Bank Concentration and Monetary Policy Pass-Through

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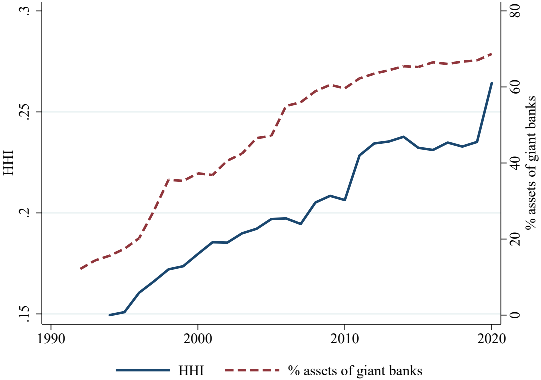
Motivation: Rise in U.S. Bank Concentration

1. **Local** Herfindahl-Hirschman Index (HHI) increased from 15% to 26%

2. Asset share of **giant** banks increased from 10% to 60%



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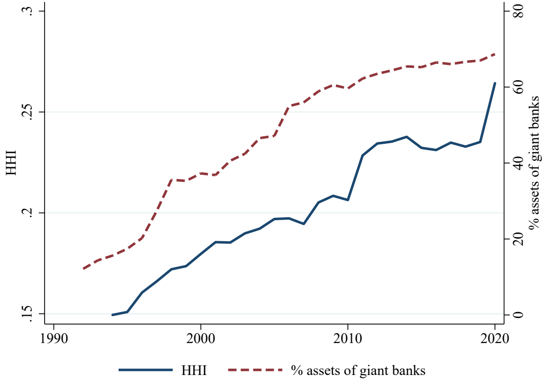

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Research Question

Research question:

How does rising bank concentration alter monetary transmission?

1. Market power channel:

   ⇒ Local bank concentration → markup → pass-through

2. Capital allocation channel:

   ⇒ Bank capital regulation → marginal cost → pass-through

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This Paper in a Nutshell

1. Uses **granular** deposit and loan rate data from *RateWatch* to quantify
   - Cross-sectional **pass-through** of monetary shocks to loan rates
   - Contribution of **local** bank concentration and **bank** capitalization
2. Uses theoretical model to rationalize empirical findings
   - Accounts for differences across banks and branches
   - Explicit modeling of bank market power and capital ratios
3. Uses quantitative framework to assess macroeconomic impact
   - Embeds theoretical model into New Keynesian model
   - Quantify change in transmission due to rising bank concentration
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Main Findings

1. **Empirical results** show that policy rate pass-through to loan rates
   - Is larger for *branches* in high vs. low concentration markets ($\sim 2\times$)
   - Is larger for *banks* with low vs. high capital ratio ($\sim 1.5\times$)
2. **Quantitative framework** reveals that rising bank concentration
   - → Amplifies monetary transmission to real economy
   - → Dampens effect on nominal variables
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Data and Empirical Findings

Combination of Banking Data Sources

1. Deposit and loan rates, *branch level*, monthly, *RateWatch* survey instrument
    - Coverage: U.S. commercial banks
    - Sample of different banking products
    - 1-year hybrid adjustable-rate mortgage (ARM) %
    - Loan rate quotes for prime customer, fixed loan amount ($175k)
    - Time period: 2000:M1 - 2019:M3
2. Bank balance sheet, *bank level*, quarterly, *FDIC* bank indicators (e.g., capital ratio)
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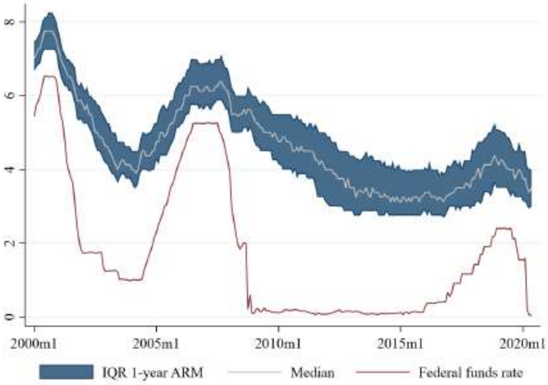
Rate Dispersion across Banks and Branches



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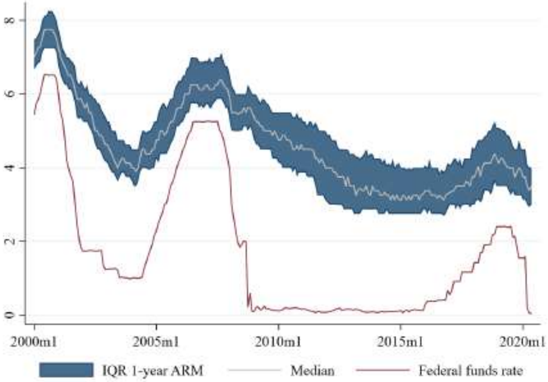

- IQR across *banks* in the same market: 1.03
- IQR across *branches* of the same bank: 0.32

deposit rate | decomposition | other loan rates

Monetary Policy Pass-Through in the Cross-Section

Local projections:

$$r_{t+h,i,c} - r_{t-1,i,c} = \alpha_i^h + \boldsymbol{\beta}^{\boldsymbol{h}} s_t + \underbrace{\boldsymbol{\gamma}^{\boldsymbol{h}} s_t \times X_{t,i,c}}_{\text{local HHI or bank capitalization}} + \theta^h X_{t,i,c} + \eta^h Z_{t,c} + \epsilon_{t+h,i,c}$$

- s_t monetary surprise (Nakamura and Steinsson, 2018) time-series
- $X_{t,i,c}$ county-level HHI, bank capital to assets ratio
- $Z_{t,c}$ controls for national and local economic conditions

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Pass-through | High: $\beta^h + \gamma^h X^{high}$

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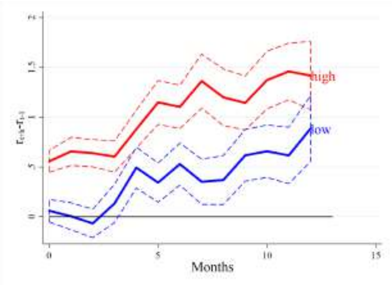
Pass-Through by Bank Concentration and Capitalization

Local bank concentration



- Monetary shock scaled to a 1 p.p. impact increase in federal funds rate.

HMDA mortg. conc. | other monetary shocks | other rates | rural vs. urban | dep % vs. # of banks

Pass-Through by Bank Concentration and Capitalization

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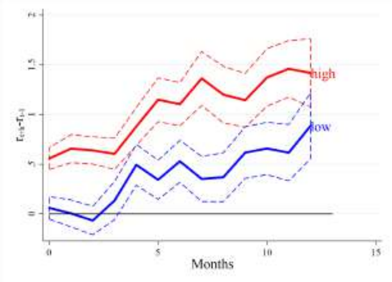
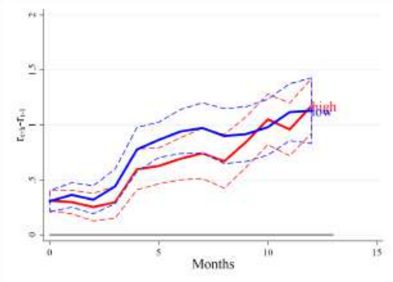


Bank capitalization



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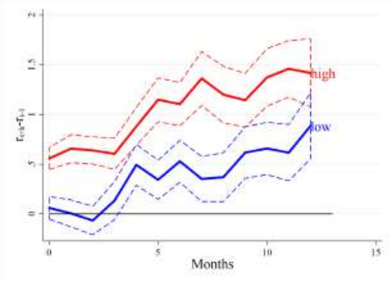

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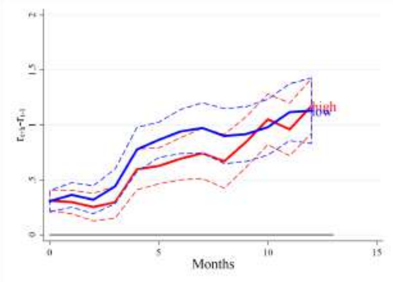

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Simple Model of Heterogeneous Pass-Through

Monopolistic Competition and Heterogeneous Banks

$$\max_{r_i^{d,c}, r_i^{l,c}} \quad \Pi_i^c = r_i^{l,c} L_i^c(r^{l,c}) + r^f R_i^c - r_i^d D_i^c(r^{d,c})$$

s.t.

