Deposit Spreads and Bank Loan Supply: The Case of Japan

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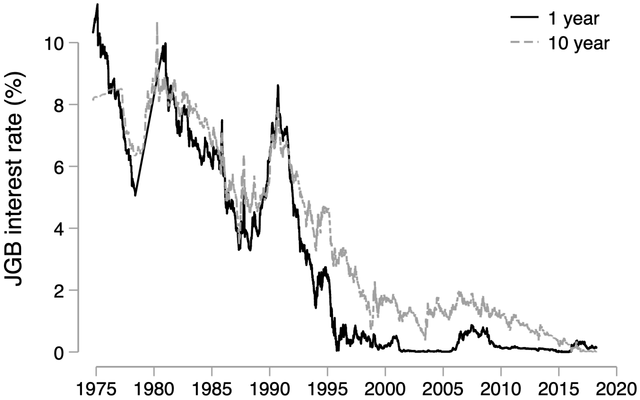

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How do low nominal rate environments affect bank credit supply?

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Low rate environments reduce banks' market power on liabilities, decreasing net worth and credit supply.

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Approach:

1. Establish mechanism theoretically in quantitative macro model
   - Heterogeneous banks intermediate between households and firms
   - Banks have market power in deposits, leverage constrains lending
2. Provide empirical evidence from Japanese banks micro data
   - Long-term variation in nominal rate
   - Identification: cross-sectional heterogeneity in bank exposure

Main results

1. Banks' profitability decreases as nominal rates fall
   - Net interest margins, net income per asset decrease
   - Retained earnings, equity decrease
2. Banks' credit supply decreases as nominal rates fall
   - Loan rate spreads increase
   - Firms borrow less, controlling for demand
3. Quantitative model findings:
   - Aggregate lending falls by 1.3% after 1% decrease in nominal rate
   - Policy effectiveness: tiering, cash tax

Literature & Contributions

Japan's lost decade(s):

- Peek Rosengren (2000,2005), Kashyap (2002), Fukao (2003), Caballero, Hoshi, Kashyap (2008), Ono et al. (2018), Hong Kandarac (2018), Amiti Weinstein (2018), Balloch (2018)

→ **This paper**: low rates depressed bank net worth and lending

Bank market power:

- Monti (1971), Klein (1972), Petersen Rajan (1995), Drechsler Savov Schnabl (2017, 2018), Egan Hortacsu Matvos (2017, 2018), Hoffmann et al. (2018)

→ **This paper**: non-interest income, efficiency gains, consolidation not enough to overturn profitability drop

Bank lending and bank net worth:

- Holmstrom Tirole (1997), van den Heuvel (2002), Bolton Freixas (2006), Chodorow-Reich (2014), Brunnermeier Sannikov (2014), Ongena et al. (2014), Huber (2018)

→ **This paper**: long-run variation in net worth

Low rates, inflation, and monetary policy:

- Eggertsson Woodford (2003), Dell'ariccia Laeven Marquez (2014), Jackson (2015), Heider Saidi Schepens (2018), Altavilla et al. (2018), Nakamura et al. (2018), Brunnermeier Koby (2018), Ulate (2019), Wang (2019), Eggertsson et al. (2019), Agarwal Kimball (2015, 2019), Andrade et al. (2019)

→ **This paper**: long-term focus, quantitative model, explore policy tools

Outline

1. Model mechanism

2. Empirical evidence

3. Quantitative evaluation

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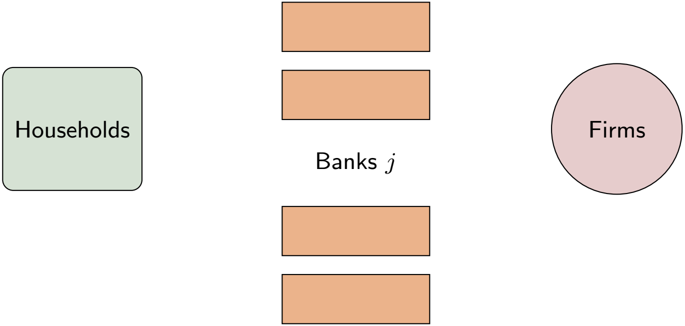
Deterministic model, discrete and infinite time ($t = 0, 1, ..., \infty$)



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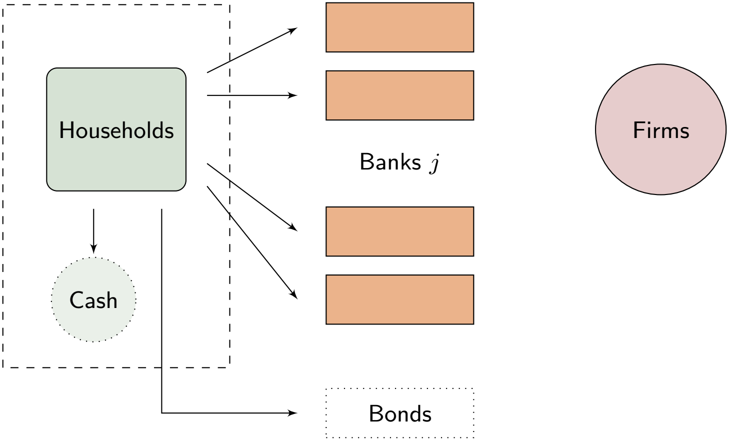

Households consume, save in **bonds, deposits, and cash** ⏩ Tradeoffs

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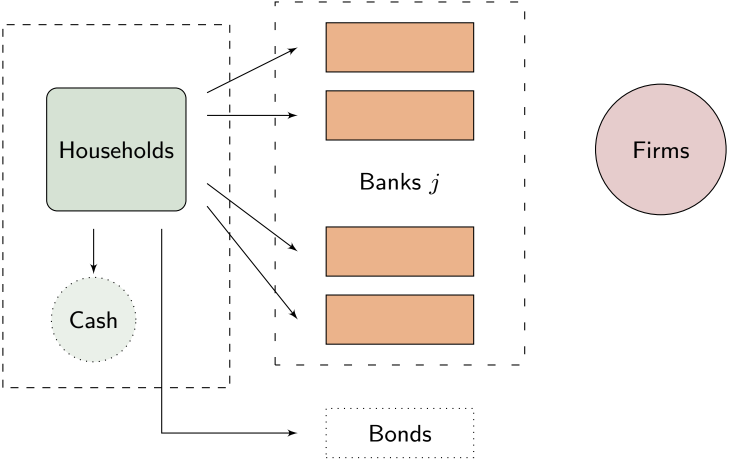

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Banks have market power in deposit markets: α_j

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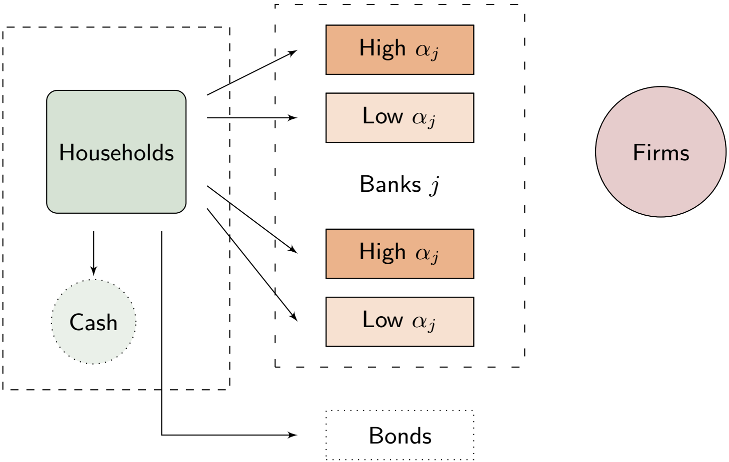

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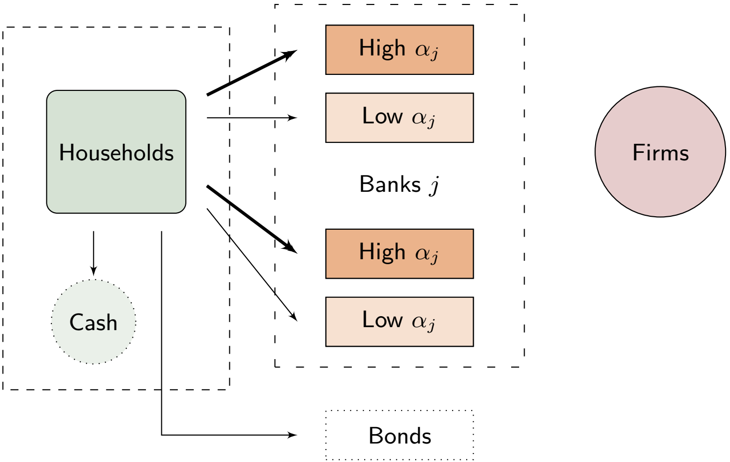

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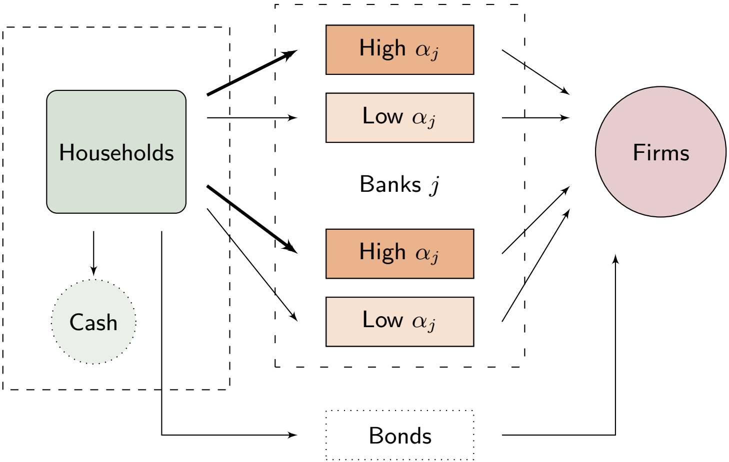

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Banks have market power in deposit markets: α_j

Firms demand loans

Bank deposits held at j banks, bank problem

Bank accounts d_{jt} where bank j has quality α_j:

Full HH problem

$$d_t = \left(N^{-\frac{1}{\varepsilon}} \sum_j \alpha_j d_{jt}^{\frac{\varepsilon-1}{\varepsilon}} \right)^{\frac{\varepsilon}{\varepsilon-1}}$$

- ε is elasticity of substitution across banks
- Microfoundation from discrete choice problem [Redding and Weinstein, 2015]

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Bank balance sheet

$$\ell_{jt} + g_{jt} = d_{jt} + e_{jt}$$

Maximization of returns $\Pi_{j,t+1}$:

$$\max_{i^{\ell}_{jt}, i^{d}_{jt}, g_{jt}} \; i^{\ell}_{jt}\ell_{jt} + i_t g_{jt} - i^{d}_{jt} d_{jt}$$

subject to:

