Galli (2021)

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

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

- Two-way empirical relationship between spreads and cycle
- Austerity policies *in response to* EZ crisis (Italy 1, Italy 2, Spain)
- Micro evidence of spreads pass-through to investment, output

$\Rightarrow$ **Default risk** is **disruptive** for the economy

Galli (2021)

Self-Fulfilling Debt Crises and Multiple Equilibria

Debt crises induce austerity and generate belief-driven equilibria. **Mechanism:**

- confidence crisis: higher spreads, costlier to borrow
- govt adjusts funding strategy: borrowing $\downarrow$, taxes $\uparrow$
- wealth effect on households: private investment $\downarrow$
- growth $\downarrow$, future default probs $\uparrow \Rightarrow$ pessimistic expectations verified

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 $(1 - \delta_1)$

Households

- 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 and Timing

Lenders

- Lenders are atomistic, risk neutral, perfectly competitive
- Anticipate **tax** policy + household **investment response** to debt auction
- *Per-bond* **recovery** upon default: $\eta \frac{z_1 f(K_1)}{B_1}$ (for today, assume recovery $= 0$)

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** $\{\mathcal{Q}(W_0, B_1)\}$ such that, given initial wealth W_0,

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

Outline:

- Default policy and private sector investment
- Conditions for existence of multiple debt price schedules
- Government policy and multiple equilibria
- Role for external policy intervention

Default Policy

Default policy at $t = 1$

- Default decision

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

- Repay IFF

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

Households Investment

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

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

Debt overhang: default expectations discourage investment

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

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

HH Problem ZPPs

Lenders' Zero Profit Condition

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

$$q_0 = \frac{1}{R}\left[1 - G(\widehat{z}_1)\right] \tag{1}$$

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

- 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)

ZPPs

Recap: Debt Pricing Equations and Multiple Equilibria

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

This paper's zero profit condition:

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

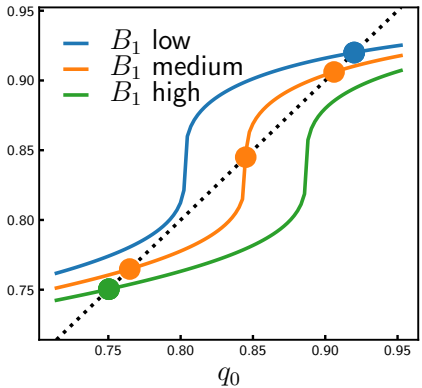
Calvo (1988) setup:

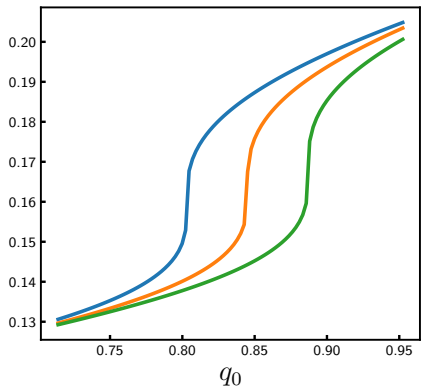
- govt picks debt revenues a today, repay $a\frac{1}{q}$ tomorrow
- repay iff $\underbrace{y - a/q}_{\text{repay}} \geq \underbrace{y(1-z)}_{\text{default}} \;\Rightarrow\; z \geq \frac{a/q}{y}$ *(y deterministic, z random)*
- zero profit condition is

