Bank Markups and Monetary Policy

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[1]Views and opinions reflect those of the author and do not necessarily reflect those of the Kansas City Fed or the Federal Reserve System.

Introduction

- This paper: examine empirical relationship between bank markups (loan + deposit) and monetary policy

- Markups μ^j act as wedge between price r^j and marginal cost mc^j

$$\mu^j = \frac{r^j}{mc^j}$$

- Markups provide information about pricing power

$$\mu^j > 1 \Rightarrow r^j > mc^j$$

- Importantly, econometrician doesn't observe mc^j

Why Does This Matter?

- Empirical evidence on bank markups and monetary policy is limited
  - Literature largely focuses on spreads: $(r^L - r)$ and $(r - r^D)$

- Results are informative for
  1. Monetary policy transmission
     - Drechsler, Savov and Schnabl (2017), Scharfstein and Sunderam (2017), Wang, Whited, Wu and Xiao (2021)
  2. Merger/competition policy
     - Vives (2016)
  3. Macro- and micro-prudential bank regulation
     - Corbae and D'Erasmo (2021), Whited, Wu, and Xiao (2021), Dell'Ariccia, Laeven and Suarez (2017)

Literature Review

Overview

(1) Estimate bank markups via production approach
  (a) US banks: 1985-2021
  (b) Markups via cost minimization of multi-product firm
  (c) Estimate production function to obtain output elasticities

(2) Estimate relationship between markups and policy rate
  (a) Fixed effects panel regression $\Delta \mu^j \sim \Delta r + \Delta r^j$
  (b) Instrument for price endogeneity

(3) Simple model of imperfect bank competition
  (a) Rationalize movements in spreads, markups and policy rate?

(4) Implications for monetary policy transmission

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Results

Bank Markup Behavior

- Exhibit incomplete pass-through (i.e. variable)
- Loan markups decrease over time
- Deposit markups increase over time

Markups and Monetary Policy

- Loan markups increase in policy rate
- Deposit markups decrease in policy rate
- Opposite of movements in spreads!

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- Exhibit incomplete pass-through (i.e. variable)
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$(r^L - r)$ and μ^L both measure pricing power

Markups and Monetary Policy

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Results

Imperfect Competition Model

- Bank with constant *mc* cannot rationalize movement of spreads, markups with monetary policy
- Introduce model ingredients to rationalize the data
  - increasing returns to scale, capital requirements, default risk

Implications for Monetary Policy

- Established view: market power affects monetary transmission
- **This paper**: monetary policy affects market power

$$r \longrightarrow \mu \qquad \longrightarrow \text{lending, rates}$$

- Implication: series of rate hikes/cuts can attenuate, or strengthen, transmission

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$$r \longrightarrow \cancel{\mu}\ \mu(\mathbf{r}) \longrightarrow \text{lending, rates}$$

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Production Approach to Markups

- Use production approach of De Loecker and Warzynski (2012)

- Cost minimization: choose labor ℓ, capital k to minimize

$$r^D F_D(\ell_D, k_D) + r^E E + w(\ell_D + \ell_L) + r^k(k_D + k_L)$$

subject to constraints

$$\begin{aligned} F_L(\ell_L, k_L) &\geq \bar{L} \\ F_L(\ell_L, k_L) &= F_D(\ell_D, k_D) + E \end{aligned}$$

- For **loan-specific labor**, implies equilibrium condition

$$\underbrace{\frac{r^L}{\lambda}}_{\text{markup } \mu_L} = \underbrace{\frac{\partial F_L}{\partial \ell_L}\frac{\ell_L}{L}}_{\text{output elasticity } \theta_L} \times \underbrace{\left[\frac{w\ell_L}{r^L L}\right]^{-1}}_{\text{inverse cost share}}$$

Markup Derivation Production Function Estimation Data

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$$r^D F_D(\ell_D, k_D) + r^E E + w(\ell_D + \ell_L) + r^k(k_D + k_L)$$

subject to constraints

Interest expense

$$F_L(\ell_L, k_L) \geq \bar{L}$$
$$F_L(\ell_L, k_L) = F_D(\ell_D, k_D) + E$$

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Markup Derivation | Production Function Estimation | Data

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Multi-product firm with budget constraint

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- For **deposit-specific** labor, implies equilibrium condition

$$\underbrace{1 - \frac{r^D}{\lambda}}_{\text{markup } \mu_D} = 1 - \underbrace{\frac{\partial F_D}{\partial \ell_D}\frac{\ell_D}{D}}_{\text{elasticity } \theta_D} \times \Big[\underbrace{\frac{\partial F_D}{\partial \ell_D}\frac{\ell_D}{D}}_{\text{elasticity} \theta_D} + \underbrace{\frac{w\ell_D}{r^D D}}_{\text{cost share}} \Big]^{-1}$$

Markup Derivation Production Function Estimation

Historical Markup Results

(1) Bank markups exhibit incomplete pass-through

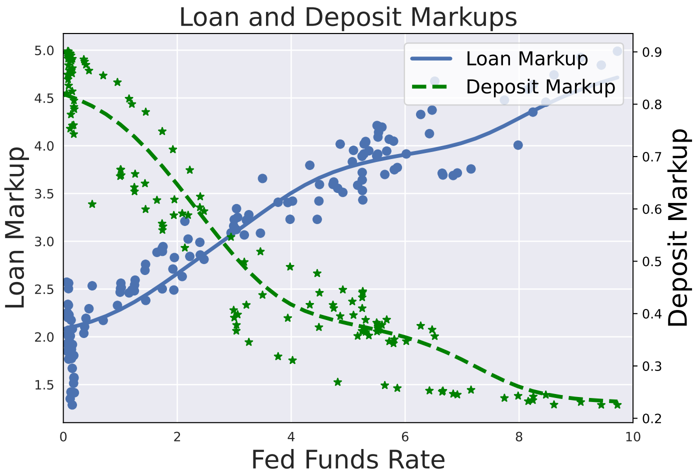
(2) Over time,

- Loan markups have decreased Loan Markups
- Deposit markups have increased Deposit Markups

(3) Significant cross-section markup variation

Pass-Through Cross-Section Percentiles Output Elasticities Relative to Literature Bank HHIs

Relationship to Monetary Policy



- Markups move in the opposite direction of spreads!

