilling to provide funds given the high probability of default.

So how would the model sketched above be affected by moral hazard? First, it is important to note, that moral hazard is a countrywide phenomenon. In so far as the inclusion of CAC may affect the repayment decision for each individual bond issue, it is captured in the model above. I assume that the distribution of pledgeable income depends on the expected cost of a restructuring for the country. This moral hazard affects the holders of CAC bonds and other bonds of the same creditor the same way.

Formally, let us state that the distribution of output $f(y)$ depends on γ such that:

$$\frac{\partial f(y)}{\partial \gamma} = g(y|m) \text{ , with} \tag{35}$$

$$g(y|m) \begin{cases} < 0 \text{ , if } y < y_2 \\ > 0 \text{ , if } y \geq y_2 \end{cases} \tag{36}$$

where m is a parameter for the degree of moral hazard such that

$$\frac{\partial g(y|m)}{\partial m} \begin{cases} < 0 \text{ , if } y < y_2 \\ > 0 \text{ , if } y \geq y_2 \end{cases} \tag{37}$$

Given these structure we can rewrite the derivatives of the bond price with respect to the degree of coordination from equations 16 and 17:

$$\begin{aligned} \frac{\partial P_{CAC}}{\partial \gamma} &= \int_0^{y_2} \alpha\theta y f(y) dy \\ &+ \underbrace{\int_0^{y_2} \beta\theta y g(y|m) dy + \int_{y_2}^{\infty} g(y|m) dy}_{\text{Moral Hazard}} \end{aligned} \tag{38}$$

$$\begin{aligned} \frac{\partial P_{NO}}{\partial \gamma} &= \int_0^{y_1} \alpha\theta y f(y) dy - \delta_1 f(y_1)(1 - \beta\theta y_1) \\ &+ \underbrace{\int_0^{y_1} \beta\theta y g(y|m) dy + \int_{y_1}^{\infty} g(y|m) dy}_{\text{Moral Hazard}} \end{aligned} \tag{39}$$

Since $G(y|m) = 0$ we can rewrite the moral hazard component as:

$$\int_0^{y_j} (\beta\theta y - 1) g(y|m) dy < 0 \tag{40}$$

where we use the fact that any additional density for $y < y_2$ must correspond to a loss of density for $y > y_2$. So if $g(y|m)$ is large enough, an increase in the degree of coordination may decrease prices and increase spreads. It follows that a sufficient amount of moral hazard can reverse the results from proposition 2 and 5.

2.4 Methodology

The standard regression to estimate the determinants of bond spreads is of the form:[12]

$$log(spread) = B\mathbf{X} + \epsilon \tag{41}$$

The dependent variable is the log of the spread. The spread is difference between the interest rate curve implied by the current bond price and the future contracted repayments and a benchmark yield curve. This is explained by a set of characteristics

[12] See Eichengreen an Mody (2000)

X. **X** contains information about the country, for example debt ratios, but also about the issue, e.g. the duration and the currency denomination. Lastly, some characteristics are not specific to the bond, especially I include time dummies. The disturbance term ϵ is a random error. General country characteristics in my regression equation include GDP growth, inflation, GDP per capita and current account balance. Explaining variables addressing the external indebtedness of the country are the debt/GDP ratio, debt/reserves, debt/exports and a ratio of short term to long-term debt. I also include a dummy for the currency in which the bond in denominated. As mentioned above I have seven points in time and use dummies to account for a general movement in the sovereign bond market. To account for the duration of a bond I include the modified duration both linear and quadratic. To assess the various predictions on the inclusion of collective action clauses I include a dummy CAC_i, indicating whether the bond entails coordination clauses. Furthermore I construct a variable to reflect the aggregated coordination facility for a country at any time. With VOL_{it} being the volume of bond i active at time t I define:

$$FRAC_t = \frac{\sum_i CAC_i VOL_{it}}{\sum_i VOL_{it}} \tag{42}$$

To account for differences in the pricing of aggregation for bonds that include CACs and bonds which don't I also include an interaction variable $CAC * FRAC$.

$$log(S) = \beta_0 + \beta_1 CAC + \beta_2 FRAC + \beta_3 CAC * FRAC + B\mathbf{X} + \epsilon \tag{43}$$

In contrast to previous studies I do not include country ratings such as those provided by Standard&Poors or Moody's. Such an assessment would inevitably regard the structure of the debt in terms of long-term versus short-term debt and consider the effects of facilitated restructuring through collective action clauses. Since the ranking is countrywide this is no problem in analyzing the pricing of the clauses (seniority effect), but will affect the pricing of the debt composition (coordination and aggregation effects).

I estimate the model by ordinary least squares. Eichengreen and Mody (2000) note that this may generate biased results if the choice on the inclusion of coordination clauses is endogenous. Two things assure me that endogeneity is not a problem in the regressions I run: first, as Becker, Richards and Thaicharoen (2003) argue, there are fewer problems with endogeneity in an analysis of secondary market spreads. At the point in time the investigation is exercised the decision on contractual features is long in the past so that it can be viewed as exogenous. Second, in my sample all countries have issued bonds with collective action clauses even under New York law. Therefore, country characteristics could hardly serve an explanation for endogeneity.[13] This also strengthens the first argument, because at most points in time I compare bonds with and without collective action clauses from the same issuers.

2.5 Data

The bond data is obtained from DATASTREAM. The dataset contains of 436 bonds issued by 19 countries that mature after April 2003. These include Belize, Brazil, Chile, Colombia, Costa Rica, Guatemala, Indonesia, South Korea, Mexico, Panama, Peru, the Philippines, Poland, South Africa, Turkey, Uruguay, and Venezuela. The CAC variable is generated following the issue date, with February 2003 marking the change. I use the information on the 19 countries reported in Drage and Hovaguimian (2004). They state:

> Thus, it now appears that [...] the inclusion of CACs in sovereign bonds issued under New York law has switched from being the exception to becoming the market standard.

Since the countries in my sample have all issued New York law bonds including CAC, I suspect that they did not return to issuing bonds without coordination clauses for later issues, where I don't have this information. Nevertheless, I think that issuance after February 2003 for New York law bonds serves as a very good instrument for CAC inclusion. For bonds issued under English law I follow Eichengreen and Mody (2000) and presume that they always include CAC. The sample also includes some bonds issued under German, Luxembourg, Swiss and Japanese law respectively. The treatment of these bonds is less obvious. In my main specification I suspect these bonds to include CAC after February 2003 just like the New York law bonds, but I also test the predictions if I assume the opposite or exclude these bonds from the sample. Macroeconomic Data is taken from the International Monetary Fund International Finance Statistics, the Joint External Debt Hub jointly developed by the Bank for International Settlements (BIS), the International Monetary Fund (IMF), the Organization for Economic Cooperation and Development (OECD) and the World Bank (WB) and the IMF World

[13] Richards and Gugiatti (2003) restrict their sample to countries that have issued with and without CAC to check whether their results are robust to endogeneity problems.

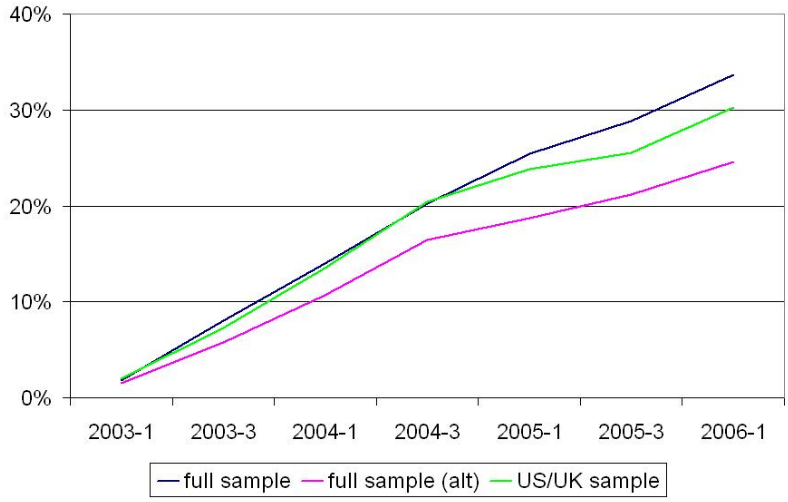

Figure 2.2: Share of Bonds with CAC

Economic Outlook (WEO). The first two sources are quarterly and the BIS is annually. In order not to stress the data too much but still allow for enough variation of the debt composition for each country, I construct a semiannual dataset from 2003-1 to 2006-1. Figure 2.2 depicts the development of the share of bonds with CAC in my sample.

The total number of observations is 1862 if you drop all bonds that have no data at that date. The reduction to 1281 observations is due to some missing data in the IFS as well as the JEDH data. In table 2.3 I report descriptive statistics for some variables. There are only 13 observations with spreads over 25% in the sample of which 11 belong to Uruguay. Deleting these outliers does not substantially alter results.

Variable	Mean	Minimum	Maximum
Spread (%)	3.86	0.015	84.69
Duration (years)	5.30	0.008	20.65
FRAC	0.23	0	0.96
GDP growth (%)	4.41	-11	18.9
GDP per capita (US$)	8.185	3.697	20.590
Inflation (%)	8.95	0.2	44.8
Current Account (%)	-0.13	-22.3	19.1
Debt/GDP	0.1575	0.0095	0.6006
Debt/Reserves	2.234	0.060	6.131
Debt/Exports	3.237	0.125	30.58
Short-Term/Long-Term	0.095	0	0.802

Table 2.3: Descriptive Statistics

2.6 Results

2.6.1 General

The first regression includes all active bonds, e.g. all bonds that were not yet repayed at the respective date. The two specifications reported in table 2.4 only differ in the construction of the CAC variable. In specification 2 all bonds issued after February 2003 under New York law and all bonds issued under UK law are counted as including CACs. In specification 1 all other bonds issued after February 2003 are assigned to have CAC as well. In addition, I report the results for a sample where I only include the US ans UK bonds to fully circumvent the equivocality of the other issues.