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

Multiple Zero Profit Prices

For a given W_0





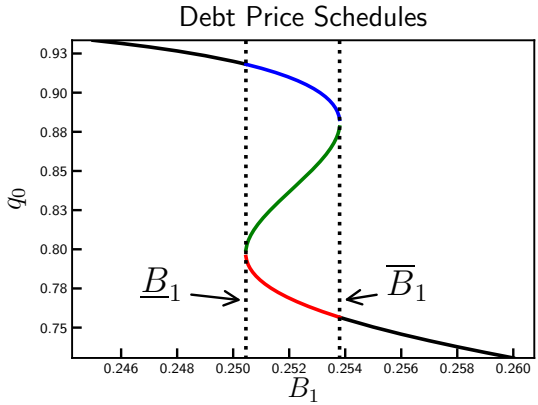
investment $\rightarrow$ debt value

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

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

$$\text{s.t.} \quad q_0 = \mathcal{Q}^i(W_0, B_1), \quad i \in \{g, b\}$$

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

$$W_0 \ \text{ given}$$

Optimality

Trade-off between funding sources → **taxation** vs. **debt issuance**

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

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

When default risk is zero: **first best**

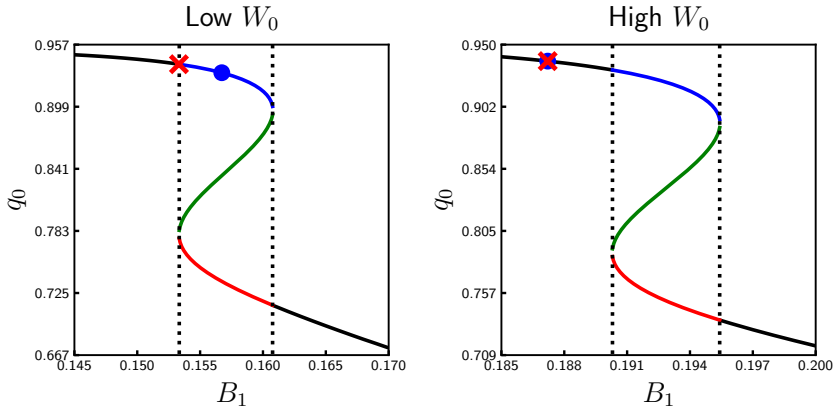
- main frictions absent (limited commitment + investment externality)
- $f'(K_1^{FB})=R$
- possible for all $W_0 \geq W_0^{FB}$

Risky policy

- investment below first-best: $K_1 < K_1^{FB}$
- debt is risky: $\mathcal{Q}^i < 1/R$

Multiplicity

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

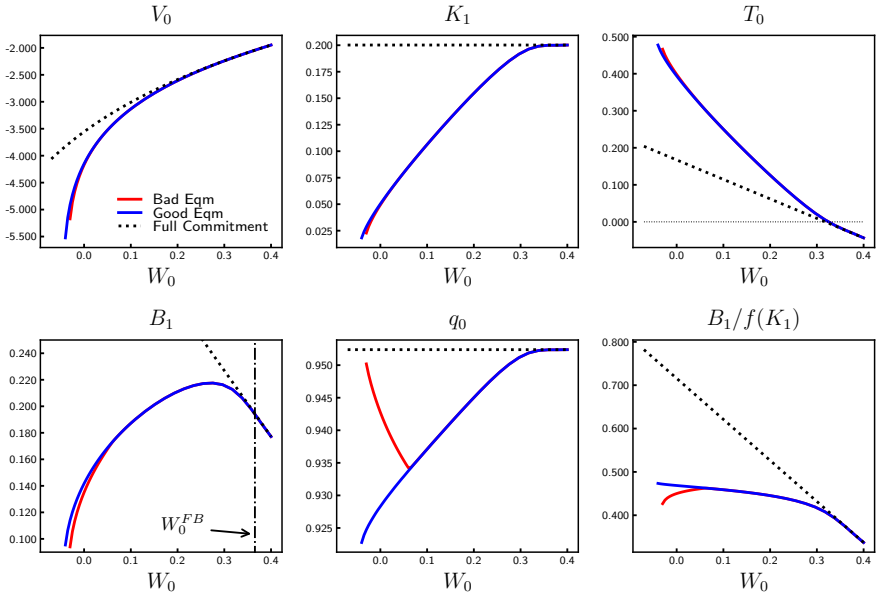


When motive to borrow is strong enough, yes:

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

Debt Revenues

Equilibria



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**:

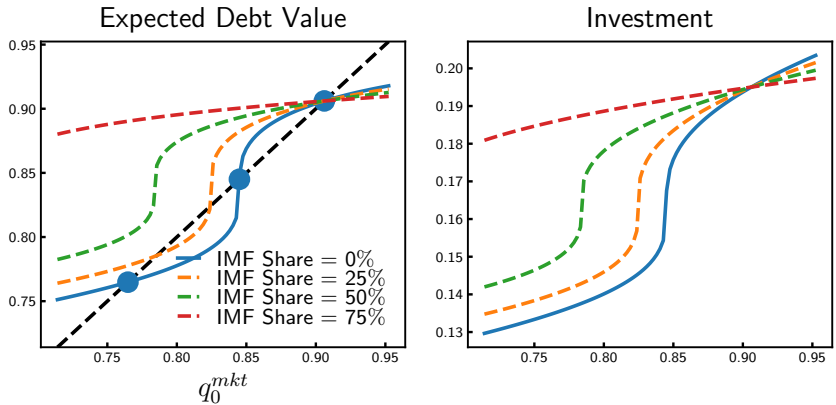
- Lack of commitment to repay
  - Lack of commitment to fiscal policy
    - lenders' coordination failure
  - Private investment externality