1. Bank capital requirement: $K_i^{b,c} \geq \underbrace{\nu_i^b}_{\text{bank-specific}} L_i^c$,

2. Local loan demand and deposit supply:*

$$L_i^c = \left(\frac{r_i^{l,c}}{\bar{r}^{l,c}}\right)^{-\overbrace{\epsilon^{l,c}}^{\text{location-specific f(HHI)}}} \bar{L}^c \qquad D_i^c = \left(\frac{r_i^{d,c}}{\bar{r}^{d,c}}\right)^{-\overbrace{\epsilon^{d,c}}^{\text{location-specific f(HHI)}}} \bar{D}^c,$$

3. Balance sheet constraint: $L_i^c + R_i^c = D_i^c + K_i^{b,c}$

*CES setup is isomorphic to heterogeneous borrowers with stochastic utility and EV distribution (Ulate, 2021)

Monopolistic Competition and Heterogeneous Banks

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$$\max_{r_i^{d,c}, r_i^{l,c}} \ \Pi_i^c = r_i^{l,c} L_i^c(r^{l,c}) + r^f R_i^c - r_i^d D_i^c(r^{d,c})$$

s.t.

1. Bank capital requirement: $K_i^{b,c} \geq \underbrace{\nu_i^b}_{\text{bank-specific}} L_i^c,$

2. Local loan demand and deposit supply:*

$$L_i^c = \left(\frac{r_i^{l,c}}{\bar{r}^{l,c}}\right)^{-\overbrace{\epsilon^{l,c}}^{\text{location-specific f(HHI)}}} \bar{L}^c \qquad D_i^c = \left(\frac{r_i^{d,c}}{\bar{r}^{d,c}}\right)^{-\overbrace{\epsilon^{d,c}}^{\text{location-specific f(HHI)}}} \bar{D}^c,$$

3. Balance sheet constraint: $L_i^c + R_i^c = D_i^c + K_i^{b,c}$

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Branch-Specific Loan Rate Decision and Pass-Trough

$$r_i^{l,c} = \underbrace{\frac{\epsilon^{l,c}}{(\epsilon^{l,c}-1)}}_{\substack{\text{markup} \\ \text{("local market")}}} \underbrace{(r^f + \nu_i^b \overbrace{\phi_i}^{\substack{\text{multiplier} \\ \text{on capital} \\ \text{constraint}}})}_{\substack{\text{marginal cost} \\ \text{("bank heterogeneity")}}}$$

$$\frac{dr_i^{l,c}}{dr^f} = \underbrace{\frac{\epsilon^{l,c}}{(\epsilon^{l,c}-1)}}_{\substack{\textit{market power} \\ \textit{channel}}} + \frac{\epsilon^{l,c}}{(\epsilon^{l,c}-1)} \underbrace{\nu_i^b \frac{d\phi_i}{dr^f}}_{\substack{\textit{capital allocation} \\ \textit{channel}}}$$

deposit rate

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deposit rate

Quantitative Assessment of Rise in Bank Concentration

Credit and Banking New Keynesian Model Gerali et al. (2010)

- Patient households save, consume, work + own housing Saver's problem
- Impatient households borrow to consume + housing Borrower's problem
- Entrepreneurs borrow to invest in capital + produce Entrepreneur's problem
- Price and wage rigidities Phillips curve
- Investment adjustment costs Capital producer
- Monetary authority operates via Taylor rule Policy rate
- Calibration of standard parameters follows Gerali et al. (2010) Calibration
- Banking sector w/ monopolistic competition + fin. frictions Repres. bank

Heterogeneous Banking Sector

Heterogeneity along two dimensions:

1. Different demand / supply elasticities in local markets: $\epsilon^{l,c}$ / $\epsilon^{d,c}$

   → Markups vary across *branches* (regions)

   → Calibrated to average markups in high/low-conc. markets

2. Size-dependent bank capital requirements: ν_i^b

   → Marginal costs vary *bank institutions*

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Counterfactual: Dimensions of Rise in Bank Concentration

Compared to 1994, in 2019 increasing

1. % of high-concentration markets: α^m
2. % of giant banks: α^b
3. Markups across all banks:* ϵ
4. Bank capital across all banks:* ν^b

* "Missing intercept", time trend

calibration details results

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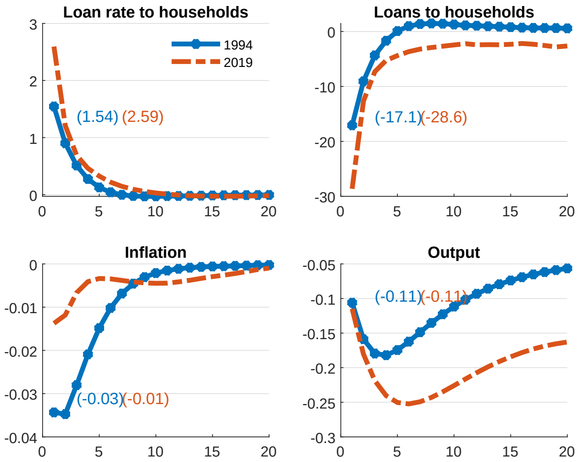
Effect Rise in Bank Concentration on Monetary Transmission



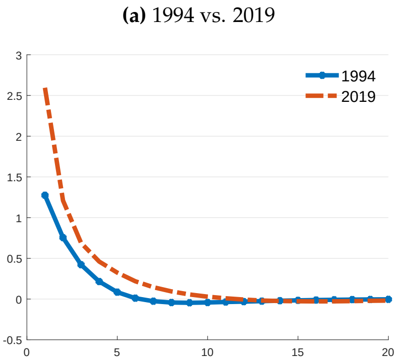
more variables Phillips curve

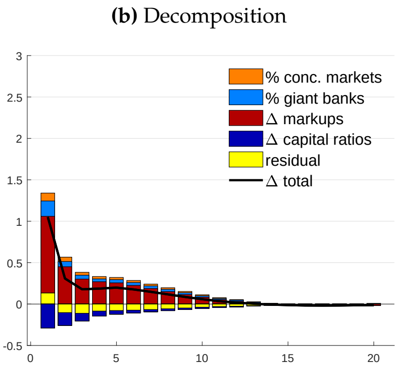
Decomposition of Change in Pass-Through over Time

$$\Delta^{\Sigma}_{t+h} = \underbrace{\Delta^{\alpha^m}_{t+h}}_{\text{\% high-concentration markets}} + \underbrace{\Delta^{\alpha^b}_{t+h}}_{\text{\% giant banks}} + \underbrace{\Delta^{\epsilon}_{t+h}}_{\text{markup}} + \underbrace{\Delta^{\nu^b}_{t+h}}_{\text{bank capital ratio}} + \underbrace{res_{t+h}}_{\text{interaction}},$$

where $\Delta^{j}_{t+h} = IRF^{j,2019}_{t+h} - IRF^{j,1994}_{t+h} \ \ \forall j \in \{\Sigma, \alpha^m, \alpha^b, \epsilon, \nu^b, res\}$.

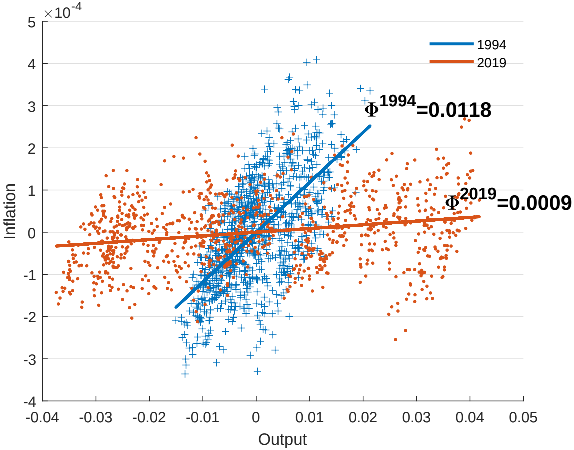
Decomposition of Pass-Through to Loan Rates





loans to households | output | inflation

Implications on the Slope of the Phillips Curve



Conclusion

- Rise in bank concentration leads to higher pass-through
- Implications for the transmission of monetary policy
- Flattening of the Phillips Curve
- Monetary policy is more effective in stimulating the economy

Extensions and robustness checks:

- Borrowing constraints on household and firm side financial frictions
- Heterogeneous pass-through across US counties map
- Asymmetric Monetary Policy Pass-Through empirics model

