The Dynamics of Sovereign Debt Crises and Bailouts: Theory and Implications for Policy-Making

ESM Workshop on “Debt Sustainability: Current Practice and Future Perspectives”

The views expressed herein are those of the authors and should not be attributed to the IMF, its Executive Board, or its management.

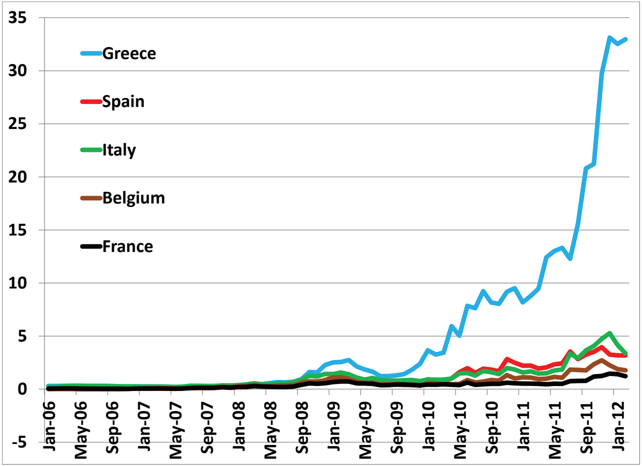
Francisco Roch and Harald Uhlig

Luxembourg, December 11th, 2018

Outline

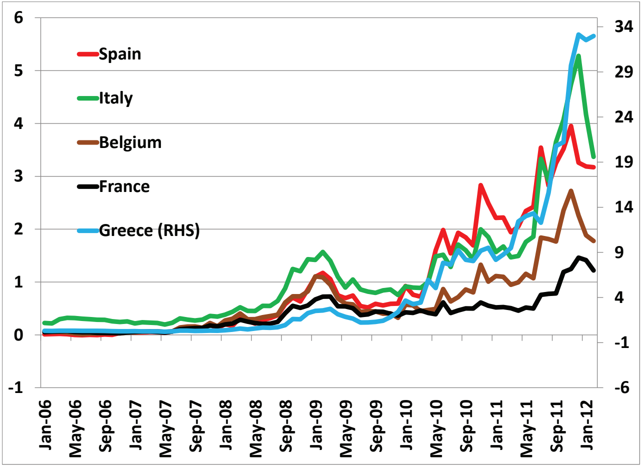
Outline

Default premia in Europe: 2006 - 2011



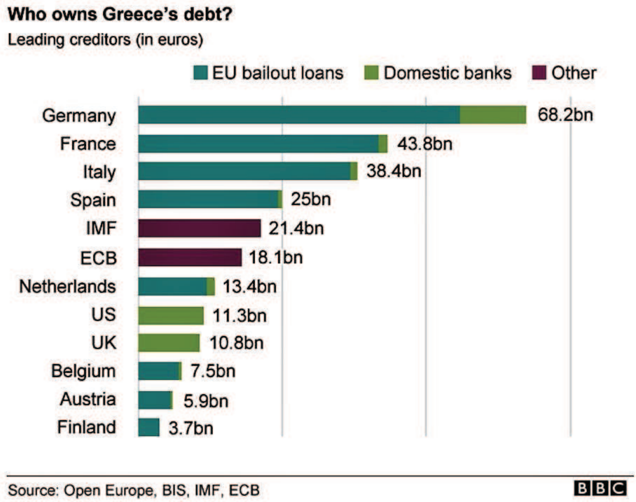
10yr yield spread to Germany. Source: Bloomberg.

Default premia in Europe: 2006 - 2011, rescaled



10yr yield spread to Germany. Source: Bloomberg.

Who owns Greece's debt? In 2015: EU bailout loans!



Source: https://www.globalresearch.ca/who-owns-greeces-debt/5460265

The ECB, OMT, and “Whatever it takes”

- 2012, July 26th, Draghi: “*... the euro is irreversible. ... Within our mandate, the ECB is ready to do whatever it takes to preserve the euro. And believe me, it will be enough.*”
- 2012, September 6th: outright monetary transactions (OMT) program: intended to reduce country-specific distress yields per potentially unlimited purchases of the short-term government bonds of that country.
- 2013, June 6th, Draghi: “*OMT has been probably the most successful monetary policy measure undertaken in recent time.*”
- 2013, June 11th, 12th. Germany’s constitutional court (BVerfG) hearings on Bundesbank participation in OMT. “Ultra vires”?
- 2016, June 21st: BVerfG decides to let the Bundesbank and ECB proceed, “*provided the volume of purchases is restricted ex ante.*”

The ESM ("European Stability Mechanism")

- Replaced two temporary programs: EFSF and EFSM.
- Treaty Establishing the ESM: Sept 2012. Amendment of article 136 of the TFEU ("Treaty on the Functioning of the European Union"). Inaugural meeting: Oct 8th, 2012.
- EMU reform plan: betw July 2017 and 2025, ESM should become fully integrated into EU law framework.
- Tools:
  1. Sovereign Bailout Loans. Require MoU ("memory of understanding"), conditionality.
  2. Bank recap programme.
  3. Precautionary finacial assistance (credit lines).
  4. Primary Market Support Facility (PMSF): bond purchases in primary market.
  5. Secondary Market Support Facility (SMSF).
- Total capital subscription of ESM: 700 billion Euro.
- Two current programs: 100 billion Euro/9 billion Euro for Spanish/Cypriotic bank recaps.

Bond Spreads: Italy vs Germany, 10yr bonds

Outline

Goal

- Modelling financial crises for a single country ...
  - self-fulfilling default possibility, Cole-Kehoe (2000)
  - random income shocks, Arellano (2008)
  - short-sighted politicians, Beetsma-Uhlig (1999)
- ... and the role of a bailout agency.
- Benchmark intervention: actuarily fair, i.e., bailout agency earns market return, in expectation.
- **Question**: how much intervention is necessary to avoid self-fulfilling defaults?

The government

Arellano (2008).

- Government objective: given $q_t(\cdot)$, choose c_t, B_{t+1}, δ_t to max.

$$U = E\left[\sum_{t=0}^{\infty} \beta^t (u(c_t) - \chi_t \delta_t)\right]$$

  - c_t: gov. spending, choice.
  - y_t: tax receipts, iid $\sim$ dens. $f(y)$ on $y \in [y_L, y_H]$, exog.
  - $\delta_t = 1$: default in t, choice. χ_t: pain of defaulting, exog.

- Budget constraint:

$$c_t + (1-\theta)B_t = y_t + q_t(B_{t+1})(B_{t+1} - \theta B_t)$$

- $0 \leq \theta \leq 1$: maturity, parameter. $\theta = 0$: one-period debt.
- Once defaulted: autarky. Then, $c_t = y_t$. Return to debt market with probability α.