- Loan demand $\ell_{jt} = \ell_{jt}(i^{\ell}_{jt})$ and deposit supply $d_{jt} = d_{jt}(i^{d}_{jt})$
- Required return to equity $1 + r_t + \varrho = (\Pi_{j,t+1} + e_{jt})/[(1 + \pi_t)e_{jt}]$
- Leverage constraint $\psi\ell_{jt} \leq e_{jt}$ (Holmstrom and Tirole, 1997)

Mechanism: bank market power on liabilities

Bank returns are separable: $\Pi_{j,t+1} = (i^{\ell} - i)\ell_{jt} + (i - i^{d})d_{jt}$

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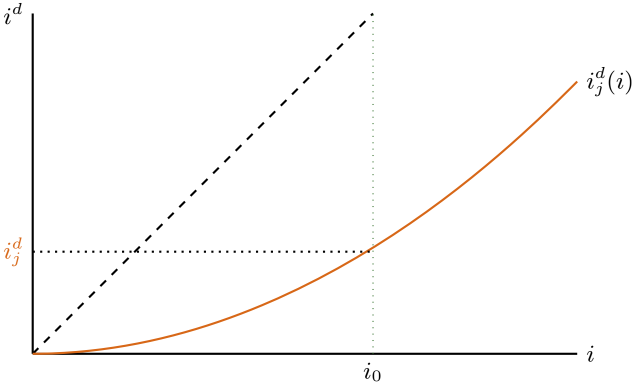

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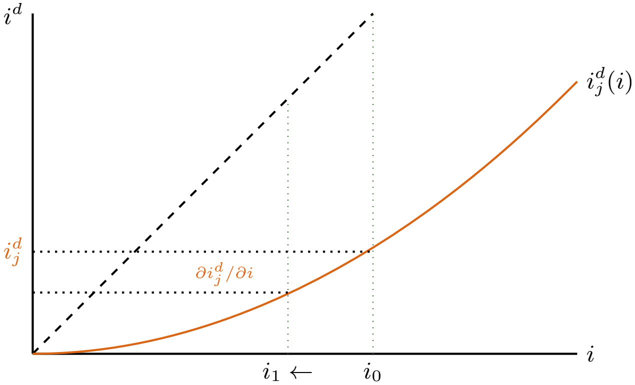

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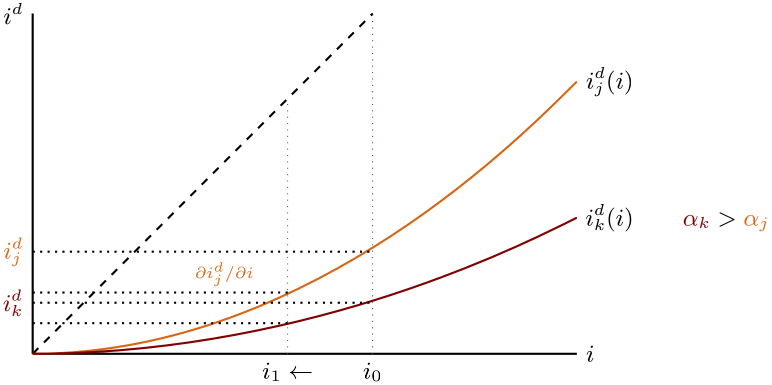

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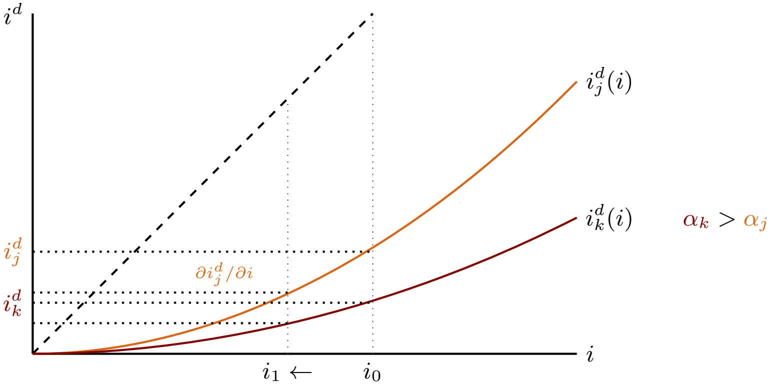
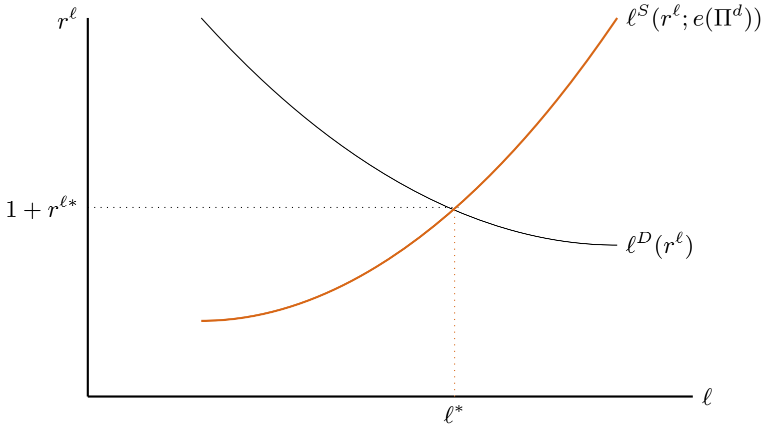


Following a decrease in the nominal rate i, **incomplete deposit pass-through, real funding profits decline, and loan rates rise.**

Loan supply falls, lending rates rise

Profits affect bank equity, and equity matters for lending:



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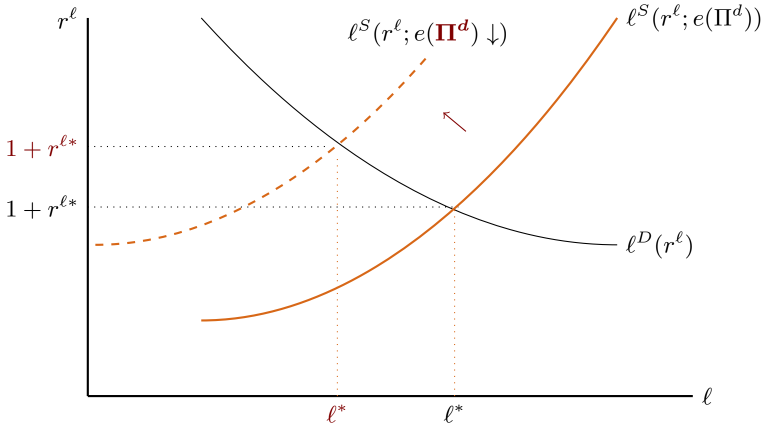

Formal results | Cross sectional predictions | Equity, lending, output decline

Outline

1. Model mechanism

2. Empirical evidence

3. Quantitative evaluation

Differential α_j: banks preferred by local depositors

Data:

- Nikkei NEEDS Financial Quest: commercial banks (1975-present)
- DBJ: firm level data for all listed firms, including loans ℓ_{ij} from banks

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  - Alternatives: 1980, 1980s average, 1995, $\frac{D_{j,1990}}{L_{j,1990}}$, $\hat{\beta}_j^{\text{exp}}$

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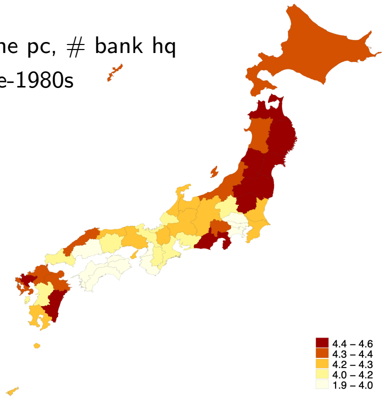
  Variation:
  - Geography: pop/density, income pc, # bank hq
  - Type: market segmentation pre-1980s

  ▸▸ All ▸▸ Regional



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Outcomes y_{jt} = interest expenses, profits, loan rates:

1. Cross-sectional changes: $\hat{\alpha}_j$ vs. $y_{j,post} - y_{j,pre}$
2. Difference in difference regression:

$$y_{jt} = \beta \cdot \mathbf{1}_{t \geq 2000} + \gamma \cdot \hat{\alpha}_j + \boldsymbol{\delta} \cdot \mathbf{1}_{t \geq 2000} \cdot \hat{\alpha}_j + X_{jt} + \epsilon_{jt}$$

3. Time series: $y_{jt} = \beta_t + \sum_s \boldsymbol{\delta}_s \cdot \mathbf{1}_{t=s} \cdot \hat{\alpha}_j + X_{jt} + \epsilon_{jt}$

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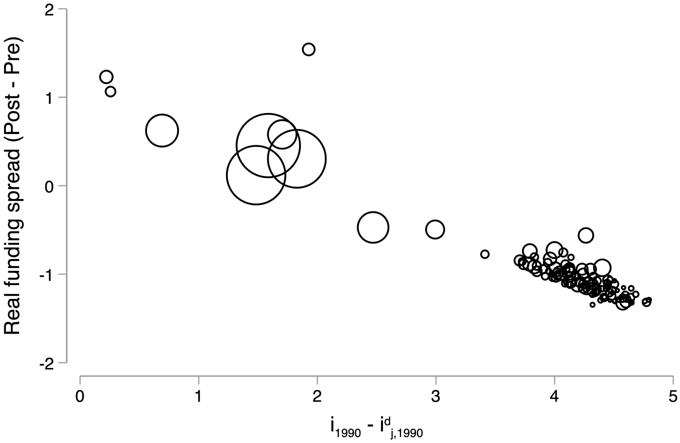
ID assumption: macro factors do not differentially affect banks along $\hat{\alpha}_j$.
X_{jt}: size, NPLs, year & bank fixed effects, type, demand. Balance of covariates

First stage: Exposed banks earn lower spreads

Scatter: $\hat{\alpha}_j$ vs. $\Delta\left(r_t - r_t^{\text{exp}}\right)$



Exposed banks cannot reduce interest expenses

$$i^{\text{exp}}_{jt} = \beta \cdot \mathbf{1}_{t\geq 2000} + \gamma \cdot \hat{\alpha}_j + \boldsymbol{\delta} \cdot \mathbf{1}_{t\geq 2000} \cdot \hat{\alpha}_j + X_{jt} + \epsilon_{jt}$$

Sample: 1990-2010	All banks			Regional banks	
	(1)	(2)	(3)	(4)	(5)
Post	-4.23***				
	(0.18)				
$\hat{\alpha}_{j,1990}$	-0.67***				
	(0.04)				
Post x $\hat{\alpha}_{j,1990}$	0.52***				
	(0.04)				
Constant	5.10***				
	(0.18)				
Year f.e.s		Y	Y	Y	Y
Bank f.e.s			Y		Y
Post x max(NPL)			Y		Y
Post x Log Assets$_{j,1990}$			Y		Y
Observations	2,309	2,309	2,309	2,082	2,082
R-squared	0.54	0.97	0.98	0.99	0.99

Note: $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$. Standard errors clustered at bank and post level.

