

Self-Fulfilling Debt Crises, Fiscal Policy and Investment

Carlo Galli

Sciences Po

Stony Brook, December 11th 2020

Self-Fulfilling Debt Crises and Multiple Equilibria

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

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

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

⇒ **Default risk is disruptive** for the economy

This Paper

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

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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

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 Kehoe (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

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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

$$c_0 = f(k_0) - T_0 - k_1$$

$$c_1^R = f(k_1) - T_1$$

$$c_1^D = f(k_1)(1 - z_1)$$

Lenders

- Lenders are atomistic, risk neutral, perfectly competitive
- Anticipate **tax** policy + household **investment response** to debt auction
- *Per-bond recovery* upon default: $\eta \frac{z_1 f(K_1)}{B_1}$

Lenders and Timing

Lenders

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- Anticipate **tax** policy + household **investment response** to debt auction
- *Per-bond recovery* upon default: $\eta \frac{z_1 f(K_1)}{B_1}$

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 $B_1 \in \mathbb{R}$;
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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
- Repay IFF

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

$$z_1 \geq \hat{z}_1(K_1, B_1) := \frac{B_1}{f(K_1)}$$

Households Investment

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

$$\frac{1}{W_0 + q_0 B_1 - K_1} = \beta f'(K_1) \left[\frac{1 - G(\hat{z}_1)}{f(K_1) - B_1} + \frac{G(\hat{z}_1)}{f(K_1)} \right]$$

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Debt overhang: default expectations discourage investment

- Household investment complementarities
- Investment response to debt prices/taxes nonlinear

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Investment externality: HH take all taxes as given \rightarrow do not internalise effect of K_1 on

- future default probabilities
- current debt prices and taxes

Lenders' Zero Profit Condition

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

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

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

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- 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:

$$q_0 = \text{Prob} \left(z_1 \geq \frac{B_1}{f(\mathcal{K}(W_0, q_0, B_1))} \right)$$

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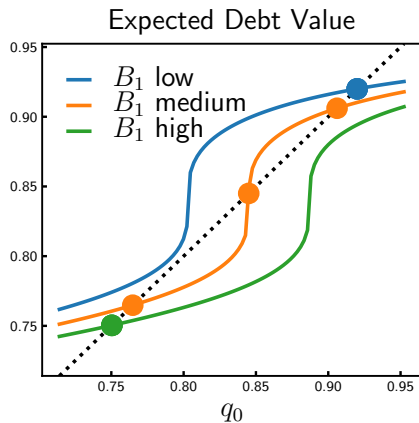
Calvo (1988) setup:

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

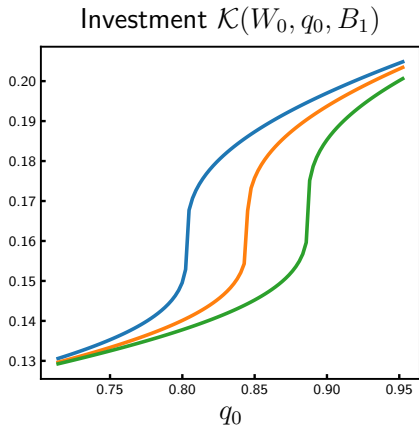
$$q = \text{Prob} \left(z \geq \frac{a/q}{y} \right)$$

Multiple Zero Profit Prices

For a given W_0



investment \rightarrow debt value



debt prices \rightarrow investment

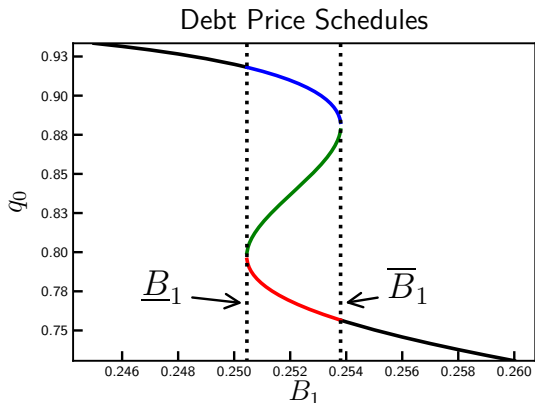
ZPC

\mathcal{K} FOC

Parameters

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)

Government Problem

Taking lenders' and HH behaviour as given

$$\begin{aligned} \max_{B_1, q_0, K_1} \quad & u(W_0 + q_0 B_1 - K_1) + \beta \int \max \left\{ u(f(K_1) - B_1), u(f(K_1)(1 - z_1)) \right\} dG(z_1) \\ \text{s.t.} \quad & q_0 = Q^i(W_0, B_1), \quad i \in \{g, b\} \\ & K_1 = \mathcal{K}(W_0, q_0, B_1) \\ & W_0 \text{ given} \end{aligned}$$