Relative to Literature Differences by Business Model

Fixed Effects Regression

- For each product, run regression

$$\Delta\mu_{it}^{j} = \alpha_t^{j} + \beta\Delta r_t + \gamma\Delta r_{it}^{j} + \boldsymbol{x}_{it}'\boldsymbol{\delta} + \epsilon_{it}^{j}$$

- Identification issues
  - Endogenous rates: instrument with cost shocks
    - Xiao (2020), Wang et al. (2021)
  - Drechsler et al. (2017): OVB works in other direction
- β identifies markup relationship to policy rate, holding bank channel fixed

Other Explanatory Variables

Regression Results

REGRESSION ANALYSIS FOR DETERMINANTS OF BANK MARKUPS

	(1) $\Delta\log\,\mu^L$	(2) $\Delta\log\,\mu^L$	(3) $\Delta\log\,\mu^L$	(4) $\Delta\log\,\mu^D$	(5) $\Delta\log\,\mu^D$	(6) $\Delta\log\,\mu^D$
Loan rate $\Delta\log\,\hat{r}_{it}^L$		-0.53^{***}	-1.44^{***}			
Policy rate $\Delta\log\,r_t$	0.043^{***}	0.072^{***}	0.208^{***}	-0.070^{***}	-0.125^{***}	-0.23^{***}
Deposit rate $\Delta\log\,\hat{r}_{it}^D$					0.238^{***}	0.48^{***}
Assets ($b)			0.0^{***}			-0.0^{***}
Equity Ratio			0.36^{***}			-0.092^{***}
Biz Cycle			-0.012^{***}			0.02^{***}
Biz Cycle $\times$ Rate r_t			0.017^{***}			-0.01^{***}
Avg. Markup Elasticity	0.04	0.07	0.21	−0.07	−0.13	−0.23
Observations	190,906	190,906	190,906	192,088	192,088	192,088
Time Periods	138	138	138	138	138	138
Banks	2,568	2,568	2,568	2,564	2,564	2,564
R-squared	0.005	0.022	0.060	0.030	0.177	0.194
Fixed Effects	✓	✓	✓	✓	✓	✓
Other Controls	X	X	✓	X	X	✓

1st Stage Regressions | Time Fixed Effects | Why increasing loan markups?
Why decreasing deposit markups? | Robustness | Interactions | Levels

Regression Results

Regression Analysis for Determinants of Bank Markups

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Loan markups increase in policy rate, holding bank channel fixed

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Deposit markups decrease in policy rate, holding bank channel fixed

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Key Discussion

- Spreads move opposite direction of markups
  - e.g. As monetary policy tightens, loan markups increase, loan spreads decrease
- Confusing, given both are used as measures of pricing power
- Approach
  (i) Develop simple theory model
  (ii) Derive conditions to test if markups, spreads are consistent
  (iii) Plug in markup estimates to evaluate conditions

Theory

- Question: Can theory rationalize the co-movements in spreads, markups and policy rate?
- Monopolistic bank facing
  - Loan demand $L(r^L; \mathbf{x_1})$
  - Deposit supply $D(r^D; \mathbf{x_2})$
  - Government bonds at rate r
  - Non-interest expense $C\big(L(r^L; \mathbf{x_1}), D(r^D; \mathbf{x_2}); \mathbf{y}\big)$
- Equilibrium

$$
\begin{aligned}
[r^L]: &\quad r^L = \mu^L\big[r + \frac{\partial C}{\partial L}\big] \\
[r^D]: &\quad r^D = (1 - \mu^D)\big[r - \frac{\partial C}{\partial D}\big]
\end{aligned}
$$

Theory Model

- Markup elasticities: to policy rate $\Gamma^j = \frac{\partial \mu^j}{\partial r}\frac{r}{\mu^j}$ and bank rate $\tilde{\Gamma}^j = \frac{\partial \mu^j}{\partial r^j}\frac{r^j}{\mu^j}$
- Spreads $s^L = r^L - r$ and $s^D = r - r^D$

Proposition

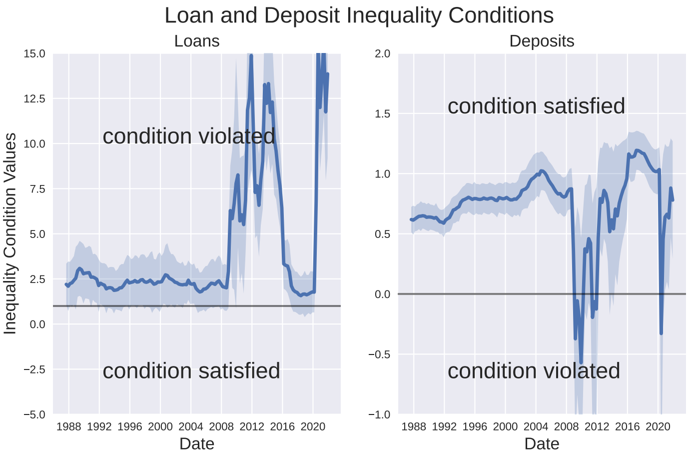
In an environment with **constant marginal costs**,

$$\frac{\partial s^L}{\partial r} < 0 \quad \Longleftrightarrow \quad \mu^L + \Gamma^L \frac{r^L}{r} + \tilde{\Gamma}^L < 1$$

Similarly, for deposits,

$$\frac{\partial s^D}{\partial r} > 0 \quad \Longleftrightarrow \quad \mu^D + \frac{\mu^D}{1-\mu^D}\left(\Gamma^D \frac{r^D}{r} + \tilde{\Gamma}^D\right) > 0.$$

Plotting The Inequality Conditions



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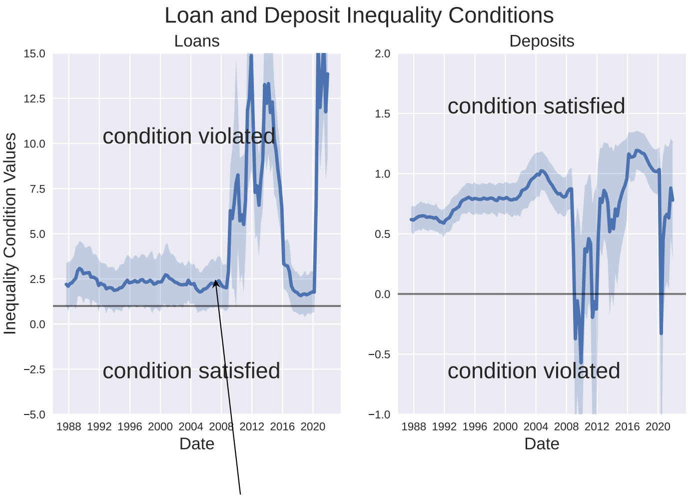
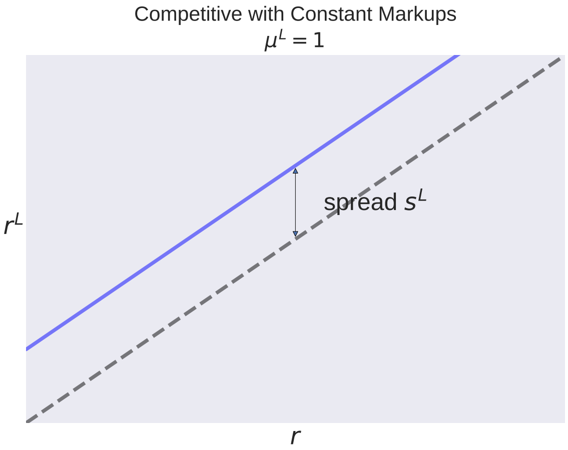