Future work: Pass-through of QE, optimal policy, distributional implications

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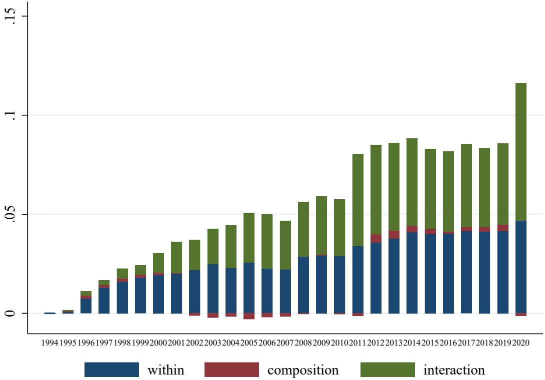
Decomposition of Rise in U.S. Bank Concentration



back

$$HHI_t - HHI_{1994} = \sum_c \left\{ \underbrace{d^c_{94}\left(HHI^c_t - HHI^c_{1994}\right)}_{\text{within}} + \underbrace{HHI_{1994}\left(d^c_t - d^c_{1994}\right)}_{\text{composition}} + \underbrace{\left(d^c_t - d^c_{1994}\right)\left(HHI^c_t - HHI^c_{1994}\right)}_{\text{interaction}} \right\}$$

Survey Instrument from *RateWatch*

"What is the current rate on a 1 year ARM, loan amount $175k, best credit, no discounts, no relationship required?"

Institution Name:
Account Number:
Contact:
Today's Date:

Current Prime Rate:

Send to: submitrates@rate-watch.com

RATE/WATCH
Accurate Financial Data Since 1989
RATEWATCH PHONE 800 348 1831

Mortgages: Please list in-house rates first. If N/A then 2nd market rates. If not offered then N/A the category. Need as close to zero point/fees @ 60 day lock period. Purchase, single family owner occupied.

1 YEAR ARM @ 175K LOAN AMOUNT	FIXED RATE	COMMENTS
RATE		
APR		
DISCOUNT POINTS		
DOWN PAYMENT TO AVOID PMI		
CAPS		
MAX AMORTIZATION TERM		
ORIGINATION FEES		

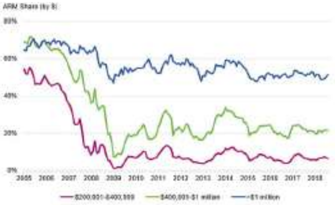
3 YEAR ARM @ 175K LOAN AMOUNT	FIXED RATE	COMMENTS
RATE		
APR		
DISCOUNT POINTS		
DOWN PAYMENT TO AVOID PMI		
CAPS		
MAX AMORTIZATION TERM		
ORIGINATION FEES		

back

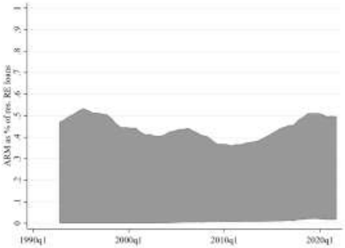
ARM share: Origination and Bank's Balance Sheet

- ARMs popular before the financial crisis
- ARMs less popular in times of low-interest rates
- ARMs make a high % of banks' real estate loans on the balance sheet
  - 26 % of residential real estate loans on average
  - 5 % of total assets on average

% of market origination



% of bank's real estate portfolio



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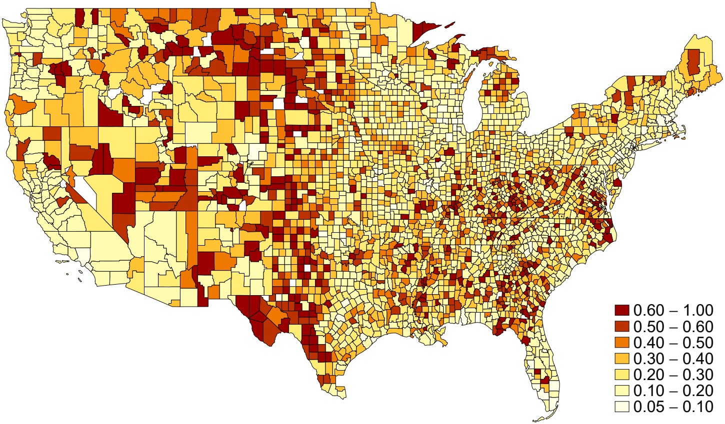
Measuring Local Bank Concentration Across the US



- Large variation in local bank concentration local markets

back

Local Markets for Consumer Loans

National Housing Survey Q1 2019 by Fannie Mae:

- 2 of 5 recent home buyers did not shop around for mortgage lenders
- On average, recent home buyers obtained **2** quotes
- Real estate agent, family and friends, and own experiences decisive
- In Canada, distance to lender on average 1.25 miles; only 28 % of customers switch away from main institution (Allen et al., 2019)
- Higher switching costs in more concentrated markets (Allen et al., 2019)

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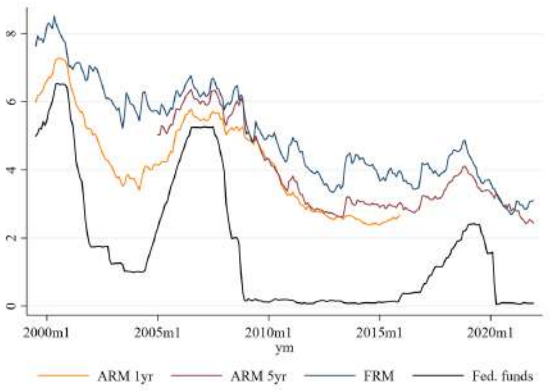
Aggregate Mortgage Rates – Across Types



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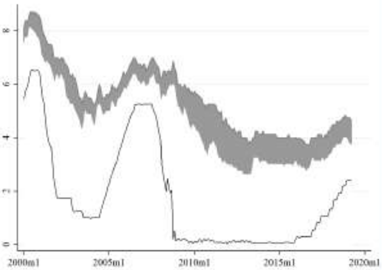
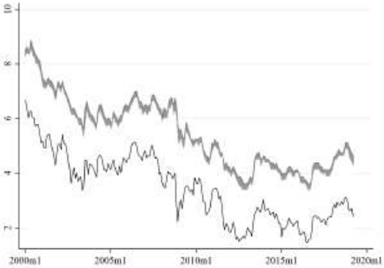
Rate Dispersion, Cyclical Spreads, Asymmetric Adjustment

(a) ARM 5yr



(b) FRM 30yr



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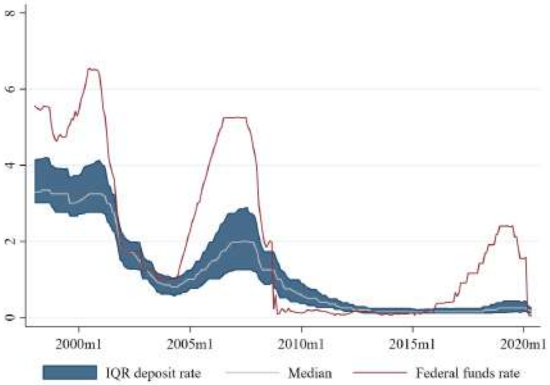

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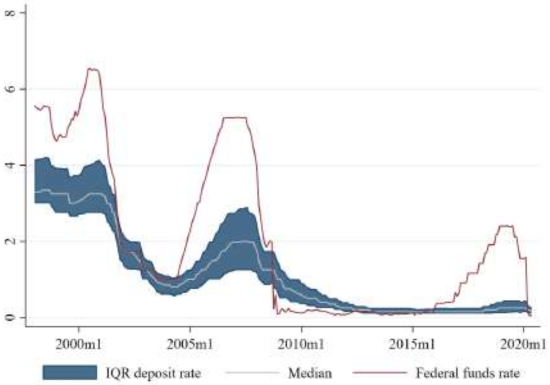

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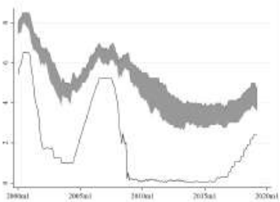
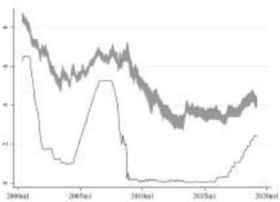
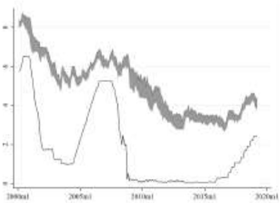


