Bailouts, Bail-ins, and Banking Industry Dynamics

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- Typical concern: do bail-ins stifle bank lending due to increased interest rates/shareholder "skin-in-game"?

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- Counterfactual: Bail-in policy instead of bailout

Preview of Findings

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- Bail-ins promote small bank entry, reducing the loss in agg lending to only 3%
- Bail-ins increase efficiency by disincentivizing risky lending by banks with lower expected loan returns and still incentivizing lending by banks with the highest expected loan returns

▸ Literature Review

Key Channels

- **Uninsured debt with risk-sensitive interest rates**
  - Extensive literature documenting "Too Big to Fail" subsidy on debt borrowed by big banks
  - Model differentiates btw insured/uninsured debt
  - Solve for endogenous interest rates based on bailout/bail-in policy

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- **Exit and entry**
  - Resolved banks affect total lending and ability of small banks to enter
  - More lending by big banks affects entry/lending of smaller banks

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- Choose to continue (repay debt) or "enter resolution"

Resolution: Liquidation or Bailout

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  $\Rightarrow$ *TBTF subsidy on interest rates of uninsured debt*

Stationary Markov Industry Equilibrium

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- Banks pay fixed cost to enter with smallest deposits
- Risky loan return R^ℓ adjusts to satisfy free entry condition
- Mass of entrants s.t. bank supply of loans = firm demand function L^D

$$L^D = \zeta(R^\ell)^\epsilon, \quad \frac{\partial L^D}{\partial R^\ell} < 0$$

Estimation Strategy

Data:

- Call Reports 1992-2006, sample of banks with $10B$^+$ in assets

Internal:

- Simulated Method of Moments, 14 moments for 13 parameters ▸ Targeted ▸ Untargeted

External:

- Markov processes calibrated from data ▸ Loan default process
- Use extensive empirical literature and regulation
  - Bailout probability (Koetter and Noth (2016))
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Key Parameters:

Bailout prob $\rho(\text{Assets}) =$

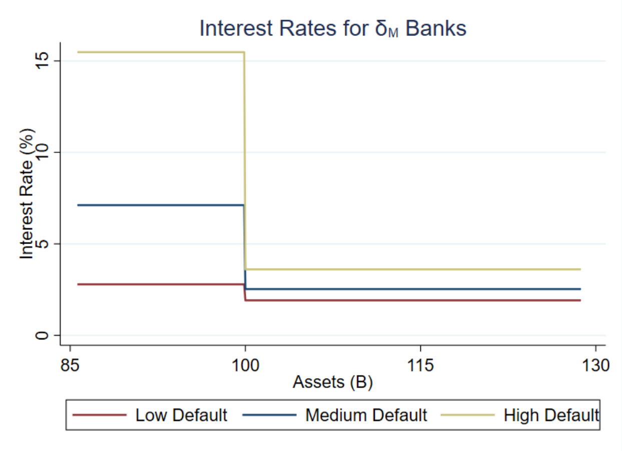
$$\begin{cases} 0 & \text{Assets} < \$100B \\ 0.9 & \text{Assets} \geq \$100B \end{cases}$$

Loan Default Rate Process $F(\lambda'|\lambda)$

	λ_L 0.43%	λ_M 2.26%	λ_H 50%
λ_L	.80	.17	.03
λ_M	.16	.78	.06
λ_H	0	.88	.12

Bailout subsidy decreases interest rates heterogeneously

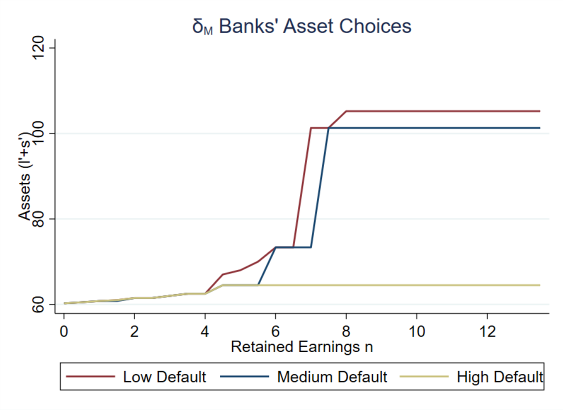
- Banks enter resolution when they receive the highest default rate $\lambda' = \lambda_H$
- Banks with higher default rates today are more likely to receive the highest default rate tomorrow
- Higher default rates today $\rightarrow$ higher interest rate
- Bailout prob significantly $\downarrow$ interest rate differences

