Self-Fulfilling Debt Crises, Fiscal Policy and Investment

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Sciences Po

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Role for **self-fulfilling beliefs** in sovereign default **crises**

- Motivated by emerging markets experience and Eurozone crisis
- Country bond spreads often disconnected to fundamentals
- EZ debt crisis: high spreads as bad equilibrium, motivation for OMT
Role for **self-fulfilling beliefs** in sovereign default crises

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Important **link** between spreads, govt policy and fundamentals

- Two-way empirical relationship between spreads and cycle
  \((\text{Neumeyer-Perri (2005), Uribe-Yue (2006)})\)
- Austerity policies in response to EZ crisis (\(\text{Italy}\), Spain)
- Micro evidence of spreads pass-through to investment, output
  \((\text{Arellano et al. (2019), Bocola (2016), Bottero et al. (2019)})\)

⇒ **Default risk** is disruptive for the economy
Framework: Standard sovereign default model + fiscal policy + endogenous output

- Non-contractible govt policy
- Spreads affect trade-off debt vs. taxes
- Taxes affect private investment & output

Debt crises induce austerity and generate belief-driven equilibria.

Mechanism:
- confidence crisis: higher spreads, costlier to borrow
  - govt adjusts funding strategy: borrowing
    - ↓ taxes
  - wealth effect on households: private investment
    - ↓ growth
    - future default probs
      ⇒ pessimistic expectations verified
This Paper

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- govt adjusts funding strategy: borrowing ↓, taxes ↑
- wealth effect on households: private investment ↓
- growth ↓, future default probs ↑ ⇒ pessimistic expectations verified
Literature

Self-fulfilling debt crises

- Calvo: Calvo (88), Lorenzoni and Werning (19), Ayres et al (18)
- Cole-Kehoe: Cole and Kehoe (00), Aguiar et al. (16), Conesa and Keohoe (17)
- Long-term debt: Aguiar and Amador (20), Stangebye (17), Corsetti and Maeng (20)
- Monetary-fiscal: Aguiar et al. (15), Corsetti and Dedola (16), Bassetto and Galli (19)

focus on spreads ↔ debt, no fundamentals

Sovereign default and austerity

- Arellano and Bai (16), Conesa, Kehoe and Ruhl (17), Balke and Ravn (16)

spreads → fundamentals, static

Sovereign default models with endogenous output

- Capital: Bai and Zhang (12), Park (17), Gordon and Guerron-Quintana (18), Broner et al. (14)
- Reform: Mueller et al. (19), Detragiache (96)

(fundamentals, policy) → spreads
Model
Setup and Government

Setup

- Two periods, \( t = 0, 1 \)
- Benevolent govt, risk-averse households, foreign risk-neutral lenders
Setup and Government

Setup
- Two periods, $t = 0, 1$
- Benevolent govt, risk-averse households, foreign risk-neutral lenders

Government
- Starts with initial debt $B_0$, faces constraints
  \[ B_0 = T_0 + q_0 B_1 \]
  \[ (1 - \delta_1) B_1 = T_1 \]
  - No initial default on $B_0$
  - Cannot commit to repayment ($1 - \delta_1$)
Preferences

\[ \log(c_0) + \beta \mathbb{E}_0 \log(c_1) \]

Save through capital \( k_t \), pay lump-sum taxes \( T_t \)

Concave production function \( f(k_t) \), full depreciation, backyard technology

Default \( \Rightarrow \) random output cost \( z_1 \sim G \)

Start with initial capital \( k_0 \), face constraints

\[
\begin{align*}
    c_0 &= f(k_0) - T_0 - k_1 \\
    c_1^R &= f(k_1) - T_1 \\
    c_1^D &= f(k_1)(1 - z_1)
\end{align*}
\]
Lenders and Timing

Lenders

- Lenders are atomistic, risk neutral, perfectly competitive
- Anticipate tax policy + household investment response to debt auction
- Per-bond recovery upon default: $\eta \frac{z_1 f(K_1)}{B_1}$
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Timing
- Government issues debt \( B_1 \)
- Lenders bid price \( q_0 \)
- Taxes \( T_0 = B_0 - q_0 B_1 \) are set to clear the budget constraints (key, more later)
- Households choose \( c_0, k_1 \) taking government tax/debt policy as given
Equilibrium Definition

