Sovereign Debt Crises & Floating Rate Bonds

Mark Aguiar

Manuel Amador

Ricardo Alves Monteiro

SOVEREIGN BORROWING

FRICTIONS

- No or limited state contingency
- Incentives to issue additional debt → dilution
- Costly defaults + lengthy renegotiations
- Vulnerability to sovereign debt crises
- Currency mismatch
- Political economy distortions

TODAY: MATURITY & DESIGN

Short maturity Bonds

- Market discipline + incentives
- Vulnerable to runs

Long maturity Bonds

- Insurance
- Safer from runs

Floating Rate Bonds

A happy medium

$\Uparrow$

Illustrate this in a model with default

Q: How to identify roll-over risk?

CAVEAT

- TODAY : Maximizing welfare/payoff of agent making debt decisions.

But,
Not necessarily the citinzenry

Aguiar, Amador, Fourakis
"On the welfare losses from external sovereign borrowing" (2020)
IMF Economic Review

limited evidence that external sovereign borrowing really helps.

Seriously Restricting Foreign Sovereign Borrowing may be a good idea

ENVIRONMENT

- Based on Eaton-Gersovitz, and subsequent literature
- Main features
  - Incomplete markets → debt is not state contingent (except for default)
  - Inability of government to commit to repay or future fiscal plans
- Merge with Cole-Kehoe model of runs
- Explore maturity and contract design

MODEL

- Small Open Economy with government
- Issues non-contingent (defaultable) bonds
- Government can default
- Endowment risk, $y(s)$ with probability $\pi(s)$
- Timing matters

TWO TIMINGS

Eaton - Gersovitz

Repay → Auction new debt →

↑

→ Default Decision

↓

Default → V^D

TWO TIMINGS

Eaton-Gersovitz

→ Default Decision ↑ Repay → Auction new debt →

Default Decision ↓ Default → V^D

Cole-Kehoe

→ Auction new debt → Settlement ↑ Repay →

Settlement ↓ Default

DEBT CONTRACTS

- Contracts
  - Perpetual youth bonds maturing rate λ
  - Pay coupon κ

b

stock of debt

λb

maturing share

κb

coupon payment

payments today

$(1-\lambda) b$

non-maturing share

to next period

DEFAULT VALUE

Deadweight loss of default

$$V^D(s) = u(y^D(s), s) + \beta\, \mathbb{E}\left[\theta \underbrace{V(s', 0)}_{\text{Re-enters markets with no debt}} + (1-\theta) V^D(s') \,\middle|\, s\right]$$

Remains in Default

θ: Reentry probability

WHAT IS $y^D(s)$?

- What are the default costs?
- How do we measure/identify them?

→ Hard perennial questions

In the talk, we just assume them

BUDGET CONSTRAINT

Under repayment:

$$y(s) - \underbrace{(\kappa + \lambda)\, b}_{\text{payments}} + \underbrace{q(s, b')}_{\text{price}} \underbrace{\left(b' - (1-\lambda)\, b\right)}_{\text{issuances}}$$

REPAYMENT CHOICE

$\boxed{\text{Eaton-Gersovitz timing}}$

$$\begin{cases} \text{Repay if } V^R \geq V^D \\ \text{Default if } V^D > V^R \end{cases}$$

$$V^R(s_{-1}, s, b) = \max_{b'} \Big\{ u(c) +$$

$$+ \beta \, \mathbb{E} \max \big\{ V^R(s', s, b), \;\; V^D(s') \big\} \Big\}$$

$$c \leq y(s) - (\kappa + \lambda)\, b + q(s, b')\,(b' - (1-\lambda)\, b)$$

$$\kappa = \mathcal{K}(s_{-1}, b)$$

coupon promised

DEFAULT DECISION & PRICES

$\mathcal{D}(s_{-1}, s, b)$: Default decision

$\mathcal{B}(s_{-1}, s, b)$: Debt policy function

RISK-NEUTRAL LENDERS : Discount R.

There is a price, q, that changes with the amount of debt.