Debt pricing and Timing

- State: $s = (B, d, z)$, where $z = (y, \chi, \zeta)$.
- $\zeta \sim U([0, 1])$: "sunspot".
- New debt: B'. Risk neutral traders. Discount future with R.
- Debt pricing schedule: $q(B'; s)$, per probability of future defaults.
- Example: one-period debt, $\theta = 1$. Then
  $q(B'; s) = \text{Prob}(\text{"no default in } t + 1\text{"})/R$.

Time line

Assume: there is some bailout agency: a large, infinitely-lived lender.

Time line:

1. Fundamental shocks (y, χ) are realized.
2. Government picks desired $B' \in \mathbb{R}$.
3. The bailout agency picks $(B'_a, q_a) \in \mathbb{R}^2$, $0 \leq B'_a \leq B', 0 \leq q_a$.
4. Sunspot shock ζ is realized.
5. Private market price q for new debt is established.
6. Government decides:
   - default or
   - pay and issue new debt $B' - \theta B$ at price q or
   - pay and issue new debt $B'_a - \theta B'$ at price q_a.
7. government consumes.

Outline

Time line without bailout agency:

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5. Government decides:
   - default or
   - pay and issue new debt $B' - \theta B$ at price q
6. government consumes.

Cole-Kehoe sunspots

- If current debt is too large $B > \bar{B}(z)$: default, even if traders were willing to buy new debt, $q(B') > 0$.
- If current debt is small, $B < \underline{B}(z)$: do not default, even if traders are not willing to buy new debt $q(B') = 0$.
- Crisis zone: sunspots

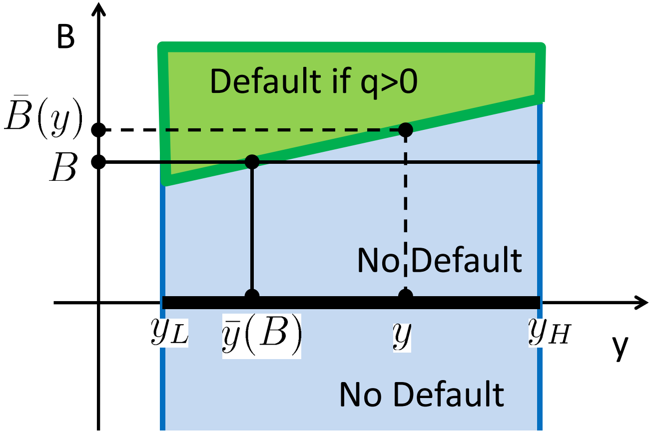
$$\underline{B}(z) \leq B \leq \bar{B}(z)$$

  - for $\zeta \leq \pi$, i.e. with prob. π: $q(B') = 0$, default.
  - for $\zeta > \pi$, i.e. with prob. $1 - \pi$: $q(B') > 0$, no default.

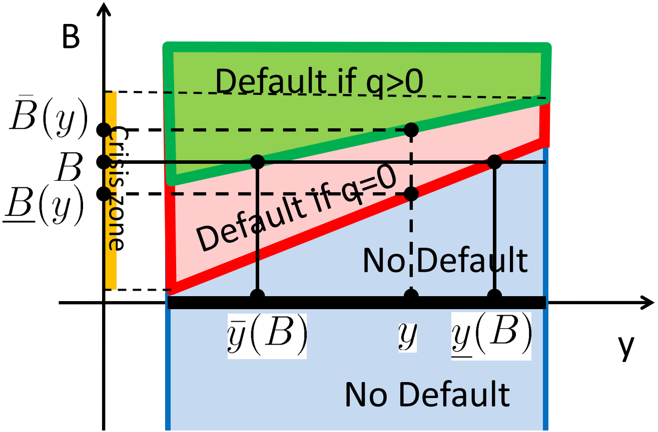
  π: exogenous parameter
- Arellano (2008): default more likely with y low. For given B, country is in crisis zone, if

$$\bar{y}(B) \leq y \leq \underline{y}(B)$$

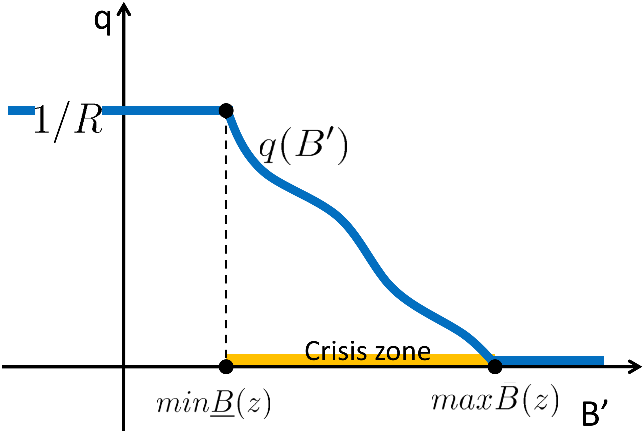
Default decision



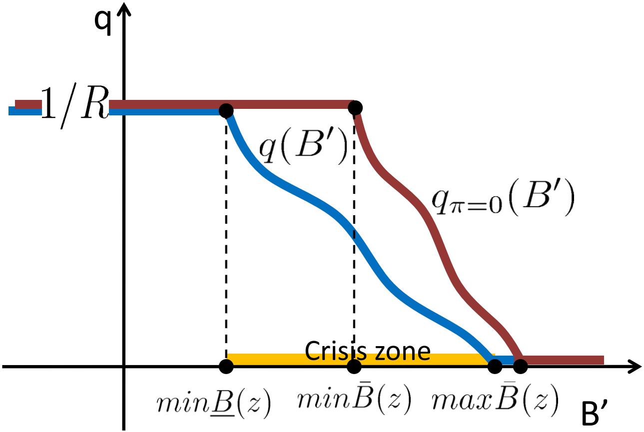
Sunspot


B
$\bar{B}(y)$
B
$\underline{B}(y)$
Crisis zone
Default if q>0
Default if q=0
No Default
$\bar{y}(B)$
y
$\underline{y}(B)$
y
No Default

