Optimal Bailouts in Banking and Sovereign Crises

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Introduction

- We study optimal bailouts in the presence of banking and sovereign crises
  - banking crises $\longrightarrow$ bailouts $\longrightarrow$ sovereign debt crises
  - sovereign debt crises $\longrightarrow$ banking crises
- Tradeoff: bailouts relax fin. frictions and $\uparrow$ output, but also $\uparrow$ fiscal needs and default risk (i.e., create a 'diabolic loop').
- Main findings
  - Optimal bailouts policies are increasing with the severity of banking crisis and productivity but decreasing in debt levels
  - Economy is ex ante better off without bailouts: the 'diabolic loop' they create is too costly.

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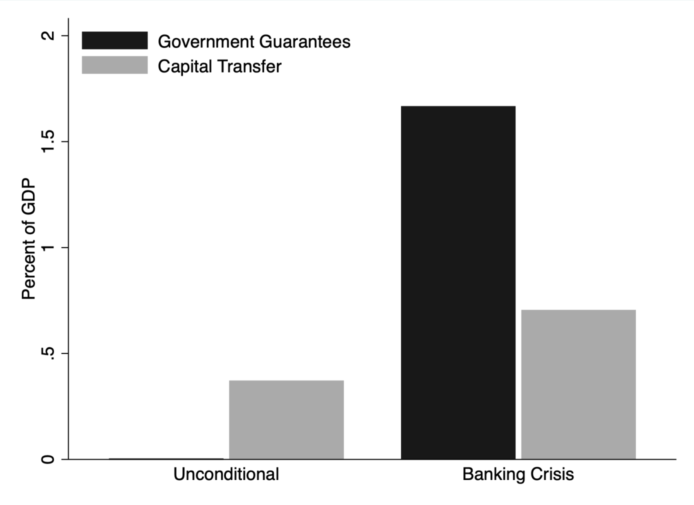
3. Our own empirical contribution: The most prevalent form of government intervention to alleviate banking crises is the issuance of sovereign guarantees

Government guarantees in banking crises

- Eurostat data on 23 countries (2007–2019) details
- We compare
  - avg net annual change in government guarantees to the banking sector
  - average capital transfers to the banking sector
  - conditional on banking crises

Government guarantees in banking crises



▸ Contingent liabilities

Related literature

- **Sovereign risk and banks.** Sosa-Padilla (2018), Bocola (2016), Perez (2015), Gennaioli, Martin and Rossi (2014), Boz, Durdu and D'Erasmo (2016), Abad (2020).

- **Domestic sovereign debt and financial frictions.** Mallucci (2020), D'Erasmo and Mendoza (Forthcoming), Pei (2020).

- **Bailouts.** Acharya, Drechsler, and Schnabl (2014), Farhi and Tirole (2014), Bianchi (2016), Azzimonti and Quadrini (2019), Gourinchas, Martin and Messer (2020).

Model

Model

- Build on Sosa-Padilla (2018)
- Given government policies, private agents optimize
  - households
  - firms
  - bankers
- Government chooses fiscal policies
  - debt and default
  - taxes and contingent transfers (bailouts)
- 4 aggregate states
  - government debt B
  - productivity z
  - potential loss of bankers' capital ε (let $s = \{z, \varepsilon\}$)
  - banker's capital A (realized in the interim)

Timing

- Gov't observes $\{B, s\}$ and decides repay/default
- If repay ($d = 0$)
  1. the government announces a bailout policy, $T(B, s)$
  2. given the bailout policy, banks decide their loan supply
     - w/ prob. π, $A = (1 - \varepsilon)\overline{A}$ (i.e. banking crisis) and gov disburses promised bailouts
     - w/ prob. $1 - \pi$, $A = \overline{A}$ and gov doesn't pay bailouts
  3. all other private decisions and new gov. borrowing and taxes are decided
- If default ($d = 1$)
  1. gov cannot promise bailouts and is excluded from fin. mkts
  2. banks determine their loan supply
     - w/ prob. π, the bank's capital is reduced by ε
  3. all other private decisions and gov. taxes are decided