**Definition (Equilibrium)**

A competitive equilibrium is a collection of government debt and default choices \( \{B_1, \delta_1\} \), households’ investment choice \( \{K_1\} \) and a debt price function \( \{Q(W_0, B_1)\} \) such that, given initial wealth \( W_0 \),

1. households choose investment to maximise their expected utility, given government policies and debt prices;
2. the debt price function \( Q(W_0, B_1) \) satisfies creditors’ zero-profit condition for all debt levels \( B_1 \in \mathbb{R} \);
3. government policies maximise households’ expected utility, subject to the households’ investment response and the debt price function.
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Outline:

1. Default policy and private sector investment
2. Conditions for existence of multiple debt price schedules
3. Government policy and multiple equilibria
4. Role for external policy intervention
Default policy at $t = 1$

- Default decision

$$\max \left\{ f(K_1) - B_1, f(K_1)(1 - z_1) \right\}$$

- Repay IFF

$$z_1 \geq \hat{z}_1(K_1, B_1) := \frac{B_1}{f(K_1)}$$
Aggregate capital investment $\mathcal{K}(W_0, q_0, B_1)$ satisfies

$$\frac{1}{W_0 + q_0B_1 - K_1} = \beta f'(K_1) \left[ \frac{1 - G(\hat{z}_1)}{f(K_1) - B_1} + \frac{G(\hat{z}_1)}{f(K_1)} \right]$$
Households Investment

Aggregate capital investment \( \mathcal{K}(W_0, q_0, B_1) \) satisfies

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**Debt overhang**: default expectations discourage investment

- Household investment complementarities
- Investment response to debt prices/taxes nonlinear
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**Debt overhang**: default expectations discourage investment
- Household investment complementarities
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**Investment externality**: HH take all taxes as given → do not internalise effect of $K_1$ on
- future default probabilities
- current debt prices and taxes
Set of zero profit prices at which lenders are willing to buy $B_1$

\[
q_0 = \frac{1}{R} \left[ 1 - G(\hat{z}_1) + \int_{\hat{z}_1}^{\hat{z}_1} \eta \frac{z_1 f(K_1)}{B_1} dG(z_1) \right]
\]

(1)

with $\hat{z}_1 = \hat{z}_1(K_1, B_1)$ and $K_1 = K(W_0, q_0, B_1)$
Lenders’ Zero Profit Condition

- Set of **zero profit prices** at which lenders are willing to buy $B_1$

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- Debt prices/revenues have $t = 0$ wealth effect on investment, via taxation
Lenders’ Zero Profit Condition

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with $\hat{z}_1 = \hat{z}_1(K_1, B_1)$ and $K_1 = K(W_0, q_0, B_1)$

- Debt prices/revenues have $t = 0$ wealth effect on investment, via taxation
- **Multiple zero profit prices**: (1) may have multiple solutions for some $(W_0, B_1)$
Recap: Debt Pricing Equations and Multiple Equilibria

Debt price $q$, lenders’ discount factor $= 1$, recovery upon default $= 0$

This paper’s zero profit condition:

$$q_0 = \text{Prob} \left( z_1 \geq \frac{B_1}{f(K(W_0, q_0, B_1))} \right)$$
Recap: Debt Pricing Equations and Multiple Equilibria

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Calvo (1988) setup:

- govt picks debt revenues $a$ today, repay $\frac{a}{q}$ tomorrow
- repay iff $y - \frac{a}{q} \geq y(1 - z) \Rightarrow z \geq \frac{a/q}{y}$ \hspace{1cm} (y deterministic, z random)
- zero profit condition is

$$q = \text{Prob} \left( z \geq \frac{a/q}{y} \right)$$
Multiple Zero Profit Prices

For a given $W_0$

Expected Debt Value

Investment $\mathcal{K}(W_0, q_0, B_1)$

investment $\rightarrow$ debt value

debt prices $\rightarrow$ investment
Debt Price Schedules and Selection Criterion

For a given $W_0$

Split correspondence into single-valued schedules

- ‘Good’ schedule: upper envelope (black + blue)
- ‘Bad’ schedule: lower envelope (black + red)

**Assumption:** govt observes schedule before debt issuance ($\approx$ secondary mkt)
Taking lenders’ and HH behaviour as given

$$\max_{B_1, q_0, K_1} u(W_0 + q_0 B_1 - K_1) + \beta \int \max \left\{ u\left(f(K_1) - B_1\right), u\left(f(K_1)(1 - z_1)\right) \right\} dG(z_1)$$

s.t.

