# *Competition, Stability, and Efficiency in the Banking Industry*

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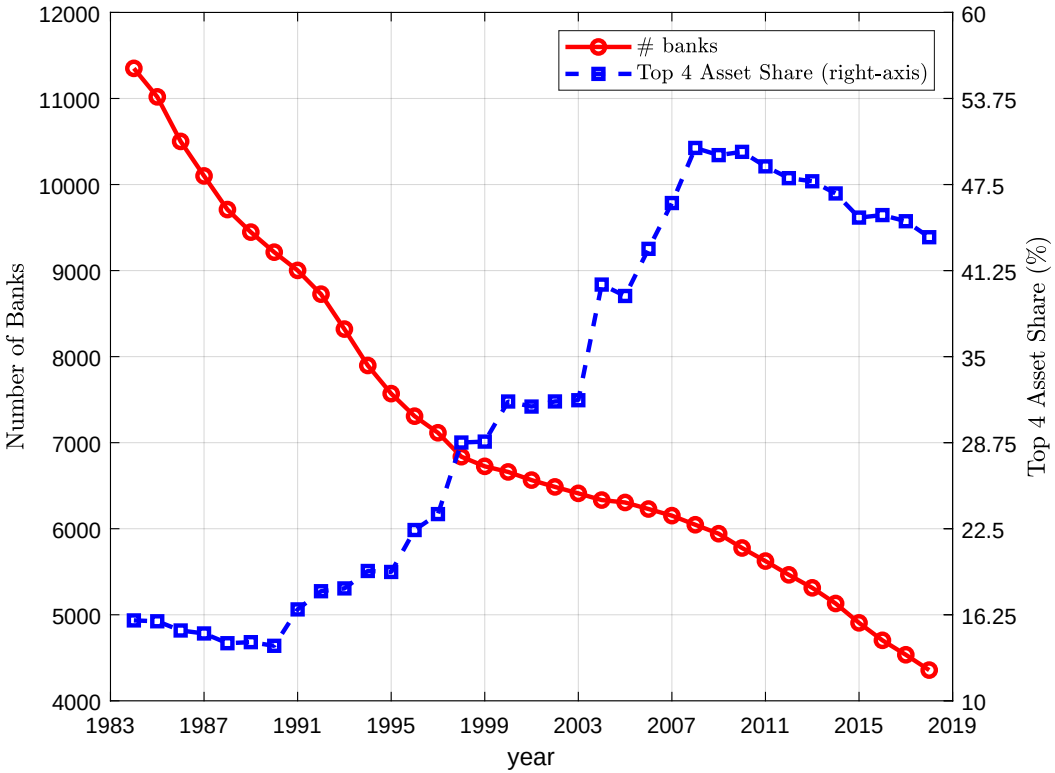
# U.S. Banking Concentration




- Number of banks fell in half (from 11,000 in 1984 to 5000 in 2018)
- Top 4 asset share nearly tripled (from 16% in 1984 to 44% in 2018) with almost 20 year transition following Riegle Neal (Interstate Banking) Act.

# Basic Idea and Challenge

- The Competition-Fragility View:
  - Too little competition can be bad for social welfare (efficiency).
  - Too much competition can be bad for social welfare (stability):
    - Erodes profits and charter values.
    - Can trigger excessive risk-taking (moral-hazard problem).

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- Challenge: Develop a Tractable Dynamic Framework with Agency Frictions Consistent with Data to Answer Policy Questions.

# What We Do:

- We develop a tractable dynamic model to assess the impact of policy on market efficiency and stability. We
  - endogenize market structure via bank entry decisions.
  - allow for agency frictions (wedge) between executives and shareholders.
  - consider the interactive effects of governance, leverage, monetary, TBTF policies and monitoring technologies on efficiency and stability.
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- Focus today on governance and leverage regulation. Our model predicts:
  - Improving governance reduces risk taking and improves market efficiency.
  - Tightening capital (leverage) regulation reduces risk taking and market efficiency.
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- These predictions are borne out in our empirical work.