Households

- Households choose consumption (c) and labor (n) to solve

$$\max_{\{c,n\}} \quad U(c,n)$$
$$\text{s.t.} \quad c = (1-\tau)wn + \Pi^F$$

  - w: wage rate
  - τ: labor income tax rate
  - Π^F: firms' profits

- Optimality condition:

$$-U_n/U_c = (1-\tau)w \tag{1}$$

Firms

- Firms choose labor (N) and loans (ℓ^d) to solve

$$\max_{\{N,\ell^d\}} \quad \Pi^F = zF(N) - wN - r\ell^d$$

$$\text{s.t. } \gamma wN \leq \ell^d \text{ (working capital constraint)}$$

  - z: aggregate productivity
  - r: interest rate charged for working capital loans
  - γ: fraction of the wage bill that must be paid up-front

- Optimality condition:

$$zF_N(N) = (1 + \gamma r)w \tag{2}$$

Bankers

- Bankers lend to both the government (b) and the firms (ℓ^s).
- Banker's capital is subject to aggregate shocks

$$A = \begin{cases} \overline{A} & \text{with probability } 1-\pi \\ \overline{A}(1-\varepsilon) & \text{with probability } \pi \end{cases}$$

- Loans to firms cannot exceed the value of bankers' resources (at any state):

$$\ell^s \leq \min_A \{A + b + T(B, s, A)\}$$

  - b: bankers' holdings of sovereign bonds
  - T: state-contingent government transfers (bailouts)

Bankers

- When the government has access to credit, the banker chooses ℓ^s, b', and x (consumption)
- ℓ^s has to be chosen after observing ε but before knowing whether shock actually hits

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$$W^R(b; B, s) = \max_{\ell^s} \mathbb{E}_A \Omega(b, \ell^s; B, s, A)$$

$$\text{s.t. } \ell^s \leq \min_A \{A + b + T(B, s, A)\}$$

$$\Omega(b, \ell^s; B, s, A) = \max_{x, b'} x + \delta \mathbb{E}_{s'|s} \left[(1 - d') W^R(b'; B', s') + d' W^D(s') \right]$$

$$\text{s.t. } x + q(B', s) b' \leq T(B, s, A) + b + r(B, s, A) \ell^s$$

  - δ: banker's discount factor
  - $q(B', s)$: price of government bonds
  - $r(B, s, A)$: interest rate on private loans
  - B', T, d: government policies for debt, bailouts, and default

Bankers

- When the government lacks access to credit, the banker chooses loans to firms (ℓ^s) and consumption (x) to solve

$$W^D(s) = \max_{\ell^s, x} x + \delta \mathbb{E}_{s'|s} \left[\theta W^R(0; 0, s') + (1-\theta) W^D(s') \right]$$

$$\text{s.t. } x \leq r_{\text{def}}(s) \ell^s$$

$$\ell^s \leq \overline{A}(1-\varepsilon)$$

  - θ: probability that the government regains access to credit
  - $r_{\text{def}}(s)$: interest rate on private loans when the government does not have access to credit
- No bailouts during default/exclusion

Equilibrium given government policies

- We focus on bailout policies that take the form:

$$
\begin{aligned}
T &= 0 && \text{if } A = \overline{A} \\
0 \leq T &\leq \varepsilon \overline{A} && \text{if } A = \overline{A}(1-\varepsilon)
\end{aligned}
$$

- When government has access to credit, bankers supply

$$\ell^s(B,s) = B + \overline{A}(1-\varepsilon) + T(B,s,\overline{A}(1-\varepsilon))$$

- When the government lacks access to credit, bankers supply
- Defaults shrink loanable funds

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Equilibrium given government policies

- From firm optimality conditions, we obtain loan demand:

$$\ell^d(B, s, A) = \gamma \left[\frac{znF_n}{1 + \gamma r} \right]$$

- Loan market clearing interest rate:

$$r(B, s, A) = \max \left\{ \frac{zn(B, s, A)F_n}{B + \overline{A}(1-\varepsilon) + T\left(B, s, \overline{A}(1-\varepsilon)\right)} - \frac{1}{\gamma}, 0 \right\} \quad (3)$$

$$r_{\text{def}}(s) = \max \left\{ \frac{zn(s)F_n}{\overline{A}(1-\varepsilon)} - \frac{1}{\gamma}, 0 \right\} \quad (4)$$

Equilibrium given government policies

- From bankers' FOCs, we obtain the bond pricing function

$$q(B';\ s) = \delta \mathbb{E}_{s'|s} \left\{ \left[1 - \underbrace{d(B', s')}_{\text{default premium}} \right] \mathbb{E}_{A'} \left[1 + \underbrace{r\left(B', s', A'\right)}_{\text{lending discount}} \right] \right\} \quad (5)$$

