HBANK: Monetary Policy with Heterogeneous Banks

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Bank Lending Channel of Monetary Policy

- Classic theme: **bank-lending channel** of monetary policy
- Macro-finance-banking literature: **representative intermediary** with perfect insurance and scale invariance $\rightarrow$R-BANK: Gertler-Kiyotaki 2010, Gertler-Karadi 2011.

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- Monetary transmission mechanism shaped by **distribution** of bank net worth and risk $\rightarrow$ H-BANK

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- This paper: revisit bank lending channel in a **"Bewley model"** of banks + nominal rigidities + endogenous **default risk**
- Monetary transmission mechanism shaped by **distribution** of bank net worth and risk $\rightarrow$ H-BANK
  - 3D covariate: MPL $\Leftrightarrow$ size (net worth) $\Leftrightarrow$ default probability
  - Responsive to monetary and (micro) prudential **policy**

HBANK In A Nutshell

1. HBANK-Empirics: strategy to estimate
   (I) Marginal Propensities to Lend (MPLs)
   (II) Heterogeneous transmission of monetary policy on (i) **default probabilities** and (ii) **bank assets**

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2. HBANK-Model
   (i) Bewley model of banks + nominal rigidities + endogenous default probability + aggregate "too-big-to fail" default costs.
   (ii) *Small* banks: high MPLs + stronger balance-sheet and default–probability responses.
   (iii) *Large* banks: marginal increases in default probabilities lead to sizable aggregate default costs ("too-big-to-fail").

A TALE OF TWO CO-VARIANCES

- Response of **aggregate lending**:

$$\underbrace{dL}_{\text{aggregate lending}} \approx \int \underbrace{\mathrm{MPL}(n,\xi)}_{\substack{\text{marg. propensity}\\ \text{to lend}}} dn(n,\xi)\, d\Gamma = \underbrace{\overline{\mathrm{MPL}}\; \overline{dn}}_{\text{representative bank}} + \underbrace{\mathrm{Cov}\big(\mathrm{MPL},\, dn\big)}_{\text{distribution channel}}$$

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- Response of aggregate **default risk**

$$\underbrace{d\Phi}_{\text{aggregate default risk}} \approx \int \underbrace{\varphi_n(n,\xi)}_{\substack{\text{bank default}\\ \text{probability}}} \; dn(n,\xi)\, d\Gamma \;=\; \underbrace{\overline{\varphi_n}\;\overline{dn}}_{\text{representative bank}} \;+\; \underbrace{\text{Cov}\big(\varphi_n,\, dn\big)}_{\text{distribution channel}}$$

Literature: Quantitative GE Models with Heterogeneous Banks

- **Liability & funding side**
  Leite (2025); Bianchi & Bigio (2022); Begenau, Landvoigt & Elenev (2026).
- **Asset & risk-taking side**
  Coimbra & Rey (2023); Corbae & D'Erasmo (2021, forthcoming); Corbae & Levine (2025); Ríos-Rull, Takamura & Terajima (2023); Begenau, Bigio, Majerovitz & Vieyra (2026).
- **Interest-rate risk exposure**
  Abad, Bigio, García-Villegas, Marbet & Nuño (2026).
- **Net worth & incomplete markets**
  Jamilov & Monacelli (2025, *Bewley Banks*).

Empirics

1. Estimating **marginal propensities to lend** (MPLs)

2. Heterogeneous transmission of monetary policy on **banks' default rates**

3. Heterogeneous transmission on banks' **assets** (Kashyap-Stein 2.0)

Quasi-Natural Experiment: 2009 FDIC Special Assessment

- Estimate **MPL** = response of **lending** to **exogenous** change in **net worth**
- **Experiment**: to rescue the **Deposit Insurance Fund** after GFC, the FDIC imposed a **one-off special assessment** (May 2009)