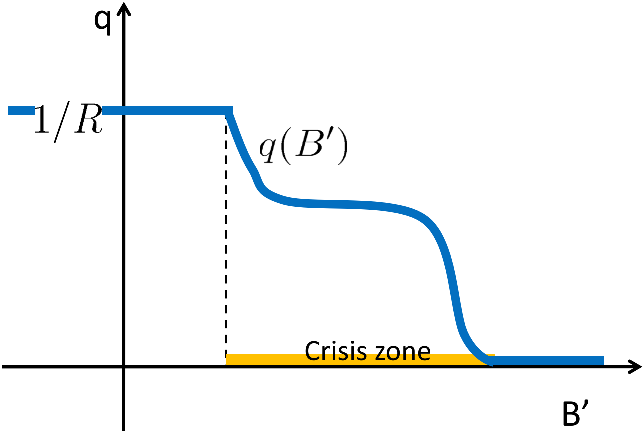
Debt pricing



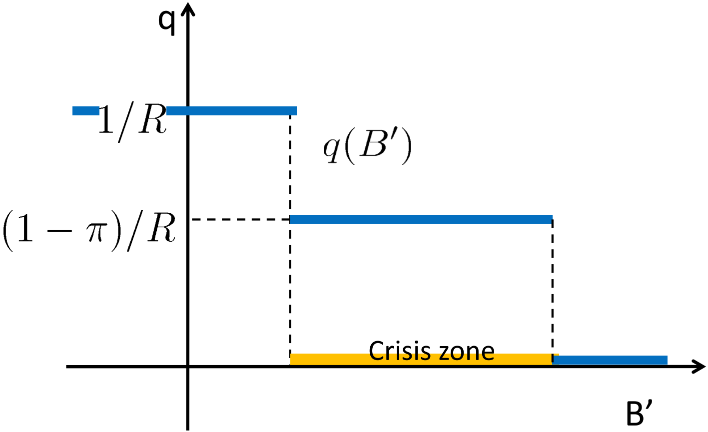
Debt pricing with and without sunspots



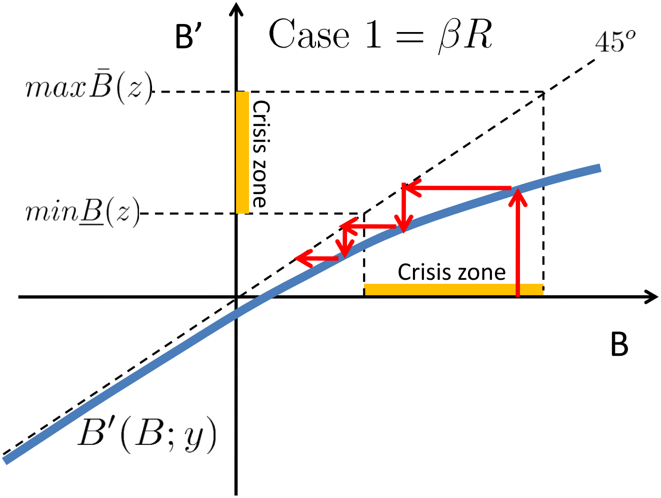
Debt pricing: small income fluctuations



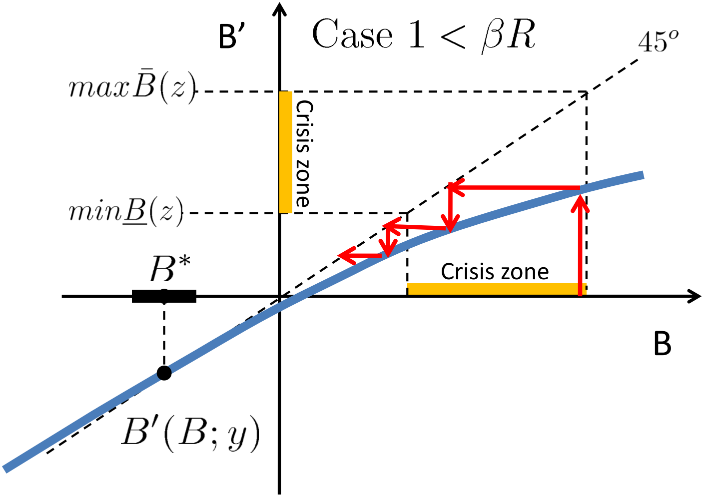
Debt pricing: no income fluctuations, Cole-Kehoe



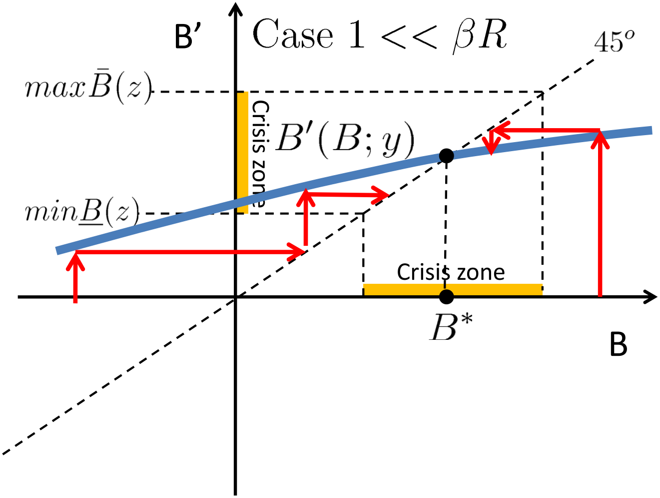
Debt dynamics, $\beta R = 1$, small income fluct.



Debt dynamics, $\beta R < 1$, small income fluct.



Debt dynamics, $\beta R << 1$, small income fluct.



Outline

The game with a bailout agency

Assume: there is some bailout agency: a large, infinitely-lived lender.

Time line:

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3. The bailout agency picks $(B'_a, q_a) \in \mathbb{R}^2$, $0 \leq B'_a \leq B', 0 \leq q_a$.
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Game Details: payoffs

If the government defaults, then we are in the "default" situation (details as usual). If the government does not default, two cases:

1. **Case A.** private sector buys at positive prices $q > 0$:
   - the government reaches the new debt level B', receiving a revenue $q(B' - \theta B)$, or paying this amount, if negative (i.e. if the government buys back debt).
   - the bailout agency receives and pays nothing.
   - the private sector pays $q(B' - \theta B)$, or receives it, if negative.
2. **Case B.** buyers' strike $q = 0$:
   - the government reaches the new debt level B'_a, receiving a revenue $q_a(B'_a - \theta B)$, or paying this amount, if negative.
   - the bailout agency pays $q_a(B'_a - \theta B)$, or receives it, if negative.
   - the private sector receives and pays nothing.

We examine equilibria, so that the government chooses "no default" in the crisis zone, even if followed by "Case B". Subsequent play is "Case A", and bailout agency never buys.