	Specification 1			Specification 2			US/UK only		
explanatory variable	Coefficient	t-Statistic		Coefficient	t-Statistic		Coefficient	t-Statistic	
Constant	4.0398	18.29	***	4.7506	26.05	***	3.8044	19.26	***
Duration	0.2795	14.18	***	0.2674	13.83	***	0.3539	14.25	***
Duration^2	-0.0149	-10.10	***	-0.0144	-9.82	***	-0.0216	-11.45	***
CAC	0.1516	1.83	*	0.2832	3.08	***	0.4737	5.82	***
FRAC	-0.6372	-2.07	**	2.0889	5.96	***	0.9605	2.95	***
CAC∗FRAC	-1.1672	-4.67	***	-1.6901	-4.86	***	-2.2222	-8.46	***
Euro	-0.1183	-2.74	***	-0.1418	-3.20	***	n/a		
Yen	0.2677	2.59	***	0.2174	2.11	**	n/a		
£	-0.1021	-0.86		-0.2247	-1.81	*	-0.2843	-2.71	***
SF	0.5712	3.27	***	0.5813	3.32	***	n/a		
2003 Q1	0.0276	0.23		0.2088	1.76	*	0.1458	1.14	
2003 Q3	-0.0930	-1.16		0.0519	0.64		-0.0188	-0.23	
2004 Q1	-0.3046	-3.98	***	-0.3021	-3.94	***	-0.3207	-4.22	***
2005 Q1	-0.0978	-1.52		-0.1899	-3.04	***	-0.1541	-2.40	**
2005 Q3	-0.2802	-3.82	***	-0.5353	-7.59	***	-0.4073	-5.61	***
2006 Q1	-0.3919	-4.55	***	-0.7199	-9.28	***	-0.5854	-7.15	***
GDP growth	0.0084	0.64		-0.0161	-1.20		0.0179	-1.37	
GDP per capita	-0.0671	-3.83	***	-0.1223	-9.76	***	0.0626	-4.54	***
Inflation	0.0311	6.95	***	0.0366	8.32	***	0.0321	6.84	***
Current Account	-0.0154	-1.16		0.0189	1.66	*	-0.0067	-0.53	
Debt/GDP	1.4290	1.47		0.6435	0.64		1.8166	1.90	*
Debt/Reserves	0.1190	2.46	**	0.0095	0.25		0.1354	3.32	***
Debt/Exports	0.2124	4.23	***	0.1617	3.31	***	0.1438	2.82	***
Short-Term/Long-Term	1.0828	2.72	***	1.1387	2.86	***	0.5551	1.37	
Adjusted R^2	0.5819			0.5808					
Observations: 1281									

Table 2.4: Regression 1

*,**,*** denote significance at the 10%,5% and 1% level respectively.

The duration has a highly significant positive effect on the spread. This reflects an upward sloping yield curve that is natural for sovereign bonds. Poorer countries pay higher interest rates as the significantly negative coefficient on GDP per capita suggests. All debt ratios have positive coefficients as expected. However, the classical debt/GDP ratio is insignificant at the 5%-level in all specifications. Inflation has a significant positive effect on the spread. This comes with no surprise as inflation often goes with real depreciation that devaluates domestic income. The significant influence of the ratio of short to long term debt in two specifications shows that markets are well aware of the risk excessive maturity mismatch imposes.

The variables of special interest are those associated with the coordination features of the outstanding debt. The seniority effect would imply that the variable CAC has a positive impact on the spread. This is indeed the case. The coordination effect would suggest that all creditors of a country, no matter whether their issues include CAC, enjoy a large share of coordinated debt. Consequently, the coefficient of FRAC should be negative. This result is present and highly significant in two specifications, but in specification 1 the exact opposite appears. I outlined above that moral hazard can potentially turn the results of FRAC in the regression. However, since all specifications are very general this does not provide a satisfyingly clarifying story. Lastly, the aggregation effect suggests that the holders of CAC bonds are willing to pay a premium for other issues being coordinated as well. The implied negative coefficient of CAC$*$FRAC shows up significantly in all three specifications. Recapitulating we have that two predictions from the ex-post model presented in section 2.3.1, the seniority effect and the aggregation effect, can be validated in the present data.

As a robustness check I present results from alternative regressions with country dummies. The dataset only spans four consecutive years. This may limit the variation of macro data on the country level over time. It may therefore be useful to substitute the set of explanatory macroeconomic variables with country dummies. In the appendix I present the results from this exercise and from regressions where I simply add the country dummies to the regressions I present in this section. For specification 1 the results are in table 2.6, for specification 2 in table 2.7 and the robustness check for the US/UK sample is presented in table 2.8.

2.6.2 Structural Breaks

In this subsection I analyze whether the effects of collective action clauses on the pricing of bonds in the secondary market varies in different circumstances. I concentrate on the question whether CAC are priced differently in stressful times. Therefore I construct a dummy to denote that a country experiences bad times in financial markets, BAD. I then run the regression equation as before but include interaction terms for the three coordination variables with the dummy BAD.

$$log(S) = \beta_0 + \beta_1 CAC + \beta_2 FRAC + \beta_3 CAC * FRAC + \\ \beta_4 BAD * CAC + \beta_5 BAD * FRAC + \beta_6 BAD * CAC * FRAC + B\mathbf{X} + \epsilon$$

The coefficients β_4,β_5 and β_6 report differences in the effect of CAC,$FRAC$ and $CAC * FRAC$ in the bad sample, i.e. how the seniority, coordination and aggregation effects occur in the sample with less creditworthy creditors. The question is of course, how to construct the sample of *bad* countries. Since the spread is a measure of the default probability it is natural to split the sample according to the level of the spread. However, the spread is not only influenced by characteristics of the country but also by issue characteristics. To control for these I first construct a fit from the first regression, where I include Duration, Duration^2 and the currency dummies if they are significant at the 5%-level. I then construct the spread over fit to get the spread that is not explained by issue characteristics. The set of bad countries is then defined as those observations, where the spread is at least 100 basis points (or 1%) larger than expected from issue characteristics. This procedure prevents me from defining most of the long-term bonds as BAD due to their high spread. The results from this regression are reported in table 2.5.

The sample of countries with higher spreads is one where the probability of default, or more precisely the expected loss due to default, is higher compared to the rest of observations. This is the situation described in section 2.3.1 where the distribution of pledgeable output is less favorable. Consequently, propositions 4 to 6 should guide us as to what results we would expect. The three effect should all be more pronounced than in the sample of countries with better repayment prospects. Indeed, the seniority effect, measured by the coefficient on $BAD * CAC$ is positive and highly significant in all specifications. This supports proposition 4 that the risk of having to write down a fraction of the debt as a CAC bond holder is especially large for less creditworthy borrowers. However, the seniority effect does no longer appear for the rest of the sample and one specification even delivers a significant coefficient with the wrong sign. This suggests that for countries with a negligible probability of default the seniority effect plays no role.

For the aggregation effect (proposition 3 and 6) we also find evidence that it is more pronounced for comparatively bad debtor countries. The coefficient on $BAD * FRAC * CAC$ is negative and highly significant in all three specifications. So apparently, creditors of stressed countries are well aware that not only the coor-

explanatory variable	Specification 1 Coefficient	t-Statistic		Specification 2 Coefficient	t-Statistic		US/UK only Coefficient	t-Statistic	
Constant	4.790316	25.06	***	5.593964	33.24	***	4.590365	25.58	***
Duration	.2354683	14.02	***	.2712132	15.83	***	.2925738	13.27	***
Duration^2	-.0123682	-9.85	***	-.0145418	-11.19	***	-.0180762	-10.89	***
CAC	-.2035657	-2.22	**	-.1219815	-1.27		-.1080107	-1.03	
FRAC	-1.610577	-6.01	***	.3341484	1.02		-.8293957	-2.69	***
CAC*FRAC	.8877467	3.27	***	1.540809	3.67	***	.8325377	2.19	**
BAD*CAC	.4723887	4.01	***	.3088721	1.96	**	.5394372	4.56	***
BAD*FRAC	4.403417	22.13	***	5.020538	18.66	***	3.678923	15.86	***
BAD*CAC*FRAC	-3.287544	-9.01	***	-3.941551	-6.97	***	-3.363281	-8.16	***
Euro	-.1282482	-3.51	***	-.1527374	-3.89	***	n/a		
Yen	.1159171	1.32		.125278	1.37		n/a		
£	-.1216374	-1.21		-.1651779	-1.50		-.2363639	-2.56	**
SF	.3337843	2.25	**	.3265095	2.09	**	n/a		
2003 Q1	.1833998	1.78	*	.192622	1.83	*	.1766597	1.58	
2003 Q3	.1223454	1.78	*	.0459324	0.64		.0887486	1.23	
2004 Q1	-.1457181	-2.24	**	-.2720775	-4.01	***	-.2166222	-3.25	***
2005 Q1	-.0570145	-1.05		-.1535934	-2.77	***	-.1277496	-2.27	**
2005 Q3	-.2580977	-4.10	***	-.4537786	-7.25	***	-.3176489	-4.97	***
2006 Q1	-.2717551	-3.68	***	-.6451858	-9.38	***	-.3808813	-5.21	***
GDP growth	.0047932	0.44		-.0114769	-0.97		-.0169033	-1.47	
GDP per capita	-.000056	-3.77	***	-.0001412	-12.61	***	-.0000548	-4.53	***
Inflation	.0178422	4.66	***	.0344037	8.80	***	.0211171	5.07	***
Current Account	-.0140858	-1.25		-.000877	-0.09		-.0045905	-0.42	
Debt/GDP	-3.219188	-3.66	***	-2.979612	-3.21	***	-1.458043	-1.64	
Debt/Reserves	-.0757027	-1.76	*	-.1462182	-4.13	***	-.0071906	-0.19	
Debt/Exports	.3177064	7.25	***	.2249561	5.07	***	.1982669	4.30	***
Short-Term/Long-Term	.0846006	0.25		.503865	1.42		-.0506312	-0.14	
Adjusted R^2	0.7009			0.6716			0.6978		
Observations	1282			1282			853		
Observations with BAD=1	560			326			191		

Table 2.5: Effects for countries with high spreads
Dependent variable is log(spread). *,** and *** denote significance at the 10%,5% and 1% level respectively.

dination embedded in their own bond contract, but also the composition of the rest of the debt matters in the event of a restructuring. This reflects the idea that holders of CAC bonds view other CAC bondholders as an asset as this will facilitate the likely restructuring, while they assess outstanding uncoordinated claims as a negative, since these bondholders might disrupt an efficient reorganization. Somewhat puzzling is the fact, that the sample split flips the result for the sample of good countries in two specifications. It appears that holders of CAC bonds judge improved coordination of other bonds as a negative in the good sample. This result can not be motivated by any economic rationale.