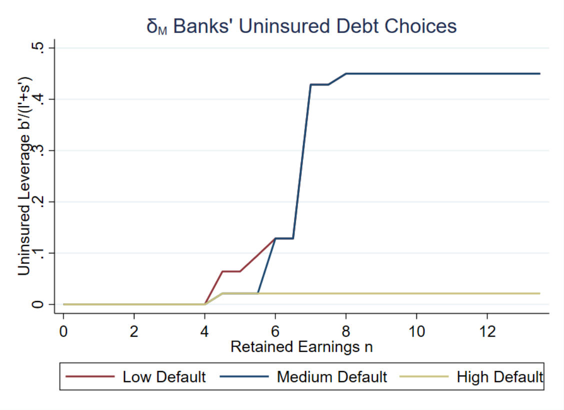


Note: Leverage choice is constant at 90%.
Risky loans to assets choice is constant at 90%.

Banks jump over $100B threshold, funded with uninsured debt

Banks ↑ assets as build up more retained earnings, until can afford to jump





Counterfactual - Replace Bailout with Bail-in

When a bank enters resolution, $(1-\rho(\text{Assets}))$ prob of liquidation and $\rho(\text{Assets})$ prob of bail-in

When a bank is bailed in:

1. Uninsured debt is "forgiven"
2. Bank is valued as one with retained earnings $=$ assets - deposits
3. Shares in this bank are given first to creditors
4. Original shareholders only receive some shares if creditors fully repaid
5. Bank continues

Counterfactual - Payoffs under Bail-in

Creditors receive the shares in the bank with forgiven uninsured debt

- Up to their original debt claim
- Bailout: full repayment guaranteed $\Rightarrow$ bail-in repayment $\leq$ bailout repayment
- Holding resolution decisions constant $\Rightarrow$ bail-in interest rates $\geq$ bailout interest rates

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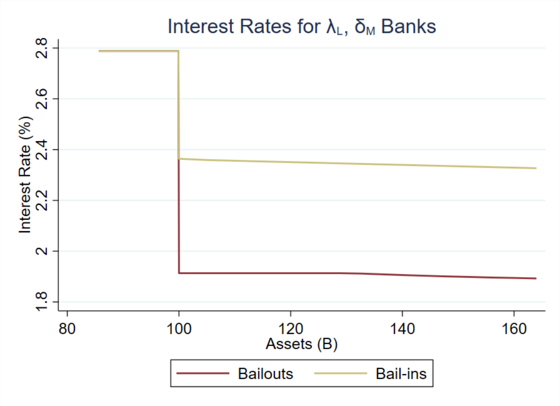
Industry: risky loan return and mass of entrants adjust in EQ ▸ q equation

Without the bailout subsidy, uninsured debt is more expensive

- EQ repayment shares are worth an avg. of 46% of uninsured debt b'
- Creditors are never fully repaid in the bail-in
- But creditors are generally repaid more in bail-in than liquidation
  - Assets are more valuable inside the bank



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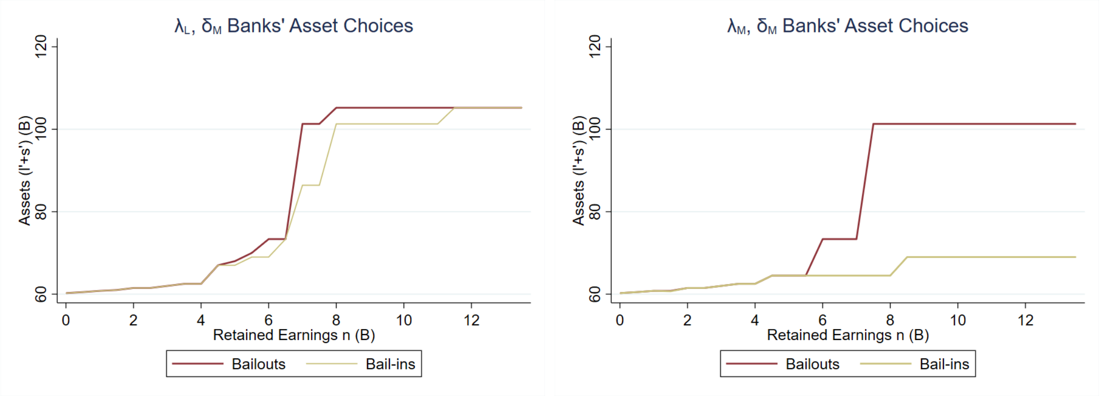
Risky assets fraction constant at 90%.