Actuarily fair interventions, ruling out sunspots

- Assume **actuarily fair intervention**: the bailout agency picks q_a so as to earn the market return R, in expectation..
- Assume bailout agency seeks to rule out the sunspot default equilibrium, per (forever) guaranteeing some debt purchase $B_a(s)$ at "good" ($\pi = 0$) equilibrium price: $q_a = q_{\pi=0}$.
- Goal: find the **minimal** intervention $B_a'(s)$ to do so.
- Note: with the guarantee and restoration of the "good" ($\pi = 0$) equilibrium, country might as well only borrow from all other lenders and not use the agency.
- Theory: B_a, compare to B'. Plots:

$$B_{a,\text{net}} = \max\{B_a - \theta B; 0\}$$

i.e. the amount that needs to be guaranteed for sales of **new** debt.

Characterizing B_a

- $\bar{B}(z)$: maximum level of current debt consistent with no default in the good $\pi = 0$ equilibrium.
- Value from non-defaulting, with assistance:

$$\begin{aligned}\underline{v}_{ND}(s) = \max_{c, B' \leq \mathbf{B_a(s)}} \{ & u(c) + \beta E\left[v(s') \mid z\right] \mid \\ & c + (1-\theta)B(s) = y(s) + q_{(\pi=\mathbf{0})}(B'; s)(B' - \theta B(s)) \\ & s' = (B', d(s), z')\}\end{aligned}$$

- For $0 \leq B \leq \bar{B}(z)$, find $B_a'(s) \geq 0$ so that

$$\underline{v}_{ND}(s = (B, 0, z)) = v_D(z(s)) - \chi(s = (B, 0, z)) \tag{1}$$

- For $B > \bar{B}(z)$, define $B_a'(s) = 0$.

Outline

Calibration

- Income dynamics: AR(1) in $\log(y)$, discretized. Aguiar-Gopinath (2009).
- (Arbitrary) benchmark: $\pi = 5\%$.
- Target:
  - Debt/Tax (i.e.: B/Y): between 2 and 3.
  - Default rates: around 5% to 8% p.a.

  Normally: hard! Here, "easy", per two-state Markov process for χ:
  - Utility: CRRA with $\sigma < 1$, low β ("impatient").
  - Set $\chi_L = 0$.
  - Calibrate χ_H and trans.prob. $\chi_H \to \chi_L$ to match target.

$$\begin{bmatrix} 0 & 1 \\ 0.04 & 0.96 \end{bmatrix}$$

Parameters (t counts years):

Government's risk aversion	σ	1/2
Interest rate	r	3.0%
Income autocorrelation coefficient	ρ	0.945
Standard deviation of innovations	σ_ϵ	3.4%
Mean log income	μ	(-1/2)σ_ϵ^2
Exclusion	α	0.2
Maturity structure	θ	0.8
Discount factor	β	0.4
Cost	χ_L	0
Cost	χ_H	0.5
SFC sunspot probability	π	0.05
Income grid	$y_1, \ldots, y_{20}$	$[0.73, \ldots, 1.37]$
debt grid	$B_1, \ldots, B_{1000}$	