Unmerged sample · Deposit dependence · Lagged deposit dependence · Dynamics

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	(0.04)	(0.04)	(0.02)		
Post x $\hat{\alpha}_{j,1990}$	0.52***	0.52***	0.52***		
	(0.04)	(0.04)	(0.04)		
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$\hat{\alpha}_{j,1990}$	-0.67***	-0.67***	-0.66***	-0.55***	-0.46***
	(0.04)	(0.04)	(0.02)	(0.03)	(0.01)
Post x $\hat{\alpha}_{j,1990}$	0.52***	0.52***	0.52***	0.46***	0.40***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)
Constant	5.10***				
	(0.18)				
Year f.e.s		Y	Y	Y	Y
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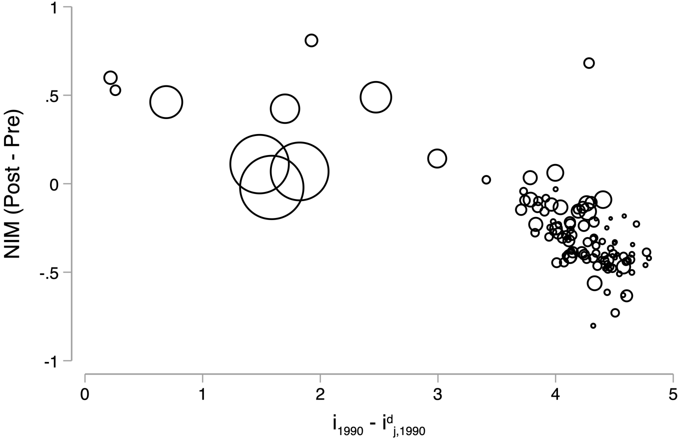
Unmerged sample | Deposit dependence | Lagged deposit dependence | Dynamics

Exposed banks are less profitable since 2000

Scatter: $\hat{\alpha}_j$ vs. $\Delta \text{NIM}_{jt} = \Delta(r_{jt}^{income} - r_{jt}^{expenses})$



Relative profitability of exposed banks has declined

$$\text{NIM}_{j,t} = \beta_t + \sum_s \boldsymbol{\delta}_s \cdot \mathbf{1}_{t=s} \cdot \hat{\alpha}_j + X_{jt} + \epsilon_{jt}$$

Notes: 90 percent confidence intervals, clustered standard errors (bank-post).

▶▶ Diff in diff regression ▶▶ Unmerged sample ▶▶ Deposit dependence ▶▶ Lagged deposit dependence

Additional empirical evidence

Exposed banks do NOT:

- Increase interest income enough ⏩ i^A
- Increase non-interest income, reduce costs enough ⏩ Fees ⏩ G&A
- Stabilize net income ⏩ Net ordinary income ⏩ Net income
- Increase capital issuance, reduce dividend payout ⏩ Capital Issuance ⏩ Dividends

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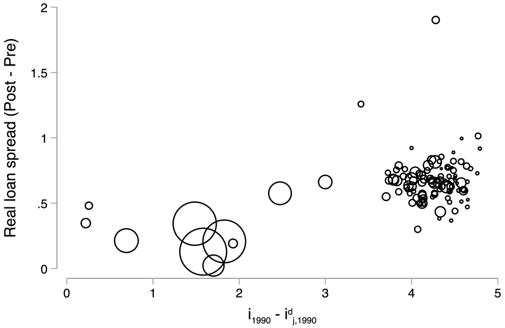
Lending effects due to equity losses:

1. Loan spreads rise for exposed banks ⏩ DiD ⏩ Dynamics



2. Loan-level regressions confirm supply effects

Loan-level results confirm supply effects

$$\Delta \log \ell_{ijt} = \gamma \hat{\alpha}_j + \boldsymbol{\delta}\, \text{Post}_t \cdot \hat{\alpha}_j + \eta_{it} + X_{jt} + \epsilon_{ijt}$$

Sample: 1990-2010	(1)	(2)	(3)
$\hat{\alpha}_{j,1990}$	0.010***	0.011***	0.015***
	(0.003)	(0.003)	(0.004)
Post x $\hat{\alpha}_{j,1990}$	-0.010*	-0.014**	-0.014**
	(0.006)	(0.006)	(0.007)
Firm fixed effects	Y		
Year fixed effects	Y		
Firm-year fixed effects		Y	Y
Bank controls$_{j,t}$			Y
Observations	208,381	208,381	187,829
R-squared	0.04	0.23	0.25

Notes: $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$. Standard errors clustered at firm and post level. Bank controls include non-interest income, extraordinary income, non-performing loans, and changes to equity due to mergers, acquisitions, and recapitalizations.

Robustness: alternate exposure measures, samples, interactions with rates.

Outline

1. Model mechanism

2. Empirical evidence

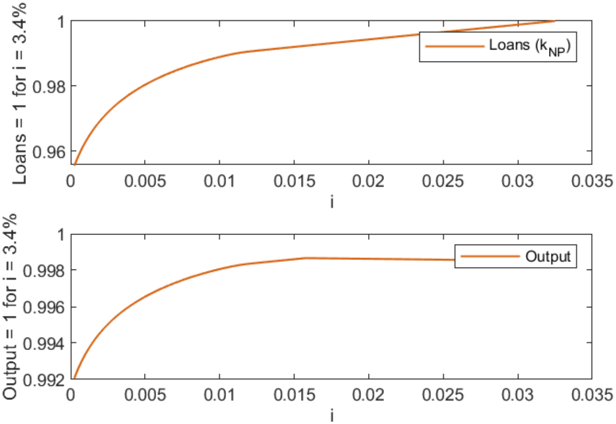
3. Quantitative evaluation

Disciplining the model to estimate aggregate effects

Calibrate liquidity preferences, bank parameters using empirical data. ⏩ Details

Experiment: $\Delta\pi = \Delta i = -3\%, \Delta r = 0$. Key results:

- Loan spread $r^{\ell} - r$ increase by 30 basis points (data: 45bp)
- Equilibrium lending ℓ^* decreases by 4.0%
- Significant effects on other macroeconomic variables

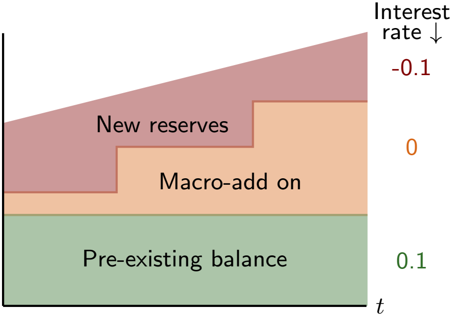


⏩ i^d, Π

Policy counterfactuals: reserve tiering, cash taxes

Two potential policies that can alleviate the effects of low rates on banks:

1. Reserve tiering



- BOJ ≈ 10bp subsidy on reserves

→ $r^\ell - r$ decreases by 2bp, loans increase by 0.25% ▶▶ Figure

2. Cash taxes

- 10 bp tax on cash holdings (e.g. Agarwal and Kimball, 2019)

→ $r^\ell - r$ decreases by 8bp, loans increases by 1% ▶▶ Figure

Conclusion

1. **Propose theory** of bank intermediation with frictions
   - Lending, equity frictions generate under-provision of loans
   - Banks provide differentiated liquid savings to households
   - Market power alleviate credit frictions; until rates are low
2. **Novel, consistent empirical evidence** from Japan
   - Profitability, deposit spreads decline since late 90s
   - Deposit dependent banks face larger effects
3. **Quantitative exercise**
   - Quantify effects in Japan in general equilibrium
   - Study scope for policy: Tiering, Cash "Tax"

Appendix slides

Implications for Monetary Policy (Brunnermeier and Koby, 2019)

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- Brunnermeier and Koby (2019):
  - "Reversal rate": rate below which interest cuts become contractionary instead of expansionary; provide existence conditions
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  - DSGE model for Europe
- For the U.S., low/negative rates less likely to be an issue:
  - Less cash dependent
  - Weaker liquidity trap (Koby and Wolf 2018)
  - Financial system $\neq$ banking system

Households save using cash, deposits, and bonds

Unit continuum of household maximize:

$$U_0 = \sum_{t=0}^{\infty} \beta^t u(c_t)$$

with the budget constraint:

$$w_t + T_t + g_{t-1} \qquad = c_t + q_t g_t$$

where prices $q_{xt} = \frac{1+\pi_t}{1+i_{xt}}$ are in real terms.

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Households save using cash, deposits, and bonds

Unit continuum of household maximize:

$$U_0 = \sum_{t=0}^{\infty} \beta^t \left[u(c_t) + \Phi \left(\mathcal{L} \left(m_t, \{d_{jt}\} \right) \right) \right]$$

with the budget constraint:

$$w_t + T_t + g_{t-1} = c_t + q_t g_t + q_{mt} m_t + \sum_j q_{jt} d_{jt}$$

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where prices $q_{xt} = \frac{1+\pi_t}{1+i_{xt}}$ are in real terms.

Liquidity $\mathcal{L}_t = 2^{-\frac{1}{\eta-1}} \left(d_t^{\frac{\eta-1}{\eta}} + \alpha_m m_t^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}}$ provides benefit through $\Phi(\cdot)$:

- η is cash substitution elasticity, α_m is relative liq. benefit of cash
- Φ is increasing, concave, with associated elasticity λ

Back

Firms require bank loans to invest

- Production uses pledgeable and non-pledgeable capital, labor:

$$y_t = A_t k_t^{\nu\alpha} n_t^{\nu(1-\alpha)}$$
$$k_t = k_{P,t}^{\rho} k_{NP,t}^{1-\rho}$$

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$$y_t = A_t k_t^{\nu\alpha} n_t^{\nu(1-\alpha)}$$
$$k_t = k_{P,t}^{\rho} k_{NP,t}^{1-\rho}$$

- Non-pledgeable capital $k_{NP,t}$ must be backed by loans ℓ_t:

$$k_{NP,t} \leq \ell_t \equiv \left(N^{-1/\varepsilon^\ell} \sum_j \ell_{jt}^{\frac{\varepsilon^\ell - 1}{\varepsilon^\ell}} \right)^{\frac{\varepsilon^\ell}{\varepsilon^\ell - 1}}$$

  - Micro-foundation: discrete choice problem [Redding and Weinstein, 2015]

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  - Micro-foundation: discrete choice problem [Redding and Weinstein, 2015]

- Prices:
  - Wage w_t
  - Pledgeable capital $r_{P,t} = r_t + \delta$
  - Non-pledgeable capital $r_{NP,t} = r_t^\ell + \delta$, where r_t^ℓ is loan rate index

Back

Bank profitability declines

Comparative static: permanent decrease in π^e and i. r constant.

Proposition (Long-run pass-through.)

If $\eta > \lambda$, the deposit pass-through is incomplete:

$$\frac{di^d}{di} < 1$$

Proposition (Funding profits.)

Following a decrease in the nominal rate i, real funding profits $\frac{\Pi^d}{1+\pi}$ decline.