- When government defaults next period $\left(d(B', s') = 1\right)$
  - the lender loses its original investment in sovereign bonds
  - and the future gains that those bonds would have created

Determination of government policies

- The government's optimization problem given by:

$$V(B,s) = \max_{d \in \{0,1\}} \Big\{ (1-d) V^R(B,s) + d\, V^D(s) \Big\} \qquad (6)$$

  - V^R: value of repaying
  - V^D: value of defaulting

- Let $\kappa \equiv (B, s, A)$ denote the complete aggregate state and $\Phi \equiv \{\tau, T, B'\}$ summarize the fiscal policies
- Value of repayment is given by

$$V^R(B,s) = \max_{\tau, B', T} \mathbb{E}_A \Big\{ U(c(\Phi;\kappa), n(\Phi;\kappa)) + \beta\, \mathbb{E}_{s'|s} V(B', s') \Big\}$$

$$\text{s.t. } \tau\, w(\Phi;\kappa)\, n(\Phi;\kappa) + B'\, q(B', s) = g + B + T$$

$$c(\Phi;\kappa) + x(\Phi;\kappa) + g = zF(n(\Phi;\kappa))$$

equilibrium conditions from private sector

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eqm conditions from priv. sector under default

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Recursive Equilibrium

- A *Markov-perfect equilibrium* for this economy is
  (i) government value functions $\{V(B,s), V^R(B,s), V^D(s)\}$
  (ii) government policies $\{B'(\kappa), \tau(\kappa), T(\kappa), d(B,s)\}$
  (iii) private sector decision rules $\{c(\Phi;\kappa), n(\Phi;\kappa), x(\Phi;\kappa), \ell(\Phi;\kappa)\}$ and $\{c_{\text{def}}(\tau;s), n_{\text{def}}(\tau;s), x_{\text{def}}(\tau;s), \ell_{\text{def}}(\tau;s)\}$
  (iv) prices $\{q(B'(\kappa),s), w(\Phi;\kappa), r(\Phi;\kappa), w_{\text{def}}(\tau;s), r_{\text{def}}(\tau;s)\}$

  such that:

  1. Given prices and private sector decision rules, government policies solve the government's maximization problem in (6)
  2. Given government policies, prices and private sector decision rules are consistent with the competitive equilibrium, satisfying (1)–(5).

Quantitative Results

Remainder of presentation

1. Describe the model calibration
2. Model validation
3. Default and bailout policies
4. Do we even want bailouts?

Functional forms and stochastic processes

- **Utility function:** $U(c,n) = \dfrac{\left(c - \frac{n^{\omega}}{\omega}\right)^{1-\sigma}}{1-\sigma}$
- **Production function:** $zF(n)$ with $F(n) = n^{\alpha}$
- **TFP shocks** (z) follow an AR(1) process:

$$\log(z_{t+1}) = \rho_z \log(z_t) + \nu_{z,t+1} \quad \text{where } \nu_z \sim N(0,\sigma_z)$$

- **Potential bank capital shocks** take values between 0 and $\bar{\varepsilon}$, and have a cumulative distribution function,

$$F_{\sigma_\varepsilon}(\varepsilon) = \frac{1 - \exp(\varepsilon)^{-\sigma_\varepsilon}}{1 - \exp(\bar{\varepsilon})^{-\sigma_\varepsilon}}$$

which is a transformation of the bounded Pareto distribution

Calibration

Parameters	Values	Target/Source
Household discount factor, β	0.81	Default probability: 0.5 percent
Risk aversion, σ	2	Sosa-Padilla (2018)
Frisch elasticity, $\frac{1}{\omega-1}$	0.67	Sosa-Padilla (2018)
Government spending, g	0.15	Gov't consumption (percent GDP): 19.1
Prob. of financial redemption, θ	0.50	Expected exclusion: 2 years
Bankers' discount factor, δ	0.96	Risk-free rate: 4 percent
Baseline bank capital, $\bar{A}$	0.28	Bailouts in banking crises (percent GDP): 1.7
Financial shock shape, σ_ε	4.26	Standard deviation of output: 3.4 percent
Prob. of banking crisis, π	0.03	Banking crisis frequency: 1.8 percent
Labor share, α	0.70	Sosa-Padilla (2018)
Working capital constraint, γ	0.52	Sosa-Padilla (2018)
TFP shock persistence, ρ_z	0.80	Standard value
TFP shock std, σ_z	0.02	Standard value