Quasi-Natural Experiment: 2009 FDIC Special Assessment

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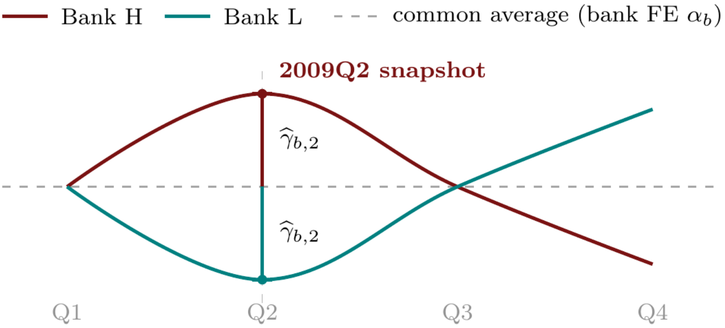
- **Experiment**: to rescue the **Deposit Insurance Fund** after GFC, the FDIC imposed a **one-off special assessment** (May 2009)
- Each bank's levy set by a fixed formula applied to a single balance-sheet snapshot, *June 30, 2009* (2009q2):

$$\text{Assess}_b = \min\Big(\underbrace{0.1\% \times \text{Deposits}_b}_{\text{cap: 10bp of deposits}},\ \underbrace{0.05\% \times (\text{Assets}_b - \text{Tier1}_b)}_{\text{5bp of assets net of Tier 1}}\Big)$$

- Raw levy **endogenous**: direct function of **size**, **funding** and **capital** = drivers of lending

Identification: Seasonality Instrument



- 2009 FDIC levy was computed from each bank's balance sheet on a single day — June 30.
- **Instrument** a bank's net-worth levy with its ***historical*** tendency to be seasonally large in Q2 (estimated on 1996–2006 data)
- →Capture variation in levy driven **purely by the timing** of the snapshot rather than by bank fundamentals.

Identification & Estimation

1. Instrument – decompose **counterfactual levy** on pre-crisis data (1996–2006):

$$\log \text{Assess}_{bt} = \underbrace{\alpha_b}_{\substack{\text{bank avg. level} \\ \text{(size, funding, capital)}}} + \underbrace{\gamma_{b,q(t)}}_{\substack{\text{seasonal deviation} \\ \text{in cal. quarter } q}} + u_{bt} \Rightarrow \underbrace{\textbf{instrument} = \widehat{\gamma}_{b2}\ \text{(Q2)}}_{\substack{\text{bank } b\text{'s } \textbf{Q2 seasonal component} \rightarrow \\ \text{variation from } \textbf{timing of measurement date} \text{ only}}}$$

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2. IV regression – **elasticity** of lending to net worth:

$$\log \text{Loans}_{bt} = \underbrace{\alpha_b + \delta_t}_{\text{bank \& time FE}} + \underbrace{\beta}_{\text{elasticity}} \underbrace{\widehat{\log \text{Equity}}_{bt}}_{\substack{\text{instrumented} \\ \text{by } \widehat{\gamma}_{b2} \times \text{Post}_t}} + u_{bt}$$

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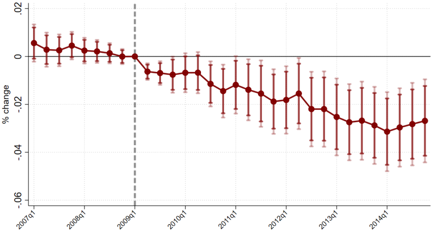
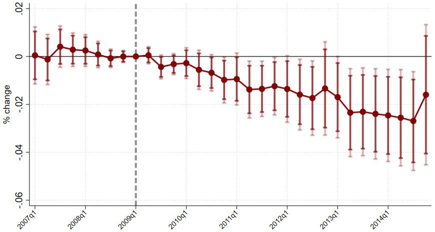
3. Convert to dollar MPL – scale elasticity by average leverage:

$$\widehat{\text{MPL}} = \underbrace{\widehat{\beta}}_{\text{estimated elasticity}} \times \underbrace{\bar{\lambda}}_{\substack{\text{avg. leverage} \\ \frac{1}{N}\sum_b \text{Loans}_b/\text{Equity}_b}} \approx \mathbf{6.2}$$

