Debt crises, fast and slow

Giancarlo Corsetti
European University Institute and CEPR

Fred Seunghyun Maeng
University of Cambridge

JEEA teaching materials

Motivation

- Debt (public and private) is at a historical height
- Default (both ex post and prospective) is very costly
- Countries may be subject to disruptive **belief-driven** turmoils when debt levels are high, i.e., there may be **multiple equilibria**
  - Slow-moving crises (hikes in costs of borrowing): European sovereign debt crises 2010-2012, Calvo (1988) Lorenzoni and Werning (2021)
  - Rollover crises: Mexico debt crisis 1994, Cole and Kehoe (2000)
- The literature lacks a unified framework to bridge these two types of self-fulfilling debt crises
  - No rollover crises in slow-moving crises setting
  - No slow-moving crises in rollover crises setting

Questions

- Under what conditions sovereigns may face hikes in borrowing costs (slow-moving crises), as opposed to losing market access (rollover crises)?
- Does the threat of belief-driven crises motivate deleveraging over consumption smoothing?

This paper

- Build a unified framework that connects **slow-moving crises** and **rollover crises**
  - Belief-driven debt crises are possible as debt grows—first in the form of hikes in borrowing costs driving a slow-moving accumulation of debt (at intermediate debt levels), then in the form of rollover crises (at high debt levels)
  - Self-fulfilling rollover crises are also possible at low levels of debt
- The threat of self-fulfilling debt crises may/may not motivate debt deleveraging ("risk reduction policies"), depending on the type of crises faced by the country
  - In economies that are vulnerable to both slow-moving and fast rollover debt crises (at intermediate and high levels of debt), welfare-maximizing policymakers generally find it optimal to run deficits and accumulate debt further
  - In economies facing the risk of rollover crises only, deleveraging is generally preferred.

Selected Literature

- **Gambling for Redemption and Self-Fulfilling Debt Crises**, Conesa, J. C. and T. J. Kehoe (2017)
- **Self-Fulfilling Debt Dilution: Maturity and Multiplicity in Debt Models** Aguiar, M. and M. Amador (2020).
- **The Mystery of the Printing Press: Monetary Policy and Self-Fulfilling Debt Crises**, Corsetti, G. and L. Dedola (2016)
- **Slow moving debt crises** Lorenzoni, G. and I.Werning (2019)
- **Sovereign Default: the Role of Expectations** Ayres J, G Navarro, JP Nicolini, and P Teles (2018).
- **Self-Fulfilling Debt Crises, Revisited**, Aguiar M, S Chatterjee, H Cole, and Z Stangebye, (2022).

A Standard Framework

For exposition clarity, presented assuming all debt is short term

- Consumer (passive) - no capital, receives endowment, consume everything after paying tax to the government
- Benevolent government with budget identity

$$qB' = \underbrace{g + B - T}_{GFN}$$

where the (endogenous) Gross Financing Need (GFN) of the government consists of (endogenous) spending g, outstanding debt B, minus taxes T

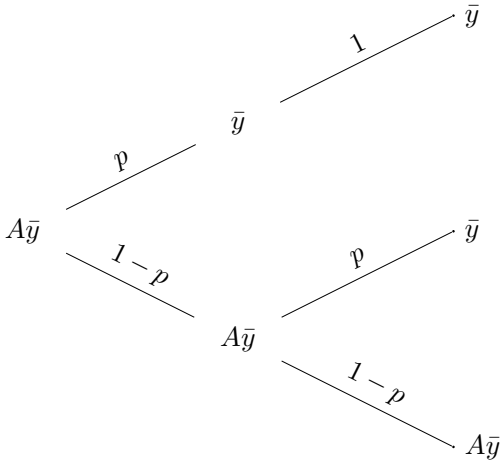
The GFN is financed by issuing new debt B' at the price q.