Simulated moments

- "diabolic loop:" default probability is higher following a banking crisis, with higher and more volatile spreads

	Unconditional	Banking crisis
Default frequency	0.5*	0.7
Sovereign spread		
mean	0.7	0.9
standard deviation	0.6	1.0
Debt/GDP	15.5	16.0
Bailout/GDP	0.9	1.7*

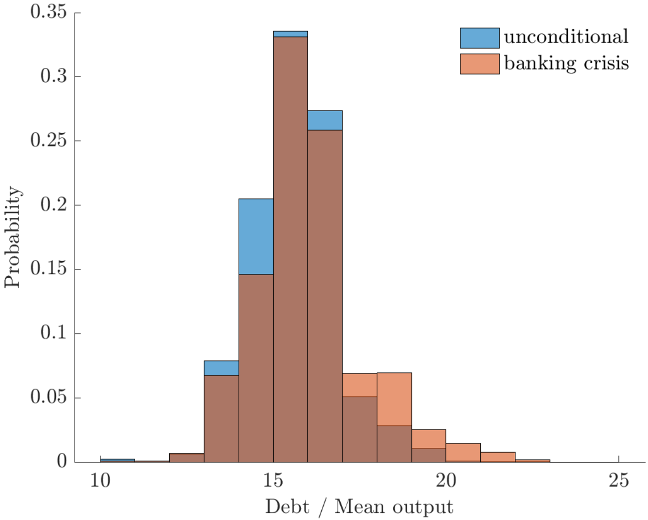
Units: percent. * denotes targeted moments.

▸ Dynamics around BC

▸ Model fit

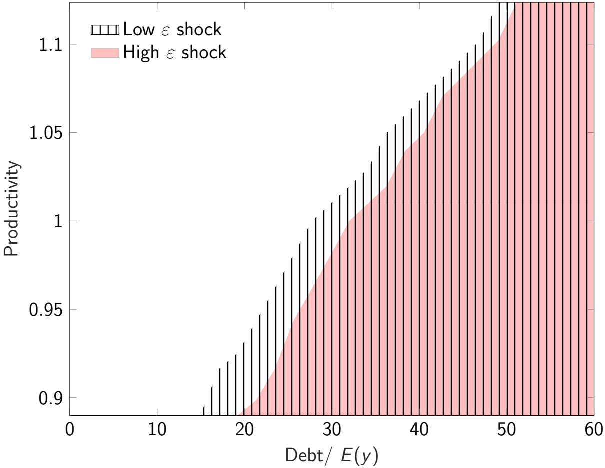
Debt dynamics

- Higher levels of debt more likely after banking crises



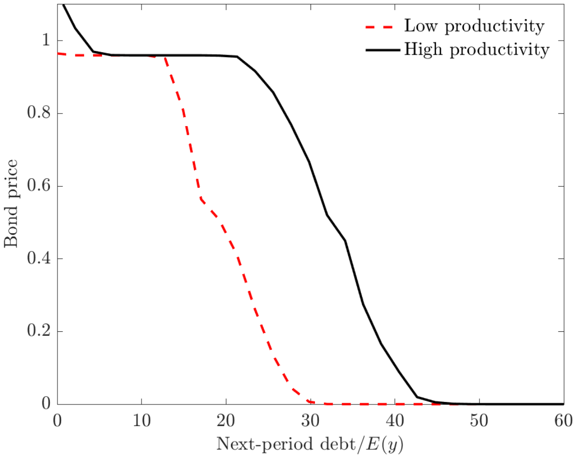
Default policy

- Default is
  - decreasing in productivity and increasing in debt
  - less likely with larger potential losses to banking capital



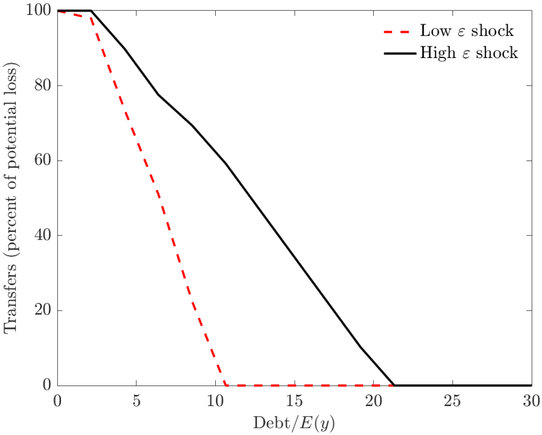
Price schedule and spreads

- Higher productivity is associated with better prices and higher debt capacity



Properties of optimal bailout policies

- Bailouts are
  - ↓ in debt (less fiscal space)
  - ↑ in the severity of banking crisis (convex output loss)