As function of leverage No Bailouts

Ex-ante riskier banks grow slower

- Despite more expensive debt, lower default rate banks (λ_L) borrow and lend about the same
- Medium default rate banks (λ_M) borrow significantly less and stay below TBTF threshold



Fewer big banks exist and fewer fail

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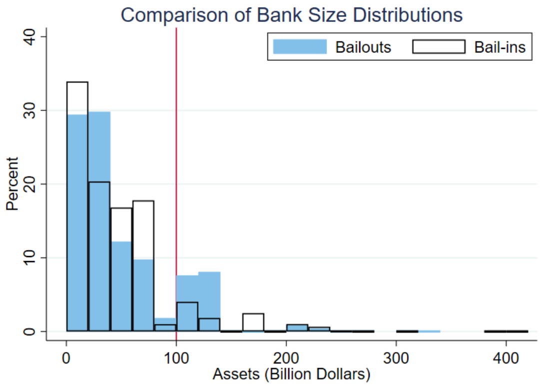

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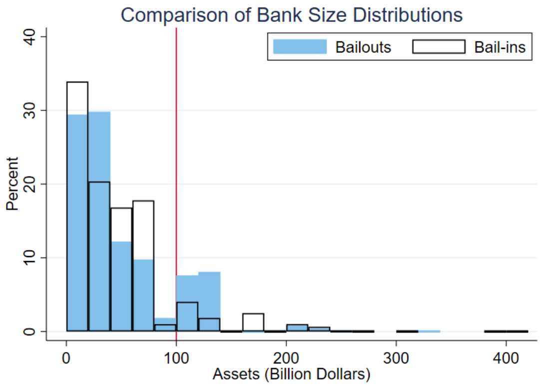

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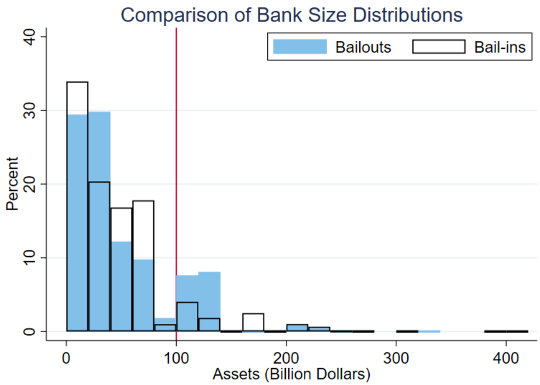

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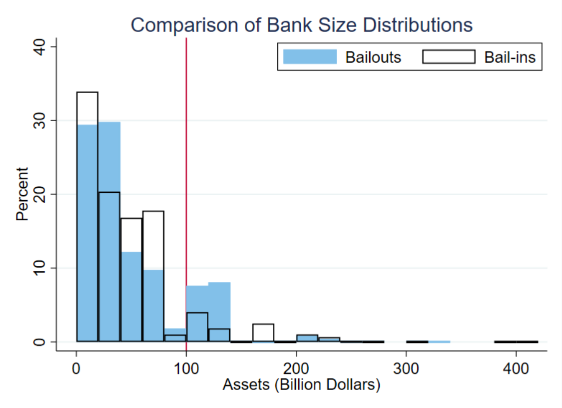

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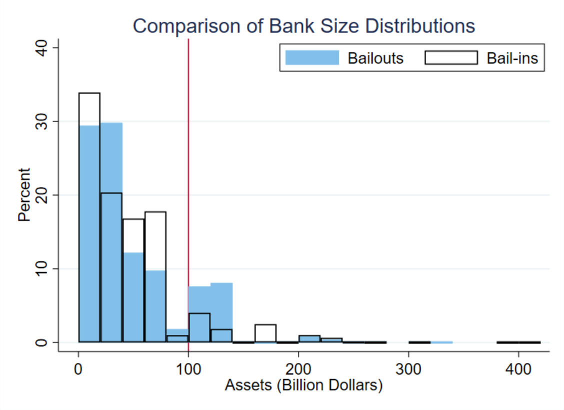
  - λ_M no longer grow large
  - λ_M borrow less, so fail less often



Quantitative Exercises

- Frictionless Environment ▸ Link
- Non-Targeted Bail-ins ▸ Link
- Decomposition of Debt and Equity Channels ▸ Link
- Aggregate Shock and Aggregate Lending Recovery ▸ Link
- Effect of Entry on Aggregate Lending ▸ Link
- Higher and Size-Dependent Capital Requirements

Can be found in the paper!