Effects of Special Assessment on Bank Equity and Loans



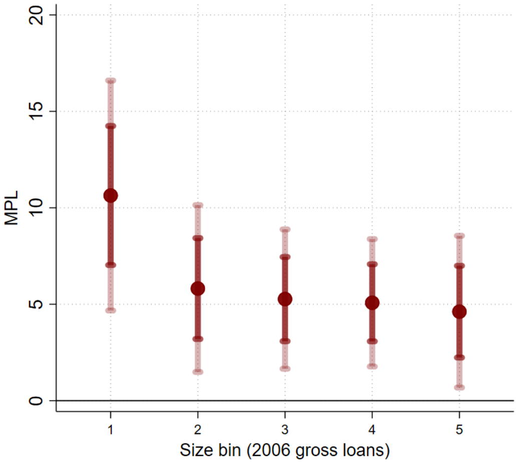
(A) Tier 1 Capital



(B) Gross loans

- Flat coefficients before 2009:Q2
- One-σ increase in $\hat{\gamma}_{b2}$ reduces equity and gross loans

HETEROGENEITY IN MPLS



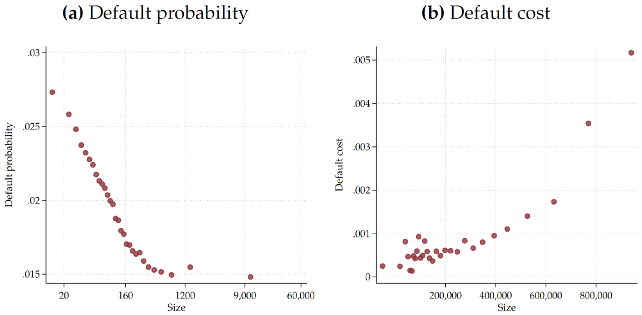
$$\log Loans_{bt} = \alpha_b + \delta_t + \beta \, \widehat{\log Equity}_{bt} + \underbrace{\chi \, \widehat{\log Equity}_{bt} \times D_b}_{\text{interaction}} + \delta_t \times D_b + u_{bt}.$$

Empirical Evidence II: Insolvency Risk

- We proxy default risk as the **inverse of the z-score**:

$$\text{z}_{it} = \frac{\text{RoA}_{it} + \text{Leverage}_{it}^{-1}}{\text{SD(RoA)}_{it}}$$

Default probability and default cost in the cross-section



Notes: binned scatter plots of default probability (panel (a)) and default cost (panel (b)) against bank size. We proxy default probability with the inverse z-score (Laeven and Levine, 2009), default cost with the 95% dollar CoVaR from Adrian and Brunnermeier (2016), and bank size with total assets. Both axes are residualized from time fixed effects.

FIGURE: Default probability and default cost in the cross-section of banks

Empirical Evidence II: Insolvency Risk

- Estimate average **default risk** response to monetary policy shocks:

$$\underbrace{\Delta \ln(Y_{it+h})}_{\text{Inverse z-score}} = \alpha_{ih} + \psi_h \varepsilon_t + \sum_{\ell=1}^{4} \gamma_{h\ell} \Delta \ln(Y_{it-\ell}) + \sum_{\ell=1}^{4} \phi_{h\ell} X_{t-\ell} + u_{iht}$$

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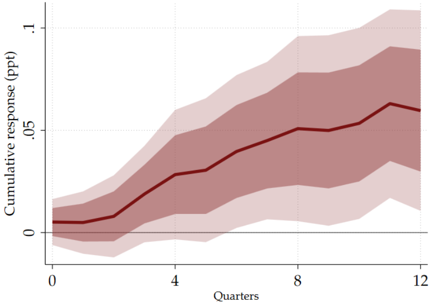
- Estimate heterogeneous response:

$$\Delta \ln(Y_{it+h}) = \underbrace{\alpha_{ih} + \delta_{th}}_{\text{Fixed effects}} + \underbrace{\beta_h D_{it} \varepsilon_t}_{\text{Size interaction}}$$

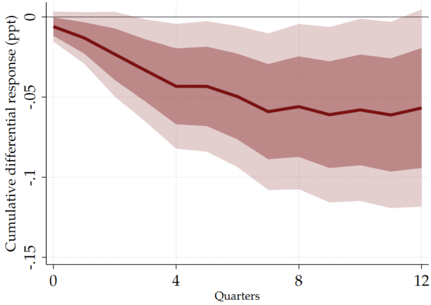
$$+ \underbrace{\psi_h D_{it}}_{\text{Interaction controls}} + \underbrace{\sum_{\ell=1}^{4} \gamma_{h\ell} \Delta \ln(Y_{it-\ell})}_{\text{Lagged controls}} + u_{iht}.$$

