Coordinating in the haircut

A model of sovereign debt restructuring in secondary markets

Adriana Cobas

DebtCon5
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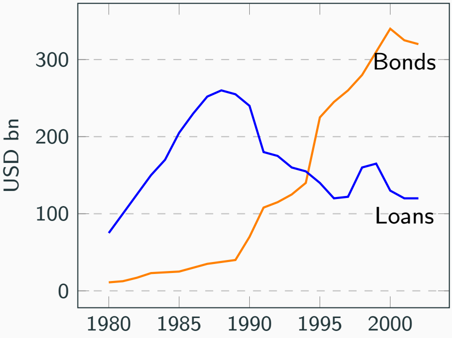
Central Bank of Chile

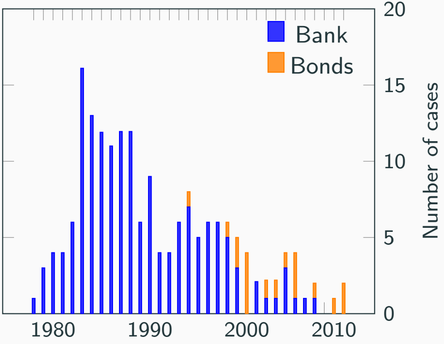
Sovereign Debt: From Banks to Capital Markets

- During the eighties **sovereign debt** experienced a dramatic disintermediation process: large international commercial banks were substituted with atomistic bondholders at global **capital markets**.
- Three milestones paved the way for this event forty years ago (Andritzky, 2006):
  - Establishment of a high yield market (1980s).
  - Brady Plan of debt securitization (1989).
  - Capital flows liberalization.

Sovereign Debt: From Banks to Capital Markets.



Stocks of privately held emerging markets debt. (Borensztein et al., 2004).



Number of annual finalized restructuring processes. (Andritzky, 2006).

What were the effects on restructuring process?

- Why disintermediation occurred so fast? Ex-ante seemed an attractive bet:
  - Issuance: scarce conditionality, cheaper funding.
  - Restructuring: low bargaining power of investors leaning results to the government.

- Ex-post effects observed in data?
  1. **Bay and Zhang (2012) on Benjamin and Wright database find a reduction of 14% in haircut.**
     - Model of bilateral negotiation with private information on the outside option of investors.
     - Secondary market reduces negotiating time revealing outside option.
  2. **This paper on Cruces and Trebesch (2014) database: average haircuts difference loans vs bonds is 27%: 66%$\rightarrow$39%.**
     - Coordination among unarticulated investors entails a cost that leans the result of restructuring against the government.

What were the effects on restructuring process?

- Cruces and Trebesch database which covers all restructuring processes in 1978-2014: 186 cases in 68 countries.

log (haircut)	(1)	(2)
Bond dummy	-0.84***	-0.64*
	(0.25)	(0.25)
Constant	*Yes*	*Yes*
Decade	*Yes*	*Yes*
Other controls	*No*	*Yes*
N	180	162
adj. R^2	0.16	0.29

Table 1: Other controls: GDPpc and GDP in logarithmic terms.

This paper

Q: What is the resulting haircut when a government negotiates with a set of investors facing a coordination problem?

1. What are the **micro determinants** of the equilibrium haircut?
2. Do coordination strategies affect restructuring outcome?
3. How can we **measure** coordination costs?
4. How significant are these **coordination effects** on restructuring outcome?
5. How the results **contrast** with those obtained **without accounting for coordination** effects.