Conclusion

Bail-ins achieve their goal of reducing big bank failure

- Banks are less incentivized to grow large and share of big banks $\downarrow$ 42%
- Avg prob of a big bank failing $\downarrow$ by 93%
  - Uninsured borrowing reduced more by banks with higher expected defaults on loans

More banks enter, and aggregate lending $\downarrow$ by 3%

Bail-ins can improve efficiency of the banking sector.

- Bail-ins keep the cost of external financing low for banks with lower default rates
- Bail-ins disincentivize risky lending by banks with higher default rates

Pre-Crisis/Crisis Resolution Policies

- Prompt Corrective Action (PCA) dictates that the FDIC resolves banks whose equity to asset ratio falls below 2%.
- **Liquidation:**
  - Assets of the bank sold off at a discount and proceeds used to pay back stakeholders according to a set order.
  - Bank exits.

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  - Bank exits.
- **Bailouts:**
  - US govt injected equity into big, distressed banks during the GFC.
  - Creditors are fully repaid.
  - Shareholders retain their shares in the bank and bought back shares of govt.
  - Bank does not exit.

Post-Crisis Resolution Policy

- Dodd-Frank Act of 2010 dictates that big banks will be resolved via bail-in if they fall below the PCA requirement.
- **Bail-in**
  - The losses of the bank are apportioned first onto equity holders and then classes of creditors, by seniority.
  - Bank is recapitalized by converting debt claims into equity claims.
  - Shareholders most likely receive 0. Creditors receive equity in the bank.
  - Bank does not exit.
- Small banks will still be liquidated.

No Bailouts Equilibrium

- "No Bailouts" = no bailouts or bail-ins; only liquidation ($\rho = 0$)

	Bailouts	Bail-ins	Constrained Efficient	First Best Efficient	No Bailou
Big Bank Avg Borrowing Cost (%)	1.9	2.6	2.0	1.2	2.8
Share of Big Banks (%)	18	10	6	3	2
Failure Rate (%)	1.6	0.9	0.4	0.0	0.4
Resolution Costs ($B)	28	8	7	0	9
Big Bank Risky Assets Fraction (%)	89	82	83	39	82
Risky Loan Return (%)	6.7	6.9	6.6	5.7	6.9
Agg Lending ($T)	4.61	4.46	4.72	5.91	4.44
Default Rate Allocative Efficiency	-47.0	-70.7	-76.1	-79.8	-71.1

◂ preview ◂ eta ◂ q

Literature Review

- Banking Industry Dynamics Models
  - Banks: Rios-Rull, Takamura, and Terajima (2023), Corbae and D'Erasmo (2021), Egan et. al. (2017), Wang et. al. (2022)

  + Inclusion of bailout and bail-in policies

- Bank Resolution
  - Bailouts: Acharya et. al. (2021), Kim (2016), Mucke et. al. (2021), Nguyen (2023)
  - Bail-ins: Beck et. al. (2017), Berger et. al. (2018), Neuberg et. al. (2019)

  + Heterogeneity & banks' choice to grow to be TBTF

- Non-financial firm exit + bankruptcy
  - Corbae and D'Erasmo (2021)

return

Frictions

Bank Problem:

- Limited liability
- Deposit Insurance
- Costly equity issuance
- Firesale and fixed costs in liquidation
- Capital requirements

◂ return

From Bailout Policy:

- Moral hazard of cash injection
- Size threshold discontinuity

Dividend Function

- $d > 0$ represents dividend issuance, $d < 0$ new equity issuance
- Slight concavity to dividend issuance due to shareholders' risk aversion
- Convex costs to issuing new equity

$$\psi(d) = \begin{cases} (d + \underline{d})^\sigma - \underline{d}^\sigma & \text{if} \quad d \geq 0 \quad (\sigma < 1,\ \underline{d} > 0) \\ 1 - e^{-d} & \text{if} \quad d < 0 \end{cases}$$

return

Value of Bailed-out Bank

Gov't injects cash θ such that bank meets the end of period capital requirement.