Loan condition violated: loan rates r^L rise too quickly in r

Loan Pricing Condition: $r^L = \mu^L[r + mc]$



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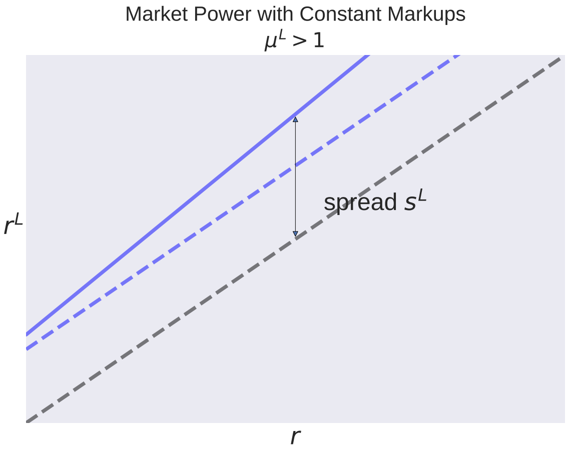

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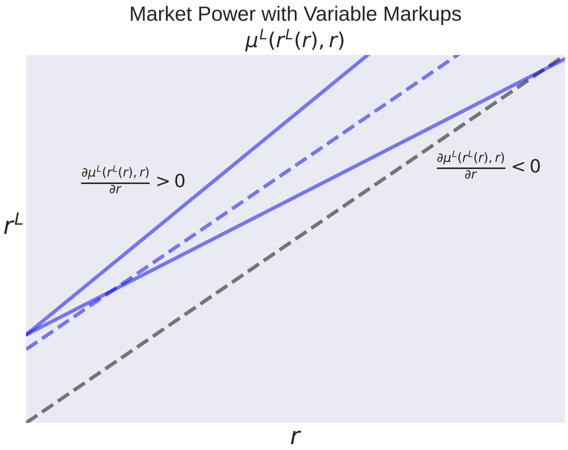

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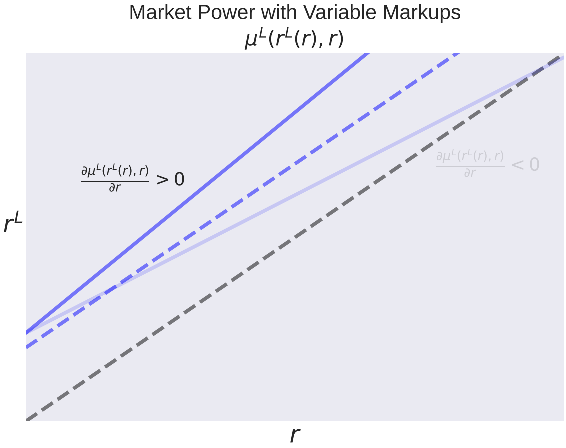

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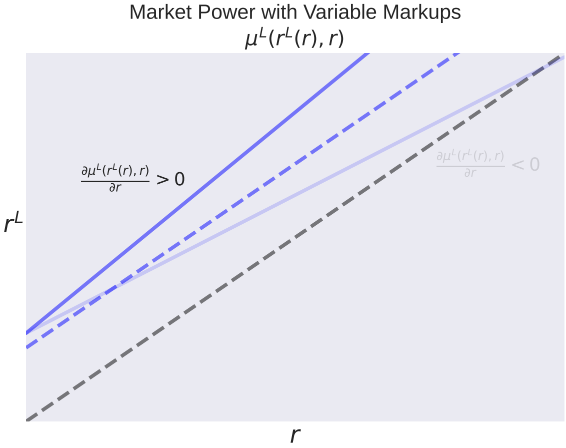

Main Idea: Need additional cost variation with policy rate r!

Model Ingredients to Rationalize Spread, Markup Variation

(1) Scale economies IRS

- Increasing returns to scale can dampen $\frac{\partial r^L}{\partial r}$
- Wheelock and Wilson (2012), Hughes and Mester (2013)

(2) Regulatory constraints Capital Requirement

- Binding capital requirements with increase in r can dampen $\frac{\partial r^L}{\partial r}$
- Godl-Hanisch (2021)

(3) Default risk Default

- Yanelle (1997), Dermine (1986)

(4) Bank supply shocks

- Direct supply shocks to reduce mc (no evidence)

Implications for Monetary Policy

Conclusion

- Estimate markups (loan + deposit) for U.S. banks 1985-2021
- Results are informative for structural modeling and policy analysis
- In relation to monetary policy,
  - Loan markups increase in the policy rate
  - Deposit markups decrease in the policy rate
- Require significant *mc* variation on supply side to rationalize co-movement of spreads, markups and policy rate
- Variable markup behavior can affect magnitude of monetary transmission

Thank You!

Literature Review

Bank Markups and Monetary Policy

- Scharfstein and Sunderam (2017), Wang, Whited, Wu and Xiao (2021), Dreschler, Savov and Schnabl (2017), Corbae and D'Erasmo (2021)
- **Contribution**: Markups via production function estimation; pass-through analysis

Markups via Production Function Estimation

- De Loecker and Warzynski (2012), Olley and Pakes (1996), Levinsohn and Petrin (2003), Pasqualini (2021)
- **Contribution**: Bank multi-product production function

Return

Inferring Loan/Deposit Origination, Spot Rates

- Posit loan stock L_{t+1} law of motion

$$L_{t+1} = l_{t+1,t+1} + (1-\delta)(1-\gamma_{t+1})L_t$$

with amortization δ, default rate γ_{t+1} and origination $l_{t+1,t+1}$

- Gross loan revenues

$$R_t = \sum_{j=0}^{\infty} r_{t-j} l_{t-j,t}$$

such that the difference $R_{t+1} - R_t$ implies

$$r_{t+1} = \frac{R_{t+1} - R_t\left[(1-\delta)(1-\gamma_{t+1})\right]}{l_{t+1,t+1}}$$