1. Brief sight of the model

Sovereign

- Proposes a debt concession asked to investors: the haircut $h \in (0, 1]$.
- Decides the result of the restructuring plan $R \in \{0, 1\}$, where $R = 1$ denotes success of proposal.
- Normalized **payoffs**:

$$G(h) = \begin{cases} \theta(1+\xi) - [\ell(1-h) + (1-\ell)\nu] & \textit{if } R = 1 \\ \theta & \textit{if } R = 0 \end{cases} \tag{1}$$

  - $\theta \sim f(\theta)$ with $\theta \in [\check{\theta}, \hat{\theta}]$: government fundamental (payment capacity, total reserves, etc).
  - $\ell \in [0, 1]$: aggregate creditor acceptance.
  - $\nu \in (1 - h, 1]$: government's provision for holdouts payment.
  - $\xi \in [0, 1]$: growth effects after exit default

Bondholders (investors)

- **Investor $i \in [0,1]$ with one unit of bond chooses reject or accept government proposal: $a_i \in \{0,1\}$.**
- Symmetric utility $u(a_i, \ell, \theta) : \{0,1\} \times [0,1] \times \mathbb{R}^+ \to \mathbb{R}$:

$$u(1,\ell,\theta) = \begin{cases} 1-h-m & \textit{if } R=1 \\ -m & \textit{if } R=0 \end{cases}$$
$$u(0,\ell,\theta) = \begin{cases} \delta\nu & \textit{if } R=1 \\ 0 & \textit{if } R=0 \end{cases} \quad (2)$$

  - $m \in [0,1]$: participation costs (small)
  - $1-\delta$: discount on holdout receipts (litigation costs, time, probability of repayment).
  - $\delta\nu \in [0, 1-h-m)$: holdouts receipts, in equilibrium. Lemma 2. Expected price utility net of litigation and waiting costs, which should coincide with junk market price.

Timing

Sovereign	**Sovereign**	Nature	**Investors**	**Sovereign**
Stage 0	Stage 1		Stage 2	Stage 3
	$\mathcal{I}^1_{gov} = \{\emptyset\}$		I. compl. info. $\mathcal{I}^2_{inv} = \{h, \theta\}$ II. incompl. info. $\mathcal{I}^2_{inv} = \{h, x_i\}$	$\mathcal{I}^3_{gov} = \{\ell, \theta\}$
Defaults on a set of bonds	Determines and releases h	Releases a draw of θ	Decide $a_i \in \{0, 1\}$ then $\ell = \int_{i \in I} a_i di$ is determined	Decide $R \in \{0, 1\}$ restructuring result

Solution

Proposition 1

There exists a θ^* such that it leaves investors (each using uninformative prior on others' behavior) indifferent about participating in the program (global games):

$$\theta^*(h) = \frac{1}{\xi}\left(1 - h + m\frac{\nu - (1-h)}{1 - h - \delta\nu}\right) \tag{3}$$

- Government determines optimal haircut h_{co} maximizing expected utility:

$$G^*(h) = \int_{\check{\theta}}^{\theta^*(h)} \theta f(\theta) d\theta + \int_{\theta^*(h)}^{\hat{\theta}} \Big(\theta(1+\xi) - [\ell(1-h) + (1-\ell)\nu]\Big) f(\theta) d\theta$$

- **Propositions 2 and 3**: prove existence and uniqueness conditions for h_{co}.

2. Results

1. Comparative statics

Corollary 1

Under certain technical conditions h_{co} is:

- *Decreasing in ν, δ, m*
- *Increasing in ξ*

1. $\frac{\partial h_{co}}{\partial \delta}, \frac{\partial h_{co}}{\partial m} < 0$: to increase participation
2. $\frac{\partial h_{co}}{\partial \nu} < 0$: to increase participation
3. $\frac{\partial h_{co}}{\partial \xi} > 0$: increase profits

Conditions

2. Coordination haircut and Nash bargaining haircut

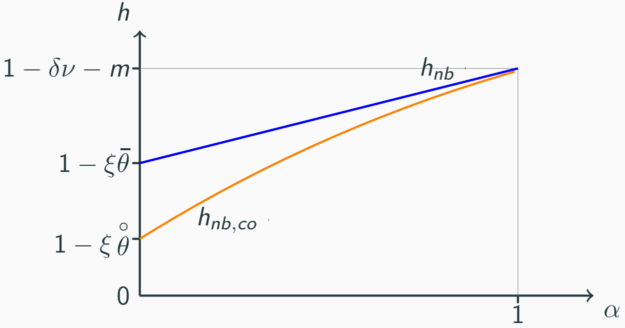


Figure 1: General and coordinated Nash bargaining haircuts.