- Risk neutral lenders—risk-neutral pricing for sovereign bonds (default risk)

Output risk

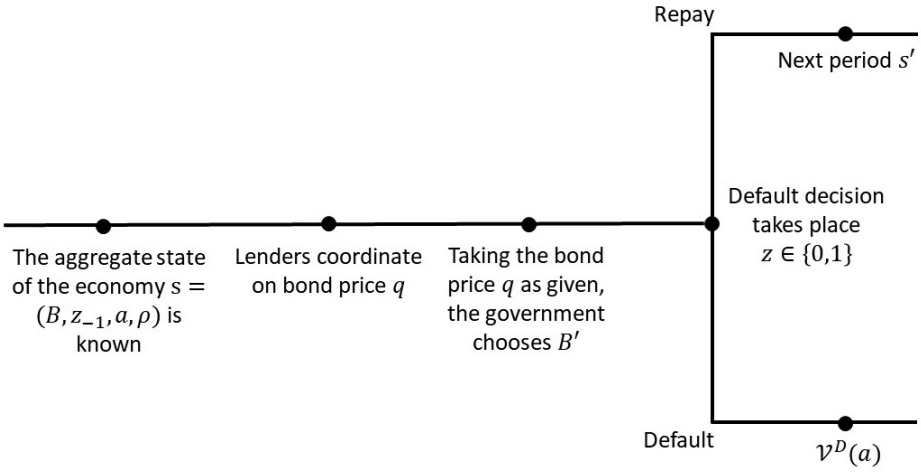
Snapshot, with initial state in recession

$A < 1$, $p < 1$



Framework

Timing



Lenders' problem

- Continuum $[0, 1]$ of competitive, risk-neutral lenders with deep pockets and discount factor β, set prices

$$q(s) = z\beta\mathbb{E}\left[z'\right] \tag{1}$$

$$\text{bond price} = \text{Default decision at the end of the period} \times \text{risk-free price} \times \text{probability of future repayment}$$

- Discretionary governments "unable to commit" to repay at the end of the period $\Rightarrow$ The term z belongs in the bond pricing
- Belief state ρ picks $q(s)$ among multiple bond prices that solve (1)
  $\Rightarrow$ Given this price, government first chooses debt issuance B', and then takes the decision to default or to repay.

Beliefs regimes ρ

Baseline "Calvo beliefs"

- Optimistic: lenders always coordinate their expectations on the equilibrium with the best price that maximizes sovereign's welfare.
- Pessimistic: coordinate expectations on equilibria where the government bonds trade at the default-risky price.

Extension "Cole and Kehoe" (CK)

- CK beliefs: agents only willing to lend at the risk-free price, if the gov't can guarantee repayment also in the event of a "sudden stop". I.e., if an individual agent expects to be repaid even if no other agent in the economy is willing to finance the new issuance of debt.

Contrast: "time-invariant belief" equilibrium (all agents consider current beliefs constant over time) with standard sunspot assumption.

Benevolent Discretionary Government

- With a single decision maker, optimization problem is reduced to:

$$V(s) = \max_{B',g,z} u(c,g) + \beta \mathbb{E}[V(s')]$$

- We assume that linear income tax is levied by the government, with tax rate τ. Tax revenue is exogenous at $T(s) = \tau y(s)$. Consumer is passive $c = (1-\tau)y(s)$.

- Gov't chooses primary surplus $\leq \tau y(s) - \bar{g}$, where $\bar{g}$ is the critical government expenditure; and whether to default.

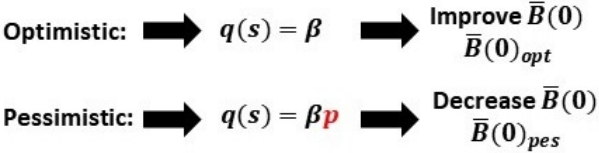
- Default condition

$$V_{repay} < V_{default}$$

- This condition determines the debt thresholds $\bar{B}(a)_\rho$ below which gov't repays.