Trade-off between funding sources → **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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When default risk is zero: **first best**

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

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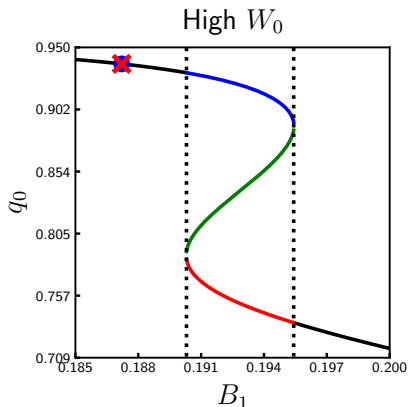
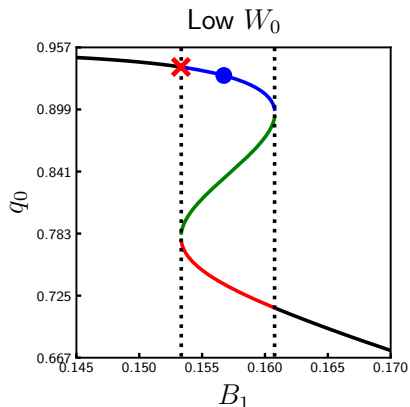
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Risky policy

- 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?

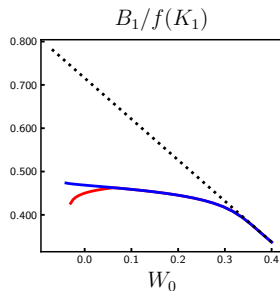
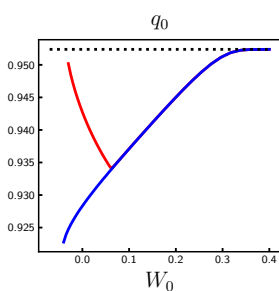
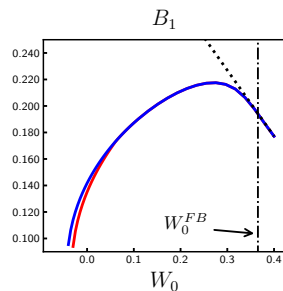
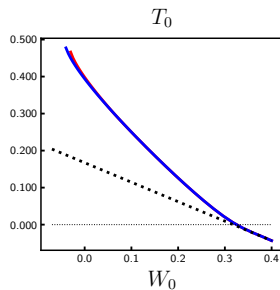
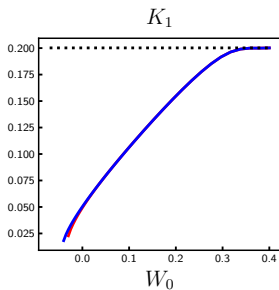
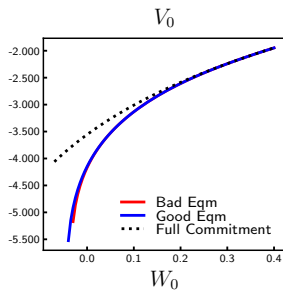


When motive to borrow is strong enough, yes:

- **bad schedule** \Rightarrow taxation cheaper source of funding \Rightarrow **austerity**

Debt Revenues

Equilibria



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
- ⇒ 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

Key **model frictions**:

- Lack of commitment to repay
 - ▶ Lack of commitment to fiscal policy
 - ★ lenders' coordination failure
 - ▶ Private investment externality

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Solutions? **Intervention of a large, external lender** (e.g. IMF or ESM)

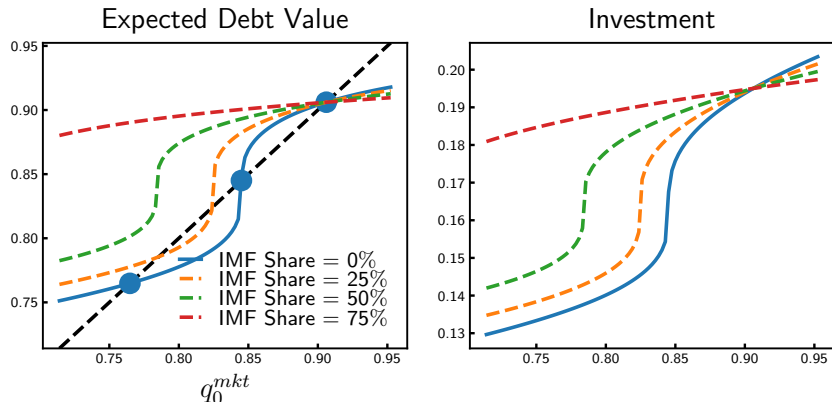
- Non defaultable debt \Rightarrow first best solution (\approx CB intervention?)
- Pari-passu lending
- Senior lending
- Investment subsidies with commitment