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

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

Pari-passu lending

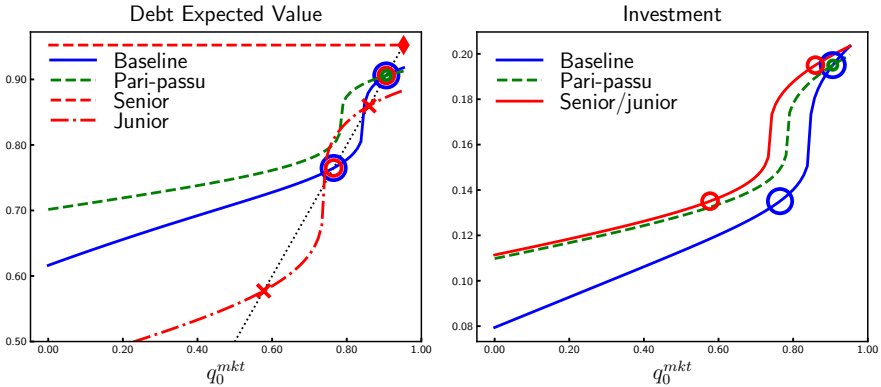
- IMF commits to buy $x\%$ of debt at good zero profit price
  - no preferred creditor status, participates in debt auction



- Private lenders' beliefs have **smaller impact** on revenues, investment, debt value
- Marginal effect on debt value $\rightarrow$ **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 $\mathcal{Q}^g$
- Then only $q_0 = \mathcal{Q}^g(W_0, B_1)$ clears the govt BC
- **Selecting the debt price schedule**, rather than take it as given

(Big) but

- govt BC violated off-equilibrium (Bassetto (2005))
- govt must **commit to strategy**, not action $\rightarrow$ *something* must adjust to clear BC
  - debt chosen ex-ante, taxes adjust (this paper)
  - taxes chosen ex-ante, debt adjusts (Calvo (1988), Lorenzoni and Werning (2019))

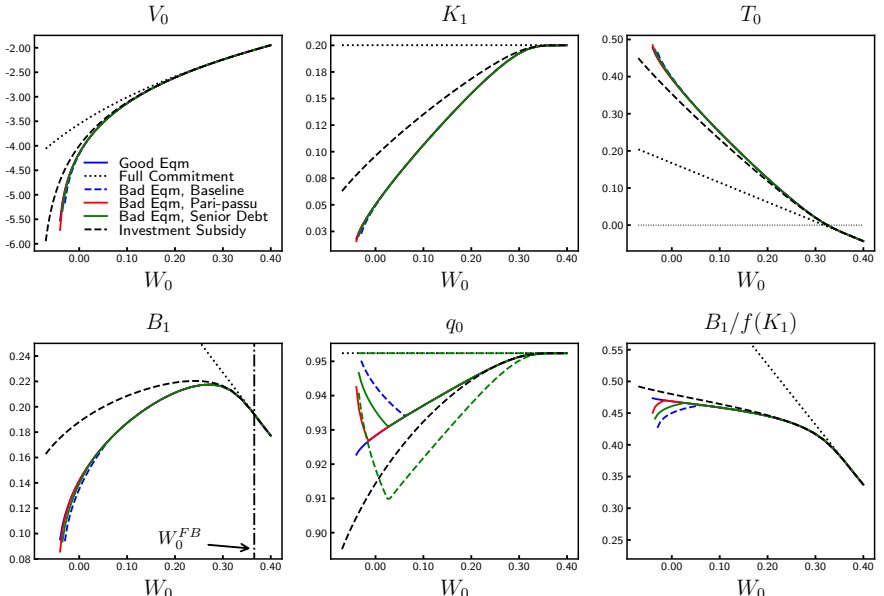
Investment subsidies with commitment

- Optimality in planner's problem

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

- Subsidy $\tau^k_0=B_1\mathcal{Q}^i_K$ 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



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

- prevent coordination failure
- possible trade-off between IMF risk and issuer welfare
- 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

$$\max_{k_1} u\Big(W_0 + q_0 B_1 - k_1\Big) + \beta \int_{\widehat{z}_1(K_1,B_1)} u\Big(f(k_1) - B_1\Big) dG(z_1)$$
$$+ \beta \int^{\widehat{z}_1(K_1,B_1)} \{u\Big(f(k_1)(1 - z_1)\Big)\} dG(z_1)$$