$\rightarrow D_{it}$ indicates banks in the top 20% bank size distribution

Default Risk: Contractionary Monetary Policy Shock



(A) Average response



(B) Heterogeneous response across size

- Estimates of ψ_h (panel a) and β_h (panel b) to a 1 std **contractionary** monetary policy shock
- **Average** default risk **increases** (left)
- Default risk rises more for **small** banks (right)

Model

Banks Heterogeneity

- Unit mass continuum
- Return on loan

$$R^T_{j,t} = \underbrace{\xi_{j,t}}_{\text{idiosyncr. AR1 return}} \times R^k_t$$

$$\xi_{j,t} = \bar{\xi} + \rho \xi_{j,t-1} + \sigma_\xi \epsilon_{j,t}$$

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- Aggregate **return on capital** (default-cost adjusted)

$$R^k_{t+1} = \frac{(1 - \tilde{S}_t) \cdot \alpha A_{t+1} K^{\alpha-1}_{t+1} H^{1-\alpha}_{t+1}}{Q_t}$$

Banks (con't)

- Balance sheet

$$\underbrace{b_{j,t}}_{\text{liabilities}} + n_{j,t} = \underbrace{Q_t l_{j,t}}_{\text{assets}}$$

- Law of motion of **net worth**:

$$n_{j,t+1} = R^T_{j,t+1} Q_t l_{j,t} - R^b_{j,t+1} b_{j,t} - \underbrace{\zeta_1 l_{j,t}^{\zeta_2}}_{\text{non-interest convex cost}}$$

Moral Hazard Friction

"Run away with the assets" $\rightarrow$ Incentive constraint

$$\lambda_{j,t} \cdot Q_t l_{j,t} \leq \underbrace{V_t(n_{j,t}, \xi_{j,t})}_{\text{bank franchise value}}$$

- Notice: $\lambda_{j,t}$ bank-specific **leverage** parameter $\rightarrow$ **Prudential policy** tool

Insolvency Risk

- Bank deposits are **not** insured (1/2 deposits in US)
- Ex-ante probability of **default**

$$\varphi_{j,t} = \mathbf{E}_t \left(\mathsf{Pr}(n_{j,t+1} < 0) \right)$$

- Bank-level convex default cost $\rightarrow$ **Large-bank** failures disproportionately **costly**

$$s_{j,t} = \omega_1 \varphi_{j,t} \cdot l_{j,t}^{\omega_2}$$

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- Aggregate (expected) default cost

$$S_t = \int_0^1 s_{j,t} dj$$

- Aggregate **default cost** as fraction of output

$$\tilde{S}_t = \frac{\psi \cdot S_t}{Y_t}$$

$\rightarrow$ ψ to match evidence of **long-run macro costs** of financial crises (Laeven-Valencia 2018, Baron et al. 2021, Jamilov et al. 2024)

Dynamic problem for individual bank j

$$\underbrace{V_t(n,\xi)}_{\substack{\text{bank } j \\ \text{value function}}} = \max_{\{l,b,n'\}\geq 0} \mathbb{E}_t \left\{ \beta \left[\left(1 - \underbrace{\varphi_t(n,\xi)}_{\substack{\text{default} \\ \text{probability}}}\right) \left((1-\sigma)n' + \sigma V_{t+1}(n',\xi' \mid \xi)\right) \right] \right\}$$

subject to:

NW accumulation: $$n' = \mathbb{E}_t\left[R^k_{t+1}\xi'\right] Q_t l - R^b_{t+1}(n,\xi)\, b - \underbrace{\zeta_1 l^{\zeta_2}}_{\substack{\text{convex} \\ \text{non-interest cost}}}$$

Balance sheet: $$b + n = Q_t l$$

Leverage constraint: $$\lambda_t(n,\xi) Q_t l \leq V_t(n,\xi)$$

Risk-adjusted deposit rate: $$1 = \Big[(1-\varphi_t(n,\xi))\mathbb{E}_t(\Lambda_{t+1}) + \varphi_t(n,\xi)(1-\omega_1)\mathbb{E}_t(\Lambda_{t+1})\Big] R^b_{t+1}(n,\xi)$$

Persistent return shock: $$\xi' = \rho_\xi \bar{\xi} + (1-\rho_\xi)\xi + \epsilon'$$