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

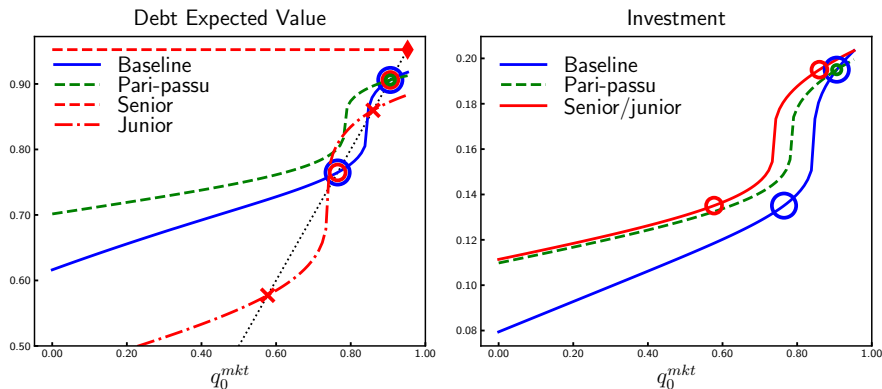
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 - ▶ no preferred creditor status
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- Private lenders' beliefs have **smaller impact** on revenues, investment, debt value
- Marginal effect on debt value → **shared** among *all* creditors

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 *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

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- **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))

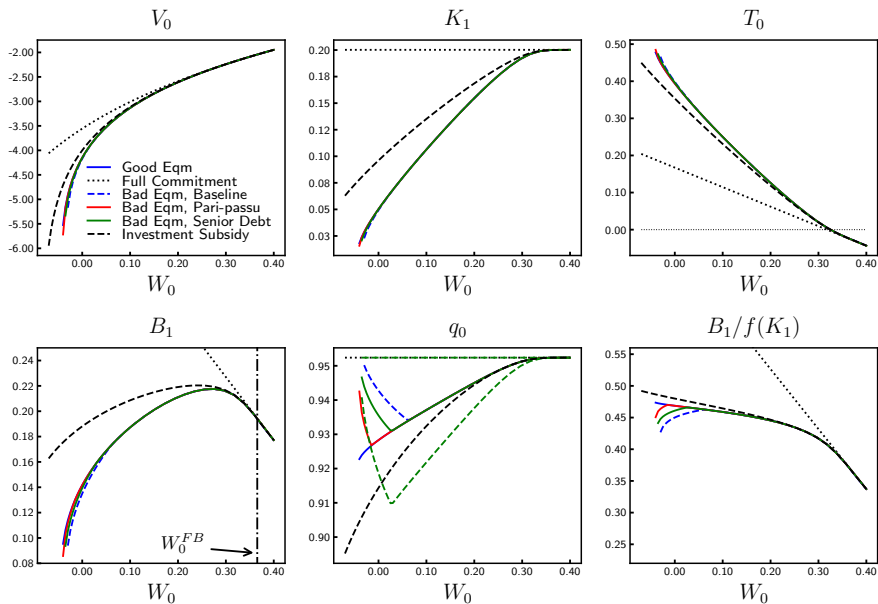
Investment subsidies with commitment

- Optimality in planner's problem

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

- Subsidy $\tau_0^k = B_1 Q_K^i$ 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



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 $\mathcal{K}(W_0, q_0, B_1)$ is $k_1 = K_1$ fixed point of

$$\begin{aligned} \max_{k_1} & u(W_0 + q_0 B_1 - k_1) + \beta \int_{\hat{z}_1(K_1, B_1)} u(f(k_1) - B_1) dG(z_1) \\ & + \beta \int_{\hat{z}_1(K_1, B_1)} \{u(f(k_1)(1 - z_1))\} dG(z_1) \end{aligned}$$