$q_0 = Q^i(W_0, B_1), \quad i \in \{g, b\}$

$K_1 = \mathcal{K}(W_0, q_0, B_1)$

$W_0$ given
Optimality

Trade-off between funding sources $\rightarrow$ **taxation** vs. **debt issuance**

$$f'(K_1) \left[ \frac{1 - G(\hat{z}_1))}{f(K_1) - B_1} + \frac{G(\hat{z}_1)}{f(K_1)} \right] = \frac{1}{Q^i + B_1 Q^i_B} \left[ \frac{1 - G(\hat{z}_1)}{f(K_1) - B_1} \right]$$

marginal product of capital (tax multiplier) level + sensitivity of default risk (debt issuance)
Optimality

Trade-off between funding sources → \textbf{taxation} vs. \textbf{debt issuance}

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marginal product of capital (tax multiplier) level + sensitivity of default risk (debt issuance)

When default risk is zero: \textbf{first best}

- main frictions absent (limited commitment + investment externality)
- \( f'(K_{1}^{FB}) = R \)
- possible for all \( W_0 \geq W_0^{FB} \)
Optimality

Trade-off between funding sources $\to$ taxation vs. debt issuance

$$f'(K_1) \left[ \frac{1 - G(\hat{z}_1)}{f(K_1) - B_1} + \frac{G(\hat{z}_1)}{f(K_1)} \right] = \frac{1}{Q_i + B_1 Q_B^i} \left[ \frac{1 - G(\hat{z}_1)}{f(K_1) - B_1} \right]$$

marginal product of capital (tax multiplier) level + sensitivity of default risk (debt issuance)

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- main frictions absent (limited commitment + investment externality)
- $f'(K_1^{FB}) = R$
- possible for all $W_0 \geq W_0^{FB}$

Risky policy

- investment below first-best: $K_1 < K_1^{FB}$
- debt is risky: $Q_i < 1/R$
Multiplicity

There may be multiple schedules... but is govt ever affected by them?

When motive to borrow is strong enough, yes:
- **bad schedule** ⇒ taxation cheaper source of funding ⇒ **austerity**
Equilibria

\[ V_0 \]

\[ K_1 \]

\[ T_0 \]

\[ B_1 \]

\[ q_0 \]

\[ B_1/f(K_1) \]
Discussion

An interpretation of the **austerity debate** through the lens of the model

- do higher surpluses reduce debt or are self defeating?
- $\uparrow B_1$ increase debt revenues, reduce taxes, increase $C_0, K_1$
- $\Rightarrow$ debt price level/sensitivity and MPK are key

Bad equilibrium resembles the **EZ crisis**

- confidence crisis makes debt prohibitively costly
- substitute debt funding with taxes, depress consumption and investment
- consistent with procyclical fiscal policy regularity in EM
Role for Policy

Key **model frictions:**

- Lack of commitment to repay
  - Lack of commitment to fiscal policy
    - Lenders’ coordination failure
  - Private investment externality

Solutions?
- Intervention of a large, external lender (e.g. IMF or ESM)
- Non defaultable debt ⇒ first best solution (≈ CB intervention?)
- Pari-passu lending
- Senior lending
- Investment subsidies with commitment
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Pari-passu lending

- IMF commits to buy \( x \% \) of debt at **good** zero profit price
  - no preferred creditor status
  - participation in debt auction equivalent to external lending
Pari-passu lending

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Private lenders’ beliefs have **smaller impact** on revenues, investment, debt value

 Marginal effect on debt value → **shared** among all creditors
Senior lending

- IMF commits to buy $x\%$ of debt, is senior to private lenders ($\approx$ risk-free lending)

Private lenders’ beliefs have small impact on revenues, investment, debt value

Marginal effect on debt value $\rightarrow$ **different impact** on senior vs. junior tranche
Fiscal Commitment

\[ B_0 = T_0 + q_0 B_1 \]