- Use $\delta = 0.1$ and bank-time-specific net charge-off rates for γ_t

Return

Data

- US bank call reports from 1985-2021
  - Balance sheet and income statements
  - Quarterly, bank-level
- Loan/deposit rates computed as total interest revenue/expense divided by total stock
  - Loans: all loans & leases
  - Deposits: savings accounts
- Issue: old rates and originations in current quarter
  - Solution: Method to determine spot rates, originations

Spot Method

Data

Summary Statistics for Bank Sample: 1985-2021

Object	Units	N	Mean	10p	50p	90p	99p
Assets	\$b	261,862	6.0	0.0	1.0	6.0	82.0
Net Interest Margin	%	259,702	3.6	2.2	3.5	4.8	9.4
Return on Equity	%	259,697	10.4	0.8	11.2	21.6	60.0
Return on Assets	%	259,702	0.2	0.0	0.2	0.5	1.4
Loan/Deposit NIM	%	203,541	7.0	4.1	7.1	9.9	14.4
Net Profit Margin	%	259,666	11.5	0.8	13.3	26.0	48.7
Loan Rate	%	216,512	8.9	4.2	7.6	10.9	14.9
Deposit Rate	%	200,090	2.5	0.2	2.3	5.4	7.2
Leverage	–	259,702	12.1	7.2	11.3	16.9	44.8
Non-Int Revenue Share	%	259,662	14.6	3.2	10.9	28.3	85.4
Exp-Asset Ratio	–	259,702	1.1	0.4	0.7	1.2	4.5
Exp-Revenue Ratio	–	259,664	44.6	22.2	39.5	65.2	113.9

Return

Derivation of Markup Expression

- Assume bank has production technology $Q_{it} = F(x_{it})exp(\omega_{it})$ where $x_{it} = \{x_{it}^1, ..., x_{it}^k\}$
- Split inputs into variable inputs x_{it}^v and inputs subject to adjustment costs x_{it}^F
- The Lagrangean is written

$$\mathcal{L} = P_{it}^v x_{it}^v + P_{it}^F x_{it}^F + \lambda_{it}\left(\bar{Q} - Q_{it}\right)$$

which yields FOC

$$\underbrace{\frac{\partial Q_{it}}{\partial x_{it}^v}\frac{x_{it}^v}{Q_{it}}}_{\text{output elasticity } \theta_{it}} = \underbrace{\frac{P_{it}}{\lambda_{it}}}_{\text{markup } \mu_{it}} \underbrace{\frac{P_{it}^v Q_{it}^v}{P_{it} Q_i}}_{\text{revenue share}}$$

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Return

Production Function Estimation

- Need output elasticities $\boldsymbol{\theta_D}$ and $\boldsymbol{\theta_L}$

- Approach: estimate production function a la Ackerberg, Caves and Frazer (2015) and Levinsohn and Petrin (2003)

$$q_{ijt} = f(\ell_{ijt}, k_{ijt}; \beta_j) + \omega_{ijt} + \epsilon_{ijt}$$

where ω_{ijt} is unobserved productivity

Identifying Assumption

(1) ω_{ijt} can be proxied by an intermediate input (e.g. materials)
   - Use non-interest expenses related to IT, marketing, consulting

(2) Lagged variable inputs (i.e. labor) not correlated with current productivity shocks

Explicit Steps Return

Production Function Estimation Steps

1. Use value-added translog production function

   $q_{ijt} = \beta_{j0} + \beta_{j\ell}\ell_{ijt} + \beta_{jk}k_{ijt} + \beta_{j\ell\ell}\ell^2_{ijt} + \beta_{jkk}k^2_{ijt} + \beta_{j\ell k}\ell_{ijt}k_{ijt} + \omega_{ijt} + \epsilon_{ijt}$

2. Assume $\omega_{ijt} = g(m_{ijt}, \ell_{ijt}, k_{ijt})$ where $g()$ is increasing in m_{ijt}
3. First stage: Non-parametrically regress

   $$q_{ijt} = f(_{ijt}, k_{ijt}; \beta_j) + g^{-1}(m_{ijt}, \ell_{ijt}, k_{ijt}) + \epsilon_{ijt}$$

   to obtain $q_{ijt} = \hat{q}_{ijt} + e_{ijt}$

4. Assume productivity law of motion

   $$\omega_{ijt} = \rho_j \omega_{ijt-1} + \xi_{ijt}$$

   s.t. $\hat{\rho}_j = (\omega_{ijt-1}\omega_{ijt-1})^{-1}\omega_{ijt-1}\omega_{ijt}$ and $\omega_{ijt}(\beta_j) = \hat{q}_{ijt} - x'_j\beta_j$

Production Function Estimation Steps

5. Then, productivity shocks are a function of production coefficients

$$\xi_{ijt}(\beta) = \omega_{ijt}(\beta_j) - \hat{\rho}_j(\beta_j)\omega_{ijt-1}(\beta_j)$$

6. Second stage: Use GMM to estimate moment conditions

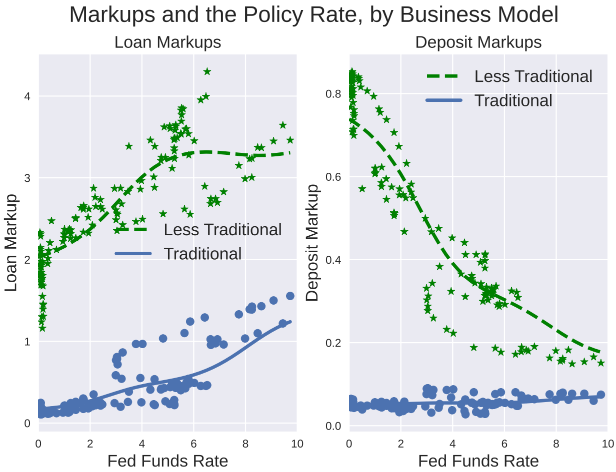
$$E\left[\xi_{ijt}(\beta_j)\begin{pmatrix} \ell_{ijt-1} \\ k_{ijt} \end{pmatrix}\right] = 0$$

where the identification assumption for lagged variable inputs shows up

Return

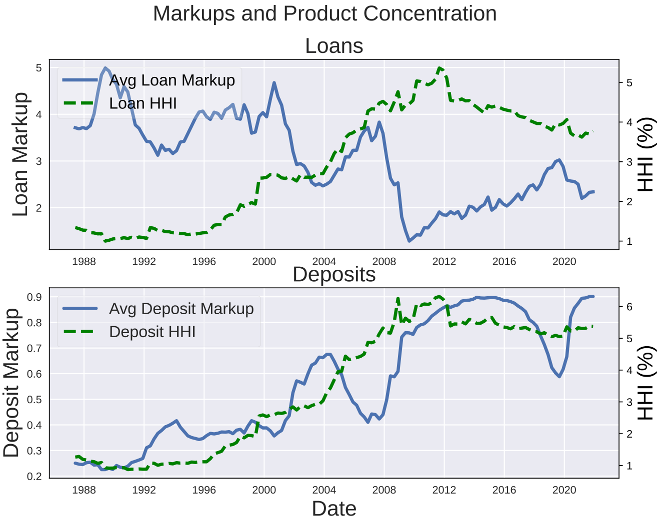
Business Model/Income Structure Matters!