Proposition 2

1. *$h_{nb,co} \leq h_{nb}$ for all bargaining power level $\alpha \in [0, 1]$.*
2. *$h_{nb} - h_{nb,co}$ is decreasing in α.*

3. Measuring coordination costs

- To compute coordination costs we use a haircut with two features:
  - complete government bargaining power: atomized powerless bondholders
  - no coordination frictions: a unique bondholder.

$$h_{NB,\alpha=1} = 1 - \delta\nu - m$$

- Then calculate coordination costs as:

$$Coordination\,costs = h_{NB,\alpha=1} - h_{co}$$

Calibration

3. Measuring coordination costs

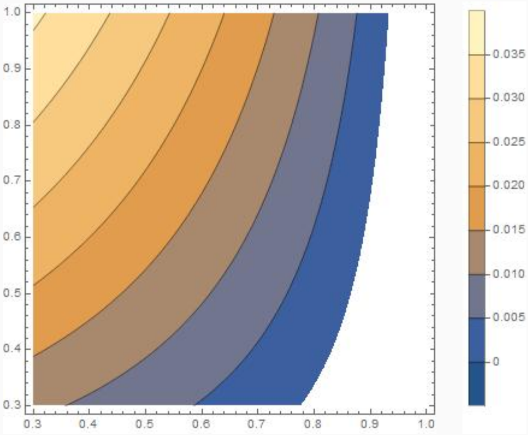


Figure 2: Contour plot: coordination costs as a function of δ (abscissa) and ν (ordinate), with $m = 0.01$, $\xi = 0.04$, assuming an exponential distribution of θ with parameter $\lambda = 0.17$. White zone is restricted for $h > 1 - \delta\nu - m$.

◂ Back

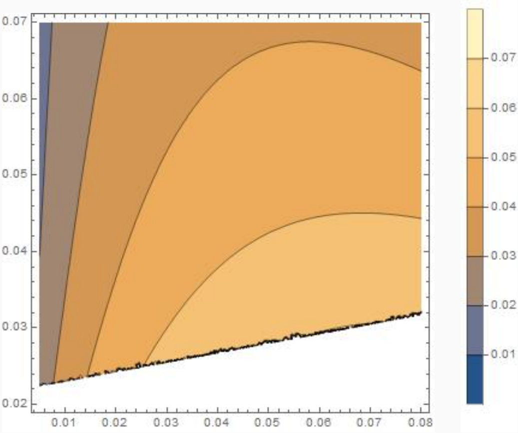


Figure 3: Contour plot: coordination costs as a function of m (abscissa) and ξ (ordinate), with $\delta = 0.375$, $\nu = 0.835$, assuming an exponential distribution of θ with parameter $\lambda = 0.17$. White zone is restricted for $h > 1 - \delta\nu - m$.

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3. Conclusion

Main takeaways

- Sovereign debt migrated from loans to bonds and average haircut reduced 27pp to 39pp. Coordination costs can help addressing such reduction.
- **Coordination effects** embedded in bond debt:
  - Grants investors a *de facto bargaining power* comprising equilibrium haircut when compared to a $NB_{\alpha=1}$ solution.
  - In calibrated simulations coordination costs reach **one fifth of banks-bonds difference**.
  - Frequent haircut determination tools do not incorporate these costs, the difference increases with investors' bargaining power.

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Stage $t = 3$

Lemma 1

Holdouts receipts δ imposes government a limit when determining haircut level h. When $\theta \in [\underline{\theta}, \bar{\theta}]$:

- $\delta > 1 - h - m \rightarrow a_i = 0 \rightarrow \ell = 0$
- $\delta < 1 - h - m \rightarrow a_i = 1 \rightarrow \ell = 1$
- $\delta = 1 - h - m \rightarrow a_i = 0 \rightarrow \ell \in (0, 1)$

WLG we can assume government will set h so that $1 - h - m > \delta$.