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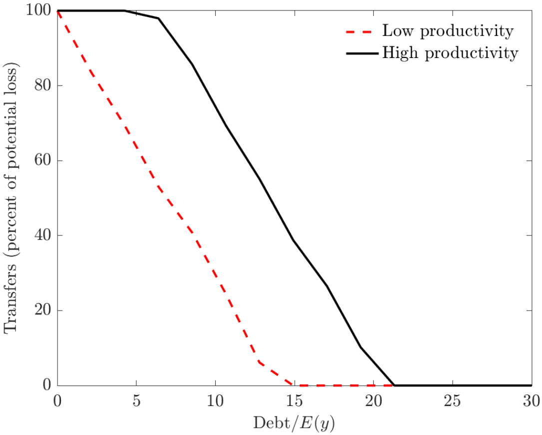

Optimality of bailouts

- Trade-off: bailouts $\uparrow$ liquidity and output during BC *but* also $\uparrow$ debt and default risk. ‘Diabolic-loop’
- Are bailouts desirable?
- Solve for ‘no-bailouts’ economy:
  - Lower default risk, lower and less volatile spreads
  - Higher debt capacity
  - Higher private lending rate r
- Bailouts may not be ex ante optimal

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Simulations for 'no-bailouts' economy

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Optimality of bailouts

- From an ex ante perspective: what restrictions, if any, should we impose on the size of the bailouts?

$$
\begin{cases} T = 0 & \text{if } A = \overline{A} \\ 0 \leq T \leq \min\{\varepsilon \overline{A}, \phi \overline{\varepsilon} \overline{A}\} & \text{if } A = (1-\varepsilon)\overline{A} \end{cases}
$$

- $\overline{\varepsilon}\,\overline{A} \equiv$ largest possible financial shock
- $\phi \in [0, 1]$. If $\phi = 0 \rightarrow$ no-bailouts; $\phi = 1 \rightarrow$ baseline

- Solve for the welfare maximizing ϕ for different levels of initial debt

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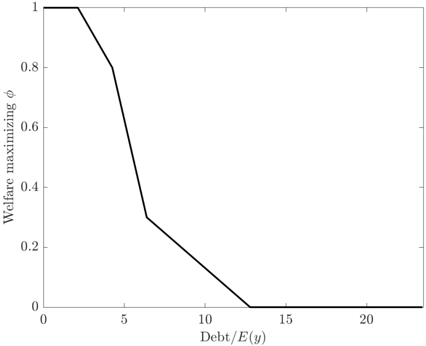
- Solve for the welfare maximizing ϕ for different levels of initial debt

Optimality of bailouts



- Low debt, prefer no restrictions
- High debt, prefer maximum restrictions (banning bailouts)

- For avg. Debt/GDP in the simulations: welfare loss of 1.5%.

Concluding remarks

- We study the dynamic relationship between sovereign defaults, banking crises, and government bailouts
- Tradeoff in bailouts: relax domestic fin. frictions and $\uparrow$ output, but also imply $\uparrow$ fiscal needs and $\uparrow$ default risk (i.e., they create a 'diabolic loop').
- Optimal bailouts are increasing with the severity of banking crisis and productivity but decreasing in debt levels
- Even though bailouts mitigate the adverse effects of BC, the economy is ex ante better off without bailouts: the 'diabolic loop' they create is too costly.

thank you!