Fiscal commitment \((T_0)\) alone

- Pick \(T_0, B_1\) \textit{jointly}, and consistent with \(Q^g\)
- Then only \(q_0 = Q^g(W_0, B_1)\) clears the govt BC
- \textbf{Selecting the debt price schedule}, rather than take it as given
Fiscal Commitment

\[ B_0 = T_0 + q_0 B_1 \]

Fiscal commitment \((T_0)\) alone

- Pick \(T_0, B_1\) jointly, and consistent with \(Q^g\)
- Then only \(q_0 = Q^g(W_0, B_1)\) clears the govt BC
- Selecting the debt price schedule, rather than take it as given

(Big) but

- govt BC violated off-equilibrium (Bassetto (05))
- govt must commit to strategy, not action \(\rightarrow\) something must adjust to clear BC
  1. debt chosen ex-ante, taxes adjust (this paper)
  2. taxes chosen ex-ante, debt adjusts (Calvo (88), Lorenzoni-Werning (19))
Investment subsidies with commitment

- Optimality in planner’s problem

\[
\frac{f'(K_1)}{1 - B_1 Q^i_K} \left[ \frac{1 - G(\hat{z}_1))}{f(K_1) - B_1} + \frac{G(\hat{z}_1)}{f(K_1)} \right] = \frac{1}{Q^i + B_1 Q^i_B} \left[ \frac{1 - G(\hat{z}_1)}{f(K_1) - B_1} \right]
\]

- Subsidy \( \tau^k_0 = B_1 Q^i_K \) corrects households’ underinvestment
- Additional policy tool: can deal with off-equilibrium prices
- **If contractible**, government internalises effect of investment on debt prices
  - Constrained efficient allocation, superior to good equilibrium w/out commitment
Equilibria With Policy

$V_0$

$K_1$

$T_0$

$B_1$

$q_0$

$B_1/f(K_1)$

$W_0$

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Summing Up

Confidence crises and fiscal policy

- more expensive to borrow, tighter govt budget set
- cut borrowing, raise taxes $\Rightarrow$ depress investment $\Rightarrow$ lower welfare

Different take on “austerity”

- funding source trade-off through the lens of the model
- fiscal tightening preferable to high (extreme here) borrowing costs
- strong austerity multiplier (one channel, there are many others)

Policy can address different frictions

1. prevent coordination failure
2. possible trade-off between IMF risk and issuer welfare
3. commit to fiscal policy + resolve externality
Thank you!
Appendix
Households’ Investment Problem

Household investment $K(W_0, q_0, B_1)$ is $k_1 = K_1$ fixed point of

$$
\max_{k_1} u\left(W_0 + q_0 B_1 - k_1 \right) + \beta \int_{\tilde{z}_1(K_1, B_1)} u\left(f(k_1) - B_1 \right) dG(z_1)
+ \beta \int_{\tilde{z}_1(K_1, B_1)} \left\{ u\left(f(k_1)(1 - z_1) \right) \right\} dG(z_1)
$$

- Investment complementarities: coordination problem $\neq$ from that of lenders
- In principle, could have multiple solutions to the fixed point problem
Numerical Example Parameters

- Capital share of output $\alpha = 0.4$
- Log utility
- Households' discount factor $\beta = 0.9$
- Lenders' opportunity cost of capital $R = 1.05$
- Recovery parameter $\eta = 0.9$
- Default output cost $z_1 \sim N(0.5, 0.035)$ over $Z = [0, 1]$
Spain

- Surplus/GDP
- 10y Spread
- Debt/GDP
- GDP Growth
- Aggregate Gross Capital Formation/GDP

Graphs showing economic indicators for Spain from 2003 to 2015, including surplus, interest, debt, GDP growth, government gross capital formation, public employees compensation, taxes, and aggregate gross capital formation. Key events like the 1st Greek Rescue Package, Greek PSI, and ECB’s OMT are highlighted.
Some EZ Debt Crisis Quotes


“These urgent measures were necessary to face a serious financial crisis that has hit [...] sovereign bond markets, Italy included.”

Italian PM Mario Monti, 29/12/2011

“Our economic fundamentals do no justify such a high government bond spread.”
Debt Schedules and Revenues

Debt Price Schedules

Debt Revenue Schedules