DEFAULT DECISION & PRICES

$\mathcal{D}(s_{-1}, s, b)$: Default decision

$\mathcal{B}(s_{-1}, s, b)$: Debt policy function

RISK-NEUTRAL LENDERS: Discount R.

$$q(s,b) = \frac{1}{R}\mathbb{E}\left[\left(1-\mathcal{D}(s,s',b)\right)\left[(\kappa+\lambda) + q\left(s', \mathcal{B}(s,s',b)\right)(1-\lambda)\right]\right]$$

where $\kappa = \mathcal{K}(s,b)$

THE TWO BONDS

constant

Fixed-rate : $k(s,b) = K$

THE TWO BONDS

upper bound on coupon

Fixed-rate : $\kappa(s,b) = \kappa$

Floating-rate :

$$\kappa(s,b) = \min\left\{ \underbrace{\frac{R}{\mathbb{E}\left[1 - D(s,s';b)\right]} - 1}_{\text{yield of a one period bond}}, \ \bar{\kappa} \right\}$$

HOW?

Issue a "small" one period bond

$$q_s(s,b) \leftarrow \text{price}$$

$$q_s(s,b) = \frac{1}{R}\,\mathbb{E}\left[\left(1 - D(s,s',b)\right)\right]$$

$\Downarrow$

use this to define a coupon

$$k(s,b) = \frac{1}{q_s(s,b)} - 1$$

Floating rate coupon compensates bond-holder for the one period ahead risk of default.

EFFICIENCY OF SHORT BONDS

- Suppose no endowment risk
- $V^D(s)$ is random, $\sim F$
- Default with probability $1 - F(V^R(b'))$

EFFICIENCY OF SHORT BONDS

- Suppose no endowment risk
- $V^D(s)$ is random, $\sim F$
- Default with probability $1 - F(V^R(b'))$

Pseudo-Planning problem

$$\boxed{\begin{aligned} B(v) &= \max_{c,\, v'} \left\{ y - c + \frac{(1 - F(v'))\, B(v')}{R} \right\} \\ \text{s.t.} \quad v &= u(c) + \beta\, \mathbb{E}\left[\max\left\{ v', V^R(s') \right\} \right] \end{aligned}}$$

Planner's Euler equation:

$$\frac{1}{u'(c')} = \frac{\beta R}{u'(c)} + \frac{f(v')\,B(v')}{F(v')}$$

(16

Planner's Euler equation:

$$\frac{1}{u'(c')} = \frac{\beta R}{u'(c)} + \frac{f(v')\,B(v')}{F(v')}$$

In equilibrium with $\boxed{\text{one-period bonds}}$

$\uparrow \lambda = 1$

$$q(b') = \frac{F(V^R(b'))}{R}$$

$$u'(c)\left[1 + \frac{q'(b')\,b'}{q(b)}\right] = \beta R\, u'(c')$$

Planner's Euler equation:

$$\frac{1}{u'(c')} = \frac{\beta R}{u'(c)} + \frac{f(v')\,B(v')}{F(v')}$$

In equilibrium with $\boxed{\text{one-period bonds}}$

$\uparrow$ $\lambda = 1$

$$q(b') = \frac{F(V^R(b'))}{R}$$

$$u'(c)\left[1 + \frac{q'(b')\,b'}{q(b)}\right] = \beta R\, u'(c')$$

Same condition:
one-period bonds
are "efficient".

EFFICIENCY LOGIC

- Prices: Reflect next period probability of default

- Government bears entire cost/benefit from marginal changes in default risk

  ↳ because all of the debt is rolled over every period.

$\boxed{\text{Not true with long-bonds and fixed coupon} \\ \hookrightarrow \text{Dilution / overborrowing.}}$

FLOATING RATE BOND

- $\lambda < 1$: long bond
- $R(s, b') = \dfrac{R}{\mathbb{E}\left[(1 - D(s', b'))\right]} - 1$

Caveat
"Calvo" mulliplicity.
Need $\bar{K}$

- Any change in default risk

  $\Rightarrow$ changes the coupon that applies to the entire stock of debt.

- Same incentives as 1 period bonds.
- Maturity is irrelevant

ROLLOVER CRISES

- SHORT-TERM BONDS : Efficient if no $\boxed{\text{confidence crises}}$

What if markets refuse to rollover bonds?

Then

$$(\kappa+\lambda)\,b$$

is due today

Government may not have enough to pay this → justifying crises

COLE-KEHOE

role of maturity

Cannot issue debt

$$V^{Run}(s,b) = u\big(y(s) - (\kappa+\lambda)\,b\big) + \beta\,\mathbb{E}\,V\big(s', (1-\lambda)\,b\big)$$

assuming $q = 0$.