◂ Back

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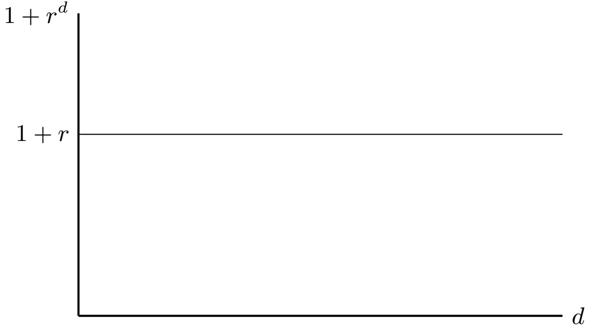

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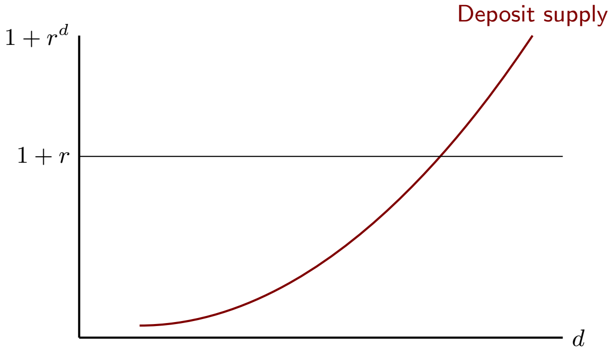

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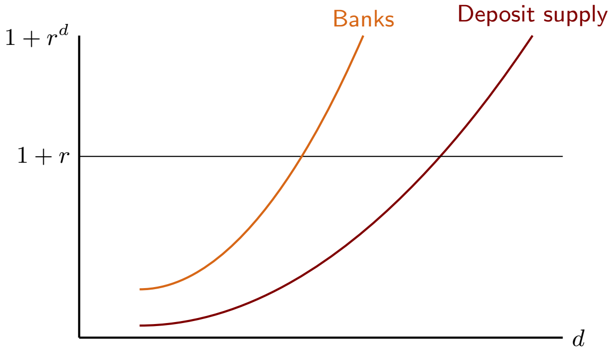

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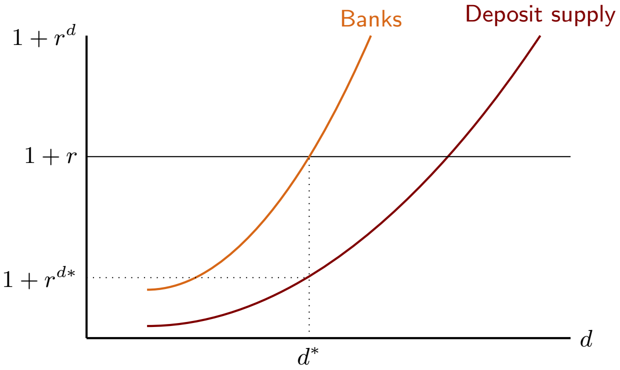

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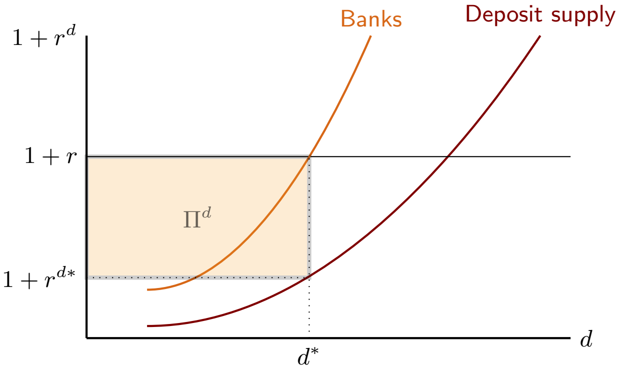

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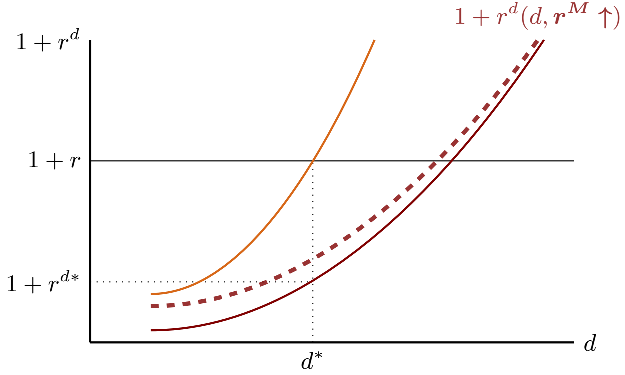

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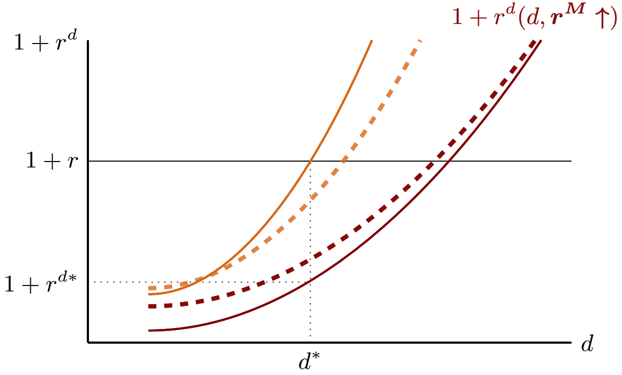

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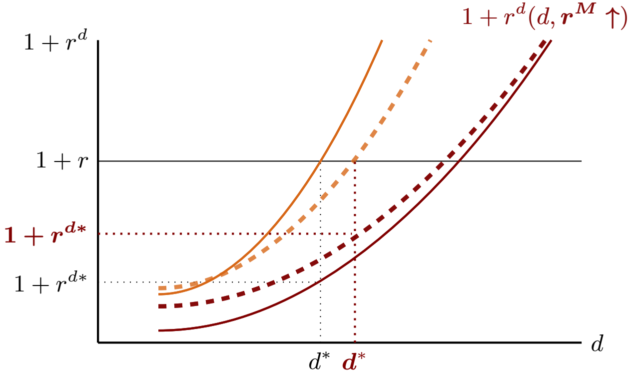

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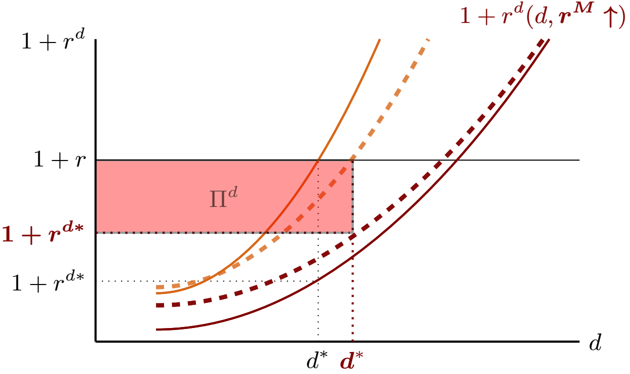

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Proposition (Funding profits.)

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Proposition (Cross-sectional implications)

Assume $\alpha_k > \alpha_j$. There exists i_0 high enough such that for any $i_1 < i_0$:

- *Bank k funding profits fall*
- *Bank k has relatively higher funding costs*

◂ Back

Decreasing Bank Profitability Lowers Lending, Capital

Proposition (Equity.)

Following a decrease in the nominal rate i, total bank profits decrease and bank equity e decreases.

◂ Back

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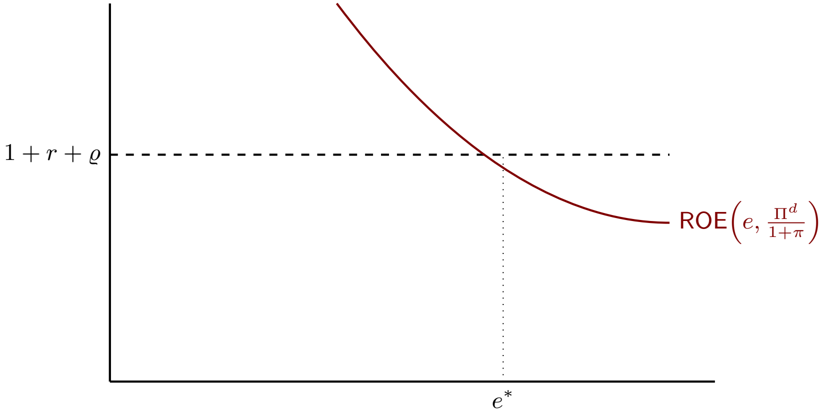

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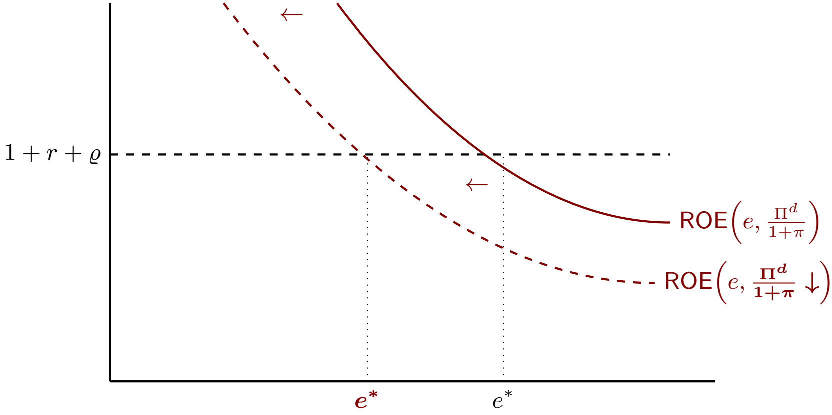

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Proposition (Lending.)

Following a decrease in the nominal rate i, the real loan rate r^ℓ increases and the quantity of loans ℓ decreases.