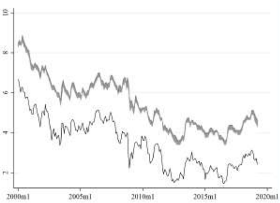
(a) ARM 3-year



(b) ARM 7-year



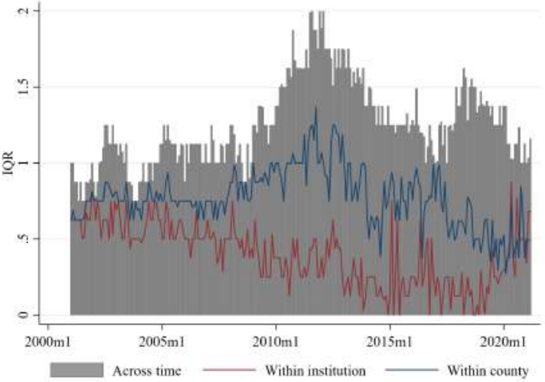
(c) FRM 10-year



(d) FRM 30-year

deposit rate back

Loan Rate Dispersion Within Institutions and Counties



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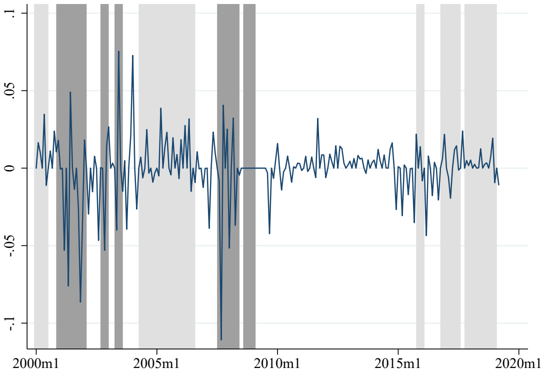
Monetary Policy Shocks Over Time



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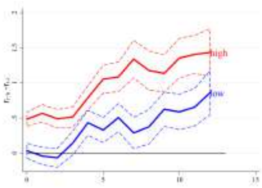
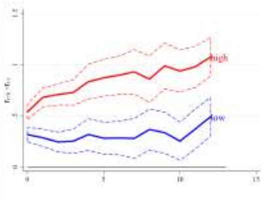
Pass-Through by Bank Concentration: Alternative Shocks

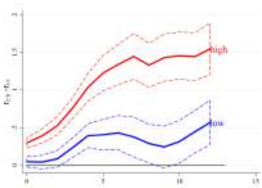
(a) Baseline



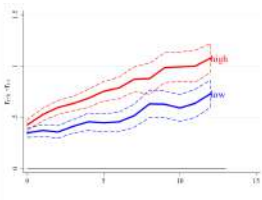
(b) *MP*1



(c) *R&R*



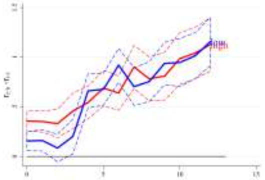
(d) dFF_t



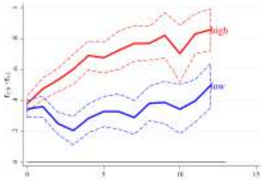
back

Pass-Through by Mortgage Market Concentration

(a) Baseline



(b) *MP*1



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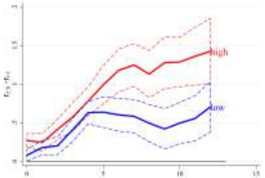

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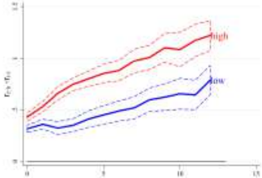
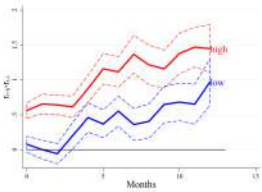
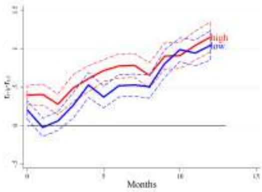


Pass-Through by Concentration: Across Rates

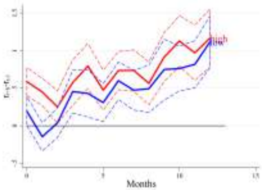
(a) ARM 1yr



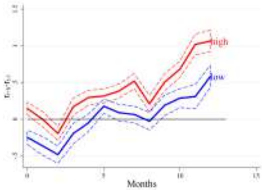
(b) ARM 5yr



(c) ARM 7yr



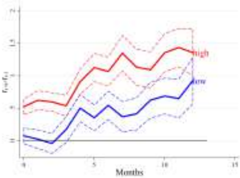
(d) FRM 30yr



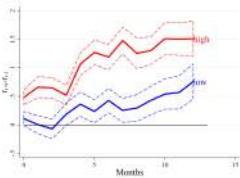
back

Pass-Through by Concentration: Different Measures

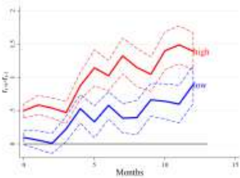
HHI deposits



Branch market share



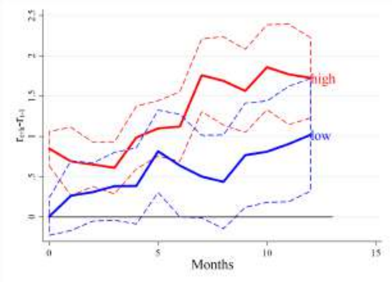
$(\text{\# of banks})^{-1}$



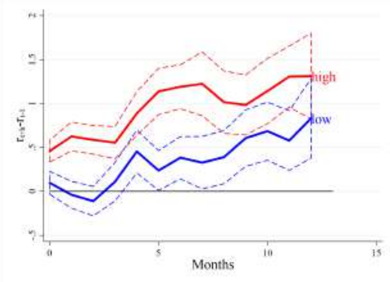
back

Pass-Through by Bank Concentration: Rural vs. Urban Areas

Rural



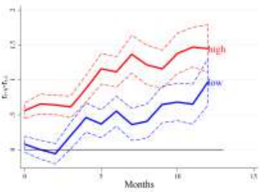
Urban



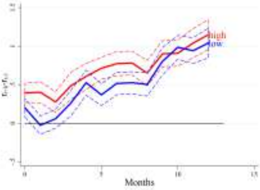
back

Pass-Through by Concentration: Across Rates

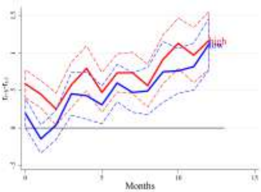
(a) ARM 1yr



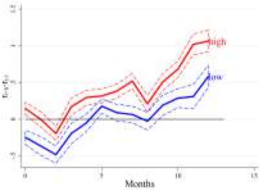
(b) ARM 5yr



(c) ARM 7yr



(d) FRM 30yr



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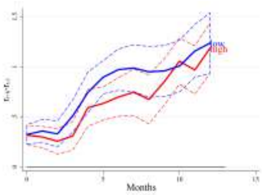
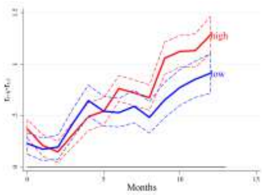
Pass-Through by Capitalization: Across Rates

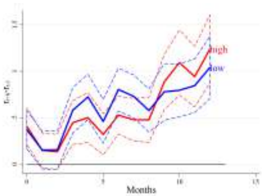
(a) ARM 1yr



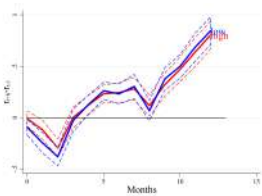
(b) ARM 5yr



(c) ARM 7yr

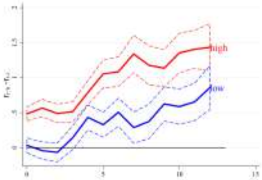


(d) FRM 30yr

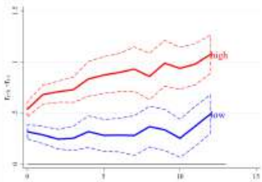


Pass-Through by Concentration: Alternative Shocks

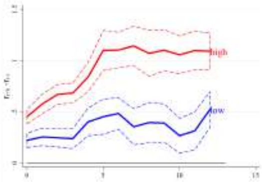
(a) Baseline



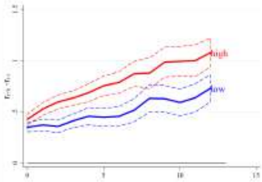
(b) $MP1$



(c) $FF4$



(d) dFF_t



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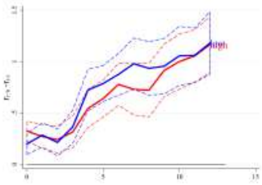
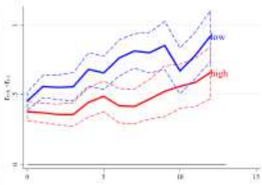
Pass-Through by Capitalization: Alternative Shocks