$$\frac{R^{\ell}(1-\lambda')\ell' + Rs' - \delta - b' + \theta(\lambda', \ell', s', b', \delta)}{R^{\ell}(1-\lambda')\ell'} = \alpha$$

$$\theta(\lambda', \ell', s', b', \delta) = \delta + b' - (1-\alpha)R^{\ell}(1-\lambda')\ell' - Rs'$$

$\tilde{n}'$ is then

$$\tilde{n}' = R^{\ell}(1-\lambda')\ell' + Rs' - \delta - b' + \theta(\lambda', \ell', s', b', \delta)$$

$$\tilde{n}' = \alpha R^{\ell}(1-\lambda')\ell'$$

return

Loan Default Rate λ Process

- Estimate an AR(1) of continuing banks' loan default 1992-2006

$$\text{Loan Default Rate}_{it} = (1-\rho_\lambda)k_0 + \rho_\lambda \text{Loan Default Rate}_{it-1} + u_{it} \tag{1}$$

- Discretize to a 2-state Markov process via Tauchen method
- Include a rare and temporary "crisis" state and estimate level and probabilities via SMM

$F(\lambda'|\lambda)$

	$\lambda_L = 0.43\%$	$\lambda_M = 2.26\%$	$\lambda_H = 50\%$
λ_L	.80	.17	.03
λ_M	.16	.78	.06
λ_H	0.0	.88	.12

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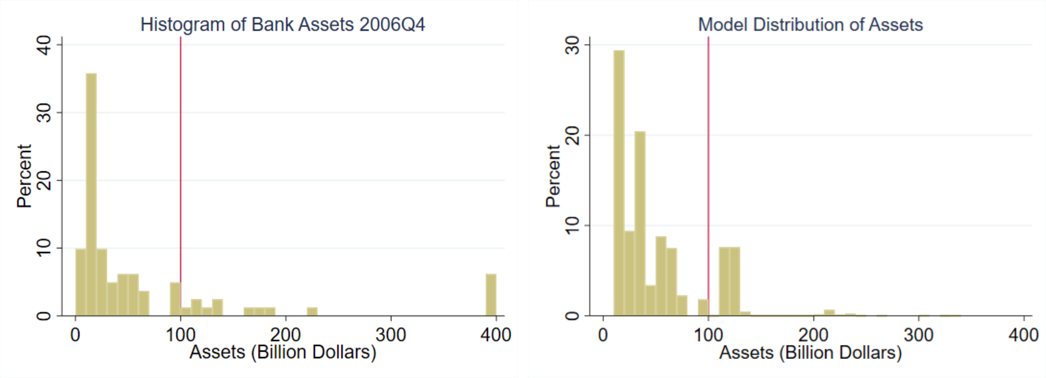
Targeted Moments

Parameter	Value	Moment	Data	Model
c_e	10.1	Avg. Leverage of Entrants	0.91	0.95
c_O	0.2	Agg. Lending ($T)	4.51	4.61
$c_M(\delta_S)$	2.5×10^{-4}	Avg. Assets ($B)	22.5	34.3
$c_M(\delta_M)$	1.3×10^{-5}	Avg. Change in Assets (%)	11.4	9.5
$c_M(\delta_L)$	6.3×10^{-6}	Avg. Change in Assets over Threshold (%)	55.2	69.2
λ_H	0.50	Avg. Dividend to Assets (%)	0.23	0.27
$F(\lambda_L\|\lambda_H)$	0.03	Avg. Leverage	0.91	0.96
$F(\lambda_M\|\lambda_H)$	0.06	Avg. Interest Income on Loans (%)	5.5	4.8
$F(\lambda_H\|\lambda_H)$	0.12	Avg. Risky Assets Fraction (%)	63.4	47.5
ζ	190.2	Share of Big Banks (%)	18.5	17.6
$H(\delta_S\|\delta_S)$	0.99	Avg. Uninsured Leverage	0.25	0.45
$H(\delta_M\|\delta_M)$	0.99	Small Bank Exit (%)	0.3	0.4
$H(\delta_L\|\delta_L)$	0.975	Avg. Net Interest Margin	3.75	1.37
		Avg. Loans to Deposits	1.1	1.2

return

Size Distribution Fit

- Model captures larger mass of small banks, clustering around \$100B, and longer right tail



return

Pricing of Uninsured Debt in Bail-in Model

- In a bail-in, creditors may receive a partial repayment.