- Differences in business model according to fee v rate pricing
  - *non-traditional*: above average fee revenue share
  - *traditional*: below average fee revenue share



Return

Concentration



Return

Bank Pass-Through

- From markup identities, recover marginal cost mc_{ijt} for bank i, product j, time t
- Regress

$$\Delta log(r_{ijt}) = \alpha_{ij} + \sum_{k=0}^{6} \beta_{jk} \Delta log(mc_{ij,t-k}) + \epsilon_{ijt}$$

- $\sum_{k=0}^{6} \beta_{jk}$: long-run pass-through for product j

Bank Pass-Through

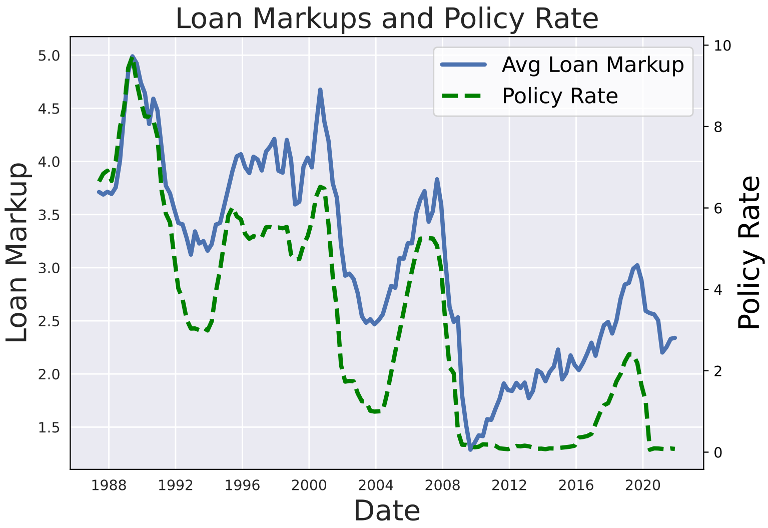
LONG-RUN COST PASS-THROUGH REGRESSION ANALYSIS

	(1) $\Delta\log r^L$	(2) $\Delta\log r^L$	(3) $\Delta\log r^D$	(4) $\Delta\log r^D$
$\Delta\log mc_t$	0.157***	0.163***	−0.011***	−0.0
$\Delta\log mc_{t-1}$	0.004	0.012	−0.047***	−0.035***
$\Delta\log mc_{t-2}$	0.001	0.006	−0.042***	−0.032***
$\Delta\log mc_{t-3}$	0.007	0.012	−0.039***	−0.027***
$\Delta\log mc_{t-4}$	−0.021**	−0.013	−0.038***	−0.024***
$\Delta\log mc_{t-5}$	0.0	0.006	−0.027***	−0.014***
$\Delta\log mc_{t-6}$	0.005	0.006	−0.014***	−0.007***
$\sum_j \hat{\beta}_{t-j}$	0.15	0.19	−0.22	−0.14
Observations	175,560	175,560	131,295	131,295
Time Periods	132	132	132	132
Banks	2,474	2,474	2,446	2,446
R-squared	0.124	0.143	0.658	0.737
Fixed Effects	X	✓	X	✓

Note: This table displays the results from regressing price on current (and lagged) marginal cost for each product: loans and deposits. Marginal costs are computed through dividing price by the respective markup. The sum of the cost coefficients is defined as the estimated long-run pass through effect of costs on prices. Robust standard errors were used and the statistical significance of each estimate is illustrated with stars (*p<0.1, **p<0.05, ***p<0.01).