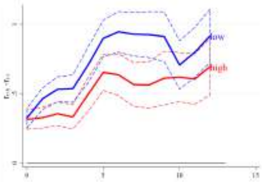
(a) Baseline



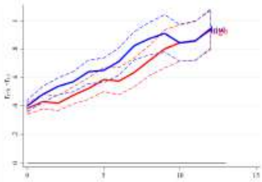
(b) $MP1$



(c) $FF4$



(d) dFF_t



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Asymmetric Pass-Through: Monetary Easing vs. Tightening

State-dependent local projections:

$$r^l_{t+h,i,c} - r^l_{t-1,i,c} = \alpha^h_i + \beta^h s_t + \underbrace{\mathbb{I}\left(\mathbb{E}_{t-1}\Delta r^f_t > 0\right)}_{\text{expected tightening}} \left(\alpha^{h,+}_i + \beta^{h,+} s_t\right)$$

$$+ \underbrace{\mathbb{I}\left(\mathbb{E}_{t-1}\Delta r^f_t < 0\right)}_{\text{expected easing}} \left(\alpha^{h,-}_i + \beta^{h,-} s_t\right) + \eta^h Z_{i,t} + \epsilon_{t+h,i,c}$$

→ "Expected" defined as: $\underbrace{\Delta r^f_t}_{\substack{\text{change} \\ \text{fed funds rate}}} - \underbrace{s_t}_{\substack{\text{monetary} \\ \text{surprise}}}$

Asymmetric Pass-Through: Monetary Easing vs. Tightening

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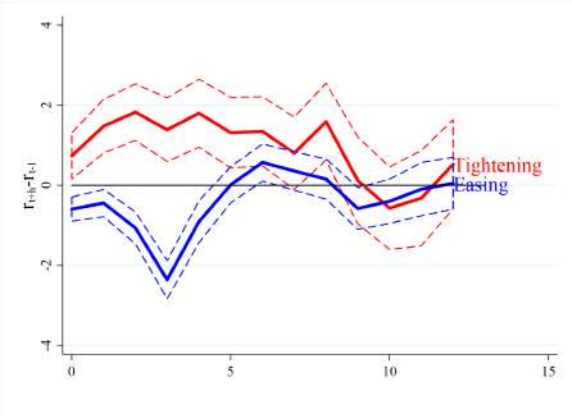
$$+ \underbrace{\mathbb{I}\left(\mathbb{E}_{t-1}\Delta r^f_t < 0\right)}_{\text{expected easing}} \left(\alpha^{h,-}_i + \beta^{h,-} s_t\right) + \eta^h Z_{i,t} + \epsilon_{t+h,i,c}$$

→ "Expected" defined as: $\underbrace{\Delta r^f_t}_{\substack{\text{change} \\ \text{fed funds rate}}} - \underbrace{s_t}_{\substack{\text{monetary} \\ \text{surprise}}}$

Asymmetric Pass-Through: Monetary Easing vs. Tightening



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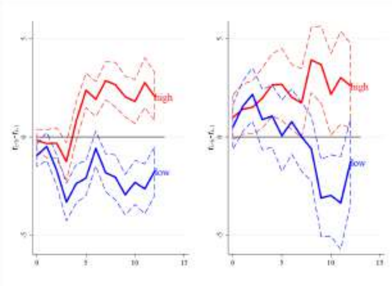
Asymmetric Pass-Through: Concentration and Capitalization

(a) Bank concentration



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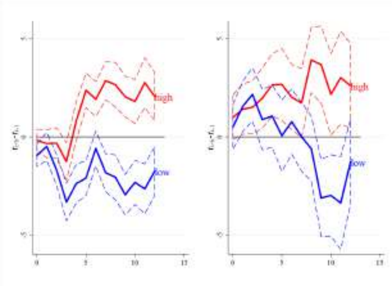
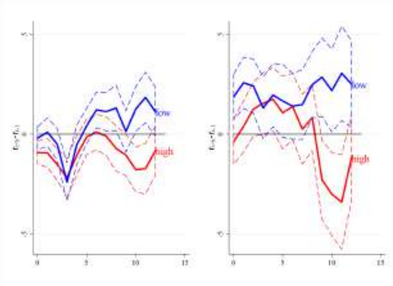
Asymmetric Pass-Through: Concentration and Capitalization

(a) Bank concentration



Bank capitalization



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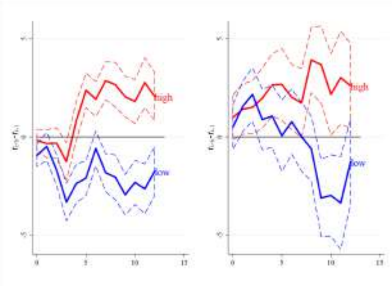
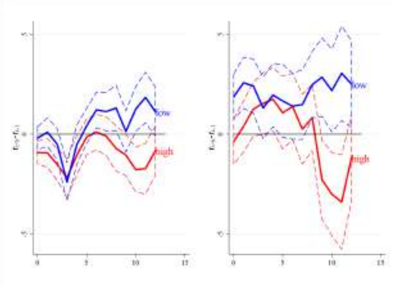
Asymmetric Pass-Through: Concentration and Capitalization

(a) Bank concentration



Bank capitalization



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Branch-Specific Deposit Rate Decision and Pass-Trough

$$r^{d,c} = \underbrace{\frac{\epsilon^{d,c}}{(\epsilon^{d,c} - 1)}}_{\substack{\text{markdown} \\ \text{("local market")}}} r^f$$

$$\frac{dr^{d,c}}{dr^f} = \underbrace{\frac{\epsilon^{d,c}}{(\epsilon^{d,c} - 1)}}_{\substack{\textit{market power} \\ \textit{channel}}}$$

Loan rate

Branch-Specific Deposit Rate Decision and Pass-Trough

$$r^{d,c} = \underbrace{\frac{\epsilon^{d,c}}{(\epsilon^{d,c} - 1)}}_{\substack{\text{markdown} \\ \text{(``local market'')}}} r^f$$

$$\frac{dr^{d,c}}{dr^f} = \underbrace{\frac{\epsilon^{d,c}}{(\epsilon^{d,c} - 1)}}_{\substack{\textit{market power} \\ \textit{channel}}}$$

Loan rate

Calibration of Baseline Model (Gerali et al., 2010)

Parameter	Description	Value
κ^{Kb}	Adjustment costs of bank capital ratio	11.49
δ^b	Management cost of bank	0.1049[a]
β^P	Discount factor of patient household	0.9943
$\beta^{I,E}$	Discount factor of impatient household and entrepreneur	0.975[b]
ϕ	Inverse of Frisch elasticity of labor supply	1
ϵ^h	Weight of housing in utility function	0.2
$a^{P,I,E}$	Habit consumption persistence	0.86
$\epsilon^{m,I}$	Steady-state LTV-ratio for impatient households	0.7[c]
α	Output elasticity with respect to capital	0.25
μ	Share of patient households of labor costs	0.8
ζ_1	Adjustment costs capacity utilization production	0.0478
ζ_2	Adjustment costs for capacity utilization production	0.00478
$\epsilon^{m,E}$	Steady-state LTV-ratio for entrepreneur	0.35[c]
κ_w	Adjustment costs of wages	99.9
ι_w	Indexation of wage inflation to past wage inflation	0.28
ϵ^l	Steady-state labor market markup	5
δ	Depreciation rate of physical capital	0.025
κ_i	Adjustment costs of investment	10.18
κ_p	Adjustment costs of good prices	28.65
ι_p	Indexation of price inflation to past price inflation	0.16
ϵ^y	Steady-state goods market markup	6
ϕ_R	Taylor rule smoothing parameter	0.77
ϕ_π	Taylor rule response to inflation	1.98[d]
ϕ_x	Taylor rule response to output	0.35
σ_r	Standard deviation of monetary shock	0.002

back

Patient Household's Problem

Each patient household i maximizes:

$$\mathbb{E}_t \sum_{t=0}^{\infty} \beta^{P,t} \left[\left(1 - a^P\right) \log\left(c_t^P(i) - a^P c_{t-1}^P\right) + \epsilon^h \log h_t^P(i) - \frac{l_t^P(i)^{1+\phi}}{1+\phi} \right]$$

s.t.