Let us now analyze the coordination effect (propositions 2 and 5). We find that the coefficient of $BAD * FRAC$ is positive and highly significant, which contradicts proposition 5. However, as is argued in section 2.3.2, moral hazard can potentially overcome the positive coordination effect. So if moral hazard was much more a concern in the bad sample, this would indeed justify the results. Indeed we can imagine that the policy control over pledgeable output is of little interest for creditors in very good times. If the economy is doing great countries seldom default, an economic rationale for which could be that the cost of default is very high in this times, e.g. proportional to output. In bad times however, dishonoring its external debt becomes a more lucrative option for debtors in financial straits. In so far we can judge the result as indicating, that creditors rightly view the merit of facilitated creditor coordination as a double-edged sword. For good creditors it is seen as an advantage to know that workouts will be orderly, while for bad creditors, the danger that the country misuses the clauses to walk away from its debt easily prevails. This is indeed the argument made by Eichengreen and Mody (2000) who find some evidence for this story in their analysis.

Some empirical analysis of collective action clauses has asked whether coordination has been priced differently over time. For example it is argued that the governing law has been a disregarded dimension of sovereign bond contracts for a long time and only very recently has gained such prominence. To see whether the days of the pathbreaking issue by Mexico in February 2003 and todays markets value coordination differently, I divide my sample in 2004-Q3. I define a dummy EARLY for quarters 2003-1 to 2004-3 and form interaction dummies similar to the exercise undertaken for countries with high spreads. The results are reported in the Appendix table 2.9. None of the coefficients in any specification is significant even at the 10% level. Consequently, I conclude that the pricing of coordination has not changed recently.

2.6.3 Existing Literature

As reviewed in the introduction most of the literature does not find evidence of any pricing peculiarities of bonds with collective action clauses. The findings just presented do not necessarily conflict with this idea. Generally speaking the analysis of Becker, Richards and Thaicharoen (2003) and Richards and Gugiatti (2003) of secondary market spreads are very similar to my regressions except for the inclusion of the variable FRAC as an explanatory variable. If FRAC and CAC∗FRAC are not included in the regression, the effect of CAC∗FRAC will partly show up in the coefficient for the collective action dummy. Intuitively, in my regression the variable CAC captures the effect the CAC inclusion has if the proportion of debt issued with CAC is 0% (which is only a logical exercise and of course not possible in the real world). In contrast, if CAC∗FRAC is dropped from the regression, CAC measures the effect of CAC inclusion for a country that has a proportion of debt issued with CAC that equals the sample average. So one would expect the effect of CAC inclusion to be downward biased if the composition of the debt is not used as an explanatory variable.

Eichengreen, Kletzer and Mody (2003) analyze primary market spreads and only include a variable similar to CAC∗FRAC in my investigation. They find insignificant results except for borrowers with very bad creditworthiness, who appear to pay higher spreads if their coordinated debt is higher. The pattern they observe (albeit not consistently significant) is similar to what I observe for the coordination effect, namely that a high share of coordination is viewed positively for good creditors and negatively for bad debtors. It may be that Eichengreen, Kletzer and Mody (2003) capture the effect more coordination has on all outstanding bonds as an effect it has on newly issued CAC bonds as they only include the interaction term CAC∗FRAC and not FRAC alone.

2.7 Conclusion

The paper presents a model to understand the pricing of bonds with and without clauses to facilitate coordination in the secondary market for sovereign debt. The model has three main predictions: (1) Creditors should require a premium for holding bonds that include collective action clauses. (2) All creditors, irrespective of the contractual embodiment of the issue they hold, value improved coordination, as long as moral hazard is no overwhelming concern. (3) CAC bondholders value coordination more than other bondholders.

The paper also delivers an empirical test of the model. A dataset containing the sovereign bonds of 19 countries that matured after April 2003 is used for this matter. The data robustly supports the predictions of the model.

The main contribution of this findings is that the composition of the debt matters for the judgment of collective action clauses and that this judgment can not be undertaken by looking at each bond issue individually. The degree of coordination, measured by the fraction of debt that contains provisions for facilitated creditor coordination, captures the expected disruption a restructuring would bring about. The effect of a variation in the degree of coordination can take either direction, depending on whether moral hazard is a concern. If moral hazard is negligible positive effects from increased efficiency in workouts prevail. Otherwise the creditors seek to implement a harsh punishment for any deviation of the contracted repayment. Then, collective action clauses are seen as a flaw.

Another important finding is that holders of coordinated bonds value the fact that they hold a CAC bond instead of an uncoordinated paper according to the fraction of coordinated bonds by the respective issuer outstanding. This suggests that CAC bondholders are aware that they by allowing for facilitated restructuring provide financial stability that is partly enjoyed by the holders of non-coordinated bonds as well. In a way, holders of uncoordinated bonds *free-ride* on the benignity of the CAC bond holders.

Appendix

explanatory variable	Specification 1 Coefficient	t-Statistic		Coefficient	t-Statistic	
Constant	4.2632	52.77	***	1.1968	0.95	
Duration	0.2327	14.22	***	0.2795	14.74	***
Duration^2	-0.0122	-9.80	***	-0.0142	-10.01	***
CAC	0.0535	0.79		0.1138	1.42	
FRAC	-0.4954	-2.19	**	-0.6581	-1.27	
CAC∗FRAC	-0.6192	-3.24	***	-1.1793	-4.88	***
Euro	-0.0189	-0.52		-0.0274	-0.64	
Yen	0.3082	3.41	***	0.4016	4.01	***
£	-0.0057	-0.05		0.0119	0.10	
SF	0.7971	4.79	***	0.7869	4.66	***
2003 Q1	0.6073	8.62	***	0.2506	1.47	
2003 Q3	0.1939	3.29	***	0.1262	1.09	
2004 Q1	0.0086	0.16		-0.1002	-0.86	
2005 Q1	-0.0625	-1.18		-0.0832	-1.26	
2005 Q3	-0.4495	-8.18	***	-0.4675	-4.11	***
2006 Q1	-0.5447	-9.28	***	-0.5734	-4.61	***
GDP growth	n/a			-0.0297	-1.60	
GDP per capita	n/a			0.2181	1.60	
Inflation	n/a			0.0056	0.68	
Current Account	n/a			0.0070	0.24	
Debt/GDP	n/a			10.1207	3.00	***
Debt/Reserves	n/a			0.0926	1.15	
Debt/Exports	n/a			-0.1574	-1.18	
Short-Term/Long-Term	n/a			0.4944	1.09	
Belize	1.7860	9.32	***	(dropped)		
Brazil	0.9518	18.04	***	0.9843	2.88	***
Chile	-0.5406	-4.78	***	-1.2242	-3.96	***
Colombia	0.8288	13.70	***	1.1597	2.58	***
Costa Rica	0.5871	7.58	***	0.3856	1.93	*
Guatemala	0.7680	6.48	***	(dropped)		
Indonesia	1.4731	7.58	***	(dropped)		
Korea	-0.3730	-2.44	**	-2.3257	-1.69	*
Panama	0.4674	5.50	***	(dropped)		
Peru	0.7161	7.72	***	1.6727	2.63	***
Philippines	0.8803	12.15	***	(dropped)		
Poland	-0.7598	-9.06	***	-1.1037	-3.23	***
South Africa	-0.1298	-1.35		-0.0343	-0.13	
Turkey	0.8672	13.19	***	1.3958	2.79	***
Uruguay	2.0910	19.99	***	0.2079	0.33	
Venezuela	1.3626	18.57	***	(dropped)		
Adjusted R^2	0.6350			0.6179		
Observations	1862			1282		

Table 2.6: Robustness Check: Specification 1
*,**,*** denote significance at the 10%,5% and 1% level respectively.

explanatory variable	Specification 2					
	Coefficient	t-Statistic		Coefficient	t-Statistic	
Constant	4.3369	55.11	***	2.4745	2.00	**
Duration	0.2237	13.87	***	0.2639	14.06	***
$Duration^2$	-0.0119	-9.61	***	-0.0137	-9.65	***
CAC	0.1689	2.33	**	0.2723	3.05	***
FRAC	-0.8123	-3.31	***	-0.8977	-1.30	
CAC*FRAC	-0.7898	-3.47	***	-1.6802	-4.97	***
Euro	-0.0410	-1.11		-0.0780	-1.77	*
Yen	0.2511	2.80	***	0.2966	2.98	***
£	-0.1366	-1.24		-0.1829	-1.52	
SF	0.7365	4.43	***	0.6981	4.11	***
2003 Q1	0.6037	9.18	***	0.2477	1.45	
2003 Q3	0.1848	3.17	***	0.0855	0.70	
2004 Q1	0.0011	0.02		-0.1231	-1.05	
2005 Q1	-0.0769	-1.47		-0.1052	-1.64	
2005 Q3	-0.4703	-8.85	***	-0.5097	-4.54	***
2006 Q1	-0.5690	-10.28	***	-0.6357	-5.26	***
GDP growth	n/a			-0.0225	-1.25	
GDP per capita	n/a			0.1284	0.96	
Inflation	n/a			0.0101	1.30	
Current Account	n/a			0.0160	0.55	
Debt/GDP	n/a			6.6641	2.09	**
Debt/Reserves	n/a			0.0437	0.51	
Debt/Exports	n/a			-0.0874	-0.67	
Short-Term/Long-Term	n/a			0.3549	0.76	
Belize	1.8529	9.57	***	(dropped)		
Brazil	0.9397	17.79	***	0.8341	2.49	**
Chile	-0.5335	-4.71	***	-0.9738	-3.28	***
Colombia	0.8358	13.77	***	1.0090	2.27	**
Costa Rica	0.5987	7.65	***	0.4827	2.26	**
Guatemala	0.8554	6.92	***	(dropped)		
Indonesia	1.7486	8.08	***	(dropped)		
Korea	-0.3477	-2.26	**	-1.4954	-1.09	
Panama	0.4785	5.63	***	(dropped)		
Peru	0.6999	7.65	***	1.2575	2.07	**
Philippines	0.8207	11.53	***	(dropped)		
Poland	-0.9862	-14.76	***	-1.2492	-3.69	***
South Africa	-0.2941	-3.54	***	-0.2121	-0.83	
Turkey	0.7924	13.61	***	1.0327	2.24	**
Uruguay	2.1251	20.44	***	0.8824	1.13	
Venezuela	1.4118	18.40	***	(dropped)		
Adjusted R^2	0.6344			0.6119		
Observations	1862			1282		