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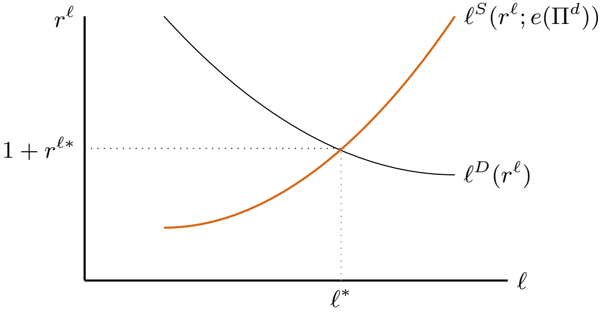

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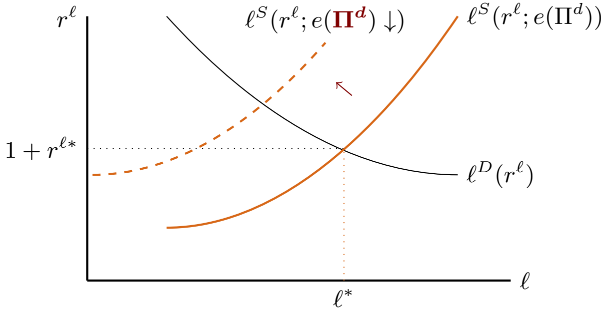

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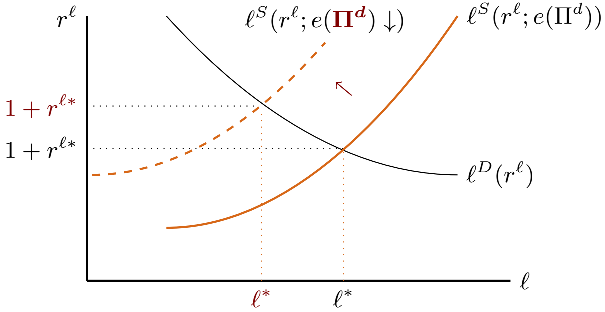

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Proposition (Aggregate implications)

Following a decrease in the nominal rate i:

- *Non-pledgeable capital k_{NP}, pledgeable capital k_P and total capital k decrease.*
- *The ratio of k_P to k_{NP} increases.*
- *Output y, wages w and consumption c decrease.*

◂ Back

Variation among banks driven by region, type

Sample: All banks

Table: Dependent variable: $\hat{\alpha} = r_{1990} - r^d_{j,1990}$

	(1)	(2)	(3)	(4)	(5)
Density		-0.42***			
		(0.07)			
Income per capita			-0.41***		
			(0.06)		
Population				-0.44***	
				(0.08)	
# Banks headquarters					-0.11***
					(0.02)
Prefecture fixed effects	Y				
Type fixed effects	Y				
Observations	110	110	110	110	110
R-squared	0.94	0.60	0.62	0.51	0.64

Note: Robust standard errors. Density, income per capita, and population are standardized to have mean 0 and standard deviation 1. Bank headquarters and population is measured in 1990, income per capita in 2001 and density in 2010 (due to data availability). Significance follows $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$.

◂ Back

Variation among regional banks driven by region, type

Sample: regional banks only

Table: Dependent variable: $\hat{\alpha} = r_{1990} - r^d_{j,1990}$

	(1)	(2)	(3)	(4)	(5)
Density		-0.11***			
		(0.03)			
Income per capita			-0.11***		
			(0.02)		
Population				-0.09***	
				(0.03)	
# Banks headquarters					-0.02***
					(0.01)
Prefecture fixed effects	Y				
Observations	101	101	101	101	101
R-squared	0.54	0.18	0.16	0.11	0.09

Note: Robust standard errors. Density, income per capita, and population are standardized to have mean 0 and standard deviation 1. Bank headquarters and population is measured in 1990, income per capita in 2001 and density in 2010 (due to data availability). Significance follows $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$.

Back

Balance of covariates

Table: Balance of covariates (2000)

	All banks		Regional banks	
	Low $\hat{\alpha}_{j,1990}$	High $\hat{\alpha}_{j,1990}$	Low $\hat{\alpha}_{j,1990}$	High $\hat{\alpha}_{j,1990}$
Assets (tr)	9,776	2,193	3,354	1,615
NIM (%)	2.08	2.28	1.89	2.02
Deposits / Liabilities	0.86	0.95	0.93	0.95
Loans / Assets	0.70	0.70	0.72	0.69
NPL/Assets (max)	4.37	3.78	4.30	3.76
Regional banks (%)	85	100	100	100
Total number of banks	60	51	50	51

◂ Back

First stage: Exposed banks cannot reduce interest expenses

$$i^{\text{exp}}_{jt} = \beta \cdot \mathbf{1}_{t \geq 2000} + \gamma \cdot \hat{\alpha}_j + \boldsymbol{\delta} \cdot \mathbf{1}_{t \geq 2000} \cdot \hat{\alpha}_j + X_{jt} + \epsilon_{jt}$$

Sample: 1990-2010	All banks			Regional banks	
	(1)	(2)	(3)	(4)	(5)
Post	-5.34***				
	(0.36)				
D/L 1990	-4.87***	-4.87***	-4.54***	-2.77***	
	(0.41)	(0.26)	(0.36)	(0.22)	
Post x D/L	3.78***	3.78***	3.22***	2.00***	0.93***
	(0.42)	(0.27)	(0.32)	(0.23)	(0.22)
Constant	6.54***				
	(0.36)				
Year f.e.s		Y	Y	Y	Y
Bank f.e.s			Y		Y
Post x max(NPL)			Y		Y
Post x Log Assets$_{j,1990}$			Y		Y
Observations	2,309	2,309	2,309	2,082	2,082
R-squared	0.53	0.97	0.98	0.98	0.99

Note: $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$. Standard errors clustered at bank and post level.

◂ Back

First stage: Exposed banks cannot reduce interest expenses

$$i_{jt}^{\text{exp}} = \beta \cdot \mathbf{1}_{t \geq 2000} + \gamma \cdot \hat{\alpha}_j + \boldsymbol{\delta} \cdot \mathbf{1}_{t \geq 2000} \cdot \hat{\alpha}_j + X_{jt} + \epsilon_{jt}$$

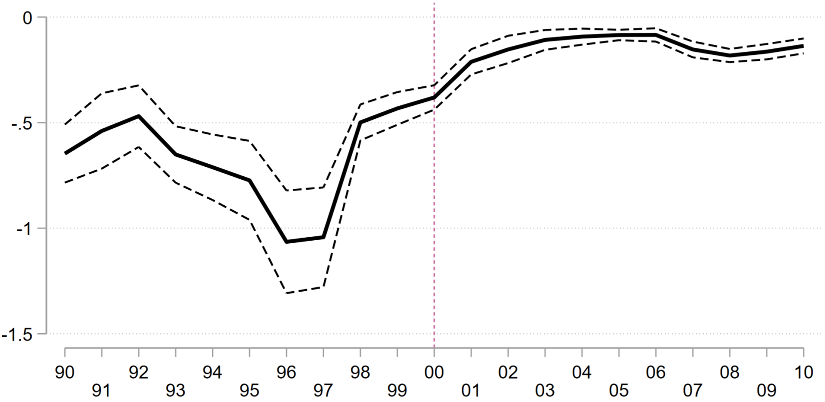
Sample: 1990-2010	All banks			Regional banks	
	(1)	(2)	(3)	(4)	(5)
Post	-4.29***				
	(0.16)				
$\hat{\alpha}_{j,1990}$	-0.68***	-0.67***	-0.71***	-0.55***	-0.48***
	(0.03)	(0.03)	(0.02)	(0.03)	(0.01)
Post x $\hat{\alpha}_{j,1990}$	0.53***	0.52***	0.49***	0.45***	0.38***
	(0.04)	(0.03)	(0.03)	(0.04)	(0.03)
Constant	5.19***				
	(0.14)				
Year f.e.s		Y	Y	Y	Y
Bank f.e.s			Y		Y
Post x max(NPL)			Y		Y
Post x Log Assets$_{j,1990}$			Y		Y
Observations	2,843	2,843	2,762	2,496	2,425
R-squared	0.53	0.97	0.98	0.98	0.99

Note: $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$. Standard errors clustered at bank and post level.

◂ Back

Time series: $\boldsymbol{\delta}_t$ for treatment × year dummies

$$i_{jt}^{\text{exp}} = \beta_t + \sum_s \boldsymbol{\delta}_s \cdot \mathbf{1}_{t=s} \cdot \hat{\alpha}_j + X_{jt} + \epsilon_{jt}$$



Notes: 90 percent confidence intervals, clustered standard errors (bank-post).

Time series: δ_t for treatment $\times$ year dummies

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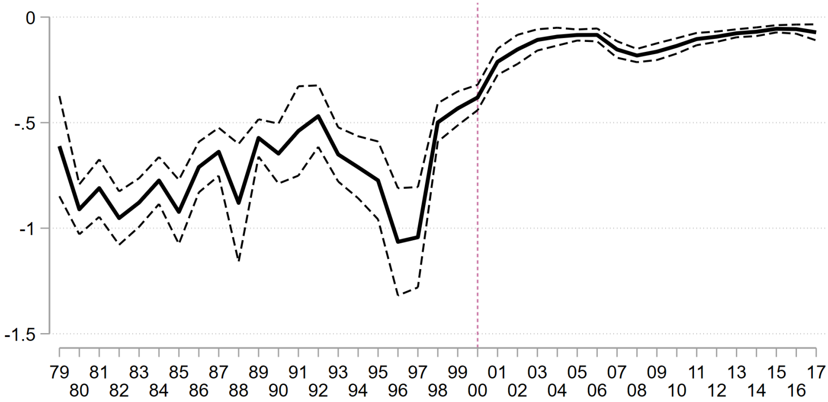

Notes: 90 percent confidence intervals, clustered standard errors (bank-post).

Exposed banks are less profitable since 2000

$$\text{NIM}_{jt} = \beta \cdot \mathbf{1}_{t \geq 2000} + \gamma \cdot \hat{\alpha}_j + \boldsymbol{\delta} \cdot \mathbf{1}_{t \geq 2000} \cdot \hat{\alpha}_j + X_{jt} + \epsilon_{jt}$$

Table: Dependent variable: Net Interest Margin$_{j,t}$ (%)

Sample: 1990-2010	All banks			Regional banks	
	(1)	(2)	(3)	(4)	(5)
Post	0.73***				
	(0.17)				
$\hat{\alpha}_{j,1990}$	0.45***	0.45***	0.46***	0.45***	0.31***
	(0.03)	(0.04)	(0.01)	(0.07)	(0.02)
Post x $\hat{\alpha}_{j,1990}$	-0.20***	-0.20***	-0.16***	-0.30***	-0.27***
	(0.04)	(0.04)	(0.02)	(0.10)	(0.04)
Constant	-0.08				
	(0.15)				
Year f.e.s		Y	Y	Y	Y
Bank f.e.s			Y		Y
Post x max(NPL)			Y		Y
Post x Log Assets$_{j,1990}$			Y		Y
Observations	2,309	2,309	2,309	2,082	2,082
R-squared	0.51	0.61	0.88	0.34	0.83

Note: $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$. Standard errors clustered at bank and post level.

Unmerged sample | Deposit dependence | Lagged deposit dependence | Dynamics

Exposed banks are less profitable since 2000

$$\text{NIM}_{jt} = \beta \cdot \mathbf{1}_{t \geq 2000} + \gamma \cdot \hat{\alpha}_j + \boldsymbol{\delta} \cdot \mathbf{1}_{t \geq 2000} \cdot \hat{\alpha}_j + X_{jt} + \epsilon_{jt}$$

Table: Dependent variable: Net Interest Margin$_{j,t}$ (%)

Sample: 1990-2010	All banks			Regional banks	
	(1)	(2)	(3)	(4)	(5)
Post	1.12***				
	(0.14)				
D/L 1990	3.12***	3.12***	3.06***	1.92***	
	(0.14)	(0.13)	(0.12)	(0.26)	
Post x D/L	-1.41***	-1.41***	-0.91***	-1.43***	-0.84***
	(0.16)	(0.16)	(0.11)	(0.33)	(0.17)
Constant	-0.94**				
	(0.12)				
Year f.e.s		Y	Y	Y	Y
Bank f.e.s			Y		Y
Post x max(NPL)			Y		Y
Post x Log Assets$_{j,1990}$			Y		Y
Observations	2,309	2,309	2,309	2,082	2,082
R-squared	0.44	0.54	0.88	0.27	0.82

Note: $^* p < 0.1, ^{**} p < 0.05, ^{***} p < 0.01$. Standard errors clustered at bank and post level.