$$c_t^P(i) + q_t^h \left(h_t^P(i) - h_{t-1}^P(i)\right) + d_t^P(i) \leq w_t^P l_t^P(i) + \left(1 + r_{t-1}^d\right) \frac{d_{t-1}^P(i)}{\pi_t} + \tau_t^P(i)$$

Differences to impatient households:

- $\beta^{I,t} < \beta^{P,t}$
- Receives transfer $\tau_t^P(i)$

back

Impatient Household's Problem

Each impatient household i maximizes:

$$\mathbb{E}_t \sum_{t=0}^{\infty} \beta^{I,t} \left[\left(1 - a^I\right) \log\left(c_t^I(i) - a^I c_{t-1}^I\right) + \epsilon^h \log h_t^I(i) - \frac{l_t^I(i)^{1+\phi}}{1+\phi} \right]$$

s.t.

$$c_t^I(i) + q_t^h \left(h_t^I(i) - h_{t-1}^I(i)\right) + b_{t-1}^I(i) \left(1 + r_{t-1}^{bH}\right) / \pi_t \leq w_t^I l_t^I(i) + b_t^I(i)$$

Differences to patient households:

- $\beta^{I,t} < \beta^{P,t}$
- Receives no transfers

back

Entrepreneur's Problem

Each entrepreneur i maximizes:

$$\mathbb{E}_t \sum_{t=0}^{\infty} \beta_E^t \log\left(c_t^E(i) - a^E c_{t-1}^E\right)$$

s.t. $$c_t^E(i) + w_t^I l_t^I(i) + w_t^P l_t^P(i) + \frac{1 + r_{t-1}^{bE}}{\pi_t} b_{t-1}^E(i) + q_t^k k_t^E(i) + \upsilon(u_t(i)) k_{t-1}^E(i) \leq$$

$$\frac{y_t^E(i)}{x_t} + b_t^E(i) + (1-\delta) q_t^k k_t^E(i),$$

$$y_t^E(i) = \varepsilon^a \left[u_t(i) k_{t-1}^E(i)\right]^{\alpha} \left[l_t^E(i)\right]^{1-\alpha} = \left[u_t(i) k_{t-1}^E(i)\right]^{\alpha} \left[\left(l_t^P(i)\right)^{\mu} \left(l_t^I(i)\right)^{(1-\mu)}\right]^{1-\alpha}$$

back

Capital and Final Goods Producers

Investment adjustment costs:

$$k_t = (1-\delta)\, k_{t-1} + \left[1 - \frac{\kappa_i}{2}\left(\frac{i_t}{i_{t-1}} - 1\right)^2\right] i_t$$

$$1 = q_t^k \left[1 - \frac{\kappa_i}{2}\left(\frac{i_t}{i_{t-1}} - 1\right)^2 - \kappa_i \left(\frac{i_t}{i_{t-1}} - 1\right)\frac{i_t}{i_{t-1}}\right] + \beta^E \mathbb{E}_t \frac{\lambda_{t+1}^E}{\lambda_t^E} q_{t+1}^k \kappa_i \left(\frac{i_{t+1}}{i_t} - 1\right)\left(\frac{i_{t+1}}{i_t}\right.$$

Phillips curve:

$$0 = 1 - \varepsilon^y + \frac{\varepsilon^y}{x_t} - \kappa_p \left(\pi_t - \pi_{t-1}^{\iota_p} \pi^{1-\iota_p}\right)\pi_t + \beta^P \mathbb{E}_t \left[\frac{\lambda_{t+1}^P}{\lambda_t^P}\kappa_p \left(\pi_{t+1} - \pi_t^{\iota_p} \pi^{1-\iota_p}\right)\pi_{t+1}\frac{y_{t+1}}{y_t}\right]$$

back

Central Bank

Central bank follows a standard Taylor rule:

$$(1 + r_t^f) = (1 + r^f)^{(1-\phi_R)} (1 + r_{t-1}^f)^{\phi_R} \left(\frac{\pi_t}{\pi}\right)^{\phi_\pi \ (1-\phi_R)} \left(\frac{y_t}{y_{t-1}}\right)^{\phi_y \ (1-\phi_R)} \varepsilon_t^R$$

back

Banking Sector with Representative Bank

Wholesale Unit:

$$\pi_t K_t^b = \left(1 - \delta^b\right) K_{t-1}^b + \Pi_{t-1}^b$$

$$\max_{B_t, d_t^p} \mathbb{E}_t \sum_{t=0}^{\infty} \Lambda_{0,t}^P \left[R_t^b B_t - R_t^d d_t^p - \mathbb{A}_{KB} \left(\frac{K_t^b}{B_t} \right) K_t^b \right] \text{ s.t. } B_t = d_t^p + K_t^b$$

Deposit branches:

$$\max_{r_t^d} \mathbb{E}_t \sum_{t=0}^{\infty} \Lambda_{0,t}^P \left[R_t^d d^p(r_t^d) - r_t^d d^p(r_t^d) - \mathbb{A}_D \left(d^p(r_t^d) \right) \bar{r}_t^d \bar{d}_t^p \right] \text{ s.t. } d^p(r_t^d) = \left(\frac{r_t^d}{\bar{r}_t^d} \right)^{-\epsilon^d} \bar{d}_t^p$$

Loan branches:

$$\max_{r_t^l} \mathbb{E}_t \sum_{t=0}^{\infty} \Lambda_{0,t}^P \left[r_t^l b_t^l(r_t^l) - R_t^b b_t^l(r_t^l) - \mathbb{A}_l \left(b_t^l(r_t^l) \right) \bar{r}_t^l \bar{b}_t^l(r_t^l) \right] \text{ s.t. } b_t^l(r_t^l) = \left(\frac{r_t^l}{\bar{r}_t^l} \right)^{-\epsilon^l} \bar{b}_t^l$$

$\forall \; l \in \; \{bH, bE\}$

back

Banking Sector with Representative Bank

Wholesale unit:

$$R_t^b = r_t^f - \kappa_{KB}\left(\frac{K_t^b}{B_t} - \nu^b\right)\left(\frac{K_t^b}{B_t}\right)^2.$$

Deposit branches:

$$-\epsilon^d \frac{R_t^d}{r_t^d} + \left(\epsilon^d - 1\right) + \epsilon^d \kappa_d \left(\frac{d_t^p}{d_{ss}^p} - 1\right)\frac{d_t^p}{d_{ss}^p} = 0$$

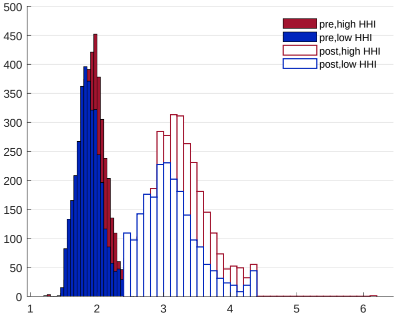
Loan branches $\forall\ l \in \{bH, bE\}$:

$$-\left(\epsilon^l - 1\right) + \epsilon^l \frac{R_t^b}{r_t^l} + \epsilon^l \kappa_l \left(\frac{b_t^l}{b_{ss}^l} - 1\right)\frac{b_t^l}{b_{ss}^l} + \frac{\epsilon^l}{\psi_l}\left\{\exp\left[\psi_l\left(\frac{b_t^l}{b_{ss}^l} - 1\right)\right] - 1\right\}\frac{b_t^l}{b_{ss}^l} = 0$$

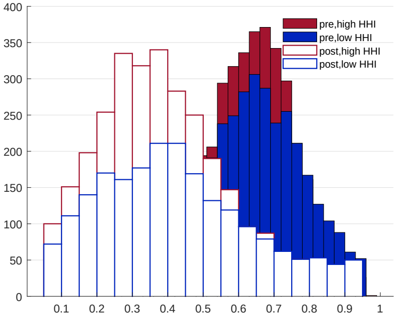
back

Markups and Markdowns across Time and Groups

(a) Markups



(b) Markdowns



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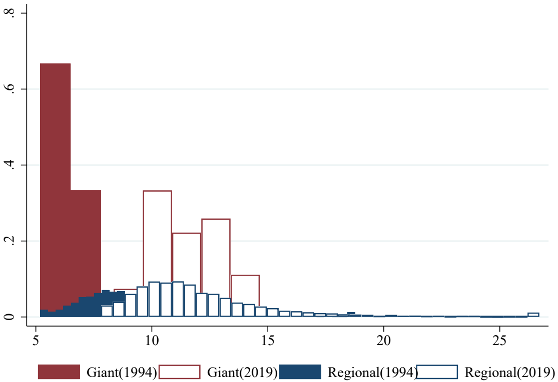
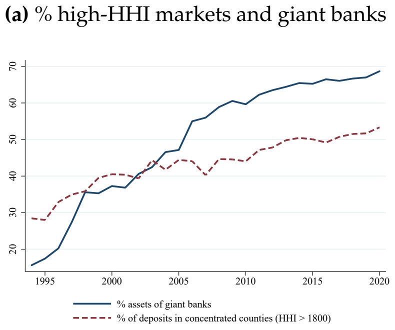
back - counterfactuals