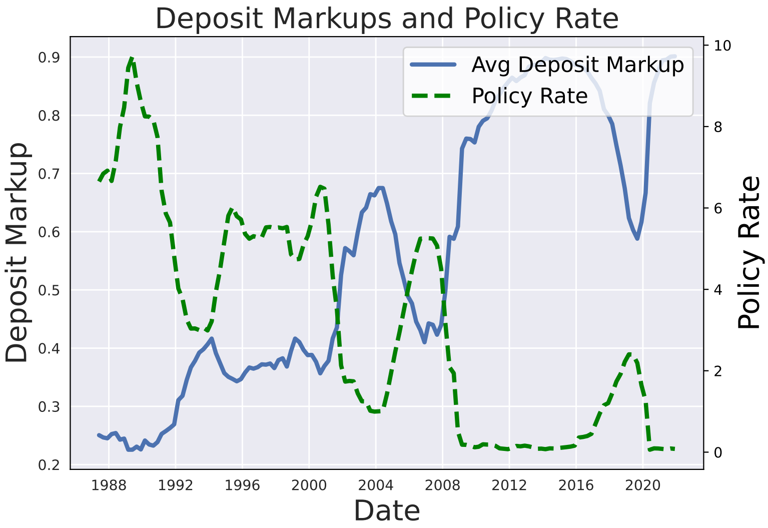
Return

Historical Loan Markups



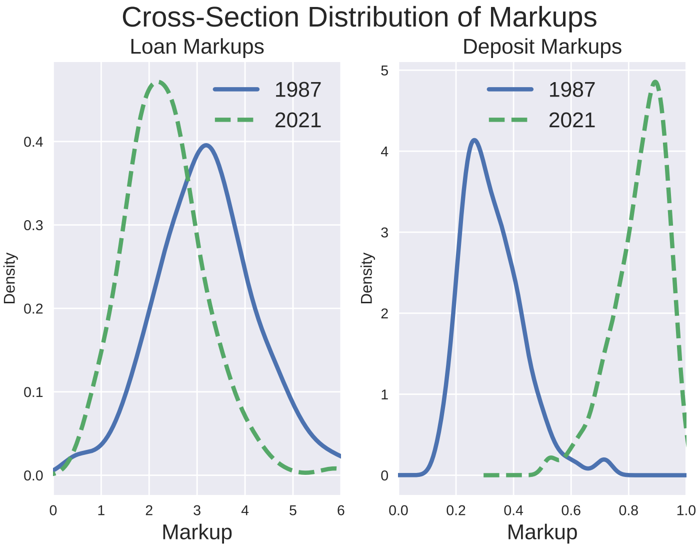
Return

Historical Deposit Markups



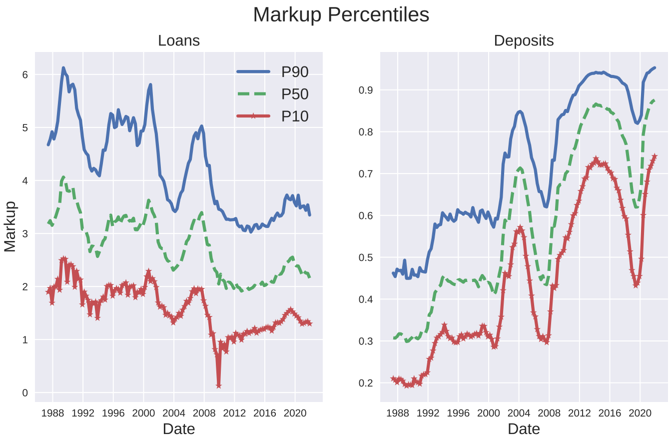
Return

Markups Cross-Section Over Time



Return

Markups Percentiles Over Time



Return

1st Stage IV Regressions

1st Stage Regression on Instruments

	(1) $\Delta\log r^L$	(2) $\Delta\log r^D$
Fixed Asset Expense Δz_1	70.977***	58.542***
Non-Interest Expense Δz_2	1.826*	6.250***
Labor Expense Δz_3	0.011***	0.008***
Observations	190,963	192,150
Time Periods	138	138
Banks	2,569	2,564
R-squared	0.052	0.172
Fixed Effects	✓	✓
Robust F-Statistic	178	936

Return

Why Increasing Loan Markups?

(1) Diminished outside competition with high rates
- Shadow bank market funding
- Jiang, Matvos, Piskorski, and Seru (2020)

(2) Firm financing costs vary with policy rate
- Business cycle literature (Jermann and Quadrini (2012), Begenau and Salomao (2022))

(3) Composition of borrowers changes with policy rate

Return

Why Decreasing Deposit Markups?

- Two channels: liquidity preference and asset return
  - Drecshler et al. (2012)
  - Liquidity preference for cash + deposits
  - Return preference bonds $\succ$ deposits $\succ$ cash
- Liquidity preference
  - $\uparrow r \Rightarrow \uparrow r^D \Rightarrow$ higher demand for deposits over cash
  - **Result**: $\uparrow \mu^D$
- Asset return
  - $\uparrow r \Rightarrow \uparrow r^B$ quicker than $\uparrow r^D \Rightarrow$ higher demand for bonds over deposits
  - **Result**: $\downarrow \mu^D$

Return

Relevant Interactions?

- Do other bank characteristics affect the magnitude of relationship between markups and monetary policy?
- Consider interactions between policy rates Δr_t and
  (1) Level of price power via instrumented markups $\hat{\mu}^j$
  (2) Bank size via total assets ($b)
  (3) Business model proxy via fee share of revenue

Relevant Interactions?

MONETARY INTERACTIONS WITH PRICING POWER, SIZE AND BUSINESS MODEL

	(1) $\Delta\log\,\mu^L$	(2) $\Delta\log\,\mu^L$	(3) $\Delta\log\,\mu^D$	(4) $\Delta\log\,\mu^D$
Loan rate $\Delta\log\,\hat{r}_{it}^L$	-1.40^{***}	-1.40^{***}		
Policy rate $\Delta\log\,r_t$	0.157^{***}	0.159^{***}	-0.615^{***}	-0.678^{***}
Deposit rate $\Delta\log\,\hat{r}_{it}^D$			0.473^{***}	0.472^{***}
$\Delta\log\,r_t \times \hat{\mu}^L$	0.017^{***}	0.017^{***}		
$\Delta\log\,r_t \times \hat{\mu}^D$			0.569^{***}	0.698^{***}
$\Delta\log\,r_t \times$ Size		0.0		-0.0002^{***}
$\Delta\log\,r_t \times$ Business Model		-0.003		0.039^{***}
Observations	190,906	190,906	192,088	192,088
Time Periods	138	138	138	138
Banks	2,568	2,568	2,564	2,564
R-squared	0.062	0.062	0.204	0.207
Bank FE	✓	✓	✓	✓
Other Controls	✓	✓	✓	✓

Return

Relevant Interactions?

MONETARY INTERACTIONS WITH PRICING POWER, SIZE AND BUSINESS MODEL

	(1) $\Delta\log\,\mu^L$	(2) $\Delta\log\,\mu^L$	(3) $\Delta\log\,\mu^D$	(4) $\Delta\log\,\mu^D$
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Bank FE	✓	✓	✓	✓
Other Controls	✓	✓	✓	✓

Level of pricing power enhances (attenuates) markup relationship for loans (deposits)

Return

Other Explanatory Variables

- Two sets of additional explanatory variables
  (1) Micro (bank-level)
    - size (assets)
    - net interest margin
    - business model (via interest revenue share)
    - capital ratio

  (2) Macro (aggregate)
    - real business cycle
    - liquidity premium (ff rate minus 3 month treasury)
    - credit risk premium (Baa corporate bond yield minus 10 year treasury)

Return

Adding Time Fixed Effects

- Time effects on 12-quarter periods
  - Some discretion around recessions/changes in monetary policy
- Tighter identification: controls for changes in market structure or monetary regimes

Regression Analysis for Determinants of Bank Markups

	(1) $\Delta\log\mu^L$	(2) $\Delta\log\mu^L$	(3) $\Delta\log\mu^L$	(4) $\Delta\log\mu^D$	(5) $\Delta\log\mu^D$	(6) $\Delta\log\mu^D$
Loan rate $\Delta\log\hat{r}^L_{it}$		-0.58^{***}	-1.46^{***}			
Policy rate $\Delta\log r_t$	0.028^{***}	0.056^{***}	0.191^{***}	-0.058^{***}	-0.116^{***}	-0.21^{***}
Deposit rate $\Delta\log\hat{r}^D_{it}$					0.266^{***}	0.48^{***}
Assets ($b)			0.0^{***}			-0.0^{***}
Equity Ratio			0.28^{***}			-0.054^{**}
Biz Cycle			-0.015^{***}			0.02^{***}
Biz Cycle × Rate r_t			0.015^{***}			-0.01^{***}
Avg. Markup Elasticity	0.03	0.06	0.19	−0.06	−0.12	−0.21
Observations	190,906	190,906	190,906	192,088	192,088	192,088
Time Periods	138	138	138	138	138	138
Banks	2,568	2,568	2,568	2,564	2,564	2,564
R-squared	0.008	0.026	0.063	0.040	0.189	0.203
Bank FE	✓	✓	✓	✓	✓	✓
Time FE	✓	✓	✓	✓	✓	✓
Other Controls	X	X	✓	X	X	✓