Results

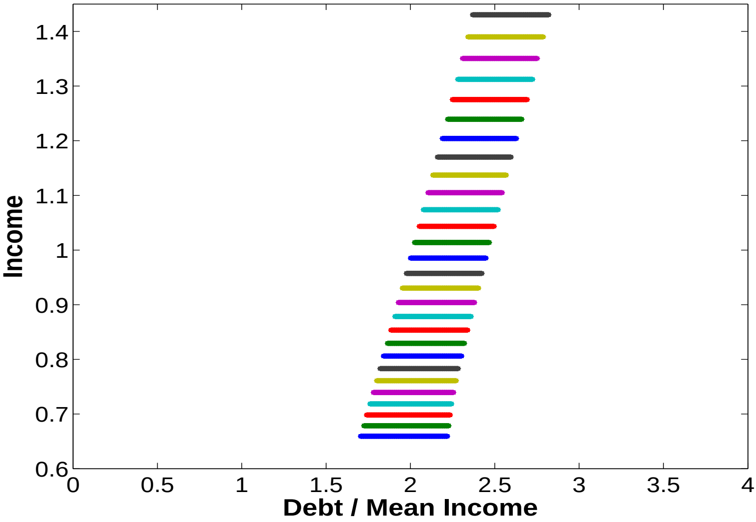
Targets

	Target	$\theta = 0.8$
Debt/Tax ratio	2 .. 3	2.4
Default rate	5% .. 8%	6.6%

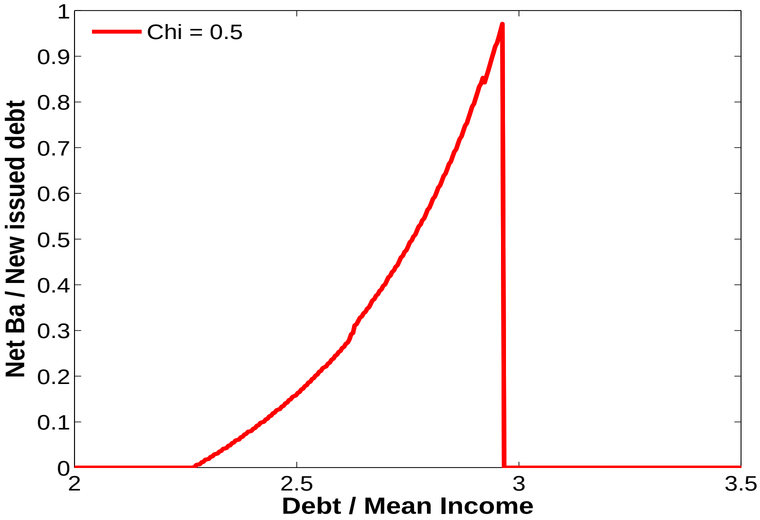
Defaults

	Buyers present	Buyers' strike
χ_L	38%	2%
χ_H	12%	48%

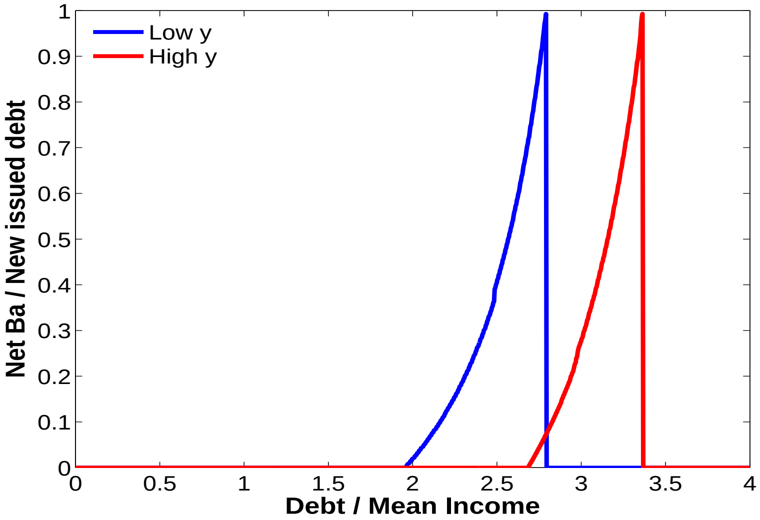
Crisis Zones



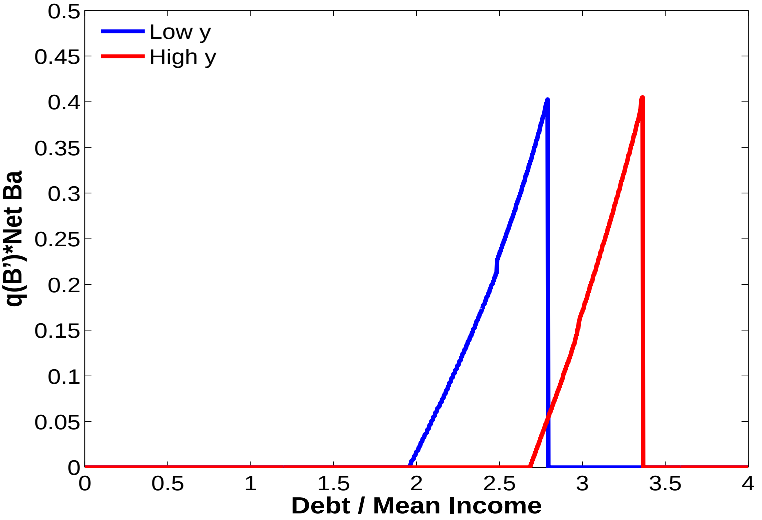
Bailout facility purchase guarantees (χ_H)



Income and bailout agency purchase guarantees



... at market values



Maturity and debt levels

Targets:

	Target	$\theta = 0.9$	$\theta = \mathbf{0.8}$	$\theta = 0.5$	$\theta = 0$
Debt/Tax ratio	2 .. 3	3.3	**2.4**	1.8	1.6
Default rate	5% .. 8%	6.6%	**6.6%**	6.2%	6.2%

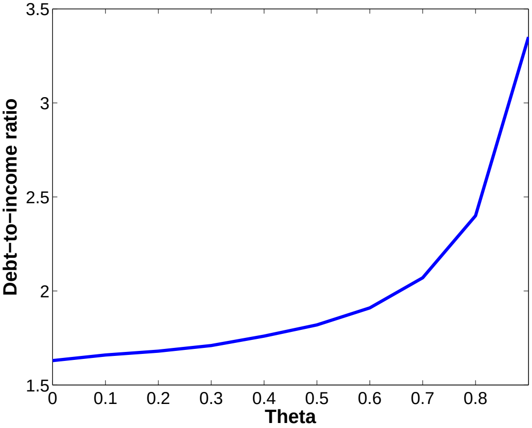
Defaults: $\theta = 0.9$

	Buyers present	Buyers' strike
χ_L	38%	2%
χ_H	16%	44%

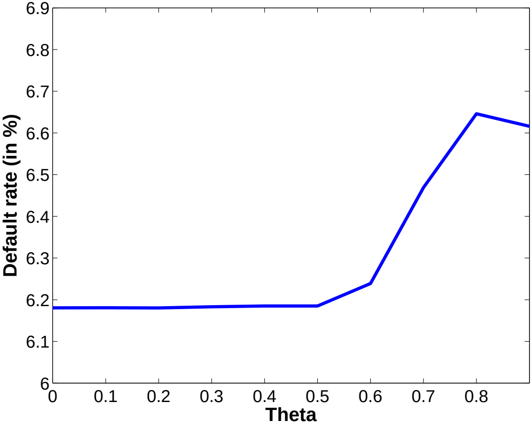
Defaults: $\theta = 0$

	Buyers present	Buyers' strike
χ_L	42%	2%
χ_H	2%	54%

Debt and θ

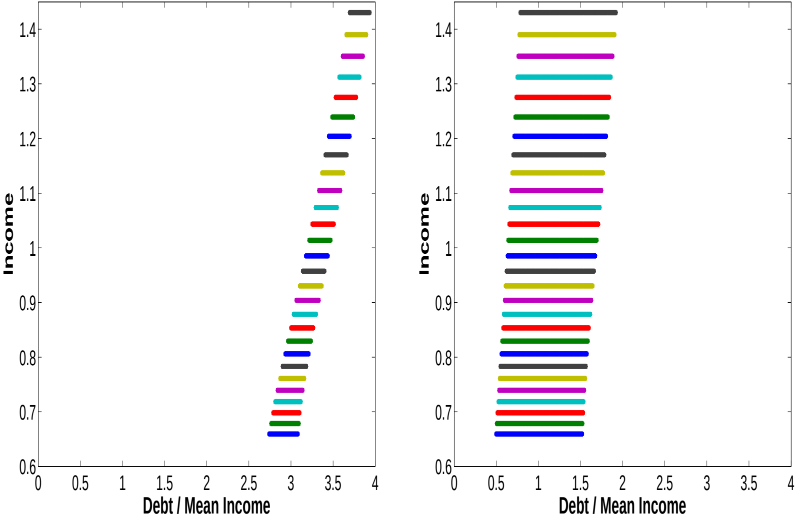


Default and θ

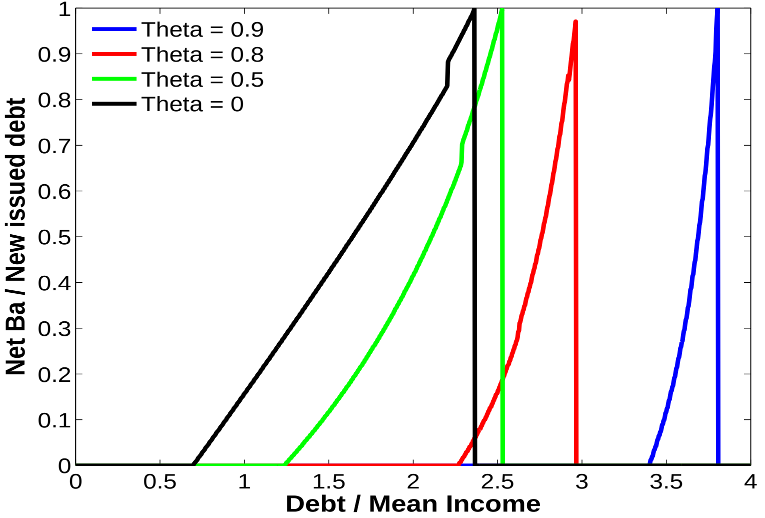


Maturity and Crisis Zones

$\theta = 0.9$ $\theta = 0$



Maturity and Bailout facility purchase guarantees



Sunspot probabilities and debt levels

	Target	$\pi = 0.2$	$\pi = 0.1$	$\pi = \mathbf{0.05}$	$\pi = 0$
Debt/Tax ratio	2 .. 3	1.8	2.1	**2.4**	2.9
Default rate	5% .. 8%	5%	8%	**6.6%**	4%

Sunspot probabilities and default details

Defaults for $\pi = 0.1$: total prob = 8%.