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

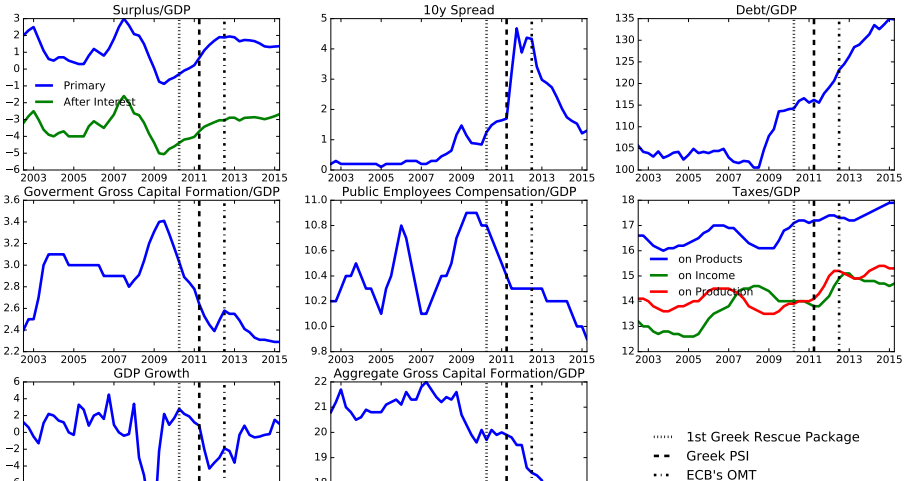
HH Investment

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 $Z = [0, 1]$

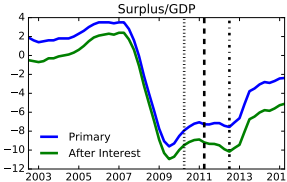
Back

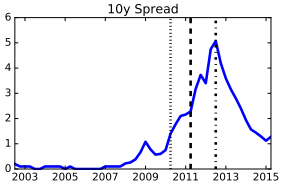
Italy

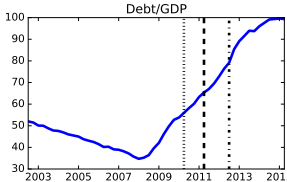

Surplus/GDP
Primary
After Interest
10y Spread
Debt/GDP
Goverment Gross Capital Formation/GDP
Public Employees Compensation/GDP
Taxes/GDP
on Products
on Income
on Production
GDP Growth
Aggregate Gross Capital Formation/GDP
1st Greek Rescue Package
Greek PSI
ECB's OMT

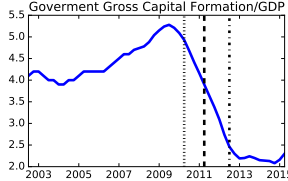
Back

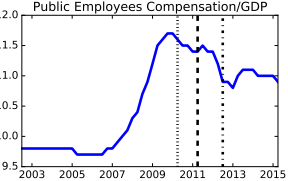
Spain

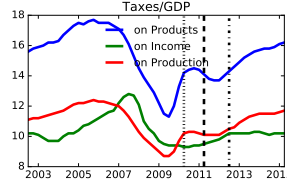


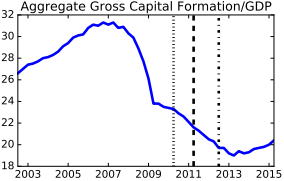












1st Greek Rescue Package
Greek PSI
ECB's OMT

Back

Some EZ Debt Crisis Quotes

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

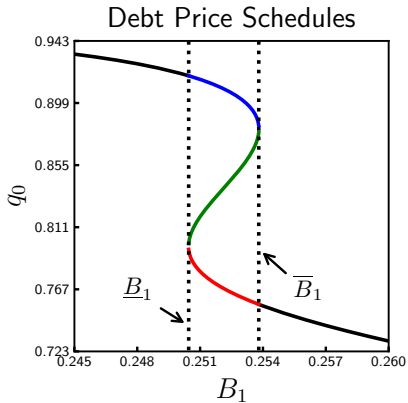
> *"These urgent measures were necessary to face a serious financial crisis that has hit [...] sovereign bond markets, Italy included."*

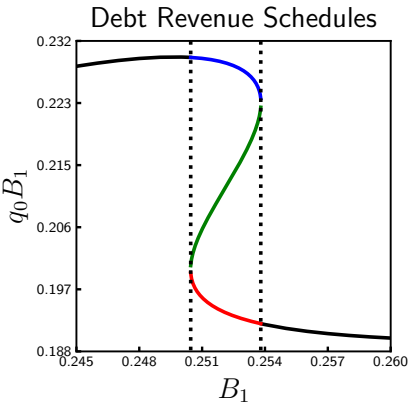
Italian PM Mario Monti, 29/12/2011

> *"Our economic fundamentals do no justify such a high government bond spread."*

Back

Debt Schedules and Revenues





Back

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