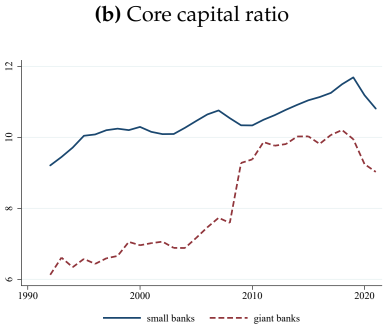
Bank Capital Ratios across Time and Groups



back back - counterfactuals

Measures of the U.S. Banking Sector Over Time





bank types counterfactuals

Calibration of Heterogeneous Banks Model

		α^m	α^b	ϵ^d	$\epsilon^{bH/E}$	ν^b
1994	Bank/Branch I	0.7	0.9	-2.60	2.51	0.09
	Bank/Branch II	0.3	0.1	-1.03	2.05	0.06
2019	Bank/Branch I	0.4	0.4	-0.99	1.68	0.12
	Bank/Branch II	0.6	0.6	-0.32	1.46	0.09

back

Calibration of Heterogeneous Banks Model

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1994	Bank/Branch I	**0.7**	0.9	-2.60	2.51	0.09
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1994	Bank/Branch I	0.7	0.9	**-2.60**	**2.51**	0.09
	Bank/Branch II	0.3	0.1	**-1.03**	**2.05**	0.06
2019	Bank/Branch I	0.4	0.4	**-0.99**	**1.68**	0.12
	Bank/Branch II	0.6	0.6	**-0.32**	**1.46**	0.09

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Calibration of Heterogeneous Banks Model

		α^m	α^b	ϵ^d	$\epsilon^{bH/E}$	ν^b
1994	Bank/Branch I	0.7	0.9	-2.60	2.51	**0.09**
	Bank/Branch II	0.3	0.1	-1.03	2.05	**0.06**
2019	Bank/Branch I	0.4	0.4	-0.99	1.68	**0.12**
	Bank/Branch II	0.6	0.6	-0.32	1.46	**0.09**

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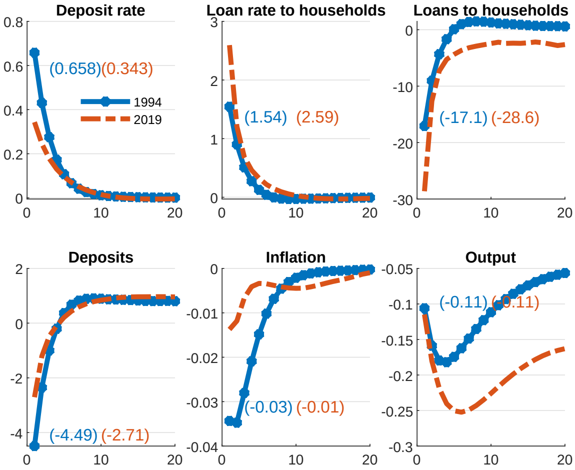
Effect Rise in Bank Concentration on Monetary Transmission



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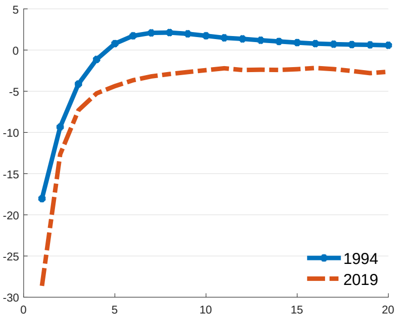
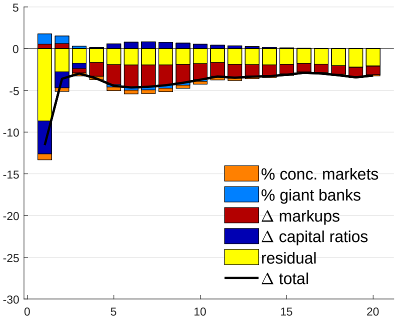
Decomposition of Pass-Through to Loans

(a) 1994 vs. 2019



(b) Decomposition



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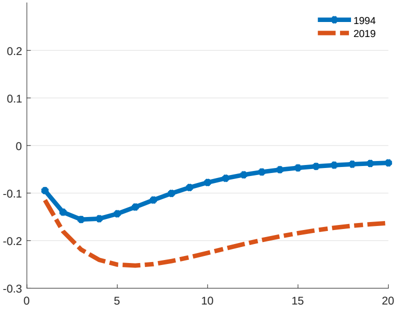
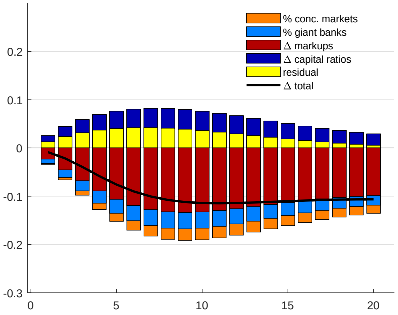
Decomposition of Monetary Transmission to Output

(a) 1994 vs. 2019



(b) Decomposition



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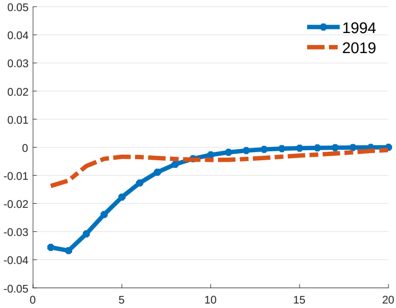
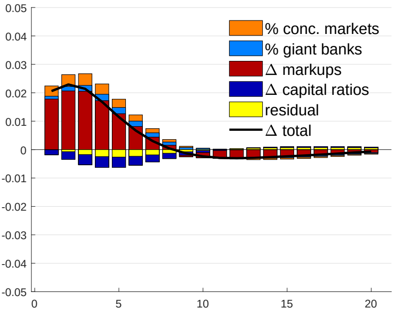
Decomposition of Monetary Transmission to Inflation

(a) 1994 vs. 2019



(b) Decomposition



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Adding Borrowing Constraints

Household's borrowing constraint lowers interest rate sensitivity:

$$\left(1 + r_t^{bh}\right) b_t^I \leq \varepsilon^{m,I} \mathbb{E}_t \left[q_{t+1}^h h_t^I \pi_{t+1} \right]$$

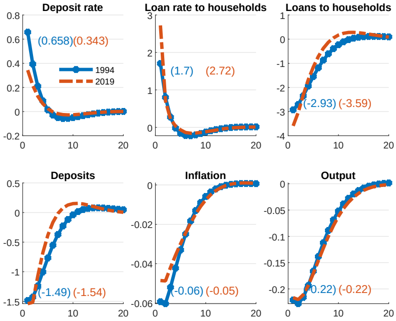
Financial accelerator effect: $r_t^f \uparrow$

- Economic downturn (i.a., $\pi_t, q_{t+1}^h \downarrow$) tightens collateral constraint
- Loan demand declines independently of higher interest costs

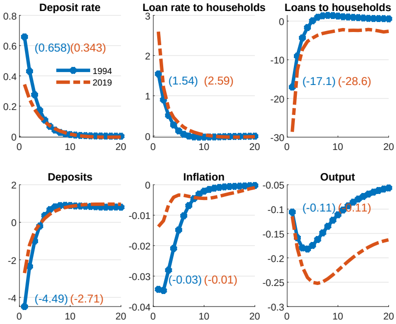
Comparison IRFs | Decomposition rates and credit | Decomposition real economy | Phillips Curve | back