Return

Markup Levels Relative to Literature

- Corbae and D'Erasmo (2021) find avg $\mu^L \approx 1.5$
  - Loan markups of 3 in 95th percentile
- Pasqualini (2021) finds avg μ^L between 1.25 and 2.5
- Output elasticities relatively close with De Loecker, Eeckhout and Unger (2020)
- Why are loan markups so high?
  - Carry certain risk/term premia not present in typical IO applications
  - Main analysis is about markup **variation, not levels**

Return

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Return

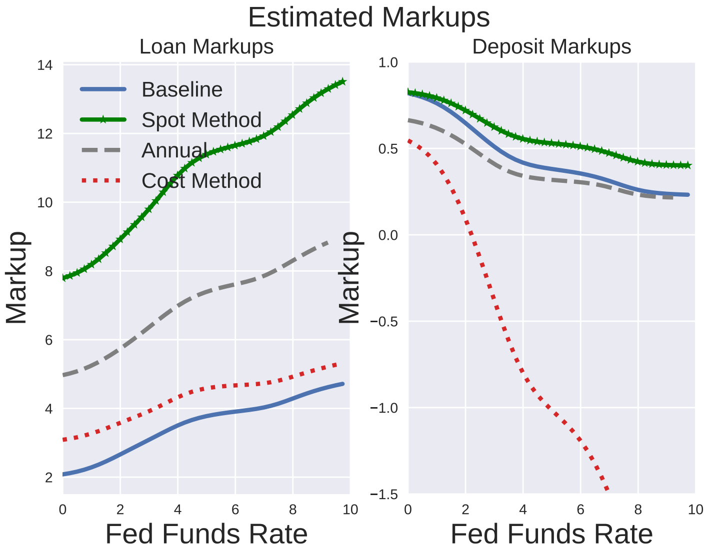
Robustness Exercises

(1) Convert data to annual frequency
- Helps treat variable labor assumption

(2) Cost function estimation
- Estimate $C = f(\ell, k, \mathbf{x}) + \epsilon$ which provides $mc_\ell = \frac{\partial C}{\partial \ell}$ and thus markups μ
- Berger and Humphrey (1997)

(3) Infer loan originations and spot rates
- Use balance sheet changes, charge-off rates and asset maturity to infer new originations

Robustness Exercises



Return

Increasing Returns to Scale

- Loan inequality condition

$$\frac{\partial s^L}{\partial r} < 0 \quad \Longleftrightarrow \quad \mu^L + \Gamma^L \frac{r^L}{r} + \tilde{\Gamma}^L + \mu^L \frac{\partial^2 C}{\partial L^2} \frac{L}{r^L} \left[\epsilon^r \frac{r^L}{r} - \epsilon^{r^L} \right] < 1$$

- Increasing returns $\Rightarrow \frac{\partial^2 C}{\partial L^2} < 0$

- <u>Mechanism</u>: less incentive to raise r^L, shrink demand, and increase marginal cost
  - Result: if strong enough, generates decreasing loan spread in r

Return

Capital Requirements

- Capital requirement $\frac{L-D}{L} \geq \phi$ generates FOC

$$r^L = \mu^L \left[r - \lambda(1-\phi) \right]$$

- Loan inequality condition

$$\frac{\partial s^L}{\partial r} < 0 \quad \Longleftrightarrow \quad \mu^L + \Gamma^L \frac{r^L}{r} + \tilde{\Gamma}^L - \mu^L(1-\phi)\frac{\partial \lambda}{\partial r} < 1$$

- Condition relaxed if $\frac{\partial \lambda}{\partial r} > 0$

- Evidence that bank leverage increases with r
  - Increases by $\sim$100% from low- to high-rate environment
  - Implies more binding capital requirements, higher λ

Return

Capital Requirements

- Capital requirement $\frac{L-D}{L} \geq \phi$ generates FOC

$$r^L = \mu^L \left[r - \lambda(1-\phi) \right]$$

Shadow value from relaxing CR

- Loan inequality condition

$$\frac{\partial s^L}{\partial r} < 0 \quad \Longleftrightarrow \quad \mu^L + \Gamma^L \frac{r^L}{r} + \tilde{\Gamma}^L - \mu^L(1-\phi)\frac{\partial \lambda}{\partial r} < 1$$

- Condition relaxed if $\frac{\partial \lambda}{\partial r} > 0$

- Evidence that bank leverage increases with r
  - Increases by $\sim$100% from low- to high-rate environment
  - Implies more binding capital requirements, higher λ

Return

Bank Default Risk

- Default risk $p(L)$ generates FOC

$$r^L = \mu^L[r + \frac{\partial p}{\partial L}\bar{V}]$$

- Loan inequality condition

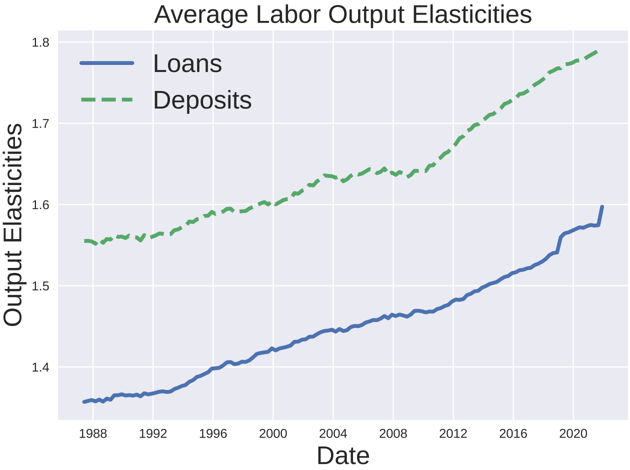
$$\frac{\partial s^L}{\partial r} < 0 \quad \Longleftrightarrow \quad \mu^L + \Gamma^L \frac{r^L}{r} + \tilde{\Gamma}^L + \mu^L \bar{V} \frac{\partial^2 p}{\partial L^2}(\epsilon^r \frac{r^L}{r} - \epsilon^{r^L}) < 1$$

- Condition relaxed if $p(L)$ concave

- Mechanism: less incentive to raise r^L, shrink demand, and shift quantity onto more sensitive/elastic part of default function