If $V^{RUN}(s,b) < V^{D}(s)$

$\Rightarrow$ a crisis can happen

In model, resolved by sunspots.

- Now, short-term borrowing makes you vulnerable to crises.
- But it provides the right incentives absent a crisis.

Floating-rate long bonds are in the middle

- Long-term bonds protect you from runs
- But have bad incentives absent crisis

DRAWBACKS OF FLOATING BONDS

- Less hedging of risks as coupon reacts
- Coupon rate needs to be market based
  - And could be manipulated

    Italy's case, Alesina-Tabellini (1990)
- Calvo multiplicity → Role for an upperbound on the coupon rate.

QUANTITATIVE EXAMPLES

- Based on Chatterjee-Eyigungor (2012) $\rightarrow$ Argentina
- Short and long term bonds
- With and without rollover risk

QUANTITATIVE EXAMPLES

- Based on Chatterjee-Eyigungor (2012) → Argentina
- Short and long term bonds
- With and without rollover risk

Simulated moments

	FR	EGST	CKST	EGLT	CKLT

QUANTITATIVE EXAMPLES

- Based on Chatterjee-Eyigungor (2012) → Argentina
- Short and long term bonds
- With and without rollover risk

Simulated moments

	FR	EGST	CKST	EGLT	CKLT
qb'/y	0.82	0.82	0.37	0.72	0.72
Default Rate	0.003	0.003	0.002	0.067	0.067
Runs/Default	0.087	0	1	0	0.003

Quantitative Examples

- Based on Chatterjee-Eyigungor (2012) → Argentina
- Short and long term bonds
- With and without rollover risk

same!