$$q(\lambda, \ell', s', b', \delta)b' = \frac{1}{1+r_F}[\underbrace{(1 - \sum_{\lambda' \in \Omega(\ell', s', b', \delta)} F(\lambda'|\lambda))b'}_{\text{repayment - no resolution}}$$

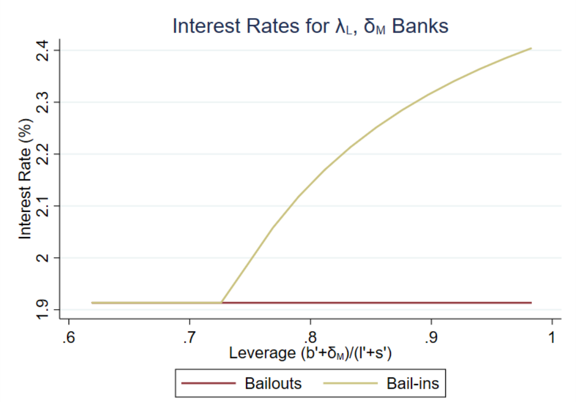
$$\underbrace{+ (1 - \rho(\ell', s')) \sum_{\lambda' \in \Omega(\ell', s', b', \delta)} \min\{b', \max\{c_L G(\lambda', \ell', s') - c_F - \delta, 0\}\}_- F(\lambda'|\lambda)}_{\text{repayment - liquidation}}$$

$$\underbrace{+ \rho(\ell', s') \sum_{z' \in \Omega(\ell', s', b', \delta)} F(\lambda'|\lambda)\{b', \mathop{\mathbb{E}}_{\delta'|\delta}(V^{d \leq 0}(\lambda', A(\lambda', \ell', s') - \delta, \delta'))\}_-}_{\text{repayment - bail-in}}]$$

return

Interest rates as a function of uninsured leverage

- There exist debt contracts at which creditor is fully repaid via bail-in
- In this case, no difference in bailout versus bail-in interest rate
- In equilibrium, banks never choose these contracts



Do bail-ins promote efficiency? Default Rate Allocative Efficiency

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Default rate allocative efficiency in a frictionless environment

Replicate an environment without financing frictions (Hopenhayn) by:

1. Allowing costless exit (no firesale discount)
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3. Balance sheet decisions no longer depend on n
   $\rightarrow$ Optimal $\ell'(\delta, \lambda)$ in absence of financing frictions

Frictionless Environment

$$V(\delta,\lambda,n) = \max_{\ell'\geq 0} \; d + \beta \mathop{\mathbb{E}}_{\lambda'|\lambda}[\max\{\underbrace{n'(\lambda'),}_{\text{Costless Exit}} \underbrace{\mathop{\mathbb{E}}_{\delta'|\delta}(V(\delta',\lambda',n'))\}}_{\text{Continuation}}]$$

s.t.

$$n'(\lambda') = R^{\ell}(1-\lambda')\ell' - \delta \qquad \textit{Future Earnings}$$

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Take-aways:

- Only lowest default rate λ_L banks invest in risky loans
  - $\rightarrow$ Lowest possible covariance (highest allocative efficiency)
- Bail-in allocative efficiency is 89% of highest possible value

	Bailouts	Bail-ins	Frictionless Environment
$cov(\mathbb{E}(\lambda'\|\lambda), \frac{\ell'(\lambda)}{\sum_{\lambda} \ell'(\lambda)})$	-.0047	-.0071	-.0080

return

What if banks can always be bailed in? Non-Targeted Bail-ins

Resolve for equilibrium in which:

- No size threshold ($\bar{a} = 0$)
- Banks in resolution are bailed in ($\rho = 1$)