Table 2.7: Robustness Check: Specification 2

*,**,*** denote significance at the 10%,5% and 1% level respectively.

explanatory variable	just country dummies Coefficient	t-Statistic		all Coefficient	t-Statistic	
Constant	4.1650	49.06	***	1.7745	1.51	
Duration	0.2852	14.16	***	0.3370	13.96	***
$Duration^2$	-0.0171	-11.14	***	-0.0198	-10.77	***
CAC	0.3013	4.55	***	0.4434	5.60	***
FRAC	-0.2654	-1.23		-0.2320	-0.44	
CAC∗FRAC	-1.2826	-6.92	***	-2.2450	-8.80	***
£	-0.1975	-2.09	**	-0.1994	1.95	*
2003 Q1	0.5136	7.31	***	0.3080	1.74	*
2003 Q3	0.1598	2.63	***	0.1092	0.90	
2004 Q1	-0.0158	-0.29		-0.1030	-0.89	
2005 Q1	-0.0959	-1.81	*	-0.0912	-1.39	
2005 Q3	-0.4521	-8.39	***	-0.5224	-4.72	***
2006 Q1	-0.5857	-10.54	***	-0.6602	-5.49	***
GDP growth	n/a			-0.0310	-1.82	*
GDP per capita	n/a			0.1860	1.48	
Inflation	n/a			0.0086	0.96	
Current Account	n/a			0.0102	-0.32	
Debt/GDP	n/a			4.9048	1.49	
Debt/Reserves	n/a			0.0611	0.74	
Debt/Exports	n/a			-0.0646	-0.49	
Short-Term/Long-Term	n/a			0.1723	0.37	
Belize	1.7154	10.34	***	(dropped)		
Brazil	0.8440	15.04	***	0.9358	2.91	***
Chile	-0.5127	-4.81	***	-0.8786	-3.08	***
Colombia	0.7482	12.31	***	1.0997	2.61	***
Costa Rica	0.5352	7.64	***	0.3562	1.69	*
Guatemala	0.7089	6.64	***	(dropped)		
Indonesia	1.5794	8.73	***	(dropped)		
Korea	-0.4279	-3.15	***	-1.9667	-1.51	
Panama	0.4889	6.47	***	(dropped)		
Peru	0.6441	7.76	***	1.4423	2.52	**
Philippines	0.8292	11.61	***	(dropped)		
Poland	-0.6017	-7.25	***	-0.9772	-3.01	***
South Africa	-0.1108	-1.16		-0.2041	-0.82	
Turkey	0.8152	11.47	***	1.1731	2.55	**
Uruguay	2.2318	20.65	***	1.4214	1.99	**
Venezuela	1.2968	15.37	***	(dropped)		
Adjusted R^2	0.6682			0.6662		
Observations	1297			853		

Table 2.8: Robustness Check: Sample: New York and English only
*,**,*** denote significance at the 10%,5% and 1% level respectively.

explanatory variable	Specification 1			Specification 2			US/UK only		
	Coefficient	t-Statistic		Coefficient	t-Statistic		Coefficient	t-Statistic	
Constant	4.016474	17.84	***	4.789051	24.73	***	3.852421	18.30	***
Duration	.2796981	14.18	***	.2675488	13.82	***	.3550521	14.28	***
$Duration^2$	-.0149394	-10.10	***	-.0143977	-9.81	***	-.0216421	-11.49	***
CAC	.1898383	1.58		.3606935	2.86	***	.5818443	4.95	***
FRAC	-.685928	-2.10	**	2.232415	5.62	***	1.113646	2.98	***
CAC*FRAC	-1.166244	-3.59	***	-1.936887	-4.24	***	-2.435222	-6.95	***
EARLY*CAC	-.0238843	-0.15		-.1380385	-0.85		-.1710013	-1.13	
EARLY*FRAC	.2999105	0.77		-.323137	-0.68		-.2213538	-0.53	
EARLY*CAC*FRAC	-.3722264	-0.66		.4361126	0.61		.1841163	0.33	
Euro	-.118262	-2.74	***	-.1410274	-3.17	***	n/a		
Yen	.2760254	2.66	***	.2177148	2.11	**	n/a		
£	-.0995869	-0.84		-.2199987	-1.77	*	-.2766058	-2.63	***
SF	.5744172	3.28	***	.5848578	3.33	***	n/a		
2003 Q1	.052341	0.41		.1813681	1.46		.1158647	0.87	
2003 Q3	-.0799884	-0.95		.032886	0.38		-.0406675	-0.46	
2004 Q1	-.3032572	-3.95	***	-.3107665	-4.00	***	-.3300753	-4.29	***
2005 Q1	-.0671005	-0.63		-.2529177	-2.59	***	-.2419338	-2.18	**
2005 Q3	-.2503852	-2.23	**	-.602307	-5.59	***	-.4991008	-4.16	***
2006 Q1	-.3649501	-3.05	***	-.7878577	-6.98	***	-.6793212	-5.39	***
GDP growth	.0085928	0.66		-.0174139	-1.29		-.0192166	-1.45	
GDP per capita	-.0000673	-3.84	***	-.0001224	-9.70	***	-.0000637	-4.57	***
Inflation	.0307069	6.84	***	.036676	8.31	***	.0325082	6.83	***
Current Account	-.0162266	-1.20		.01989	1.70	*	-.0046576	-0.35	
Debt/GDP	1.374358	1.39		.7885081	0.76		2.041586	2.05	**
Debt/Reserves	.113228	2.31	**	.0121354	0.31		.1363549	3.33	***
Debt/Exports	.2192314	4.22	***	.1540308	3.03	***	.1320609	2.44	**
Short-Term/Long-Term	1.064973	2.66	***	1.105148	2.72	***	.5348472	1.30	
Adjusted R^2	0.7009			0.6716			0.6978		
Observations	1282			1282			853		

Table 2.9: Effects over time

*,**,*** denote significance at the 10%,5% and 1% level respectively.

Chapter 3

Macroeconomic Hedging for Sovereign Debtors

3.1 Introduction

Emerging market economies face macroeconomic volatility. For example, as the IMF World Economic Outlook 2005 notes the volatility of output growth in emerging market and developing countries is almost three times as large as in industrial countries.[1] While the WEO 2005 also makes the point that volatility is harmful for growth, welfare, and poverty we can also think that countries more generally have a preference for smooth output paths. This paper focuses on the macroeconomic volatility of emerging market economies with open capital accounts and external government debt. One source of large scale fluctuations in these countries is the immaturity of their economies. Many emerging market economies depend on very few commodity or specific sector exports. Furthermore Kaminsky et al establish that international capital flows have the potential to amplify macroeconomic swings. Also, Tornell et al argue that while beneficial for the long run growth trend, financial liberalization leads to financial fragility and a greater incidence of crises.

Output fluctuations mostly pass through to the stream of government income. When the economy is doing bad tax income and other form of government revenue is typically low. Standard public finance wisdom suggests that the government should not react to this by allowing expenditures to swing in the same way. In contrast it is advised that governments should increase expenditures during recessions, i.e. exercise a counter-cyclical fiscal policy. This implies that governments have to increase borrowing or decrease debt service payments in bad times. While this simplified logic is not even easily carried out in western economies, emerging market and developing economies face additional difficulties due to the riskiness of their debt. If an economy faces distress, the country may end up in a debt crisis, magnifying difficulties even further.

What we perceive in the real world is not only that emerging countries do not exercise countercyclical fiscal policies, but that they regularly default on their external debt. While this partly allows the government to smooth its expenditures in the short run, the costs of this procedure are considerable. First, debt crises are associated with adverse consequences for the domestic economy because for example international trade becomes more difficult to exercise while the government is in default on it's external claims. Second, the occurrence of defaults increases interest rate spreads ex ante which in turn makes government debt financing less beneficial for sovereign debtors.

[1] Volatility is measured as standard deviation of per capita real output over ten years.

This paper focuses on the opportunity to smooth the path of government income or adjust the stream of payments in order to avoid disorderly defaults. In the presented model default is essentially an inefficient way to deviate from the originally contracted repayment. In the event of default the country faces an economic cost which serves to derive its willingness to pay. It is shown that indexing improves matters if default can be avoided in some states of the world. I also argue that collateralizing a sovereign bond with an indexed instrument is equivalent to an indexed bond. Furthermore, I argue that this kind of macroeconomic hedging is impeded by existing debt contracts and the uncertain prospect that financial gains might be seized by international creditors.

This paper relates to some papers on contingent debt repayments for sovereigns. For example Borensztein and Mauro analyze the prospects of indexing sovereign bonds to GDP. They develop the argument that such indexation makes unsustainable debts less likely and discourages pro-cyclical fiscal policies. In the debate on debt forgiveness following the debt crisis of the 1980s Froot et al suggested indexed debt to promote investment in indebted countries. An IMF report on sovereign debt structure also emphasizes the role new financial instruments, particularly the indexation to real variables, could play to prevent crises. Kletzer proposes the use of derivative instruments to deal with macroeconomic volatility. Caballero stresses the importance of indexing to factors outside the countries control and suggests that Central Banks or the IFIs should structure benchmark instruments that trace country specific external shocks.