Back

Exposed banks are less profitable since 2000

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Table: Dependent variable: Net Interest Margin$_{j,t}$ (%)

Sample: 1990-2010	All banks			Regional banks	
	(1)	(2)	(3)	(4)	(5)
Post	0.64***				
	(0.16)				
$\hat{\alpha}_{j,1990}$	0.46***	0.46***	0.31***	0.44***	0.26***
	(0.03)	(0.03)	(0.03)	(0.06)	(0.04)
Post x $\hat{\alpha}_{j,1990}$	-0.18***	-0.18***	-0.15***	-0.27***	-0.25***
	(0.04)	(0.04)	(0.03)	(0.09)	(0.04)
Constant	-0.14				
	(0.13)				
Year f.e.s		Y	Y	Y	Y
Bank f.e.s			Y		Y
Post x max(NPL)			Y		Y
Post x Log Assets$_{j,1990}$			Y		Y
Observations	2,843	2,843	2,762	2,496	2,425
R-squared	0.57	0.65	0.90	0.33	0.82

Note: $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$. Standard errors clustered at bank and post level.

Back

Loan rate

$$i^{\ell}_{jt} = \beta \cdot \mathbf{1}_{t \geq 2000} + \gamma \cdot \hat{\alpha}_j + \boldsymbol{\delta} \cdot \mathbf{1}_{t \geq 2000} \cdot \hat{\alpha}_j + X_{jt} + \epsilon_{jt}$$

Table: Dependent variable: Interest on loans / Loans

Sample: 1990-2010	All banks			Regional banks	
	(1)	(2)	(3)	(4)	(5)
Post	-3.02***				
	(0.39)				
D/L 1990	-0.07	-0.07	-0.23	-0.60**	
	(0.44)	(0.12)	(0.15)	(0.30)	
Post x D/L	0.93**	0.93***	1.02***	0.85**	0.57***
	(0.46)	(0.16)	(0.17)	(0.40)	(0.22)
Constant	4.55***				
	(0.38)				
Year f.e.s		Y	Y	Y	Y
Bank f.e.s			Y		Y
Post x max(NPL)			Y		Y
Post x Log Assets$_{j,1990}$			Y		Y
Observations	2,309	2,309	2,309	2,082	2,082
R-squared	0.43	0.95	0.99	0.96	0.99

Note: $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$. Standard errors clustered at bank and post level.

Back

Loan rate

$$i^{\ell}_{jt} = \beta \cdot \mathbf{1}_{t\geq 2000} + \gamma \cdot \hat{\alpha}_j + \boldsymbol{\delta} \cdot \mathbf{1}_{t\geq 2000} \cdot \hat{\alpha}_j + X_{jt} + \epsilon_{jt}$$

Table: Dependent variable: Interest on loans / Loans

Sample: 1990-2010	All banks			Regional banks	
	(1)	(2)	(3)	(4)	(5)
Post	-2.97***				
	(0.17)				
$\hat{\alpha}_{j,1990}$	0.00	0.02	-0.12***	0.00	-0.07
	(0.03)	(0.02)	(0.01)	(0.10)	(0.06)
Post x $\hat{\alpha}_{j,1990}$	0.16***	0.15***	0.17***	0.19	0.14***
	(0.04)	(0.04)	(0.02)	(0.13)	(0.04)
Constant	4.56***				
	(0.13)				
Year f.e.s		Y	Y	Y	Y
Bank f.e.s			Y		Y
Post x max(NPL)			Y		Y
Post x Log Assets$_{j,1990}$			Y		Y
Observations	2,843	2,843	2,762	2,496	2,425
R-squared	0.42	0.95	0.98	0.96	0.99

Note: $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$. Standard errors clustered at bank and post level.

Back

Interest expenses, lagged deposit dependence

$$i^{\text{exp}}_{jt} = \beta \cdot \mathbf{1}_{t\geq 2000} + \gamma \cdot D/L_{j,t-1} + \boldsymbol{\delta} \cdot \mathbf{1}_{t\geq 2000} \cdot D/L_{j,t-1} + X_{jt} + \epsilon_{jt}$$

Sample: 1990-2010		All banks		Regional banks	
	(1)	(2)	(3)	(4)	(5)
Post	-5.54***				
	(0.35)				
D/L$_{j,t-1}$	-5.11***	-4.21***	-2.16***	-2.79***	-0.92***
	(0.38)	(0.21)	(0.31)	(0.25)	(0.25)
Post x D/L$_{j,t-1}$	4.00***	3.12***	3.02***	1.82***	0.63**
	(0.39)	(0.22)	(0.29)	(0.28)	(0.31)
Constant	6.83***				
	(0.34)				
Year f.e.s		Y	Y	Y	Y
Bank f.e.s			Y		Y
Post x max(NPL)			Y		Y
Post x Total Assets$_{j,1990}$			Y		Y
Observations	2,309	2,309	2,309	2,082	2,082
R-squared	0.53	0.97	0.98	0.98	0.99

Note: $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$. Standard errors clustered at bank and post level.

Back

Profitability, lagged deposit dependence

$$\text{NIM}_{jt} = \beta \cdot \mathbf{1}_{t \geq 2000} + \gamma \cdot D/L_{j,t-1} + \boldsymbol{\delta} \cdot \mathbf{1}_{t \geq 2000} \cdot D/L_{j,t-1} + X_{jt} + \epsilon_{jt}$$

Table: Dependent variable: Net Interest Margin$_{j,t}$ (%)

Sample: 1990-2010	All banks			Regional banks	
	(1)	(2)	(3)	(4)	(5)
Post	0.47***				
	(0.13)				
D/L$_{j,t-1}$	2.80***	2.73***	0.86***	2.22***	0.54***
	(0.10)	(0.09)	(0.13)	(0.30)	(0.18)
Post x D/L$_{j,t-1}$	-0.75***	-0.63***	-0.62***	1.91***	0.17
	(0.15)	(0.13)	(0.10)	(0.52)	(0.29)
Constant	-0.72***				
	(0.09)				
Year f.e.s		Y	Y	Y	Y
Bank f.e.s			Y		Y
Post x max(NPL)			Y		Y
Post x Total Assets$_{j,1990}$			Y		Y
Observations	2,309	2,309	2,309	2,082	2,082
R-squared	0.53	0.60	0.88	0.35	0.82

Note: $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$. Standard errors clustered at bank and post level.

Back

Loan rate, lagged deposit dependence

$$i^{\ell}_{jt} = \beta \cdot \mathbf{1}_{t \geq 2000} + \gamma \cdot D/L_{j,t-1} + \boldsymbol{\delta} \cdot \mathbf{1}_{t \geq 2000} \cdot D/L_{j,t-1} + X_{jt} + \epsilon_{jt}$$

Table: Dependent variable: Interest on loans / Loans

Sample: 1990-2010	All banks			Regional banks	
	(1)	(2)	(3)	(4)	(5)
Post	-4.33***				
	(0.38)				
$D/L_{j,t-1}$	-1.08***	0.06	-0.12	-0.13	-0.72***
	(0.40)	(0.10)	(0.26)	(0.32)	(0.22)
Post x $D/L_{j,t-1}$	2.35***	1.27***	1.01***	5.07***	1.27***
	(0.42)	(0.17)	(0.18)	(0.59)	(0.36)
Constant	5.41***				
	(0.35)				
Year f.e.s		Y	Y	Y	Y
Bank f.e.s			Y		Y
Post x max(NPL)			Y		Y
Post x Total Assets$_{j,1990}$			Y		Y
Observations	2,309	2,309	2,309	2,082	2,082
R-squared	0.44	0.95	0.99	0.96	0.99

Note: $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$. Standard errors clustered at bank and post level.

Back

Net interest income over assets

Table: Dependent variable: Net Interest Income over Assets (%)

Sample: 1990-2010	All banks			Regional banks	
	(1)	(2)	(3)	(4)	(5)
Post	1.68***				
	(0.23)				
D/L 1990	3.67***	3.67***	3.52***	1.15***	
	(0.23)	(0.23)	(0.33)	(0.31)	
Post x D/L	-2.08***	-2.08***	-1.64***	-0.60	-0.14
	(0.26)	(0.26)	(0.28)	(0.39)	(0.23)
Constant	-0.97***				
	(0.20)				
Year f.e.s		Y	Y	Y	Y
Bank f.e.s			Y		Y
Post x max(NPL)			Y		Y
Post x Total Assets$_{j,1990}$			Y		Y
Observations	2,309	2,309	2,309	2,082	2,082
R-squared	0.39	0.45	0.83	0.17	0.82

Note: $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$. Standard errors clustered at bank and post level.

Back

Net ordinary income over assets

Table: Dependent variable: Net Ordinary Income over Assets (%)

Sample: 1990-2010	All banks			Regional banks	
	(1)	(2)	(3)	(4)	(5)
Post	1.33***				
	(0.39)				
D/L 1990	1.33***	1.33***	1.42***	4.32***	
	(0.30)	(0.27)	(0.46)	(1.63)	
Post x D/L	-1.64***	-1.64***	-0.79	-3.10	-1.83**
	(0.43)	(0.39)	(0.79)	(2.17)	(0.75)
Constant	-0.97***				
	(0.28)				
Year f.e.s		Y	Y	Y	Y
Bank f.e.s			Y		Y
Post x max(NPL)			Y		Y
Post x Total Assets$_{j,1990}$			Y		Y
Observations	2,309	2,309	2,309	2,082	2,082
R-squared	0.02	0.11	0.21	0.10	0.33

Note: $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$. Standard errors clustered at bank and post level.

Back

Net income over assets

Table: Dependent variable: Net Income over Assets (%)

Sample: 1990-2010	All banks			Regional banks	
	(1)	(2)	(3)	(4)	(5)
Post	0.86***				
	(0.30)				
D/L 1990	0.93***	0.93***	1.00***	3.02***	
	(0.21)	(0.19)	(0.33)	(1.14)	
Post x D/L	-1.08***	-1.08***	-0.43	-2.28	-1.35**
	(0.33)	(0.30)	(0.59)	(1.52)	(0.54)
Constant	-0.68***				
	(0.19)				
Year f.e.s		Y	Y	Y	Y
Bank f.e.s			Y		Y
Post x max(NPL)			Y		Y
Post x Total Assets$_{j,1990}$			Y		Y
Observations	2,309	2,309	2,309	2,082	2,082
R-squared	0.02	0.11	0.21	0.11	0.33

Note: $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$. Standard errors clustered at bank level.