- Consequence of Lemma 1: investors hold out avoiding to lose $-m$ in case proposal fails, and not for extraordinary payments.
- $\nu - \delta > 0$ is a non participating loss attributed to:
  - litigation expenses
  - loss for selling defaulted bonds at secondary market.

Net participation gain and loss

- Using Proposition 1 and Lemma 3 we obtain net expected participation gain and loss:

$$(1 - h - m - \delta\nu)(1 - \ell^*(\theta)) - m\,\ell^*(\theta) = 0$$

Derivamos:

$$-(1 - \ell^*(\theta)) - \frac{\partial \ell}{\partial h}(1 - h - \delta\nu)$$

Stage $t = 2$

- In demonstration below we use Morris Shin (2002) framework for common values global games: a set of sufficient conditions for payoff gain function.
- From (2) we construct in (4) the action gain function $\pi(\ell, \theta) : [0,1] \times [\check{\theta}, \hat{\theta}] \to \mathbb{R}$ as $\pi(l, \theta) = u(1, \ell, \theta) - u(0, \ell, \theta)$.

$$\pi(\ell, \theta) \equiv \begin{cases} 1 - h - \delta - m & \text{if} \quad \ell \geq \ell^* \\ \\ -m & \text{if} \quad \ell < \ell^* \end{cases} \tag{4}$$

Stage t=2

- Morris and Shin conditions for common values global games.

1. Action monotonocity: incentive to participate is increasing in ℓ
2. State monotonocity: incentive to participate is non decreasing in fundamental θ
3. Strict Laplacian state monotonocity: there is a unique crossing for a player with Laplacian beliefs
4. Uniform limit dominance: there is a pair of fundamental values for which we can identify dominant strategies in the payoffs.
5. Continuity: expectation of gain payoffs is continuous in signal
6. Integral on signal: of gain function is well defined.

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Stage $t = 2$

- **A1: Action monotonicity: incentive to choose action $a = 1$ is increasing in ℓ.**
  $\pi(\ell, \theta)$ is a step function in ℓ discontinuous at $\ell = \ell^*$.
  - If $1 - h - \delta > -m$ then function is increasing in other players' actions: $\pi(\ell^{*+}, \theta) = 1 - h - \delta > \pi(\ell^{*-}, \theta) = -m$ (strategic complementarity).
  - If $1 - h - \delta < -m$, $\pi(\ell, \theta)$ is decreasing in ℓ: rejecting government proposal is a strictly dominant strategy (strategic substitutes).

Stage $t = 2$

- **A2: State monotonicity: the incentive to choose $a = 1$ is non decreasing in fundamental θ.**
  $\ell^*_\theta < 0$ in (**??**), implies that increases in θ reduce the lower bound of $\pi(\ell, \theta)_+$,expanding $a = 1$ dominance region (when A1: $\pi(\ell^{*+}, \theta) > \pi(\ell^{*-}, \theta)$): better fundamental weaken acceptance threshold increasing probability of success.

- **A3: Strict Laplacian state monotonicity: ensures there is a unique crossing for a player with Laplacian beliefs.**

$$\int_{\ell=0}^{\ell=1} \pi(\ell, \theta) d\ell = \int_{\ell=0}^{\ell=\ell^*} -m \, d\ell + \int_{\ell=\ell^*}^{\ell=1} 1 - h - \delta - m \, d\ell = 0 \quad (5)$$

Equation (5) is a linear function on θ with unique solution θ^*:

$$\theta^* = \frac{1}{\xi} \left(1 - h + m \frac{\nu - (1 - h)}{1 - h - \delta} \right) \quad (6)$$