Debt tolerance thresholds

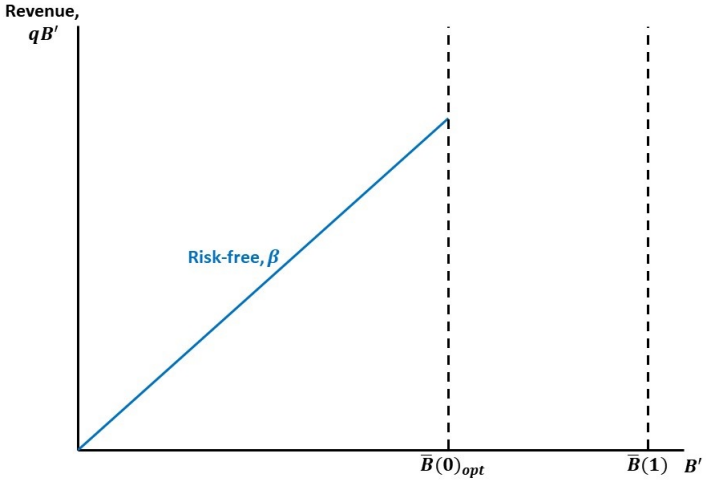
- Debt thresholds conditional on **output** and **beliefs of lenders** (**opt** and **pes**)
  - in a recession ($A < 1$), $\bar{B}(0)_{opt} > \bar{B}(0)_{pes}$



  - In the recovery state (the output recovers from $A\bar{y}$ to $\bar{y}$) , $\bar{B}(1)$ does not depend on whether beliefs are **opt** or **pes**—as output stays at $\bar{y}$ forever by assumption.

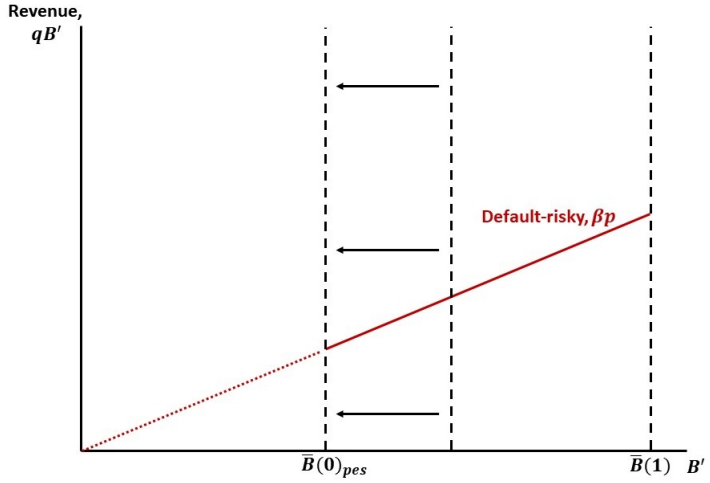
How revenue rises with debt issuance: optimistic beliefs

Debt thresholds $\bar{B}(0)_{opt}$, $\bar{B}(1)$ conditional on optimistic beliefs



How revenue rises with debt issuance: pessimistic beliefs

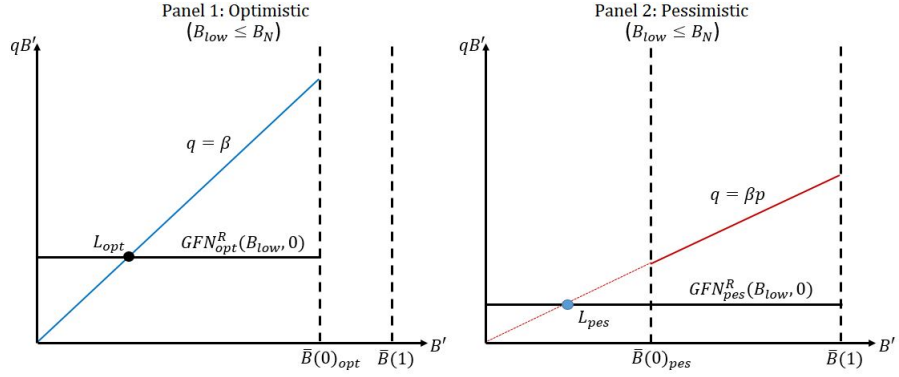
Debt thresholds $\bar{B}(0)_{pes}$, $\bar{B}(1)$ conditional on pessimistic beliefs