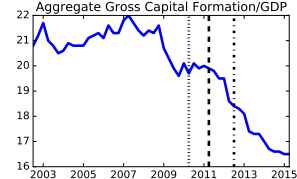
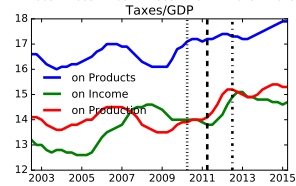
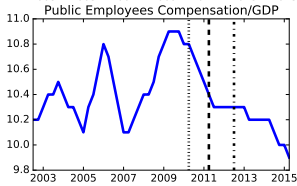
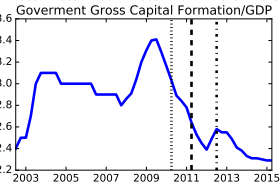
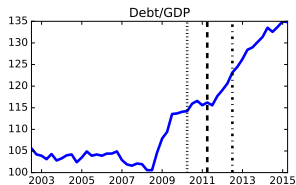
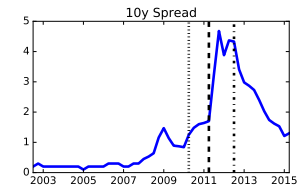
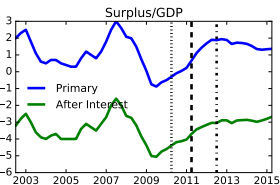
- Investment complementarities: coordination problem \neq from that of lenders
- In principle, could have multiple solutions to the fixed point problem

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 $Z = [0, 1]$

Back

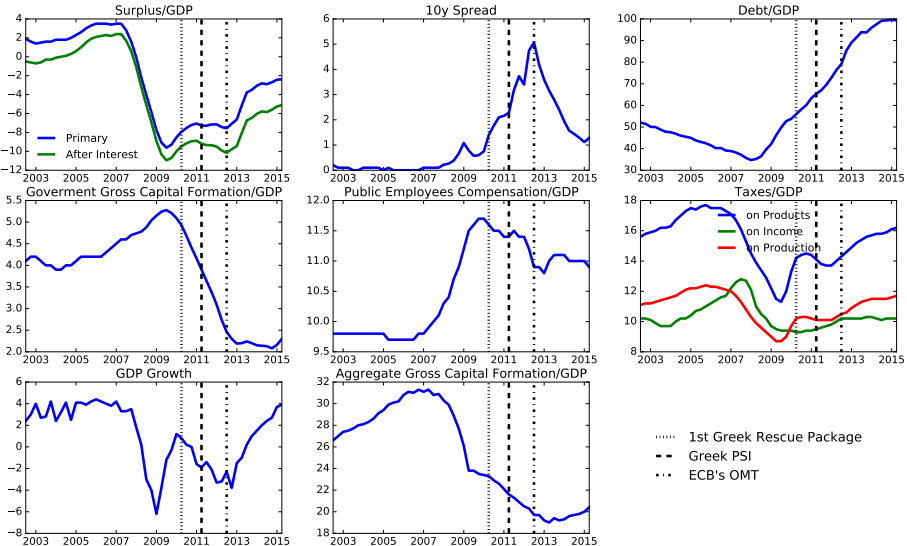
Italy



- 1st Greek Rescue Package
- - - Greek PSI
- ... ECB's OMT

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Spain



Some EZ Debt Crisis Quotes

Italian Government Press Release on “Salva Italia” measures, 4/12/2011

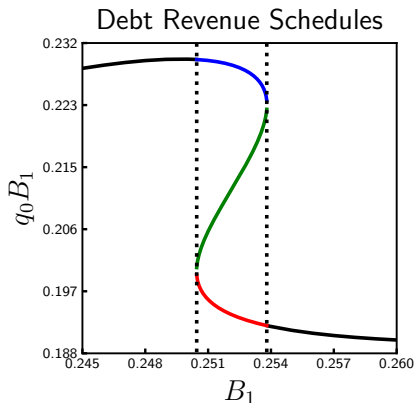
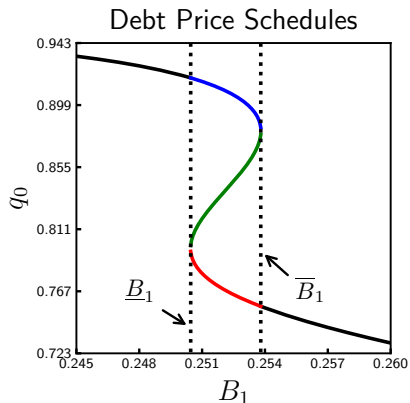
“These urgent measures were necessary to face a serious financial crisis that has hit [...] sovereign bond markets, Italy included.”

Italian PM Mario Monti, 29/12/2011

“Our economic fundamentals do not justify such a high government bond spread.”

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Debt Schedules and Revenues



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