◂ Back

Interest income insufficient to offset expenses

Dependent variable: Interest income / assets$_{j,t}$, (%)

Sample: 1990-2010	All banks (1)	(2)	(3)	Regional banks (4)	(5)
Post	-3.51***				
	(0.14)				
$\hat{\alpha}_{j,1990}$	-0.23***	-0.23***	-0.34***	-0.10	0.00
	(0.03)	(0.03)	(0.02)	(0.08)	(.)
Post x $\hat{\alpha}_{j,1990}$	0.32***	0.32***	0.36***	0.17	0.12***
	(0.03)	(0.03)	(0.03)	(0.11)	(0.04)
Constant	5.02***				
	(0.12)				
Year f.e.s		Y	Y	Y	Y
Bank f.e.s			Y		Y
Post x max(NPL)			Y		Y
Post x Total Assets$_{j,1990}$			Y		Y
Observations	2,309	2,309	2,309	2,082	2,082
R-squared	0.56	0.95	0.97	0.96	0.99

Note: $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$. Standard errors clustered at bank and post level.

Back

Fees over assets

Table: Dependent variable: Fees/ Assets (%)

Sample: 1990-2010	All banks			Regional banks	
	(1)	(2)	(3)	(4)	(5)
Post	-0.01				
	(0.31)				
$\hat{\alpha}_{j,1990}$	-0.10*	-0.10*	0.01	0.03*	0.00
	(0.06)	(0.06)	(0.02)	(0.02)	(.)
Post x $\hat{\alpha}_{j,1990}$	0.02	0.02	0.06***	-0.04	-0.01
	(0.07)	(0.07)	(0.02)	(0.03)	(0.01)
Constant	0.62**				
	(0.25)				
Year f.e.s		Y	Y	Y	Y
Bank f.e.s			Y		Y
Post x max(NPL)			Y		Y
Post x Total Assets$_{j,1990}$			Y		Y
Observations	2,309	2,309	2,309	2,082	2,082
R-squared	0.19	0.22	0.82	0.47	0.83

Note: $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$. Standard errors clustered at bank and post level.

Back

General and administrative expenses over assets

Table: Dependent variable: G&A/ Assets (%)

Sample: 1990-2010	All banks (1)	(2)	(3)	Regional banks (4)	(5)
Post	0.24*				
	(0.14)				
$\hat{\alpha}_{j,1990}$	0.26***	0.26***	0.16***	0.38***	0.00
	(0.03)	(0.03)	(0.03)	(0.06)	(.)
Post x $\hat{\alpha}_{j,1990}$	-0.10***	-0.10***	-0.08***	-0.09	-0.07***
	(0.03)	(0.03)	(0.03)	(0.08)	(0.03)
Constant	0.35***				
	(0.10)				
Year f.e.s		Y	Y	Y	Y
Bank f.e.s			Y		Y
Post x max(NPL)			Y		Y
Post x Total Assets$_{j,1990}$			Y		Y
Observations	2,309	2,309	2,309	2,082	2,082
R-squared	0.37	0.40	0.90	0.22	0.88

Note: $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$. Standard errors clustered at bank and post level.

◂ Back

Dividend payments over assets

Table: Dependent variable: Divident payments/ Assets (%)

Sample: 1990-2010	All banks			Regional banks	
	(1)	(2)	(3)	(4)	(5)
Post	0.11***				
	(0.03)				
$\hat{\alpha}_{j,1990}$	-0.00**	-0.00*	0.01	0.00	0.00
	(0.00)	(0.00)	(0.01)	(0.00)	(.)
Post x $\hat{\alpha}_{j,1990}$	-0.02***	-0.02***	-0.01**	-0.02***	-0.02***
	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)
Constant	0.03***				
	(0.00)				
Year f.e.s		Y	Y	Y	Y
Bank f.e.s			Y		Y
Post x max(NPL)			Y		Y
Post x Total Assets$_{j,1990}$			Y		Y
Observations	2,309	2,309	2,309	2,082	2,082
R-squared	0.11	0.14	0.30	0.11	0.21

Note: $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$. Standard errors clustered at bank and post level.

Back

Equity issuance over assets

Table: Dependent variable: Equity issuance / Assets (%)

Sample: 1990-2010	All banks			Regional banks	
	(1)	(2)	(3)	(4)	(5)
Post	-0.04				
	(0.08)				
$\hat{\alpha}_{j,1990}$	-0.02*	-0.02*	0.01	-0.03*	0.00
	(0.01)	(0.01)	(0.03)	(0.02)	(.)
Post x $\hat{\alpha}_{j,1990}$	0.00	0.00	-0.02	0.03	0.01
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)
Constant	0.13***				
	(0.04)				
Year f.e.s		Y	Y	Y	Y
Bank f.e.s			Y		Y
Post x max(NPL)			Y		Y
Post x Total Assets$_{j,1990}$			Y		Y
Observations	2,309	2,309	2,309	2,082	2,082
R-squared	0.01	0.06	0.08	0.08	0.10

Note: $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$. Standard errors clustered at bank and post level.

Back

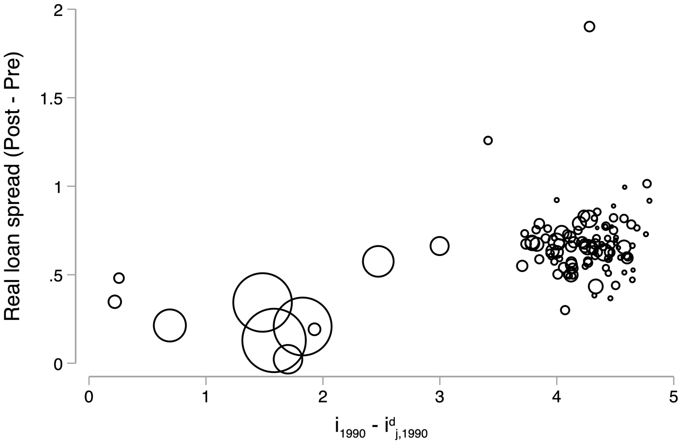
Exposed banks' loan spreads rose since 2000

Scatter: $\hat{\alpha}_j$ vs. Δr^{ℓ}_{jt}

Back

Exposed banks' loan spreads rose since 2000

Scatter: $\hat{\alpha}_j$ vs. Δr^{ℓ}_{jt}



Back

Loan rate

$$i^{\ell}_{jt} = \beta \cdot \mathbf{1}_{t \geq 2000} + \gamma \cdot \hat{\alpha}_j + \boldsymbol{\delta} \cdot \mathbf{1}_{t \geq 2000} \cdot \hat{\alpha}_j + X_{jt} + \epsilon_{jt}$$

Table: Dependent variable: Interest on loans / Loans

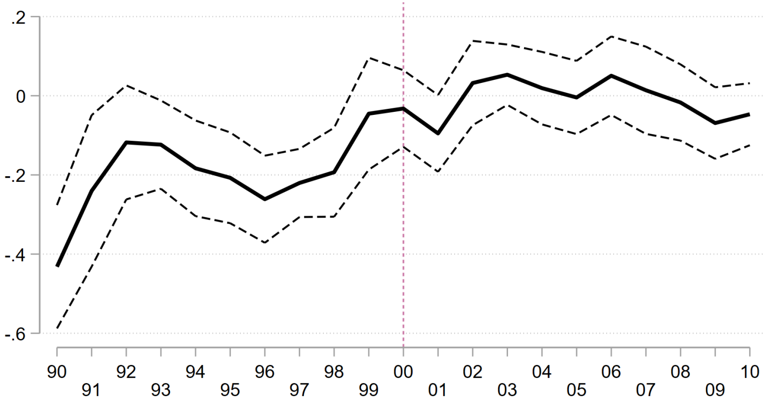
Sample: 1990-2010	All banks			Regional banks	
	(1)	(2)	(3)	(4)	(5)
Post	-2.77***				
	(0.15)				
$\hat{\alpha}_{j,1990}$	0.01	0.01	-0.03**	0.06	-0.11*
	(0.02)	(0.02)	(0.01)	(0.10)	(0.06)
Post x $\hat{\alpha}_{j,1990}$	0.14***	0.14***	0.17***	0.14	0.11***
	(0.04)	(0.04)	(0.02)	(0.13)	(0.04)
Constant	4.45***				
	(0.08)				
Year f.e.s		Y	Y	Y	Y
Bank f.e.s			Y		Y
Post x max(NPL)			Y		Y
Post x Log Assets$_{j,1990}$			Y		Y
Observations	2,309	2,309	2,309	2,082	2,082
R-squared	0.44	0.95	0.99	0.96	0.99

Note: $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$. Standard errors clustered at bank and post level.

Aggregate spreads · Unmerged sample · Deposit dependence · Lagged deposit dependence · Back

Dynamics: δ_t for treatment × year dummies

$$i^{\ell}_{j,t} = \beta_t + \sum_s \boldsymbol{\delta}_s \cdot \mathbf{1}_{t=s} \cdot \hat{\alpha}_j + X_{jt} + \epsilon_{jt}$$



Notes: 90 percent confidence intervals, clustered standard errors (bank-post).

Back

Dynamics: δ_t for treatment × year dummies

$$i^{\ell}_{j,t} = \beta_t + \sum_s \boldsymbol{\delta}_s \cdot \mathbf{1}_{t=s} \cdot \hat{\alpha}_j + X_{jt} + \epsilon_{jt}$$

Notes: 90 percent confidence intervals, clustered standard errors (bank-post).

Robustness regressions

Dependent variable:	μ^{exp}_{jt} (1)	i^{exp}_{jt} (2)	NIM_{jt} (3)	NOI_{jt} (4)	i^{ℓ}_{jt} (5)
A. Baseline results					
$\hat{\alpha}_{j,1990}$	0.62**	-0.67**	0.45**	0.29**	0.01
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Post x $\hat{\alpha}_{j,1990}$	-0.43***	0.52***	-0.20**	-0.34**	0.14**
	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)
Observations	2,288	2,309	2,309	2,309	2,309
R-squared	0.90	0.97	0.61	0.13	0.95
C. Exposure measure: $\hat{\alpha}_{j,1980}$					
$\hat{\alpha}_{j,1980}$	0.84**	-0.90**	0.54**	0.33**	-0.05
	(0.04)	(0.03)	(0.04)	(0.02)	(0.03)
Post x $\hat{\alpha}_{j,1980}$	-0.60**	0.72**	-0.22*	-0.33*	0.24**
	(0.02)	(0.01)	(0.02)	(0.05)	(0.01)
Observations	2,288	2,309	2,309	2,309	2,309
R-squared	0.78	0.96	0.44	0.11	0.95
E. Exposure measure: β_j					
β_j	7.66*	-8.15**	5.18*	2.53	0.15
	(0.61)	(0.56)	(0.52)	(0.45)	(0.41)
Post x β_j	-5.69**	6.70**	-1.96*	-2.52	2.34**
	(0.25)	(0.23)	(0.21)	(1.08)	(0.17)
Observations	2,288	2,288	2,288	2,288	2,288
R-squared	0.66	0.94	0.40	0.10	0.95
G. Sample of unmerged banks					
$\mu^{b}_{j,1990}$	0.63**	-0.67***	0.46**	0.19**	0.02
	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)
Post x $\mu^{b}_{j,1990}$	-0.44***	0.52***	-0.18**	-0.21**	0.15**
	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)
Observations	2,752	2,843	2,843	2,843	2,843
R-squared	0.87	0.97	0.65	0.08	0.95
Controls (all panels):					
Year f.e.s	Y	Y	Y	Y	Y