	Buyers present	Buyers' strike
χ_L	27%	3%
χ_H	8%	62%

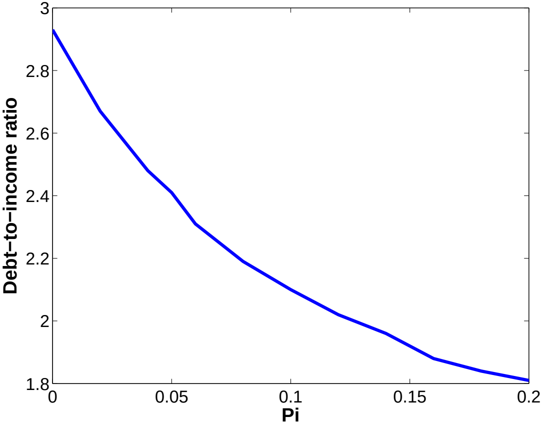
Defaults for $\pi = 0.05$ (Benchmark): total prob = 6.6%.

	Buyers present	Buyers' strike
χ_L	38%	2%
χ_H	12%	48%

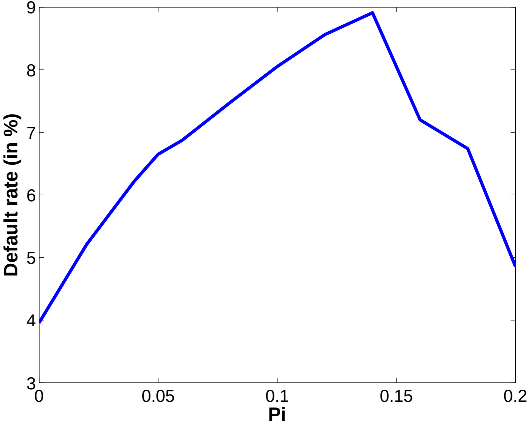
Defaults for $\pi = 0$:total prob = 4%.

	Buyers present	Buyers' strike
χ_L	81%	0%
χ_H	19%	0%

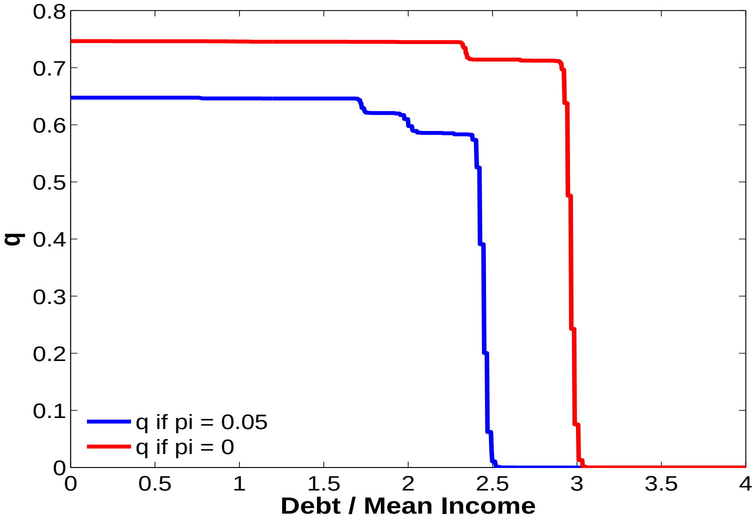
Debt and π



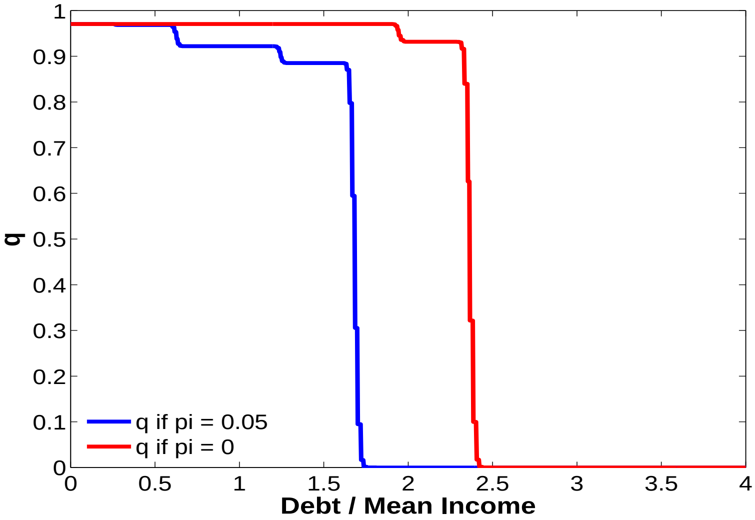
Default and π



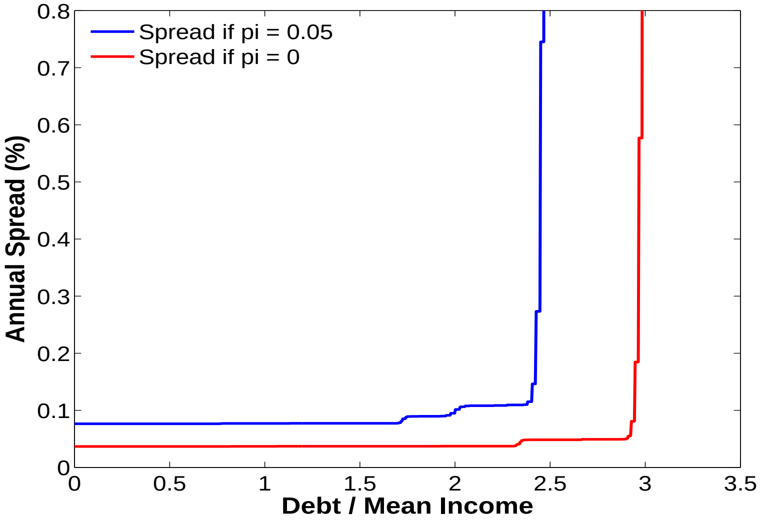
Debt pricing function, $\pi = 0.05$ vs $\pi = 0$.