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- Choice Variables: S,D,N,E, Parameters: A,$\eta$,$b$,$\gamma$,$\delta$, Policy: $\kappa, \lambda, \beta, \alpha$

# Decision Problems

- Incumbent bank $i$'s static profit imposing limited liability is

$$\pi_i(S_i, D_i; N) = p(S_i) \overbrace{[A \cdot S_i - (r_D(Z) + \alpha)]}^{\text{interest margin } R_i} D_i \tag{1}$$

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$$V_i(N) = \max_{S_i, D_i} \pi_i(S_i, D_i; N) + \beta p(S_i) V_i(N') \tag{2}$$

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- Shareholders with discount rate $\delta$ will inject equity to fund bank $i$ entry provided

$$E_i(N) \equiv \frac{\pi_i(N)}{1 - \delta p(S_i)} \geq \kappa. \tag{4}$$

# Equilibrium Risk Taking and Lending

- In the short run, optimal bank choices over portfolio risk ($S$) and external funding ($D$) in a symmetric equilibrium where the leverage requirement is non-binding are: ▸ Binding Case

$$p(S) = -\frac{p'(S)}{A} \cdot \left[ R + \beta \cdot \frac{E(N)}{D} \cdot w(S) \right], \tag{5}$$

$$R \equiv A \cdot S - (r_D(Z) + \alpha) = \frac{r'_D(Z)}{N} \cdot Z, \tag{6}$$

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- (6) implies that the interest margin $R$ is declining in competition (since $\frac{r'_D(Z)}{N} = \frac{\gamma}{N}$) (i.e. more competition, more market efficiency)

# Cournot Equilibrium

Taking policy parameters $\Theta = (\kappa, \beta, \alpha, \lambda)$ as given, a *symmetric steady state Cournot equilibrum* is simply 3 equations in 3 unknowns: ▸ Policy

- F.O.C. w.r.t. Risk Taking $S$ ($\rightarrow$ loan portfolio success prob. $p(S)$).
- F.O.C. w.r.t. Deposit Funding $D$ ($\rightarrow$ aggregate lending $Z = N \cdot D$).
- Free entry condition $N$ ($\rightarrow$ bank market concentration $\frac{1}{N}$).

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Our experiments (unanticipated policy shocks $\Theta'$) consider two cases:

- Short Run: Taking market structure $N$ as given, how do $S$ and $Z$ change transitioning with expected duration to a new long run $N'$ in $20 = \frac{1}{\zeta}$ years as in Fig. 1 (i.e. $\zeta = 0.05$)?

$$V_{\Theta'}(N) = \max_{S,D} \pi_{\Theta'}(N) + \beta p(S_{\Theta'}) \left[(1-\zeta) V_{\Theta'}(N) + \zeta V_{\Theta'}(N')\right]$$

- Long Run: Market structure $N'$ changes since policy affects the charter value of the bank (and hence entry).

# Parameterization

Table: Data (from JLL (2018)) and Benchmark Model Moments

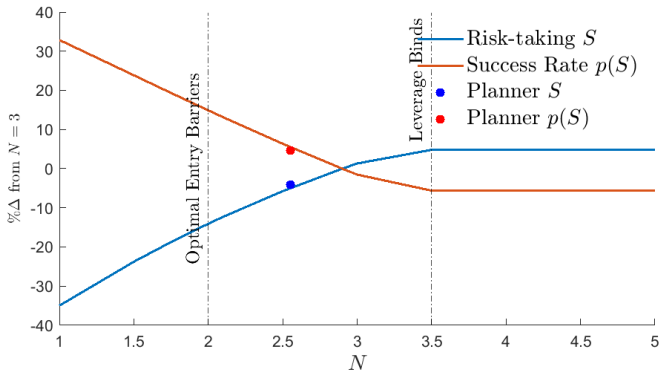
| | Data | Model |
|---|---|---|
| **Concentration** | 0.330 | 0.333 |
| **ROA** | 0.04 | 0.025 |
| **cv(ROA)** | 0.203 | 0.019 |
| **D/E** | 14.830 | 15.56 |
| **log(Deposits)** | 22.466 | 22.62 |
| **Real deposit rate** | 0.01 | 0.006 |