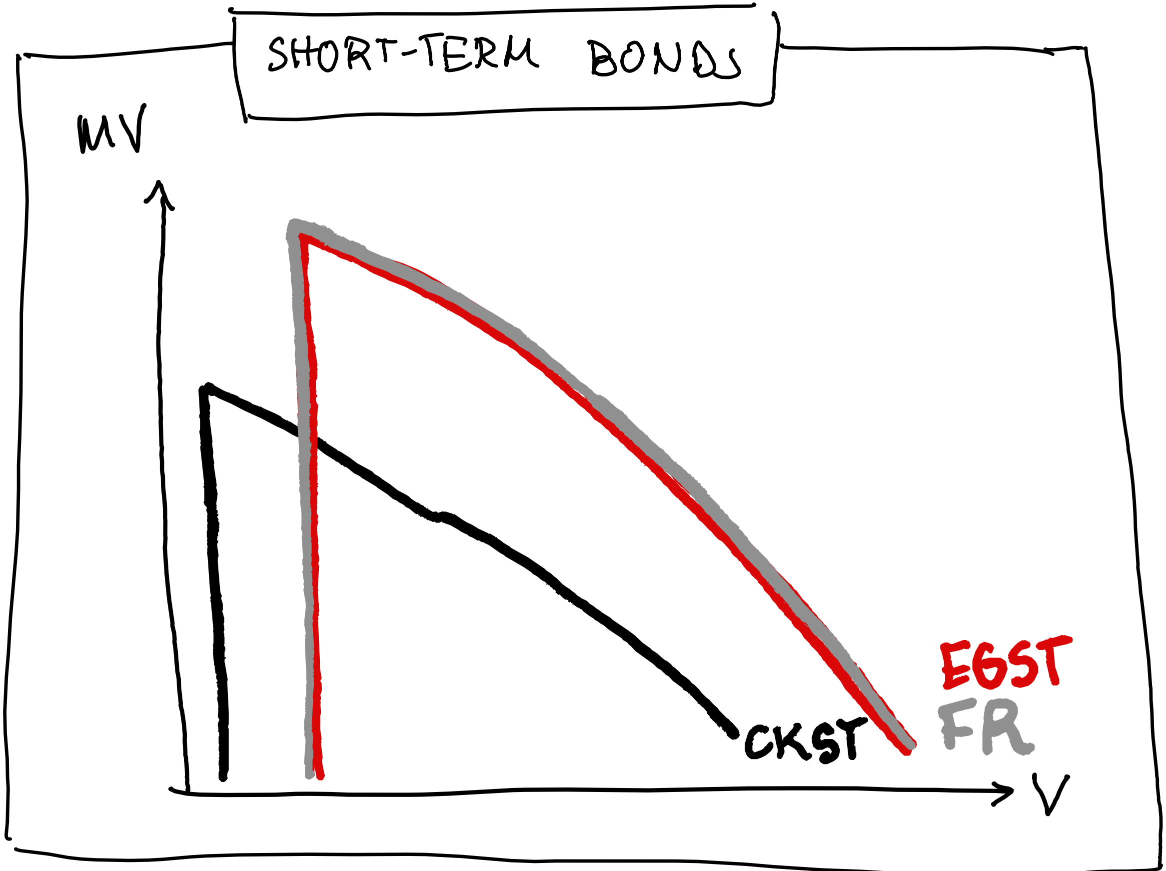
Simulated moments

	FR	EGST	CKST	EGLT	CKLT
qb'/y	0.82	0.82	$\boxed{0.37}$	0.72	0.72
Default Rate	0.003	0.003	0.002	0.067	0.067
Runs/Default	0.087	0	1	0	0.003

very similar

PARETO FRONTIERS

$$MV = (1-D)\,b\,\big((\kappa+\lambda)+(1-\lambda)\,q\big) \leftarrow \text{market value}$$

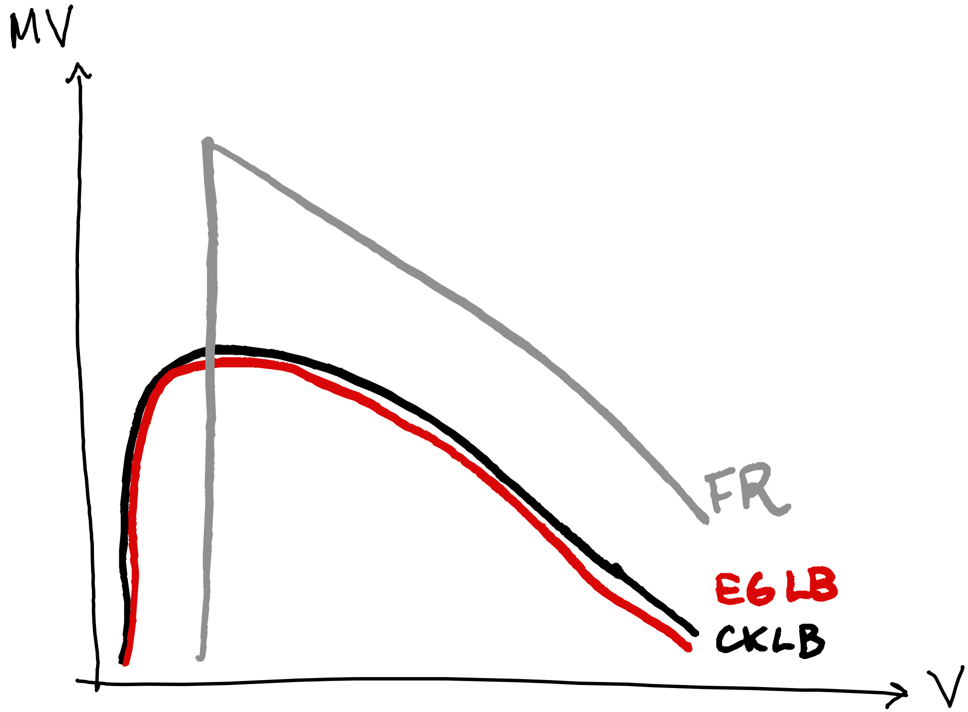


FR is similar to 1period debt model without rollover risk

⇓

But dominates once rollover risk appears

LONG-TERM BONDS*



With long bonds, rollover risk is not important but the long bonds are inefficient.

Floating rate bonds dominate.

* Actual simulations in the paper. All code available online.

CONCLUSION

- Explored Floating rate bonds in a sovereign default model
- Showed advantadges over fixed rate bonds
- There are caveats
  - Loss of insurance $\begin{cases} \text{changes in risk premia} \\ \text{changes in world } R \end{cases}$
  - Calvo multiplicity
  - Implementation drawbacks.
- Do we want to make sovereign borrowing more efficient?