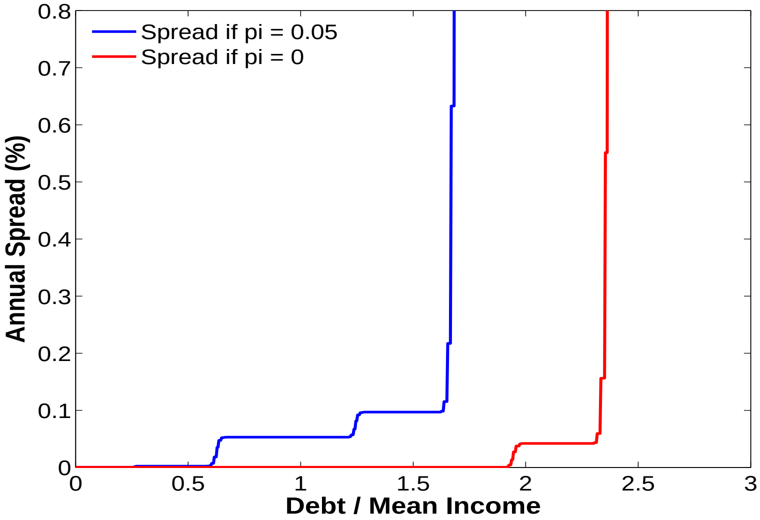
Debt pricing function, $\pi = 0.05$ vs $\pi = 0$, when $\theta = 0$.



Risk Yield Spreads, $\pi = 0.05$ vs $\pi = 0$.

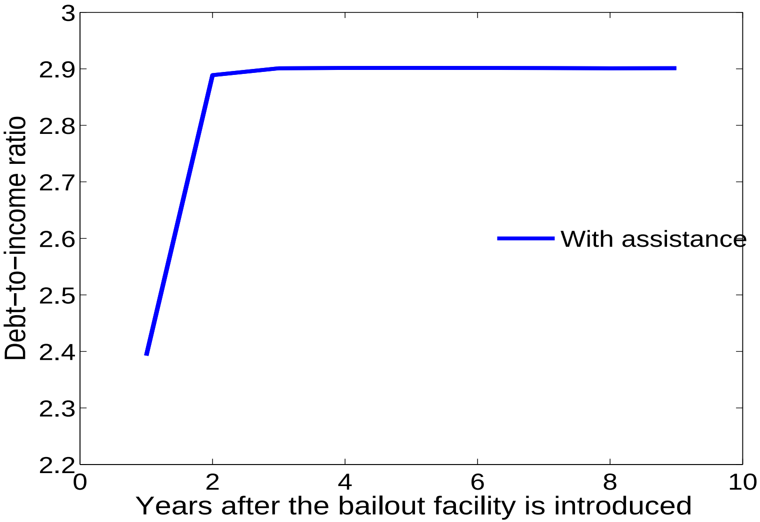


Risk Yield Spreads, $\pi = 0.05$ vs $\pi = 0$, when $\theta = 0$.



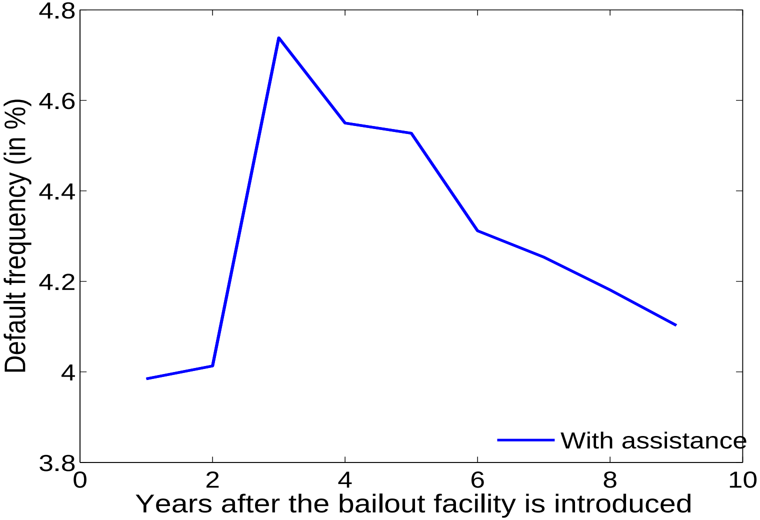
Debt dynamics after bailout agency launch

Starting point: $\pi = 0.05$, mean income, mean debt/gdp ratio



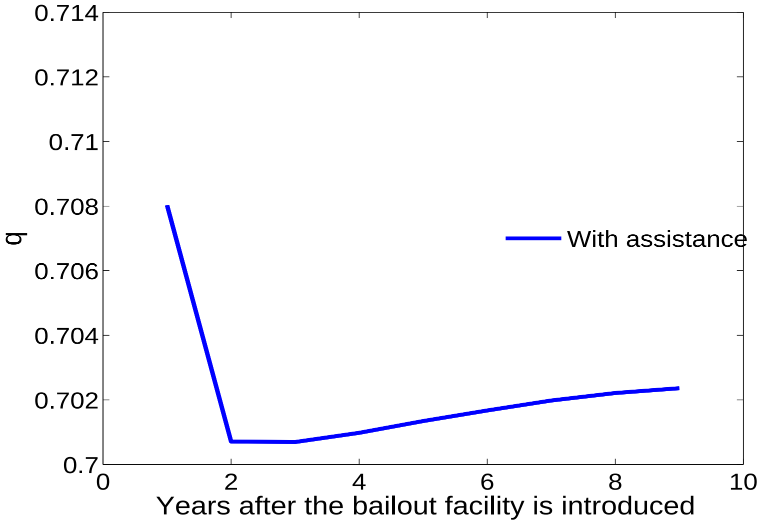
Default frequency after after bailout agency launch