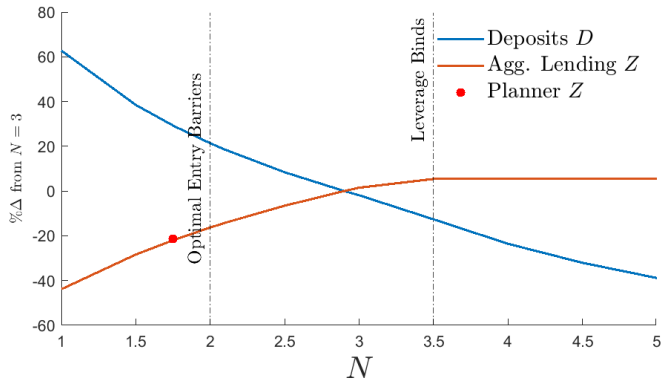
Table: Benchmark Parameters

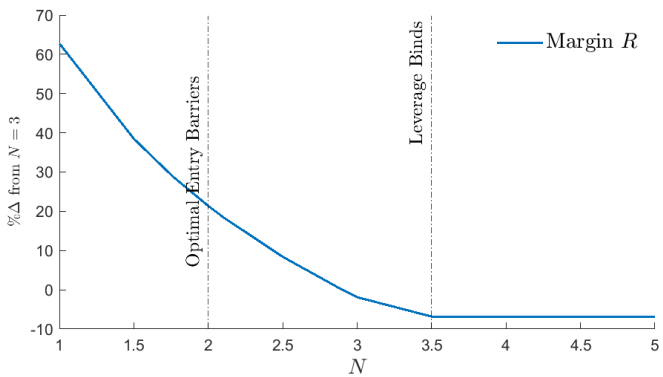
| | **values** |
|---|---|
| $\delta$ | 0.970 |
| $\lambda$ | 18.20 |
| $\alpha$ | 0.030 |
| $\beta$ | 0.600 |
| **A** | 0.125 |
| $\eta$ | 2.000 |
| $b$ | -0.114 |
| $\gamma$ | $6 \times 10^{-12}$ |
| $\kappa^*$ | 429.25 |

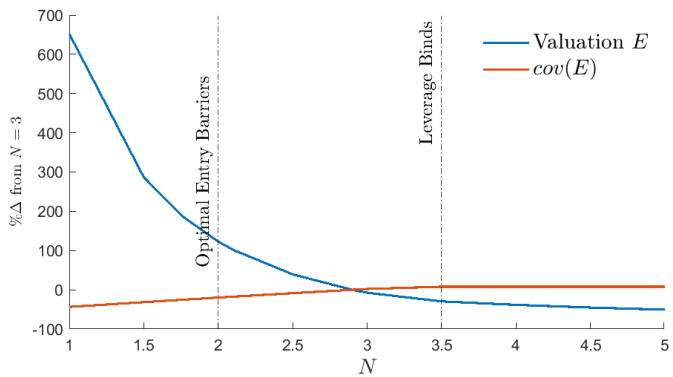
Left Table: * In millions. Right Table: Parameters above the line are chosen outside the model. Parameters below are chosen inside the model.

# Competition, Stability, and Efficiency



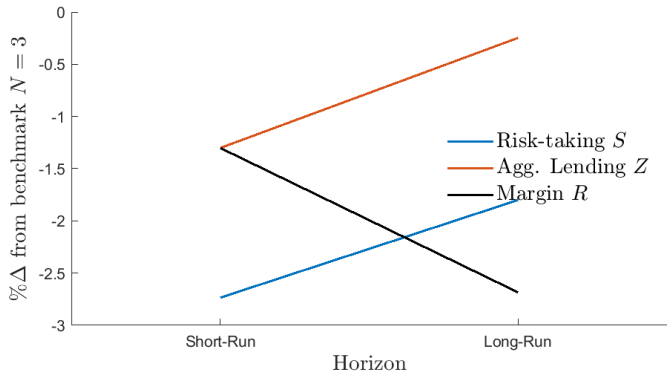



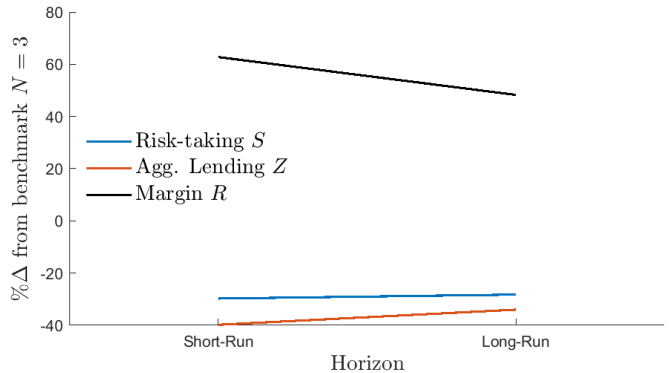



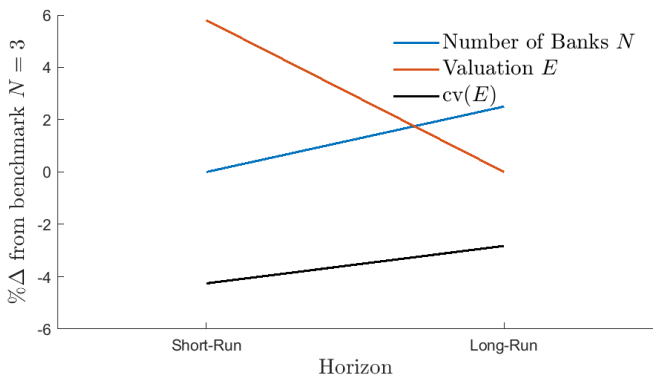

- Too little (too much) competition $\longrightarrow$ inefficiently low (high) risk taking.
- Since decentralized bank choices differ from the social planner $\longrightarrow$ role for regulatory policy (raise $\kappa$ to induce $N = 2$ - i.e. implement a duopoly).