- Gertler-Kiyotaki-Karadi RBANK: bank problem **homogeneous degree 1** in net worth
- **HBANK**: break scale-invariance $\rightarrow$ Optimal **leverage ratio** heterogeneous across banks

Marginal Propensity to Lend

- Individual MPL (partial equilibrium)

$$\mathrm{MPL}_t(n,\xi) = \frac{\mathbb{E}_t\left\{\Omega_{t+1}R^b_{t+1}(n,\xi)\right\}}{Q_t\Big(\lambda_t(n,\xi) - \mathbb{E}_t\left\{\Omega_{t+1}\left(R^k_{t+1}\xi' - R^b_{t+1}(n,\xi)\right) + \zeta_1\zeta_2 l^{\zeta_2-1}\right\}\Big)}.$$

- MPL **heterogeneous** in
  - size n
  - idiosyncratic return ξ
  - prob. default φ
  - deposit rate R^b

New Keynesian Block

Retailers with convex adjustment costs:

$$Y_t = \left(\int_0^1 y_{i,t}^{\frac{\gamma-1}{\gamma}} di \right)^{\frac{\gamma}{\gamma-1}} \quad , \qquad y_{i,t} = K_{i,t}^{\alpha} L_{i,t}^{1-\alpha}$$

$$P_t = \left(\int_0^1 p_{i,t}^{1-\gamma} di \right)^{\frac{1}{1-\gamma}} \quad , \qquad y_{i,t} = \left(\frac{p_{i,t}}{P_t} \right)^{-\gamma} Y_t$$

NK Phillips curve:

$$log\, \Pi_t = \frac{\gamma-1}{\theta} (logMC_t - logMC) + \beta E_t \left[\Lambda_{t+1} log\, \Pi_{t+1} \right]$$

POLICY RULES

Monetary policy rule

$$r_t^N = \bar{r} + \phi_\pi \, \pi_t + v_t$$

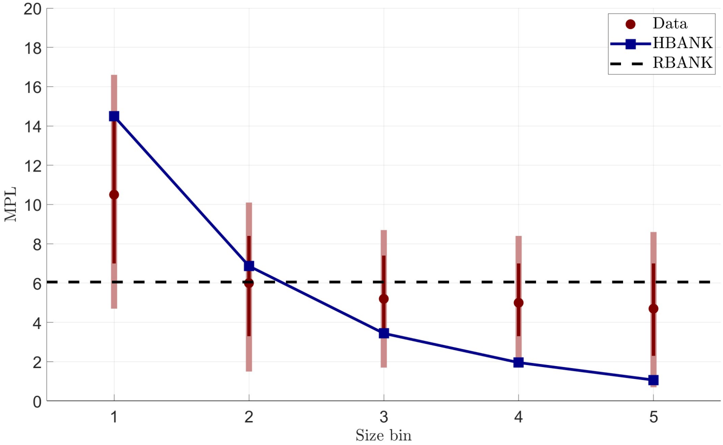
Prudential policy rule

$$\lambda_{j,t+1} = \lambda_j \cdot \left(\underbrace{\frac{s_{j,t+1}}{s_j}}_{\text{bank-specific default cost}} \right)^{\phi_\lambda}, \qquad \phi_\lambda > 0$$

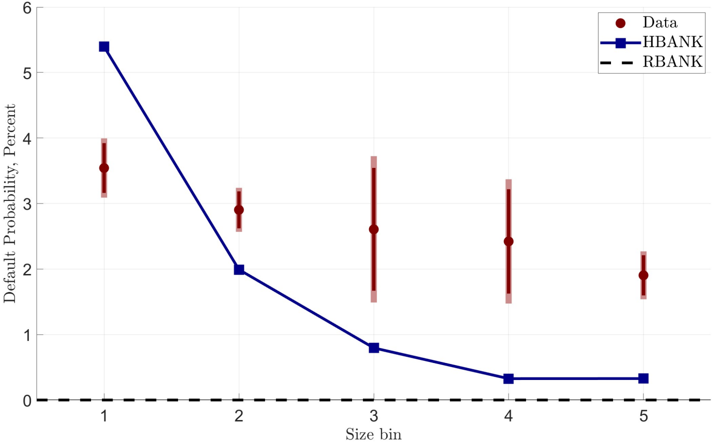
- Target **bank-specific default cost**
- Alternative: default probability (similar)