Crises: none, slow and fast

Debt sufficiently low: the bond price in equilibrium is risk-free

$$qB' = \underbrace{g + B - T}_{GFN\text{: vary with beliefs}}$$

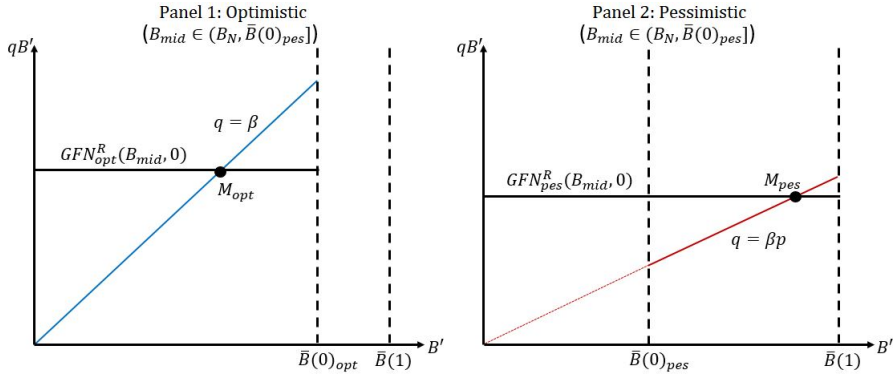


Crises: none, slow and fast

Intermediate debt: two equilibria for "opt" "pes" beliefs

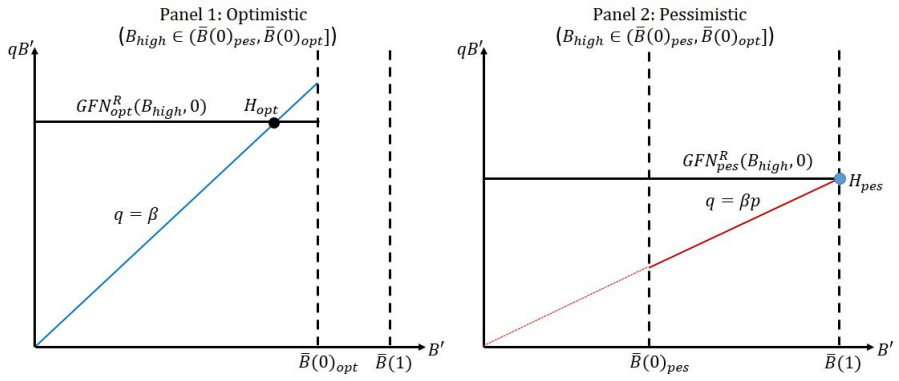
$$qB' = \underbrace{g + B - T}$$

GFN: shifts upward with larger B



Crises: none, slow and fast

High enough debt: pessimistic beliefs cause loss of market access



Crises: none, slow and fast
Why isn't borrowing (at H_{pes}) an equilibrium?

- At a relatively high stock of debt, when lenders turn pessimistic

  $\Rightarrow$ Market access possible only at the risky rate, provided $B' \leq \bar{B}(1)$

  $\Rightarrow$ At the risky price, reducing GFN to keep $B' \leq \bar{B}(1)$ is suboptimal: even with new financing, the government would prefer to default at the end of the period

  $\Rightarrow$ Anticipating this, lenders refuse to lend

- Contrast with the canonical rollover crisis in Cole and Kehoe (2000).
  - This paper: lenders consider offering the default-risky prices at auction $\Rightarrow$ at this low debt price, the gov't opts to default after the auction $\Rightarrow$ lenders refuse to buy bonds
  - Cole and Kehoe (2000): lenders coordinate on zero price $\Rightarrow$ the surplus adjustment required to avoid default too large and harsh already at relatively low levels of debt $\Rightarrow$ the gov't defaults conditional on losing market access $\Rightarrow$ lenders refuse to buy bonds

Full model calibration

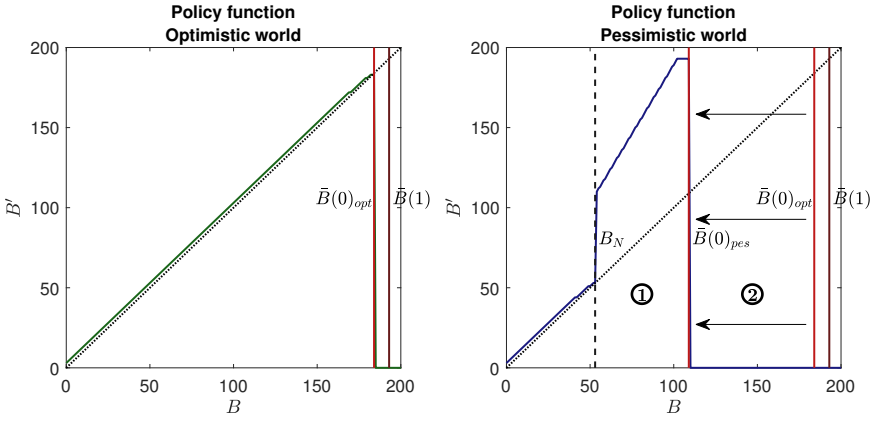
$$u(c, g) = log(c) + \gamma log(g - \bar{g})$$