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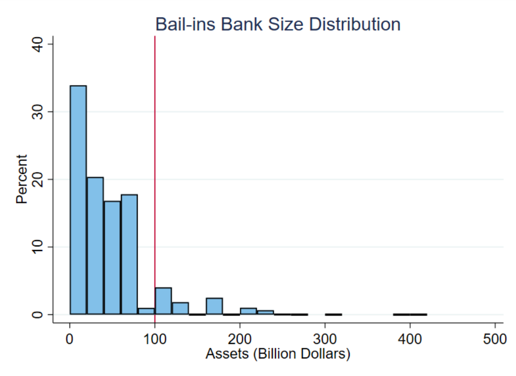
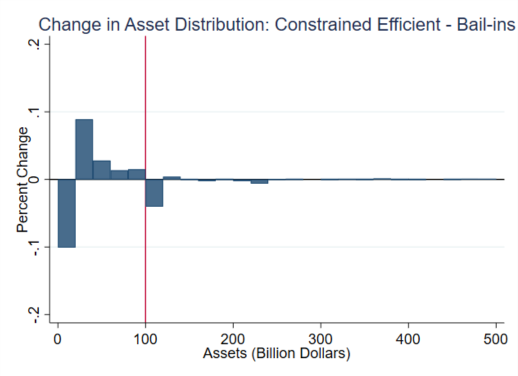
- Fewer banks grow above the $100B threshold without the bailout/bail-in incentive

Small banks grow larger and fewer banks are above $100B threshold

- Small banks can grow larger due to cheaper debt prices





▸ Non-Targeted Distribution ▸ Compare to Bailouts

Failure rate decreases and aggregate lending increases

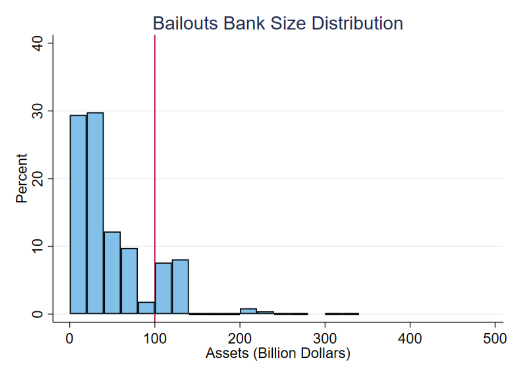
- As small banks can be bailed-in, interest rate is lower than in bailout equilibrium
- Entrants have cheaper debt $\rightarrow R^{\ell} \downarrow$, agg lending $\uparrow$

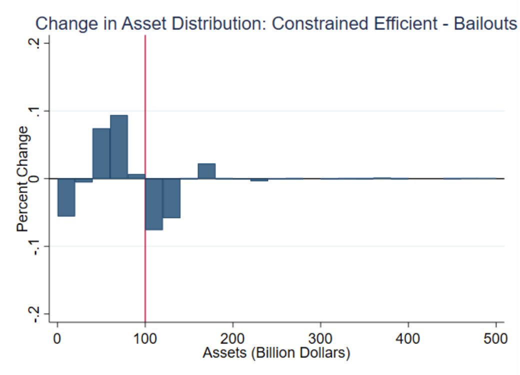
	Bailouts	Bail-ins	Frictionless Environment	Non-Targeted Bail-ins
Failure Rate (%)	1.6	0.9	0.0	0.4
Bailout/Bail-in Rate (%)	0.8	0.1	-	0.3
Avg Bail-in Repayment (%)	-	46	-	81
Avg Interest Rate (%)	2.17	2.12	1.18	1.92
$R^{\ell} - 1$ (%)	6.7	6.9	5.7	6.6
Aggregate Lending ($)	4.61	4.45	5.91	4.72
Share of Big Banks (%)	18	10	3	6
Default Rate Allocative Efficiency	-.0047	-.0071	-.0080	-.0076

return

Comparison to Targeted Bailouts

- There is greater mass below the TBTF threshold, but the biggest banks actually grow larger





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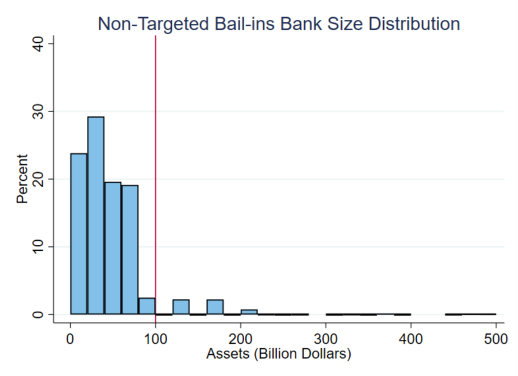
Constrained Efficient Distribution



return

Decomposing Debt and Equity Effects

- Payoffs to both shareholders and creditors change from bailout to bail-in
- Do banks jump over TBTF threshold due to cheaper debt prices or higher equity value?