Constrained vs. Unconstrained: 2019 vs. 1994

(a) Constrained



(b) Unconstrained



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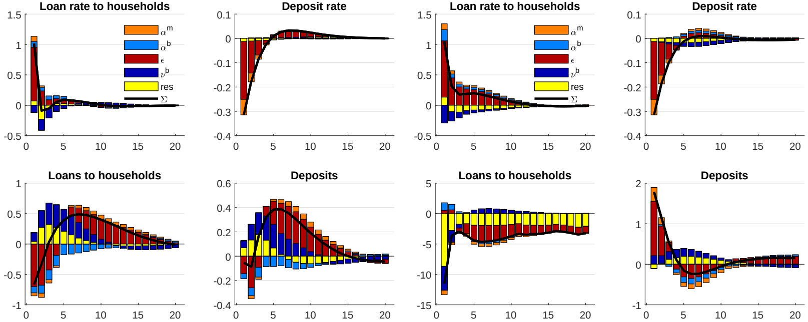
Constrained vs. Unconstrained: Decomposition Rates and Credit

(a) Constrained **(b)** Unconstrained



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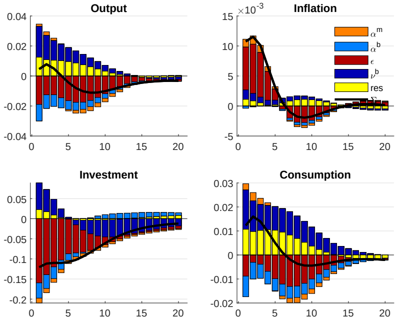
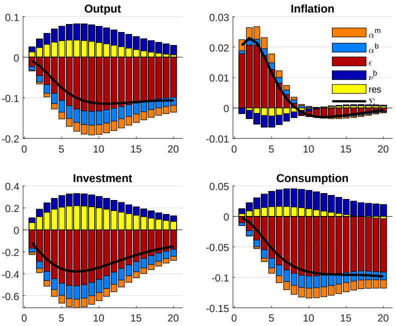
Constrained vs. Unconstrained: Decomposition Real Economy

(a) Constrained



(b) Unconstrained



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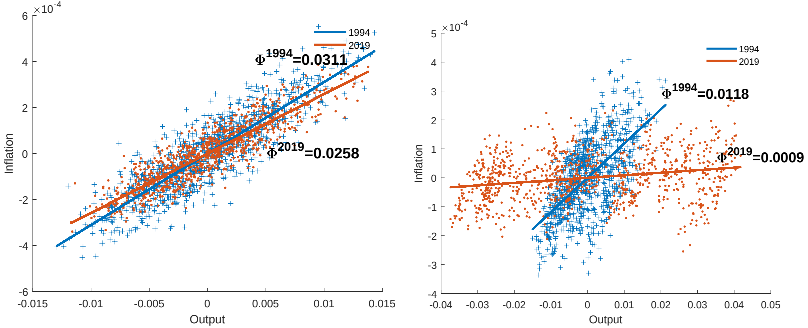
Constrained vs. Unconstrained: Implications on the PC

(a) Constrained

(b) Unconstrained



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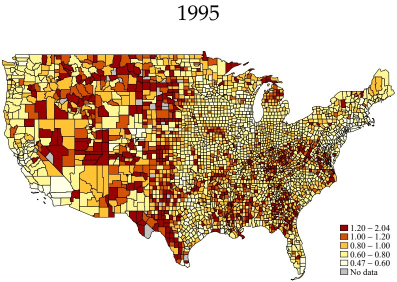
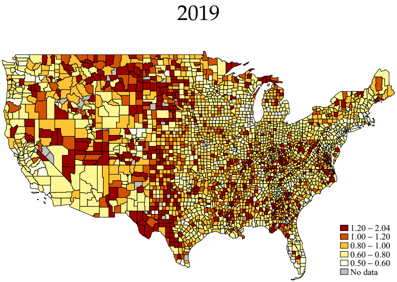
Heterogeneous Pass-Through Across US Counties





- County-level Pass-through: $\widehat{\beta}^h + \widehat{\gamma}_1^h HHI_{c,t-1} + \widehat{\gamma}_2^h \bar{m}(\%)_{t-1}$
- Aggregated average pass-through increased by 50 %.

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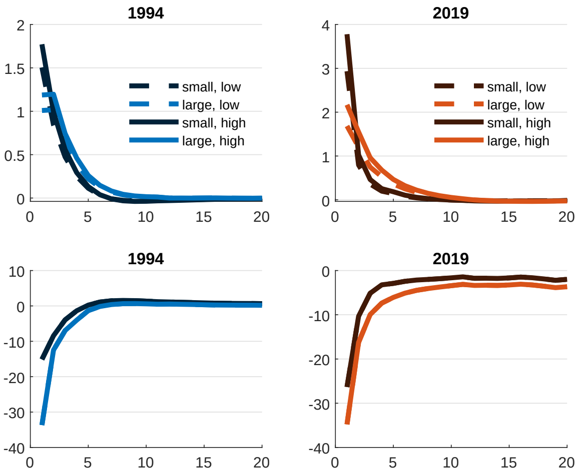
Heterogeneous Pass-Through Across Branches



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Motivation: Anecdotal Evidence from WSJ, Bloomberg, ..

Banks Fire Up Their Mortgage Machine for a Refinancing Boom

Bloomberg

Big banks fumble the ball on spiking mortgage demand

With Rates Low, Banks Increase Mortgage Profit

- *"We, like all of the lenders in the market, have* ***not lowered*** *our interest rates as much to make sure we have* ***enough capacity*** *to close the loans on time."*
- *"Everybody is trying to* ***staff up****."*
- *"That includes outsourcing work to other countries and* ***boosting pay*** *for some employees (...). Underwriters are being offered compensation packages worth $130K, up from about $80K in nonpeak times."*

back

Asymmetric Adjustment Costs

Asymmetric adjustment cost function:

$$Costs_t = \frac{\kappa_l}{2}\left(\frac{b_t^l}{b_{ss}^l} - 1\right)^2 + \frac{1}{\psi_l^2}\left\{\exp\left[\psi_l\left(\frac{b_t^l}{b_{ss}^l} - 1\right)\right] - \psi_l\left(\frac{b_t^l}{b_{ss}^l} - 1\right) - 1\right\}$$

- κ_l and ψ_l govern the convexity and asymmetry
- ψ_l increasing costs when lending is above steady state

$$-\left(\epsilon^l - 1\right) + \epsilon^l \frac{R_t^b}{r_t^l} + \epsilon^l \kappa_l \left(\frac{b_t^l}{b_{ss}^l} - 1\right)\frac{b_t^l}{b_{ss}^l} + \frac{\epsilon^l}{\psi_l}\left\{\exp\left[\psi_l\left(\frac{b_t^l}{b_{ss}^l} - 1\right)\right] - 1\right\}\frac{b_t^l}{b_{ss}^l} = 0$$

back

Asymmetric Adjustment Costs

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back

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back

Asymmetric Adjustment Costs

Asymmetric adjustment cost function:

$$Costs_t = \frac{\kappa_l}{2}\left(\frac{b^l_t}{b^l_{ss}} - 1\right)^2 + \frac{1}{\psi_l^2}\left\{\exp\left[\psi_l\left(\frac{b^l_t}{b^l_{ss}} - 1\right)\right] - \psi_l\left(\frac{b^l_t}{b^l_{ss}} - 1\right) - 1\right\}$$

- κ_l and ψ_l govern the convexity and asymmetry
- ψ_l increasing costs when lending is above steady state

$$-\left(\epsilon^l - 1\right) + \epsilon^l \frac{R^b_t}{r^l_t} + \epsilon^l \kappa_l \left(\frac{b^l_t}{b^l_{ss}} - 1\right)\frac{b^l_t}{b^l_{ss}} + \frac{\epsilon^l}{\psi_l}\left\{\exp\left[\psi_l\left(\frac{b^l_t}{b^l_{ss}} - 1\right)\right] - 1\right\}\frac{b^l_t}{b^l_{ss}} = 0$$

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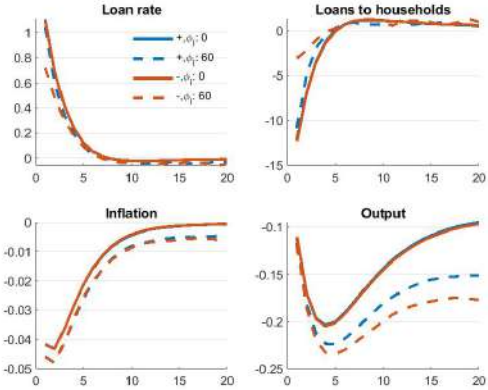
Asymmetric Monetary Transmission: Hikes vs. Cuts



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