$\bar{y}$	Output	100
β	Discount factor	0.98
Z	Cost of defaulting	0.95
γ	Relative weight of c and g in the utility function	0.20
τ	Government revenue as a share of output	0.36
$\bar{g}$	The critical level of expenditure	25
δ	Ammortization rate of government debt	0.2
A	Fraction of output during recession	0.9
p	Probability of leaving the recession	0.2

Same as in Conesa and Kehoe (2017)

Long-term debt (5-year), time-invariant beliefs

Policy function for $\bar{y} = 100$, $A\bar{y} = 90$, $p = 0.2$, $1 - Z = 5\%$

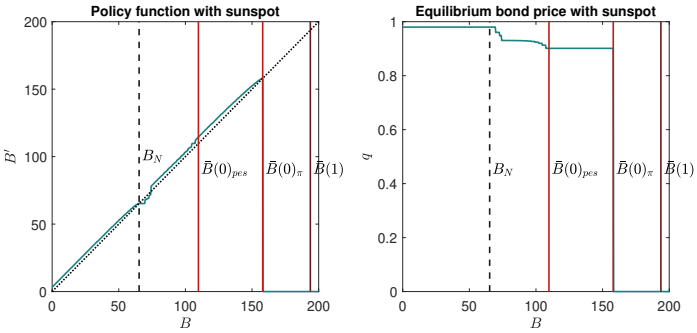


- No crisis $[0, B_N]$, slow-moving crisis $(B_N, \bar{B}(0)_{pes}]$, fast crisis $(\bar{B}(0)_{pes}, \bar{B}(0)_{opt}]$

Robustness

Long-term debt (5-year), sunspot $\rho \in \{opt, pes\}$

Beliefs-switch probability $\pi = 4\%$, 5-year bonds, $\bar{y} = 100$, $A\bar{y} = 90$, $p = 0.2$, $1 - Z = 5\%$



- Deleveraging optimal only when debt is close to B_N, at which the government can eliminate self-fulfilling crises altogether (with a 'cliff effect' on welfare)
- When B is far above B_N, welfare-maximizing governments run deficits in a recession. The benefits from deleveraging would be lower borrowing costs ('price effect'), but these are more than offset by the costs of raising surpluses

Welfare effects of deleveraging

- 'Cliff effect': gains in expected utility from eliminating sunspot crises altogether by bringing B below B_N.
- 'Price effect': gains from lowering borrowing costs by bringing B below $\bar{B}(0)_{pes}$ (gains are larger, the shorter debt maturity)

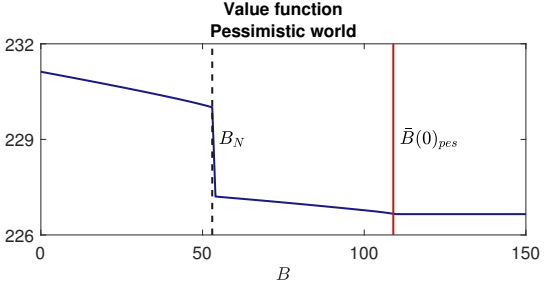
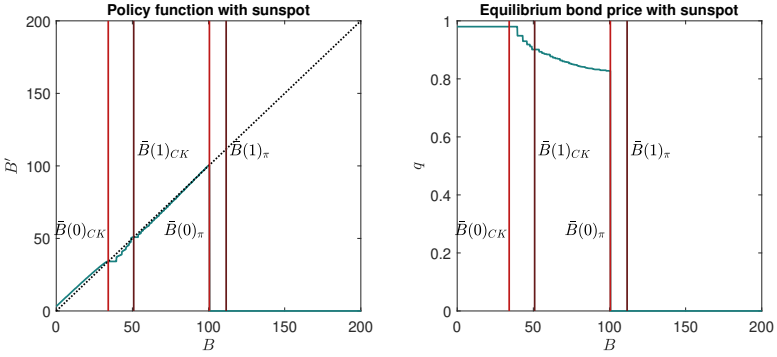