The rest of the paper is structured as follows: Section 2 presents a benchmark model. It shows that complete contingency is optimal for sovereign debtors. However, if debt levels are high full insurance is not sustainable. Also it is shown that collateralizing claims from financial derivatives is equivalent to indexing sovereign bonds. Section 3 extends this model. First, it is shown that moral hazard has only a level effect on the optimal contract. The level of contingency is much lower, but contingent contracts outperform non-contingent ones. Second, it is shown that existing debt is a severe impediment to hedging contracts. If the claims are partly seizable by external creditors the country can not undertake the desired smoothing. Section 4 considers the possible use of contingency in the real world. An empirical assessment takes a look at the hedging potential with external variables such as commodity prices and interest rates. Also, alternative views on the lack of contingent claims in sovereign borrowing are summarized. Section 5 concludes.

3.2 A Benchmark Model

3.2.1 Theory of Sovereign Debt

In this section I will briefly describe a theory of sovereign debt that underlies the payoffs in the model. I assume that no official enforcement tool exists, i.e. no assets of the country can be seized in court. However, if the country defaults it faces default costs proportional to output. These can be thought of as direct costs, such as difficulties to arrange foreign trade, or more indirect costs, such as loss of reputation. The proportionality of the default cost embeds the stylized fact that countries tend to default in bad states of the world rather than in good states. This implicitly incorporates a theory of sovereign debt in line with Bulow and Rogoff (1987) more than with that of Eaton and Gersowitz who focus on reputation effects which implies defaults in good states of the world. Let output be y and the default cost fraction 2θ, so that default costs amount to $2\theta y$.

A default situation (with the debtor being punished and the creditors receiving nothing) is pareto inefficient. I assume that this will be recognized by both parties and that the debtor will eventually repay θy. This can be interpreted as the result of a bargaining game. However, this agreement comes with costly delay to both parties, so that in case of default the creditors only receive $\alpha\theta y$ and the debtors payoff is $\alpha(1-\theta)y$, with $\alpha \in (0,1)$. The cost of default $(1-\alpha)$ can be interpreted as the cost of the time passed until an agreement is reached, i.e. interest cost for the creditors and output loss for the sovereign. Alternatively, one may like to think of a sort of costly state verification process since the true value of θ is not known. So given that the debt is denoted D the debtor will choose to repay if:

$$\begin{aligned} y - D &\geq \alpha(1-\theta)y \\ (1-\alpha(1-\theta))y &\geq D \\ y &\geq \frac{D}{1-\alpha(1-\theta)} \end{aligned} \tag{1}$$

This structure is common knowledge.

3.2.2 Standard Debt Contract

The country wants to finance a project which has a return of x_H with probability γ or a return of x_L otherwise. The project costs R and the country has no own wealth so that it approaches international capital markets. Creditors are assumed to be risk neutral, i.e. they buy any bond with expected value of R. This can either be a contract that repays R in both states (no-default contract) or a contract where the country defaults in the bad state (default contract). This contract has to suffice:

$$\gamma D + (1-\gamma)\alpha\theta x_L = R \tag{2}$$

Let us now assess whether the country will prefer to sign a default or a no-default contract. The expected utility for the country for each type of contract respectively is:

$$\begin{aligned} E[U|\text{no-default}] &= \gamma U(x_H - D) + (1-\gamma)U(x_L - D) \\ E[U|\text{default}] &= \gamma U(x_H - D) + (1-\gamma)U(\alpha(1-\theta)x_L) \end{aligned} \tag{3}$$

From equation 2 we know that $D = \frac{R-(1-\gamma)\alpha\theta x_L}{\gamma} > R$ for the default contract. So the good state payoff is higher in the no-default case. And from equation 1 we know that the bad state payoff is also better in the no-default contract. So the no-default contract dominates the default contract. However, the no-default contract is only feasible for low values of R, namely $R \leq (1-\alpha(1-\theta))x_L$. The largest project that can be financed with a default contract is corresponding to $D = (1-\alpha(1-\theta))x_H$ resulting in $R = \gamma(1-\alpha(1-\theta))x_H + (1-\gamma)\alpha\theta x_L$. So, capital scarce countries will end up signing a default contract.

3.2.3 Hedge Contract

Suppose now that the country is risk averse, i.e. $-\frac{U''(x)}{U'(x)} > 0$ and it can also enter a hedge contract to smooth payoffs across states. A hedge contract specifies a premium to be paid in the good state Π and a payment to the country Z in the bad state. The hedge is offered by risk neutral markets so that $\gamma\Pi = (1-\gamma)Z$.

Given the country decides to enter a hedge contract it is another decision on how to use the proceeds. By committing itself to use the proceeds to repay creditors it sacrifices some of the direct insurance effect, but creditors will offer better conditions if default risk is mitigated. Formally, we specify that in case of default the debtor is entitled to ϕZ and the creditors receive $(1-\phi)Z$. One can argue that ϕ is close to zero in the real world. The contractor of the hedge would likely be a financial company based outside of the debtor country, most likely even based in the (western) country whose jurisdiction the bond contract is subject to. In this case creditors might have good prospects to seize these assets. But let us first consider how the country would like to write a contract without this restriction.

Once again the country can decide between two types of contract: a default and a no-default contract. We shall now evaluate the respective expected utilities for both types and see what parameter restrictions apply.

No-Default contract

To find the best possible no-default contract we have to solve the following maximization problem:

$$\max_{D,\phi,Z} \quad \gamma U(x_H - \Pi - D) + (1-\gamma)U(x_L + Z - D) \tag{4}$$

$$s.t. \qquad D = R \tag{4A}$$

$$\gamma \Pi = (1-\gamma)Z \tag{4B}$$

$$x_L + Z - D \geq \alpha(1-\theta)x_L + \phi Z \tag{4C}$$

$$x_H - \Pi - D \geq \alpha(1-\theta)x_H \tag{4D}$$

Where 4 A and 4 B characterize the bond and hedge market respectively and 4 C and 4 D ensure that the country can credibly commit not to default in either state. I substitute Π and D from 4 A and 4 B. We then solve the unconstrained problem and only then check for which parameter values the constraints 4 C and 4 D impede this optimum.

$$\max_{\phi,Z} \quad \gamma U(x_H - \frac{1-\gamma}{\gamma}Z - R) + (1-\gamma)U(x_L + Z - R) \tag{5}$$

Since ϕ is not in the equation the only first order condition is:

$$\frac{\partial U}{\partial Z} = -(1-\gamma)U'(x_H - \frac{1-\gamma}{\gamma}Z - R) + (1-\gamma)U'(x_L + Z - R) = 0 \tag{6}$$

which boils down to

$$Z = \gamma(x_H - x_L) \tag{7}$$

If possible the country will implement full insurance such that payoffs in both states are equal. This implies $\Pi = (1-\gamma)(x_H - x_L)$. It is straightforward to see that the payoff for the country in either state is $\gamma x_H + (1-\gamma)x_L - R$, which is just expected output minus the debt. If we sub this values into the no default constraint 4 D we get:

$$\begin{aligned} & x_H - (1-\gamma)(x_H - x_L) - R && \geq \alpha(1-\theta)x_H \\ \Leftrightarrow \quad & R && \leq \gamma x_H + (1-\gamma)x_L - \alpha(1-\theta)x_H \end{aligned} \tag{8}$$

So the no default constraint for the good state defines an upper bound for the amount the country can borrow in a contract without default. The other no default condition 4 C yields:

$$\begin{aligned} & x_L + \gamma(x_H - x_L) - R && \geq \alpha(1-\theta)x_L + \phi\gamma(x_H - x_L) \\ \Leftrightarrow \quad & R && \leq \gamma(1-\phi)x_H + (1-\gamma(1-\phi))x_L - \alpha(1-\theta)x_L \end{aligned} \tag{9}$$

It follows immediately that for $\phi = 0$ condition 8 is stricter than condition 9. The intuition why default in the good state is more restrictive is that the payoffs when repaying orderly are equal in both states due to the full insurance nature of the contract. But the outside option, to default on the claims, is more profitable in the good state. If ϕ takes positive values defaulting becomes more attractive in the bad state, so that for some $\phi > \frac{\alpha(1-\theta)}{\gamma}$ condition 9 becomes the tighter constraint. We have seen already that expected payoffs and hence utility does not depend on the choice of ϕ, any value for $\phi \in (0, \frac{\alpha(1-\theta)}{\gamma})$ yields the same utility. Obviously, the distribution of the insurance benefits in case of default makes no difference as long as the contract ensures that the country does not default. If ϕ takes on too high values the country would choose to default in the bad state because it enjoys a sufficient fraction of the insurance benefits.

If $R > \gamma x_H + (1-\gamma)x_L - \alpha(1-\theta)x_H$ full insurance is not possible. Then condition 4 D becomes binding and the optimal insurance is given by:

$$Z = \frac{\gamma}{1-\gamma}((1-\alpha(1-\theta))x_H - R) \tag{10}$$

If we take this into condition 4 C we can solve for the maximum R that can be sustained with this contract:

$$R \leq (1 - \alpha(1 - \theta))(\gamma x_H + (1 - \gamma)x_L) \tag{11}$$

The right hand side of the inequality 11 is the expected pledgeable output. So creditors extract as much output as possible with this contract. Note that this and equation 10 implies that Z is positive for the largest loan, so insurance is not crowded out by the need for money. Proposition 1 summarizes the findings for the no-default contract.