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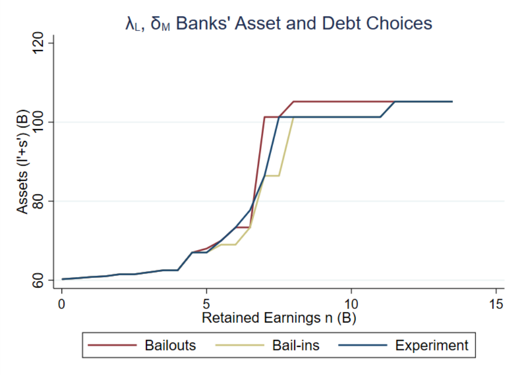
- Predictions: If experiment results resemble
  - Bailouts $\rightarrow$ equity channel dominates
  - Bail-ins $\rightarrow$ debt channel dominates
- Answer: Effect differs by default rate λ

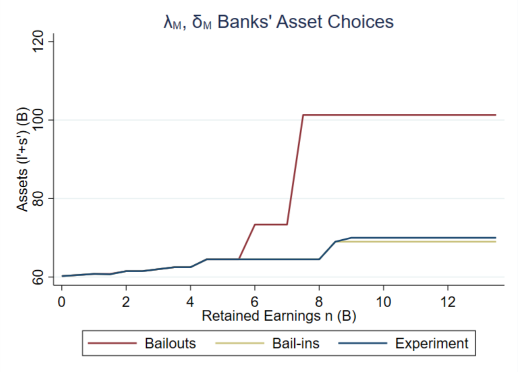
return

Low default rate banks are affected by both debt and equity changes

- (δ_M, λ_L) banks grow slower than bailouts, but faster than bail-ins
- Bailout & experiment: issue equity in order to grow over TBTF threshold
  - Bail-in: do not grow over TBTF threshold until can fund with only n, δ, b'
- λ_L banks willing to $\uparrow$ "skin-in-the-game" for high equity payout



Medium default rate banks are driven by debt prices



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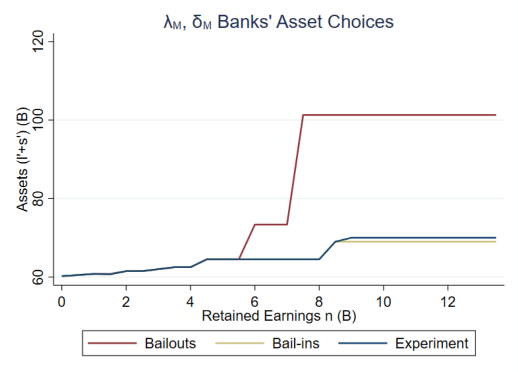

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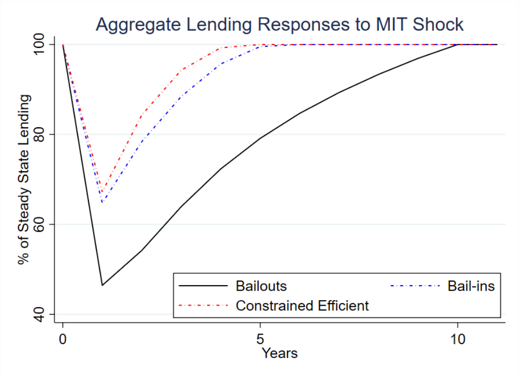
- Market discipline is important for size distribution
  - Share of big banks $= 10\% =$ bail-in share big banks
- Higher equity payoff to low default banks increases efficiency
  - Allocative Efficiency $= -.0073 < -.0071$

return

Aggregate lending drops less and recovers faster under bail-ins

- One-time, unanticipated increase in each λ and plot agg lending IRF
- Non-Targeted Bail-ins: Drop in lending is even less



return

Effect of Loan Market Clearing

- Keep risky loan return R^ℓ at bailout rate but solve for policy functions and price schedules with bail-in policy in place
- Solve for the distribution one period later with measure of entrants $M = M^*$
- Aggregate lending drops to \$2.9 T from \$4.4 T

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- Measure of banks is 25% lower
- In the long-run, these entrants grow and increase agg lending

return