Starting point: $\pi = 0.05$, mean income, mean debt/gdp ratio

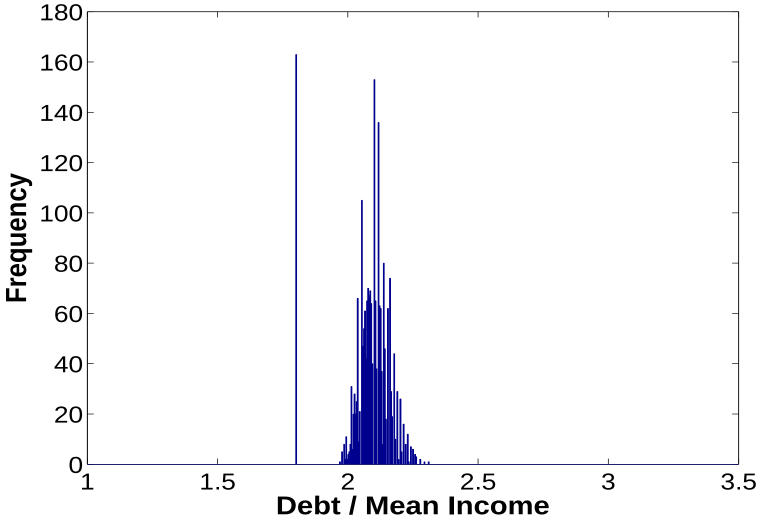


Bond prices after after bailout agency launch

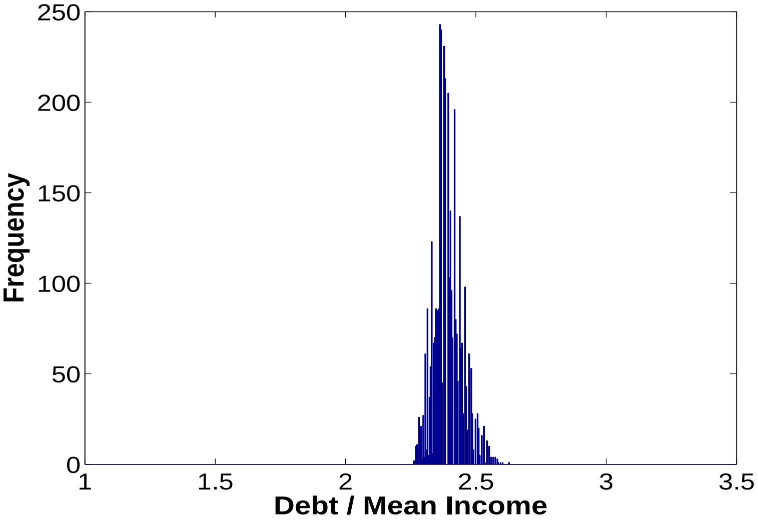
Starting point: $\pi = 0.05$, mean income, mean debt/gdp ratio.



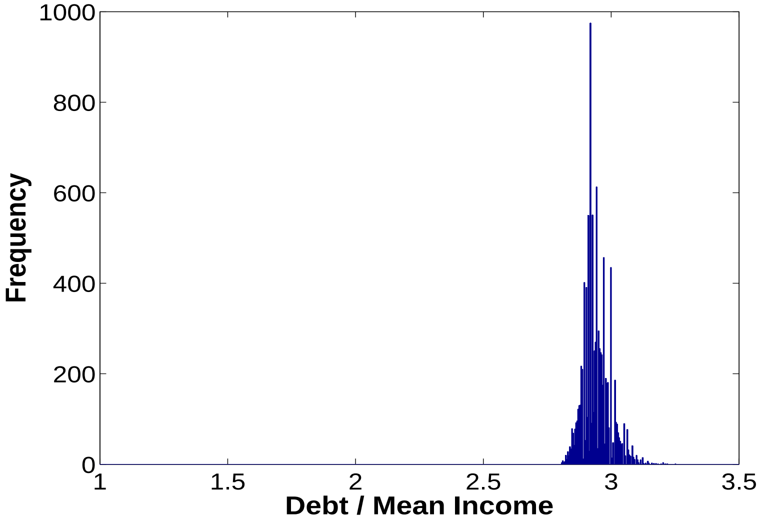
Debt Distribution with sunspots: $\pi = 0.1$



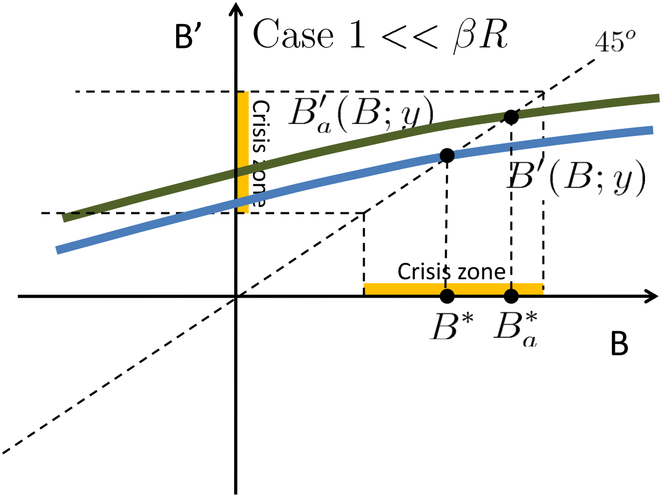
Debt Distribution with sunspots: $\pi = 0.05$



Debt Distribution without sunspots / with assistance



Stationary debt dynamics, permanent assistance



Outline

Summary of the paper: main messages (Aitor Erce).

1. Interventions can successfully eliminate non-fundamental crises
   - If distinction between illiquid and insolvent is unclear, losses can be large
   - Program size can be substantial
2. Such interventions can be designed to imply no transfers:
   - Actuarially fair
3. Presence of bailout agency has consequences:
   - Increased debt level (a form of moral hazard?)
   - default probabilities may remain unchanged
4. Bailouts are fickle:
   - small changes in fundamentals may lead the bailout agency to remove its support
5. Maturity of debt matters:
   - Longer maturities reduce the crisis zone

Policy issues

1. Conditionality:
   - **Hope**: enforces fiscal discipline.
   - **Danger**: some “bad equilibria” remain, increasing bond premia and default risk.
2. ESM lending capacity smaller than ECB.
   - **Hope**: limit to putting tax payer money at risk.
   - **Danger**: limit to stopping bad equilibria.
3. ESM is senior lender.
   - **Hope**: tax payers get repaid first.
   - **Danger**: private money flees, increasing buyer strike potential.
4. Contagion and spill-overs.
   - **Hope**: stopping the crisis in Greece stops the crisis in Italy.
   - **Danger**: stopping the crisis in Greece empties the coffers, increasing fears of those buying Italian debt.
5. Is Italy too large, in any case?
6. Should we have a fiscal union in Europe? The U.S. example.

Bond Spreads: Italy vs Germany, 10yr bonds

Outline

Conclusions

- The Roch-Uhlig paper offers a framework to think about potential roles of a bailout agency such as the IMF, the ECB or the ESM.
- One role: ruling out "buyer-strike" equilibria. This can be done in an actuarily fair way, but may involve substantial resources and running the risk of bailing out insolvent countries, at a potentially huge cost.
- Other roles worthy of investigation.
- Issues such as conditionality, lending seniority, contagion, banking unions or fiscal unions are still in need of deeper clarification and research. The tradeoffs are intricate.

Source: Roch, Francisco & Uhlig, Harald, 2018. "The dynamics of sovereign debt crises and bailouts," Journal of International Economics, Elsevier, vol. 114(C), pages 1-13.