Proposition 1. No-default contract: *A contract that ensures full repayment in both states is a no-default contract. It has the following characteristics:*

For $R \leq \gamma x_H + (1 - \gamma)x_L - \alpha(1 - \theta)x_H$*:*

$$\begin{aligned} Z =& \gamma(x_H - x_L) \\ U =& U(\gamma x_H + (1 - \gamma)x_L - R) \end{aligned}$$

For $R \in (\gamma x_H + (1 - \gamma)x_L - \alpha(1 - \theta)x_H, (1 - \alpha(1 - \theta))(\gamma x_H + (1 - \gamma)x_L))$*:*

$$\begin{aligned} Z &= \frac{\gamma}{1-\gamma}((1 - \alpha(1 - \theta))x_H - R) \\ E[U] &= \gamma U(\alpha(1 - \theta)x_H) + (1 - \gamma)U(x_L + \frac{\gamma}{1-\gamma}(1 - \alpha(1 - \theta))x_H - \frac{R}{1-\gamma}) \end{aligned}$$

Default Contract

The country may also sign a contract promising to repay a debt D that is so high that it will only choose to repay in the good state and default in the bad state. This contract solves:

$$\max_{D,\phi,Z} \quad \gamma U(x_H - \Pi - D) + (1 - \gamma)U(\alpha(1 - \theta)x_L + \phi Z) \tag{12}$$

$$s.t. \qquad \gamma D + (1 - \gamma)(\alpha\theta x_L + (1 - \phi)Z) = R \tag{12A}$$

$$\gamma\Pi = (1 - \gamma)Z \tag{12B}$$

$$x_H - \Pi - D \geq \alpha(1 - \theta)x_H \tag{12C}$$

Let us again incorporate the bond market and insurance market conditions (12 A and 12 B) and solve the unconstrained problem. Expected utility is:

$$\begin{aligned} E[U] =& \gamma U\left(x_H - \frac{1-\gamma}{\gamma}Z - \frac{R-(1-\gamma)(\alpha\theta x_L + (1-\phi)Z)}{\gamma}\right) \\ &+ (1-\gamma)U(\alpha(1-\theta)x_L + \phi Z) \\ =& \gamma U\left(x_H - \frac{R-(1-\gamma)\alpha\theta x_L}{\gamma} - \frac{1-\gamma}{\gamma}\phi Z\right) \\ &+ (1-\gamma)U(\alpha(1-\theta)x_L + \phi Z) \end{aligned} \tag{13}$$

From equation 13 is apparent that either ϕ or Z will be redundant in the optimization problem. This stems from the risk neutrality of the creditors. They are indifferent between all fair priced insurance schemes. A marginal variation in the creditors insurance causes exactly the same variation in the demanded repayment D and in the insurance premium Π. So the country's payoffs are unaffected by providing some insurance for the creditors. Accordingly, we can assume that the country only hedges for its own benefit, i.e. $\phi = 1$. Then the first order condition is:

$$\begin{aligned} \frac{\partial U}{\partial Z} =& -(1-\gamma)U(x_H - \frac{R-(1-\gamma)\alpha\theta x_L}{\gamma} - \frac{1-\gamma}{\gamma}Z) + (1-\gamma)U(\alpha(1-\theta)x_L + Z) = 0 \\ \Leftrightarrow \quad & x_H - \frac{R-(1-\gamma)\alpha\theta x_L}{\gamma} - \frac{1-\gamma}{\gamma}Z = \alpha(1-\theta)x_L + Z \\ \Leftrightarrow \quad & Z = \gamma(x_H - \frac{R-(1-\gamma)\alpha\theta x_L}{\gamma} - \alpha(1-\theta)x_L) \end{aligned} \tag{14}$$

So the country desires full insurance. The premium is $\Pi = (1-\gamma)(x_H - \frac{R-(1-\gamma)\alpha\theta x_L}{\gamma} - \alpha(1-\theta)x_L)$ and the payoff in each state of the world is $\gamma x_H + (1-\gamma)\alpha x_L - R$, which is expected output minus the size of the loan. We know that for this to be a feasible contract it must be ensured that the country repays D in the good state, i.e. that the constraint 12 C is satisfied. By plugging in from equation 14 into the constraint we see that this is the case if:

$$\begin{aligned} & \gamma x_H + (1-\gamma)\alpha x_L - R \geq \alpha(1-\theta)x_H \\ \Leftrightarrow \quad & R \leq \gamma x_H + (1-\gamma)\alpha x_L - \alpha(1-\theta)x_H \end{aligned} \tag{15}$$

If equation 15 is violated we have a corner solution such that the constraint 12 C holds binding so that $Z = \frac{\gamma}{1-\gamma}(1-\alpha(1-\theta))x_H + \alpha\theta x_L - \frac{R}{1-\gamma}$. In this type of contract the insurance component is driven out by increasing R. The highest loan the country can sustain with a default contract is when no insurance takes place and $D = (1 - \alpha(1-\theta))x_H$. This corresponds to $R = \gamma(1-\alpha(1-\theta))x_H + (1-\gamma)\alpha\theta x_L$

Proposition 2. Default contract: *A default contract is a debt contract that entails default in the bad state of the economy. It has the following characteristics:*

For $R \leq \gamma x_H + (1-\gamma)\alpha x_L - \alpha(1-\theta)x_H$*:*

$$Z = \gamma(x_H - \frac{R-(1-\gamma)\alpha\theta x_L}{\gamma} - \alpha(1-\theta)x_L)$$
$$U = U(\gamma x_H + (1-\gamma)\alpha x_L - R)$$

For $R \in (\gamma x_H + (1-\gamma)x_L - \alpha(1-\theta)x_H, (1-\alpha(1-\theta))\gamma x_H + (1-\gamma)\alpha\theta x_L))$*:*

$$Z = \frac{\gamma}{1-\gamma}((1-\alpha(1-\theta))x_H + \alpha\theta x_L - R)$$
$$E[U] = \gamma U(\alpha(1-\theta)x_H) + (1-\gamma)U(\alpha x_L + \frac{\gamma}{1-\gamma}(1-\alpha(1-\theta))x_H - \frac{R}{1-\gamma})$$

The Optimal Contract

From propositions 1 and 2 it is easy to see that utility is unambiguously higher for the country if it signs a contract it can repay in all states of the world. Both contracts yield the expected project outcome minus the loan. But if the country defaults in one state the project outcome is partly destroyed, i.e. default is inefficient. It is also apparent that the no-default contract can sustain a larger loan. We can conclude that the country will always desire to use the hedge such that it can credibly commit to repay in all states of the world. Any inefficiency arising from default in some states of the world would be borne by the country. This implies that the country should use the hedge claims to collateralize its debt.

We have also seen that not collateralizing the hedge never yields higher utility for the country. At worst, it distorts the incentive to repay in the bad state so that the efficiency gain is not realized. Another thought experiment is to compare the proposed hedging as collateral with a situation in which the creditors buy the hedge. This does not improve on the non-contingent contract, because the country still defaults in the bad state. Even if the creditors payoffs are perfectly smoothed they remain entitled to a higher payment by the country than it is willing to pay. So, collateralizing the hedge is the only way of establishing the same payoffs a state contingent bond would yield.

3.3 Extensions

3.3.1 Moral Hazard

The analysis so far has neglected any moral hazard the debtor country might face. This is unrealistic and dissatisfying from a theoretical point of view, too. The sovereign debt literature usually motivates the existence of unstable features in the sovereign debt markets by arguing that market imperfections exist and that the contracts observed are second best in the given environment. Especially, moral hazard and asymmetric information problems explain why sovereign debt often exhibits maturity mismatch and currency mismatch.

In the model presented above only some moral hazard comes through the backdoor of limited enforcement. The country's decision to default or not is not contractible. Thus, the creditors have to sign a contract that either maintains incentives to undertake the good action in both states (the no-default contract) or account for the loss if the country chooses the bad action (default contract). As a result full contingency can only be implemented for low debt levels.

However, the typical hidden action we have in mind when we consider sovereigns and insurance economics in general, is an action that determines the outcome variable. A standard approach to incorporate this into the model is to let the random outcome depend on the country's policy choice, which demands an effort. Let us assume the country can determine the probability of the good state γ by exerting effort $e(\gamma)$. The effort can for example be interpreted as unfavorable short term consequences of a sustainable macro policy. The country's policy choice would then be determined by:

$$\max_{\gamma} \quad \gamma U(x_H - \Pi - D) + (1-\gamma) U(x_L + Z - D) - e(\gamma) \tag{16}$$

The first order condition implies that

$$e'(\gamma) = U(x_H - \Pi - D) - U(x_L + Z - D) \tag{17}$$

If we assume for simplicity that $e(\gamma) = \frac{1}{2}\gamma^2$ this implies $\gamma = \Delta U$. This is an additional constraint in the optimization problem to find the best contract, if we assume that the country can not precommit to a policy. To see how the analysis of the last part is affected by moral hazard we have to compare the solutions for two optimization problems. One, where the country fulfills its obligation in both states of the world and one where it repudiates on its debt if output is low. Again, I assume $\phi = 0$ for the no-default contract and $\phi = 1$ for the default contract. The optimization problems are,

for the no-default contract with moral hazard:

$$\max_Z \quad \gamma U(x_H - \frac{1-\gamma}{\gamma}Z - R) + (1-\gamma)U(x_L + Z - R) - \frac{1}{2}\gamma^2 \tag{18}$$

$$s.t. \quad \gamma = U(x_H - \frac{1-\gamma}{\gamma}Z - R) - U(x_L + Z - R) \tag{18A}$$

$$x_L + Z - R \geq \alpha(1-\theta)x_L \tag{18B}$$

$$x_H - \frac{1-\gamma}{\gamma}Z - R \geq \alpha(1-\theta)x_H \tag{18C}$$

and for the default contract with moral hazard:

$$\max_Z \quad \gamma U(x_H - \frac{1-\gamma}{\gamma}Z - D) + (1-\gamma)U(\alpha(1-\theta)x_L + Z) - \frac{1}{2}\gamma^2 \tag{19}$$

$$s.t. \quad \gamma = U(x_H - \frac{1-\gamma}{\gamma}Z - R) - U(x_L + Z - R) \tag{19A}$$

$$D = \frac{R - (1-\gamma)(\alpha\theta x_L + Z)}{\gamma} \tag{19B}$$

$$x_H - \frac{1-\gamma}{\gamma}Z - D \geq \alpha(1-\theta)x_H \tag{19C}$$

We will now continue to show that given any financing need R if a feasible default contract exists, there exists a no-default contract that outperforms the default contract in terms of expected utility. A sketch of the proof reads as follows: we construct a no-default contract that yields the same payoff in the bad state as the corresponding default contract. We continue to show that this no-default contract yields an unambiguously higher payoff in the good state.