Dependent variable:	μ^{exp}_{jt} (1)	i^{exp}_{jt} (2)	NIM_{jt} (3)	NOI_{jt} (4)	i^{ℓ}_{jt} (5)
B. Deposits / Liabilities$_{j,1990}$					
D/L 1990	4.49**	-4.87**	3.12*	2.45**	-0.07
	(0.17)	(0.16)	(0.25)	(0.19)	(0.14)
Post x D/L	-3.06**	3.78**	-1.41**	-2.74**	0.93**
	(0.07)	(0.07)	(0.10)	(0.08)	(0.06)
Observations	2,288	2,309	2,309	2,309	2,309
R-squared	0.86	0.97	0.54	0.14	0.95
D. Exposure measure: $\hat{\alpha}_{j,1980}$ (1975-2017)					
$\hat{\alpha}_{j,1980}$	0.86**	-0.88**	0.57**	0.16*	-0.15
	(0.02)	(0.02)	(0.04)	(0.02)	(0.03)
Post x $\hat{\alpha}_{j,1980}$	-0.69***	0.74***	-0.30**	-0.20	0.30**
	(0.01)	(0.01)	(0.02)	(0.06)	(0.01)
Observations	4,577	4,618	4,618	4,618	4,618
R-squared	0.97	0.97	0.66	0.17	0.97
F. Exposure measure: DSS β					
DSS β	-4.36**	4.94**	-3.79**	-1.97*	-0.45
	(0.29)	(0.26)	(0.26)	(0.27)	(0.23)
Post x DSS β	2.80**	-3.73**	1.65**	2.79	-0.90*
	(0.12)	(0.11)	(0.11)	(0.66)	(0.10)
Observations	2,288	2,309	2,309	2,309	2,309
R-squared	0.54	0.93	0.40	0.11	0.95
H. Nominal rate elasticity					
$\hat{\alpha}_{j,1990}$	0.22***	-0.21***	0.26***	0.14	0.17***
	(0.04)	(0.05)	(0.03)	(0.13)	(0.04)
Rate i_t x $\hat{\alpha}_{j,1990}$	0.15***	-0.16***	0.07***	-0.01	-0.07***
	(0.02)	(0.02)	(0.01)	(0.03)	(0.02)
Observations	2,288	2,309	2,309	2,309	2,309
R-squared	0.87	0.97	0.60	0.10	0.95
Controls (all panels):					
Year f.e.s	Y	Y	Y	Y	Y

Notes: Significance follows * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors are double clustered at the bank and pre/post level. $\mu^{exp}_{jt} = i_t - i^{exp}_{jt}$ where i^{exp}_{jt} are interest expense rate and i_t is the three-month libor. We extract the business cycle component of μ^{exp}_{jt} bank-by-bank using an HP filter and remove it. NIM is interest income rate minus the interest expense rate. NOI is net ordinary income, the sum of net interest income and net non-interest income. i^{ℓ}_{jt} is the realized loan rate.

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Disciplining the model

Use 1990 as baseline steady state, transition to low i:

- Cash and liquidity preferences
  - Household cash holdings (FOF: 4% $\rightarrow$ 11%)
  - Empirical for funding spreads (average, cross section)
- Bank frictions
  - Fixed ROE
  - Estimated loan spread
  - Elasticity of loans to equity (using capital injections)
- Macro parameters
  - Standard
  - Share of non-pledgeable capital: match loans to GDP

Current version: smooth leverage costs $c_j(\ell_j, e_j)$, two bank types (H,L), leverage advantage for L, minimum cash $\bar{m}$ and liquidity.

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Empirical targets in data and model (%)

Moment	Data	Model
Savings		
Average initial $i - i^d$	0.87	1.18
$\Delta(i - i^d)_{post-pre}$	-0.84	-0.84
Diff-in-diff $i - i^d$	-0.56	-0.26
Cash holdings, pre	4.0	4.8
Cash holdings, change	7.0	7.5
Loans-to-Liabilities	65.0	59.4
Lending		
$i - i^\ell$ spread, initial equilibrium	1.64	1.60
Loans-to-Assets ratio	58	53
Loan market share of "low" banks	63.0	63.0
Lending response to equity injection	1.66	1.42
Equity		
Return on Equity	8.0	9.3

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Empirical results used in calibration

$$i^b_{pre} = 6.54 - 4.87 \frac{\text{Deposits}}{\text{Liabilities}}_{j,1990}$$

$$i^b_{post} = (6.54 - 5.61) - (4.87 + 4.03) \frac{\text{Deposits}}{\text{Liabilities}}_{j,1990}$$

Three targets based on average, diff-in-diff:

	D/L_{1990}	Pre ($i = 3.5\%$) i^b	$i - i^b$	Post ($i = 0.5\%$) i^b	$i - i^b$	Post-Pre diff
Average	0.81	2.60	0.80	0.25	-0.05	-0.85
Low	0.76	2.83	0.56	0.29	-0.09	-0.65
High	0.95	1.91	1.48	0.13	0.07	-1.41
diff	0.19	-0.92	0.92	-0.16	0.16	-0.76

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Fitted parameters

Parameter	Description	Value
Savings		
$\bar{L}$	Liquid savings shifter	3.5
λ	Elasticity of liquid savings	43.0
$\bar{m}$	Minimum cash holdings	0.11
α_m	Cash shifter	1.04
α_H	H bank advantage	1.26
$\frac{1}{\varepsilon^b - 1}$	EOS across bank savings	0.58%
$\frac{1}{\eta - 1}$	EOS across bank and cash	0.022%
Lending		
$\bar{\gamma}$	Maximal equity-to-capital ratio	15.87%
κ_L	Asset cost parameter	0.21%
ζ	L bank leverage advantage	0.53
$\frac{1}{\varepsilon^l - 1}$	EOS across bank loans (mark-up)	0.7

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Macro parameters

Table: Macroeconomic parameters for initial steady state.

Parameter	Description	Value
$\bar{n}$	HH labor supply	1
δ	Capital depreciation	0.1
α	Capital share	0.35
ν	Scale parameter	0.85
ρ	NP Capital share	0.5
β	Discount factor	0.98
i	Nominal rate	3.4

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Real rate drop

- Assume instead that $\Delta r^* = \Delta i, \Delta\pi = 0$
- There are three scenarios:
  1. $\frac{d\log l}{d\log e}$ is roughly constant (no non-linearities): equivalent shift in loan supply
  2. $\frac{d\log l}{d\log e}$ is non-linear, and r^* drops because β rises
     - Saving and investment boom $\rightarrow$ banks benefit
     - Mitigation of loan supply shift
  3. $\frac{d\log l}{d\log e}$ is non-linear, and r^* drops because productivity (consumption growth) drops
     - Saving and investment bust $\rightarrow$ banks benefit
     - Amplification of loan supply shift

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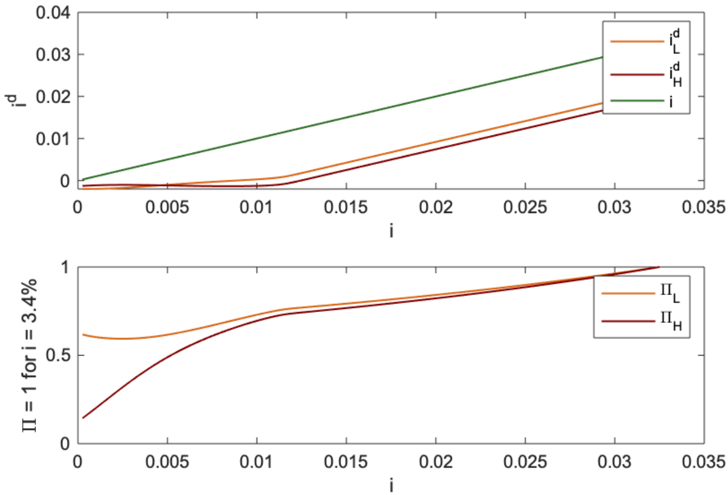
Equilibrium rates and profits fall



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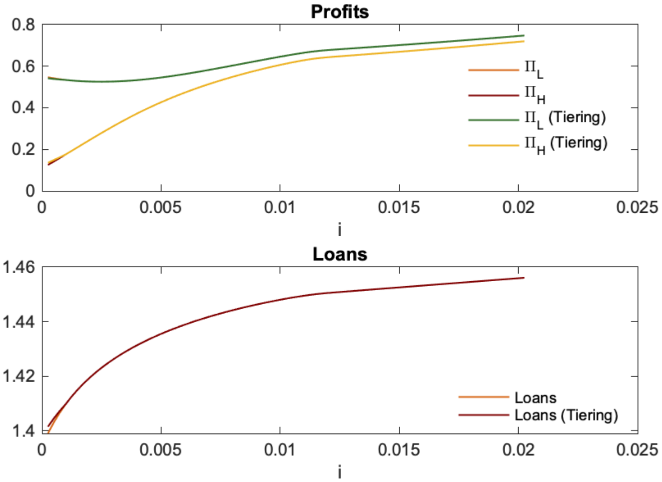
Tiering in the model

Effect of Tiering on Profits, Loans



Notes: Implementation assumes bond holdings include reserves equal to 20% of assets at $i = 0$; apply $i^R = 0.05\%$ on 80% of R.

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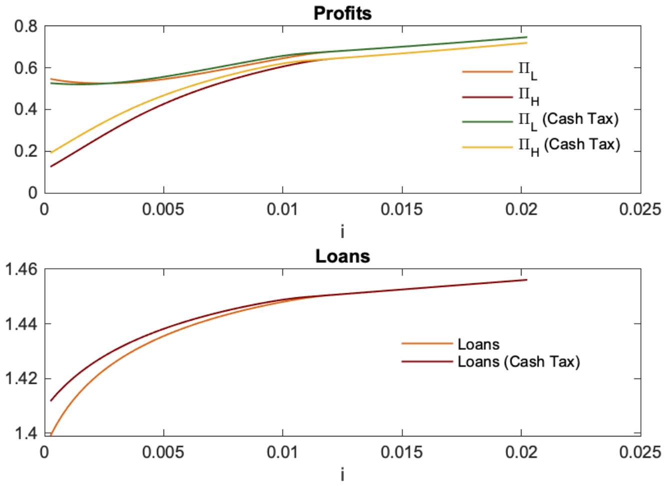
Nominal return on cash at -0.1%

Effect of Cash Tax on Capital, Rates



Notes: Agarwal and Kimball (2019) suggest establishing an electronic money system which targets the exchange rate between paper currency and reserves, which discounts withdrawals and charges deposit fees.

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