Stage $t = 2$

- **A4*:Uniform limit dominance:** There exists a pair of values $\{\theta_0, \theta_1\} \in \mathbb{R}$, and $\varepsilon \in \mathbb{R}_{++}$, such that [1] $\pi(\ell, \theta) \leq -\varepsilon$ for all $\ell \in [0, 1]$ and $\theta \leq \theta_0$; and [2] there exists θ_1 such that $\pi(\ell, \theta) > \varepsilon$ for all $\ell \in [0, 1]$ and $\theta \geq \theta_1$.
  From (**??**) we know that $\ell^*(\theta)$ is a linear function with value 1 at $\underline{\theta} = \frac{1-h}{\xi}$ (figure 1). Using $\ell^*_\theta < 0$ in lemma **??** we can define $\theta_0 = \frac{1-h}{\xi} - \varepsilon$, such that $\ell^*(\underline{\theta}) = 1 + \varsigma$ (for ς very small) and as a consequence $\pi(\ell, \theta) = -m$ for all $\ell \in [0, 1]$ and every $\theta \leq \theta_0$.
  The analogue demonstration can be done for [2], taking in this case $\theta_1 = \frac{\nu}{\xi} + \varepsilon$.

Stage $t = 2$

- **A5: Continuity:** $\int_{\ell=0}^{\ell=1} g(\ell)\pi(\ell, x)d\ell$ **is continuous with respect to signal** x **and density** g**.**
  $\pi(\ell, x)$ presents only one point of discontinuity at $\ell = \ell^*$. So for a continuous density $g(\ell)$, discountinuity adquires zero mass, then integral is weakly continuous.

- **A6: Finite expectations of signals:** $\int_{\ell=0}^{\ell=1} g(\ell)\pi(\ell, x)d\ell$ **is well defined for integration.**
  $g(\ell)$ defined as a continuous density function, while $\pi(\ell, x)$ is a real value bounded function so $\int_{\ell=0}^{\ell=1} g(\ell)\pi(\ell, x)d\ell < +\infty$ in $\ell = [0, 1]$.

- Gain function $\pi(\ell, \theta) = u(1, \ell, \theta) - u(0, \ell, \theta)$ complies with conditions 1-6 MS(2002) and so the coordination game can be solved into a unique equilibrium with iterated deletion of strictly dominated strategies.

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Conditions for comparative static signs

Lemma 2

Sufficient conditions for sign:

1. *Positive slope:* $\frac{\partial f(\theta^*(h,x))}{\partial \theta^*(h,x)}$
2. *Bounded peakedness if negative slope:*

$$\frac{\partial f(\theta^*(h,x))}{\partial \theta^*(h,x)} \leq \frac{\frac{\partial^2 \theta^*(h,x)}{\partial h \partial x_i}\gamma + \frac{\partial \theta^*(h,x)}{\partial x_i}\left(\frac{\partial \theta^*(h,x)}{\partial h}\xi + 1\right)}{\frac{\partial \theta^*(h,x)}{\partial x_i}\frac{\partial \theta^*(h,x)}{\partial h}\gamma}$$

with $\gamma = 1 - h - \xi\theta^*$

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Solving algorithm

1. We start by choosing initial values for next period value functions $V^f(d', y', 0)$, $V^f(d', y', 1, h)$, prices $q(d', y')$ and the recovery function $\gamma(d', y', h)$.

2. Then compute the first iteration of the value functions $V^c(d, y, 0)$, $V^c(d, y, 1, h)$, $V^b(d, y, h)$ and the policy functions $D(d, y, z)$ and $D(d, y, z, h)$.

3. With the value functions of the previous step, update $V^f(d, y, 1, h)$ and $V^f(d, y, 0)$, the policy functions $Z(d, y, z)$ and the sets $R(d, h)$.

4. Use $R(d, h)$ and the value functions $V^c(d, y, 1, h)$ and $V^b(d, y, h)$ in an inner loop to obtain the recovery rate $\gamma(d', y', h)$.

5. Finally update the price using the Gauss-Seidel algorithm.

6. Iterate until convergence of the main components.

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3. Measuring coordination costs

Parameter		Value	Source
Holdout payment	ν	0.835	Holdout premium
Discount on holdout payment	δ	0.375	Moody's avge. prices
Recovery after restructuring	ξ	0.040	Das (2012)
Participation costs	m	0.010	
Exponential distribution	λ	0.17	

Table 2: Model parameters in simulations

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