Proposition 3. MORAL HAZARD: *If the country faces a moral hazard problem, i.e. utility is given by $E(U) = \gamma U(good) + (1-\gamma)U(bad) - e(\gamma)$, a hedge contract that avoids default in the bad state is always better than a default contract.*

Proof: The payoff in the bad state for the default contract is $\alpha(1-\theta)x_L + Z_{def}$ and $x_L + Z_{no} - R$ for the no-default contract. In order for these to be equivalent we need:

$$\Delta Z = Z_{no} - Z_{def} = R - (1 - \alpha(1-\theta))x_L \tag{20}$$

This is strictly positive if $R > (1-\alpha(1-\theta))x_L$ which is the case for all R where a default contract would be signed in the absence of hedging tools. So, with a no-default contract the country has to insure more than with a default contract in order to achieve a given payoff in the bad state. This reflects that default has an insurance function. Our claim that the no-default contract is better demands that:

$$\begin{aligned} x_H - \frac{1-\gamma}{\gamma}(Z_{def} + \Delta Z) - R &> x_H - \frac{1-\gamma}{\gamma} Z_{def} - D \\ -\frac{1-\gamma}{\gamma}(R - (1-\alpha(1-\theta))x_L) - R &> -\frac{R - (1-\gamma(\alpha\theta x_L}{\gamma} \\ -\frac{R - (1-\gamma)(1-\alpha(1-\theta))x_L}{\gamma} &> -\frac{R - (1-\gamma)(\alpha\theta x_L)}{\gamma} \\ (1-\alpha(1-\theta))x_L &> \alpha\theta x_L \\ (1-\alpha) &> 0 \quad \square \end{aligned} \tag{21}$$

So, for each default contract there exists a no-default contract that is actually better. This means that the results from the previous section still hold. However, the level of contingency that can be implemented is much lower than in the case without moral hazard, where full insurance was possible for some parameter constellations. In the presence of risk aversion on behalf of the agent there is a trade-off between incentives (which imply that the agent should be residual claimant, e.g an uncontingent debt contract) and insurance (which implies full contingency).[2]

3.3.2 Hedging into Existing Debt

The last section suggests that a country should hedge its creditors against the risk of default. The main underlying argument is that the country fully benefits from this insurance through better credit conditions. In this section we turn to the case where the country has signed a standard debt contract in the past and decides now whether to enter a hedge contract or not.

From section 3.2.2 we know that the contract signed in the absence of any derivatives can be either a no-default contract or a default contract, where the latter is only feasible for low values of $R \leq (1-\alpha(1-\theta))x_L$. In this case ex-post hedging does not provide

[2]For an overview of the financing structure of firms, where the discussion takes place under the label debt vs. equity, see Dowd (1992) and Harris and Raviv (1991). The key reference for the optimality of standard debt contracts in more complex settings are Diamond (1984) and Gale and Hellwig (1985). However, Hellwig (200,2001) shows that the results from Diamond (1984) are not robust to the introduction of agent risk aversion.

spectacular insights. The country buys full insurance and lives on happy ever after. For the case that a default contract was signed in ancient times the country can try to accomplish one of two things by signing an insurance contract: it can (1) sign a contract that yields enough payment in the bad state, so that default can be avoided (i.e. the country switches from a default to a no-default contract). Or, the country can also decide to (2) hedge its own position and stick to defaulting in the bad state.

This latter case (2) is only possible if ϕ is sufficiently high. In the extreme case where $\phi = 0$ the country can not achieve any insurance and still default in the bad state. Any value of $\phi < 1$ implies that part of the bad state payment of the hedge will accrue to the creditors. From the debtors point of view the price of the insurance is higher, but a risk averse country may still decide to buy the hedge.

In the real world it seems realistic to assume that ϕ is close to zero. As mentioned above the contractors of the hedge are likely to be subject to a non domestic jurisdiction so that the proceeds are likely to be claimed by creditors in the event of default. In this situation it is more likely that the country will try to sign an insurance contract in order to circumvent default in the bad state. But, since the creditors benefits from the hedge are not priced into the initial debt contract, this is less beneficial than in the benchmark presented above.

In this analysis we will assume that $\phi = 0$ and that the country's motivation to hedge is to switch from a default contract to a no-default contract. This describes a situation where the creditors can seize the countries claims in the bad state. The contract we are looking for is a no-default contract, similar to the optimization problem 4. The optimization problem is:

$$\max_{D,\phi,Z} \quad \gamma U(x_H - \Pi - D) + (1-\gamma)U(x_L + Z - D) \tag{22}$$

$$s.t. \qquad \gamma\Pi = (1-\gamma)Z \tag{22A}$$

$$x_L + Z - D \geq \alpha(1-\theta)x_L \tag{22B}$$

$$x_H - \Pi - D \geq \alpha(1-\theta)x_H \tag{22C}$$

Condition 22 B implies not only that the country will repay in the bad state but also that a sufficiently risk averse country will choose to buy the insurance. Similar to the analysis in the previous section the implied optimum of the unconstrained problem is full insurance, $Z = \gamma(x_H - x_L)$. But 22 C implies that insurance is bounded from above:

$$Z \leq \frac{\gamma}{1-\gamma}((1-\alpha(1-\theta))x_H - D) \tag{23}$$

This condition is fulfilled if:

$$D \leq (1-\alpha(1-\theta))x_H - (1-\gamma)(x_H - x_L) \tag{24}$$

If inequality 24 holds full insurance is the solution. Plugging $Z = \gamma(x_H - x_L)$ into condition 22 B we get another upper bound for D:

$$D \leq \gamma x_H + (1-\gamma-\alpha(1-\theta))x_L \tag{25}$$

The right hand side of inequality 25 is unambiguously larger than that of inequality 24. So, if full insurance is possible, i.e. if inequality 24 holds, it is possible to switch to a no-default contract. More specifically, in this case we can think of a sufficiently risk averse country that will enter a hedge contract although some proportion of it accrues to the creditor.

Otherwise, if $Z = \frac{\gamma}{1-\gamma}((1-\alpha(1-\theta))x_H - D)$. constraint 22 B becomes.

$$D \leq \gamma(1-\alpha(1-\theta))x_H + (1-\gamma)(1-\alpha(1-\theta))x_L \tag{26}$$

Equation 26 defines the upper bound for the inherited debt of the country. If D is higher, there is no $U(\cdot)$ that would enter a hedge contract. The upper bound defined here is strictly lower than the maximum amount of debt that could reasonably be inherited, $D = (1-\alpha(1-\theta))x_H$. Even if D is below the upper bound the country must (depending on parameter values) be very risk averse to sign a hedge contract. Any reasonably capital scarce country that entered a default contract in the past is likely not to profit from hedging into the existing debt. Only very risk averse countries with an intermediate amount of debt will choose to hedge.

3.4 Practical Considerations

3.4.1 Empirical Plausibility

The theoretical part suggests that macroeconomic hedging, i.e. the introduction of contingency in sovereign claims can indeed profit both debtor countries and creditors by avoiding inefficient default. However, any indexation would raise moral hazard issues. Firstly, the country may try to change the underlying values by misreporting (measurement problem), but also secondly, the country may lack incentives for improvements in some policy areas (policy problem).

The measurement problem basically excludes all variables from indexation that can not be verified by an independent and transparent party. Other than that the debt contract requires the country to pay just as much as it wants to. Tackling the policy problem requires to ensure that the changes affected are limited, but to a certain extend moral hazard will persist: the ultimate benefit of the proposed contingency is that the bad state is less bad and the good state less good for the country. If one believes in some steering ability of economic policy this must affect the countries decision making. Nevertheless, moral hazard can be limited by indexing the contract to variables out of the countries direct control. Indexing with respect to international interest rates, commodity prices or share prices presumably causes less severe moral hazard than indexing to exports, domestic inflation or the balance of payments. In addition indexation to variables that are either fully exogenous and independent to the country (US interest rates) or are traded prices reduces the potential influence the country can exert to manipulate the underlying to zero.

The question that arises is whether indexation to external variables provides the country with a meaningful hedge against macroeconomic risks. The theoretical part is monodimensional in the sense that there is one variable (output y) that determines the country's utility and repayment. In reality this approximation may not be valid. It is not only GDP that drives the repayment decision. As the underlying theory suggests, the gains of trade determine the cost of default. And the scarcity of dollars can be disentangled from GDP if the exchange rate is volatile. In this section I will try to propose measures of the macro financial situation in the country that pin down their need for flexibility in repayments to external lenders. Next, I will try to identify which external factors mimic this indicator and are thus potential variables for indexation.

The indicator variable should track two closely interrelated things: the country's general financing needs and the country's willingness to repay. The latter follows directly from the analysis so far. The benefit of the contingency is to avoid default so that we are looking for a financial instrument that steps in whenever the country would like to default. To hedge the financing needs of the country seems natural at first sight. Empirically we can then deter also almost defaults. Economically we extend the scope of hedging from pure default avoidance towards a less cyclical fiscal policy.

A good starting point for the analysis is the empirical literature on the prediction of sovereign debt crises. Manasse et al develop an early warning model for sovereign debt crises. They estimate a logit model to see which variables predict sovereign debt crises. Most variables they find significant are within the countries control, e.g. debt related variables (debt ratios), reserves, current account.