Results

MPL heterogeneity in the Stationary Distribution

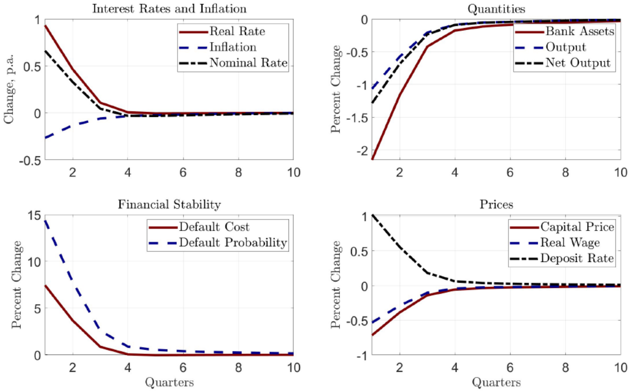


Default risk heterogeneity



Monetary Policy Transmission

Aggregate Monetary Policy Effects



- Monetary contraction increases **average** default cost and probability
- Monetary policy → Financial (in)stability

Heterogeneous Responses to Monetary Policy Shocks

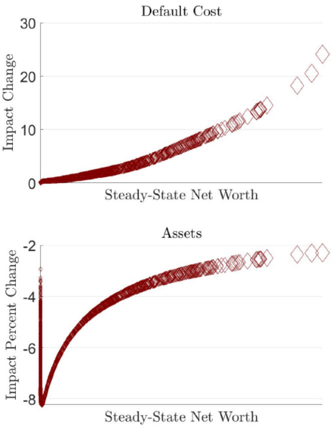


FIGURE: Heterogeneity in Monetary Policy Responses

- **Lending** and **default risk** responses larger for small banks
- Default cost response large for big banks

HBANK VS RBANK

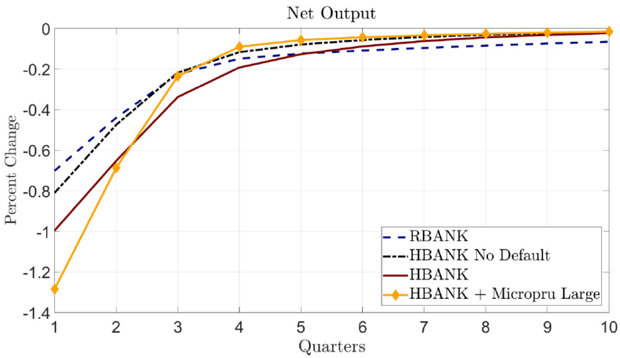
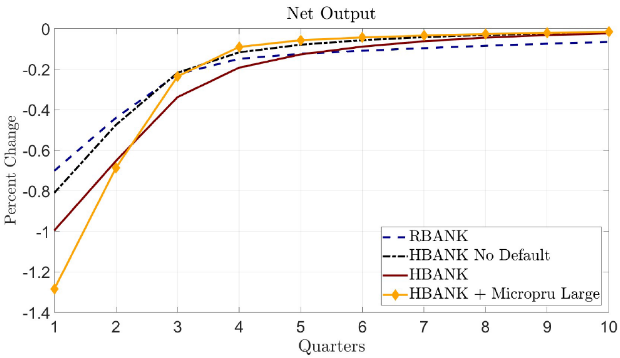


FIGURE: HBANK amplification vs RBANK

- Output response in HBANK up to 78 % larger than in RBANK

HBANK VS RBANK



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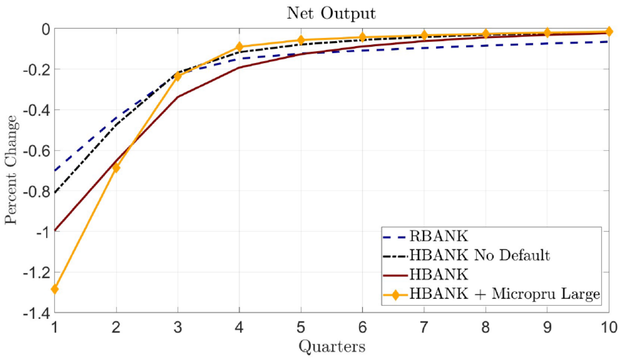
- **Amplification** via 4 channels
  1. Financial accelerator: $\downarrow l \Rightarrow \downarrow \mathrm{Q} \Rightarrow \downarrow nw \Rightarrow \downarrow l \rightarrow \ldots$ (**R-BANK**)