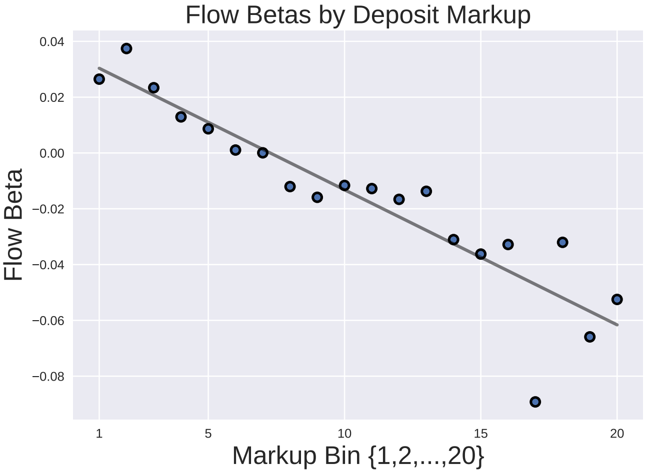
Return

Estimated Output Elasticities: $\theta_j = \frac{\partial F_j}{\partial \ell_j} \frac{\ell_j}{F_j}$



Return

DSS [2017] Deposit *Flow Betas*



Return

Monetary Transmission Regression

MONETARY TRANSMISSION VIA DEPOSIT PRICING POWER

	(1) Δlog deposit$_{it}$	(2) Δlog deposit$_{it}$
Policy rate Δr_t	-0.009^{***}	-0.041^{***}
Interaction $\Delta r_t \times r_t$		0.008^{***}
Observations	192,088	192,088
Time Periods	138	138
Banks	2,564	2,564
R-squared	0.204	0.207
Bank FE	✓	✓
Other Controls	X	X

Return

Implications for Monetary Policy

- Market power is affected by monetary policy (this paper), thus affects transmission

$$r \longrightarrow \cancel{\mu}\ \mu(\mathbf{r}) \longrightarrow \text{lending, rates}$$

- For example, Drechsler, Savov, Schnabl (2017) find monetary transmission via

$$\Delta\text{deposits} \sim \beta \Delta r \times \text{Concentration}$$

- This paper: market power changes quickly with monetary policy
- **Punchline**: repeat cycles of rate hikes/cuts affect magnitude of transmission

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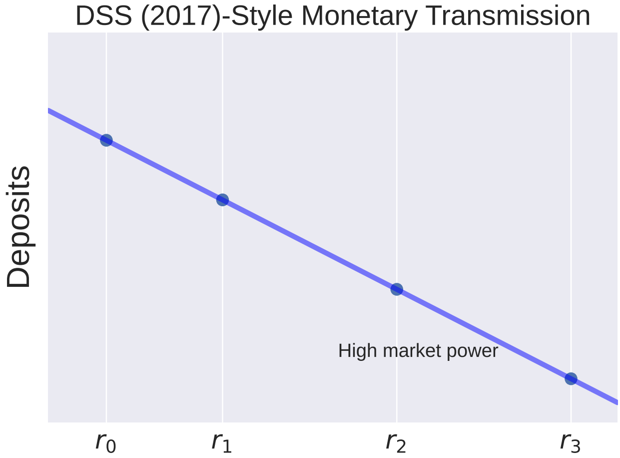
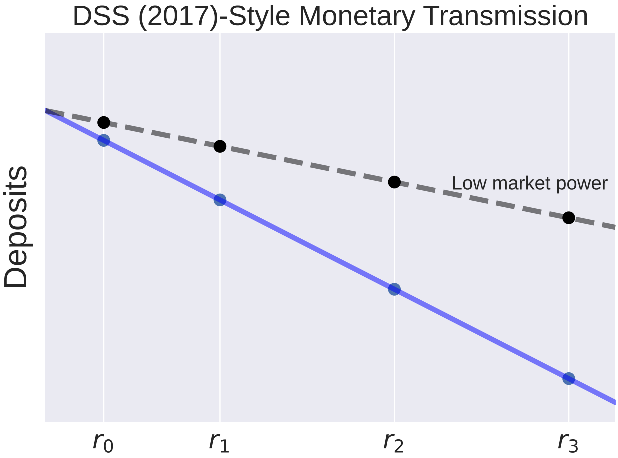
- **Punchline**: repeat cycles of rate hikes/cuts affect magnitude of transmission

Their proxy for market/price power.
Relatively fixed at short- or medium-horizons

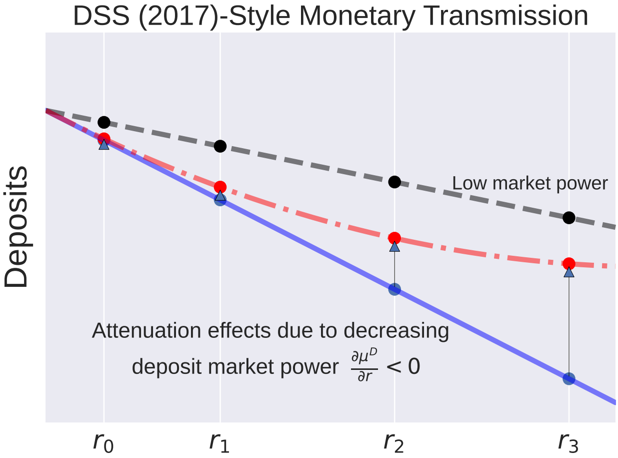
Implications for Monetary Policy



Implications for Monetary Policy



Implications for Monetary Policy



Implications for Monetary Policy

- Can replicate some of Drechsler, Savov, Schnabl [2017] using markups instead of concentration as market power proxy
  - Transmission magnitudes are smaller

DSS Flow Betas

- Test for attenuation effects through simple regression

$$\Delta log\ deposit_{it} = \alpha_i + \beta \Delta r_t + \gamma \Delta r_t \times r_t + \epsilon_{it}$$

  - Find $\hat{\beta} < 0$ (standard transmission effect)
  - Find $\hat{\gamma} > 0$ (**attenuation effect**)

Regression Results

- Loss of deposit market power consistent with the attenuation effect

Return

Regression Results

- Previous results are for markup **elasticities**
  - For loans, $\frac{\Delta\mu^L/\mu^L}{\Delta r/r} \approx 0.21$
  - For deposits, $\frac{\Delta\mu^D/\mu^D}{\Delta r/r} \approx$ -0.23
- Useful for theory (up next) but goofy when thinking about low-rate environment
- Also do analysis in **level differences**: increase r by 100 bp
  - Increase loan markups by 12%
  - Decrease deposit markups by 8%

Return