Kruger and Messmacher (2004) use a similar dataset but include an index variable measuring the financing need of the sovereign. This index relates the need for international money for imports and debt service to the amount available, reserves, exports and transfers. I follow their notation and label the indicator proportion of new financing needs, PNF:

$$PNF_{it} = \frac{\text{Debt Service}_{it} + \text{Imports}_{it}}{(\text{Gross International Reserves - IMF Credit})_{it} + \text{Exports}_{it} + \text{Net Transfers}_{it}}$$

Their results identify the PNF indicator to be a highly significant predictor of a sovereign debt crisis. To get an idea of the hedging potential with variables outside of the countries control I regress a set of external variables on the PNF indicator. But which external variables should be used? As a starting point I take price indices for important export commodities. Since countries of course differ in the composition of their exports this analysis is undertaken countrywise. To account for liquidity in the global bond market I include the EURO and USD interest rate (3 month libor). From Appendix Table 1 in IMF (2004) I identify countries with a high share of exports in the top three export goods in the period 1990-1999. Due to data availability I choose Chile, Colombia, Kenya and Peru. The export shares are summarized in Table 3.1.

The PNF is constructed with Data from the joint BIS-IMF-OECD-WB Debt Database and the IMF International Financial Statistic Country Tables. Commodity price indices and interest rates are taken from the IMF International Financial Statistics. The data is quarterly from 1990/1-2005/4. Due to data availability of some series the dataset had to be truncated individually. Data for all countries includes the years 1994-2002. The regression results are summarized in table 3.2.

Country	Product 1	%	Product 2	%	Product 3	%	Total %
Colombia	Petroleum and crude oils	28.8	Coffee	12.3	Coal, lignite and peat	7.2	48.3
Kenya	Tea	28.4	Coffee	10.4	Refined petroleum products	8.2	47.0
Chile	Copper	27.2	Ores, metal concentrates	12.1	Fruits and nuts	7.1	46.5
Peru	Gold, non-monetary	20.1	Copper	12.2	Ores, metal concentrates	10.3	42.7

Source: IMF (2004)

Table 3.1: Export Shares

The expected sign for commodity prices is negative and positive for interest rates. Colombia performs best in this dimension, where two variables are significant in the correct direction. Coal is somewhat puzzling, but it is the least important export of the three tested and only significant at the 10%-level. For Peru also two commodities are significant and have the predicted sign. However, the metal-index seems to capture a correlation not predicted by the theory. For Kenya all commodities have the correct sign, but only coffee is significant at meaningful levels. Chile is completely dissatisfying: the only significant commodity price points in the wrong direction.

The results for interest rates are ambiguous, too. For Colombia and Peru both USD and EURO interest rates are significant, but only one enters with an intuitive sign. Coefficient and significance are in both cases higher for the interest rate with the favorable sign. For Colombia one might argue that the US-Dollar plays a more important role in determining country specific liquidity and that the EURO interest rate captures something unrelated to the theory in this paper. However, the counterargument for Peru (that the German Mark or the EURO are the dominating international currency) seems less plausible. For Kenya and Chile, the DM/EURO interest rate was highly insignificant, so I dropped it from the regression. The USD interest rate enters with the correct sign in both regressions.

The overall explanatory power of the set of external variables varies a lot, too. While the adjusted R-squared for Colombia and Peru is around 80%, Kenya with 57% and Chile with 12% perform much worse. For the case of Chile one can argue that the Chilean economy is the most developed in the sample. That means that commodity price fluctuations don't pass so easily into the whole economy that rests on other pillars as well.

Colombia

	Coeff.	Std.Dev.	t
Petrol	-.0027053	.0005304	-5.10
Coffee	-.0006084	.0002724	-2.23
Coal	.0014708	.0008084	1.82
Libor DM/EU	-.0496908	.0113191	-4.39
Libor USD	.0679244	.0075581	8.99
constant	.6608505	.1300318	5.08

Number of observations = 40
R-squared = 0.8612
Adj. R-squared = 0.8408

Peru

	Coeff.	Std.Dev.	t
Gold	-.0013169	.0003188	-4.13
Copper	-.0018842	.0004965	-3.80
Metal	.0038456	.0008208	4.69
Libor DM/EU	.0198494	.0019963	9.94
Libor USD	-.0052355	.0021759	-2.41
constant	.2334034	.0595249	3.92

Number of observations = 49
R-squared = 0.8153
Adj. R-squared = 0.7938

Kenya

	Coeff.	Std.Dev.	t
Tea	-.0013561	.0009407	-1.44
Coffee	-.00063	.0002847	-2.21
Petrol	-.000492	.0006239	-0.79
Libor USD	.0607938	.0094745	6.42
constant	1.358239	.0959453	14.16

Number of observations = 41
R-squared = 0.6165
Adj. R-squared = 0.5738

Chile

	Coeff.	Std.Dev.	t
Copper	.0007929	.0005715	1.40
Iron Ore	.00265	.0009863	2.69
Metal	-.0022814	.0012494	-1.83
Libor USD	.0096891	.0043528	2.23
constant	.5994297	.1208968	4.96

Number of observations = 49
R-squared = 0.1984
Adj. R-squared = 0.1256

Table 3.2: PNF Regressions

The undertaken approach to analyze the potential for external indexation by econometric regressions has some limitations, some of which lead to overestimation and some to underestimation of the expected merit from indexation. A heavy weighting argument in disfavor of indexation is that we only observe ex-post correlations. For useful indexation, the policy maker had to expect this correlations in advance which would introduce at least a significant error. However, there is also an argument in favor of the proposed indexation: the implied hedge portfolios in the analysis are static, whereas in the real world the portfolio could be rebalanced occasionally. So, if the importance of some commodities is changing over time, the country can account for it. The ideal exercise one would like to undertake to analyze the benefit from hedging with variable portfolios is the following: take a set of internal and external variables that determine a country's risk exposure at that date, RE_t. Define a general function that translates the risk exposure RE into a hedge contract, $H_{t+1} = (\Pi_{t+1}, Z_{t+1})$. Estimate $H_{t+1} = f(RE_t)$ to maximize the correlation between H_t and PNF_t. In addition, one might also like to improve on the dependent variable.

In light of so many open questions it is difficult to conclude the empirical plausibility check. The regression analysis shows that sovereign financing needs can be somewhat predicted by a set of external factors. Still, to design adequate hedge portfolios remains a delicate task.

3.4.2 Alternative Views

Taking a look at macroeconomic volatility and instability in emerging and developing economies surely justifies a closer look into the issue of contingency of government claims. However, it is worth asking why this path has not been pursued so far. The arguments implicitly in this paper are basically twofold: first, financial innovation is a haphazard process. All financial instruments were only developed at a certain time, although in most cases their use would have been useful in advance. Consequently, proposing an instrument that is not used so far, does not imply it is useless or it won't be used in the near future.[3] Second, for the part of collateralizing sovereign bonds with derivative instruments we have shown that it is unclear from a judicial point who will ultimately benefit from such an arrangement. This can obstacle improvement due to the complex creditor structure of many debtor countries.

Still, it is easy to think of alternative explanations for the lack of macroeconomic hedging. Most importantly, it may be the case that such insurance implicitly exists. Financial support and emergency loans by international financial institutions are often viewed as a country's insurance against economic crises. Also, it is reported that proposals to arrange a formal insurance for Caribbean states against natural disasters were rejected by the targeted countries. Apparently, official and private aid serve as a better hedge and come with no upfront cost.[4]

It is also obvious that macroeconomic insurance requires some foresight and a sufficiently forward looking planning horizon. Political instability and bad governance may imply that politicians horizons are very short and that they don't take any measures for the far future, especially if that would tighten today's budget. One may also think of a political economy picture behind the scenes: If politicians require good states to stay in office and bad states are sufficiently rare it may be optimal for them to enjoy the ride as long as it lasts.

Lastly, it is somewhat uncertain how the entry of a potentially very large player into the hedging market would affect these markets. It may be that the assumption

[3] Closely related to this argument is the idea that those countries in need of better macroeconomic insurance lack the human capital to arrange a sophisticated contingency scheme.

[4] On the insurance function of official financial flows for developing countries affected by natural disaster see Yang (2006).

of an infinite mass of risk neutral market participants is unrealistic and that a high premium were needed to attract investors to carry these risks.

3.5 Policy Implications

The analysis in this paper suggests that contingency in sovereign borrowing can reduce the probability of default and benefit both lenders and borrowers. While moral hazard limits the extend to which contingency can be implemented it should not lead to a break down of the market. To ameliorate the problem, it is important to find variables for indexation that lie out of the countries scope for potential manipulation.

The way to introduce contingency can either be by writing indexed bond contracts or by underlying standard bond contracts with derivative instruments as collateral. Both contractual constructs establish equivalent contingency. However, a few second thoughts may be rewarded for the implementation in the real world.

The proposed contractual implementation has two advantages. First, it is often argued that new financial instruments are difficult to establish, especially for developing countries. In so far it may be easier to simply combine existing instruments. Second, transition problems are easier to handle with collateral. The benefit from indexed bonds for the creditors is enhanced stability. This may not prove very worthy if only one bond issue is indexed, because this little contingency may not influence the default probability significantly. In contrast, the collateral benefits the creditors in bad states independent of the existence of other non-contingent claims. The biggest disadvantage of the collateralization is the impact sovereigns may have in the markets for the respective derivatives. If market prices are distorted heavily this limits the benefits of contingency considerably. Also, the collateralization idea depends on the existence of derivative markets.

Proposals for indexation of sovereign bonds have become frequent in recent years. Maybe in the haphazard process of financial innovation the contingent sovereign borrowing is the next step. This paper suggests that this would benefit both borrowers and lenders. Still, a lot of obstacles mark the way. These include not only the technical difficulties in designing appropriate hedging or indexing portfolios. Furthermore, political problems have to be solved. Firstly, because better governance in the borrowing country limits moral hazard and makes more effective contingency possible. Secondly, it may be necessary that international financial institutions support these ideas, to solve technical difficulties, but also to increase awareness for this topic. This should make it more difficult for policy makers to run a short sighted instable borrowing policy.

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Eidesstattliche Versicherung

Ich versichere hiermit eidesstattlich, dass ich die vorliegende Arbeit selbständig und ohne fremde Hilfe verfasst habe. Die aus fremden Quellen direkt oder indirekt übernommenen Gedanken sowie mir gegebenen Anregungen sind als solche kenntlich gemacht. Die Arbeit wurde bisher keiner anderen Prüfungsbehörde vorgelegt und auch noch nicht veröffentlicht.

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Ossip Robert Hühnerbein