Appendix

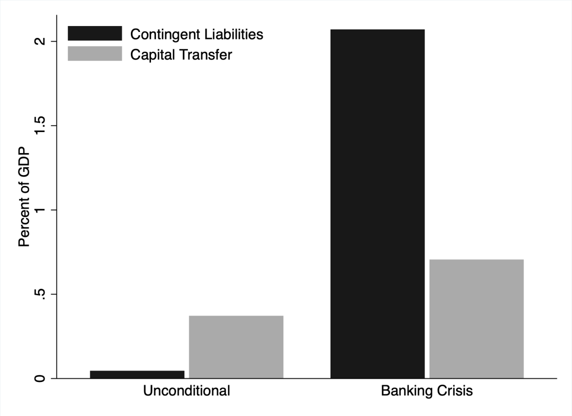
Government guarantees ◂ guarantees

- Arrangements whereby the guarantor undertakes to a lender that if a borrower defaults, the guarantor will make good the loss the lender would otherwise suffer ▸ website
- Data on guarantees do not include:
  - government guarantees issued within the guarantee mechanism under the European Financial Stability Facility (EFSF) and the European Stability Mechanism (ESM)
  - derivative-type guarantees meeting the ESA2010 definition of a financial derivative
  - deposit insurance guarantees and comparable schemes
  - government guarantees issued on events which are difficult to cover via commercial insurance (earthquakes, etc)
  - stocks of debt already assumed by government

Contingent liabilities and capital transfers

◂ Motivating facts

- Contingent liabilities include government guarantees, public–private partnerships (PPP) recorded off-balance sheet of the government, and liabilities of government controlled entities classified outside of general government



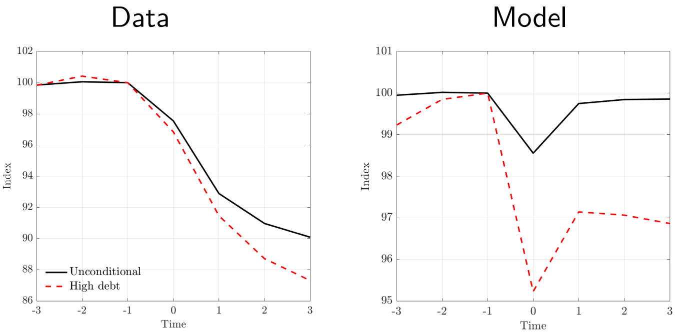
Model fit

	Model	Data
Default frequency	0.5	0.5
Banking crisis frequency	1.8	1.8
Gov't spending/GDP	19.1	19.1
Bailouts/GDP (banking crisis)	1.7	1.7
Sovereign spread		
mean	0.7	1.2
standard deviation	0.6	1.8
corr(spread,output)	–0.3	–0.7
Debt/GDP	15.5	25.8

Units: percent.

Model validation: dynamics around crises

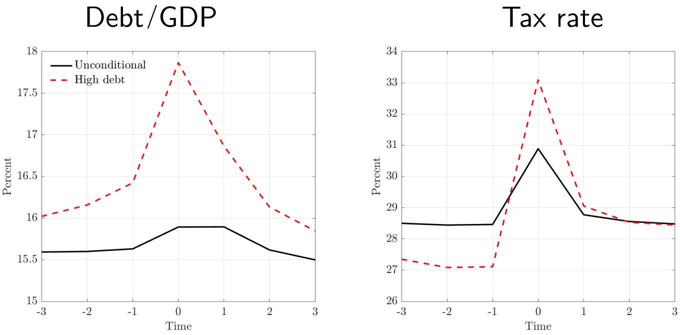
Figure: Output around banking crises



▸ (back)

Model validation: dynamics around crises

Figure: Debt and taxes around banking crises



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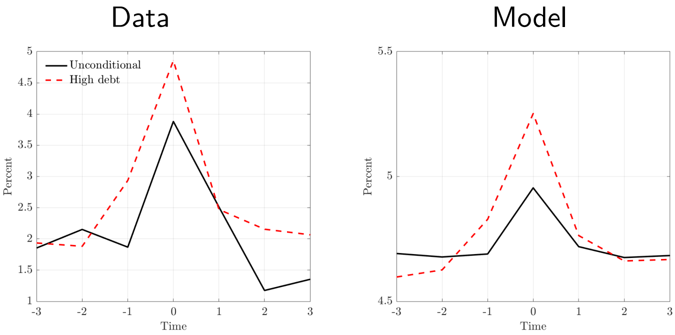
Model validation: dynamics around crises

Figure: Sovereign yields around banking crises



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Simulations for no-bailouts economy

	Baseline model	Model without bailouts
Default frequency	0.5*	0.3
Sovereign spread		
mean	0.7	0.5
standard deviation	0.6	0.5
corr(GDP, spread)	-0.2	-0.3
Debt/GDP	15.5	26.8
Mean lending rate	0.0	0.2

Units: percent. * denotes targeted moments.

(back)