HBANK VS RBANK



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  2. Shift of NW distribution $\rightarrow$More banks become constrained (high MPL - **extensive** margin)
  3. Small $\uparrow$ prob. of default $\rightarrow$ Large $\uparrow$ **default cost** of big banks
  4. **Micro-pru** policy tightens endogenously

Monetary Transmission under Financial Fragility

Is Bank Lending Channel Stronger under Financial Fragility?

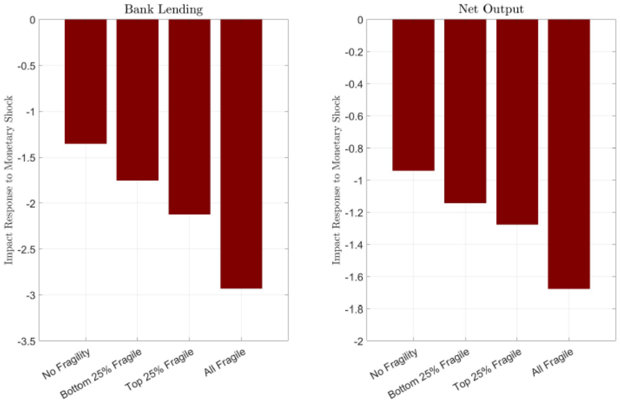

FIGURE: Lending and output contract by more in states of high **financial fragility**

- Perturb stationary NW distribution by raising bank-level **default probability** by 2.5% per quarter for chosen subset of banks.
- Hit economy with aggregate **mp shock**

Improving macro-financial stability tradeoff

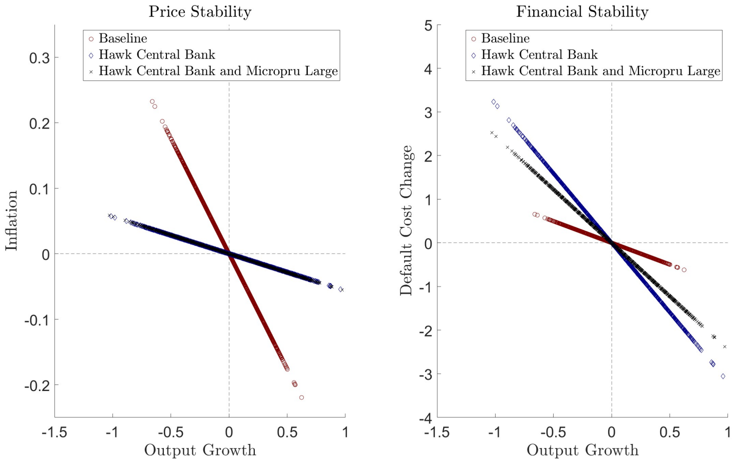

FIGURE: Improving macro-financial stability tradeoff via micro-pru policy

2021-23 INFLATION EPISODE

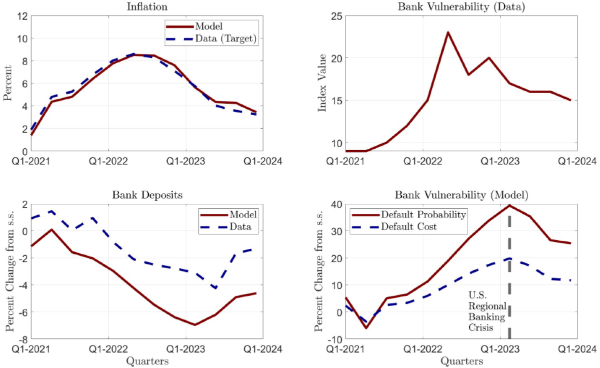

FIGURE: 2021-23 inflation episode and macro-financial stability tradeoff

Conclusion

- Bank-lending channel in HBANK
- Tractable analysis of GE effects of policy with heterogeneous intermediaries
- 3D equilibrium covariate: MPL, size, default probability
- **Trade-off** between macro stabilization and financial stability
- Key role of **micro-prudential** policy