Figure: $\delta = 0.2$, $A = 0.9$, $p = 0.2$ with sunspot

Sunspot with CK beliefs ($\rho \in \{opt, CK\}$)

Beliefs-switch probability $\pi = 4\%$, 5-year bonds, $\bar{y} = 100$, $A\bar{y} = 90$, $p = 0.2$, $1 - Z = 5\%$



- Deleveraging is generally preferred when $\rho \in \{opt, CK\}$

Comparing baseline with CK beliefs

Sunspot with $\rho \in \{opt, pes\}$ and $\rho \in \{opt, CK\}$

Model ($\pi = 4\%$)	Proportion of deleveraging (%)
Baseline, $\rho \in \{opt, pes\}$	**9.38**
Cole and Kehoe, $\rho \in \{opt, CK\}$	**83.66**

Table: Debt dynamics

- Proportion of deleveraging (%): the range of debt in the crisis region over which the government finds it optimal to deleverage (expressed in percentage of the total width of the crisis region)
- When a country is at the risk of self-fulfilling debt crises, the government chooses to deleverage for much wider region when $\rho \in \{opt, CK\}$, in comparison to $\rho \in \{opt, pes\}$.

Full table

Conclusion

- Multiplicity pervasive in debt default models featuring discretionary policymakers.
  - Belief-driven slow-moving crises at intermediate levels of debt, and fast debt crises at high levels
  - At high levels of debt, the bond price may suddenly deteriorate from the risk-free price to zero, due to a belief-switch to pessimism
- The threat of self-fulfilling crises under pessimistic beliefs is not enough to motivate deleveraging (risk reduction policies)
  - Forward-looking benevolent governments generally prefer to run deficits in a recession.

Comparing baseline with CK beliefs

Full table

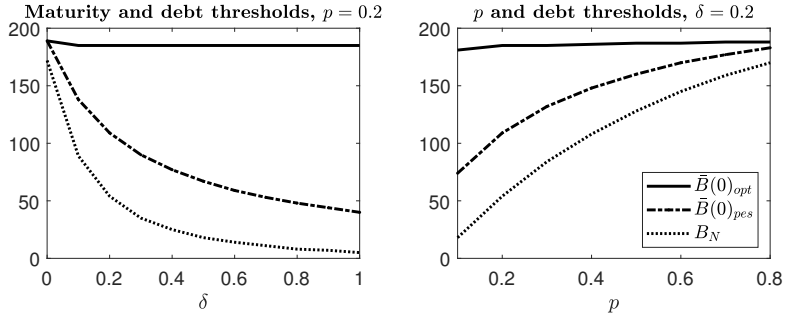
Model	The maximum debt to GDP ratio immune to debt crises (%)	$\bar{B}(0)_\pi/(A\bar{y})$ (%)	Proportion of deleveraging (%)
	Long-term bonds ($\delta = 0.2$)		
Baseline, $\rho \in \{opt, pes\}$	73	176	9.38
Cole and Kehoe, $\rho \in \{opt, CK\}$	38	112	83.66
	One-period bonds ($\delta = 1.0$)		
Baseline, $\rho \in \{opt, pes\}$	13	141	13.83
Cole and Kehoe, $\rho \in \{opt, CK\}$	8	83	84.66

Table: Relevant thresholds and debt dynamics

- Debt crises may occur at much lower levels of debt when $\rho \in \{opt, CK\}$
- The maximum sustainable debt level is also much lower when $\rho \in \{opt, CK\}$

Back

Resilience to self-fulfilling debt crises



- $\bar{B}(0)_{opt}$ barely affected by the maturity of debt (δ) and the probability of recovery (p), since the government is able to borrow at the risk-free rate when lenders are optimistic.
- $\bar{B}(0)_{pes}$ rises with longer debt maturity (lower δ), and a higher probability of recovery p —as both raise the net bond revenue in a pessimistic world, $\beta p(B' - (1-\delta)B) - \kappa B$. Back