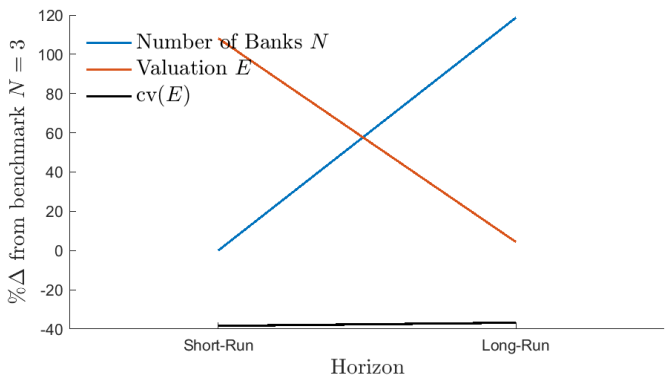
▸ Table ▸ Social Planner's Problem

# Regulatory Policy Counterfactuals




- Better governance lowers risk, raises market efficiency, increases market value in the short run, and competition in the long run.
- Tighter leverage lowers risk, reduces market efficiency, increases market value in the short run, and competition in the long run.

▸ Table ▸ Monetary

# Other Policy and Technological Changes

Policy:

- Too-Big-To-Fail ▸ Details
  - Introduce a probability of a bailout $B$ with deadweight loss $1-\theta$.
- Rise of Shadow Banking ▸ Details
  - Competition from nonbank finance raises slope $\gamma$ of inverse deposit supply function $r_D(Z) = b + \gamma Z$.
- Regulatory Arbitrage ▸ Details
  - Tighter Leverage Requirements (lower $\lambda$) coupled with rise in $\gamma$.

Technology:

- Fintech ▸ Details
  - Monitoring improvements raise the parameter $\eta$ in $p(S) = 1 - S^{\eta}$.
- Business Cycles ▸ Details
  - Boom raises parameter $A$ in production technology $A \cdot S$.
- Contagion and Runs ▸ Details
  - Contagion modeled as an externality captured in $p(S, S_{-i})$.

▸ Table

# Model Predictions Summary

- More competition leads to lower bank profit margins and more risk-taking (more fragility).
- Better governance and tighter leverage constraints lead to less risk taking. There is a positive *interaction* between better governance and tighter leverage.
- Contractionary monetary policy leads to more risk-taking. There is a negative *iteraction* between monetary policy and competition.
- We take these model predictions to the data (a validation exercise).

# Empirical Results

There are two key building blocks to Jiang, Levine, and Lin's (JLL) construction of bank-state-time-varying measures of the regulation-induced competitive pressures in the US from 1982-1995:

- Time ($t$) and State ($s$) Level Variation: Starting in 1982, individual states began removing cross-state branching restrictions ending with the Riegle-Neal Act of 1994.
- Bank ($b$) Level Variation: Use a gravity model to generate geographic costs of BHC expansion to nearby markets (consistent with earlier empirical evidence that BHCs are more likely to expand into geographically close markets).

Assess the impact of competition/contestability on bank risk (s.d. of stock returns) using the following regression specification:

$$Y_{bst} = \gamma_C \cdot Competition_{bst} + \gamma'_X \cdot \mathbf{X}_{bst-1} + \theta_b + \theta_{st} \ + \varepsilon_{bst} \qquad (8)$$

▸ Definitions ▸ Measure

# Empirical Results

## Table: Competition and Risk

Competition and Risk

| | Bank Risk | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Bank Competition | 0.6618*** | 0.6572*** | 0.6704*** | 0.5994*** | 0.6265*** |
| | (0.1859) | (0.1992) | (0.1951) | (0.1778) | (0.1787) |
| Leverage-Lagged | 0.0243*** | 0.0234*** | 0.0244*** | 0.0119** | 0.0142** |
| | (0.0047) | (0.0048) | (0.0047) | (0.0048) | (0.0056) |
| Ln(Bank Assets)-Lagged | -0.1978** | -0.1937** | -0.1968** | -0.1919** | -0.1968** |
| | (0.0751) | (0.0776) | (0.0757) | (0.0748) | (0.0742) |
| % Institutional Ownership | | -0.4530*** | | -1.1725*** | |
| | | (0.0837) | | (0.1968) | |
| Blockholders Top 10 | | | -0.2711** | | -1.1070*** |
| | | | (0.1150) | | (0.2414) |
| Leverage*Institutional Ownership | | | | 0.0497*** | |
| | | | | (0.0129) | |
| Leverage*Blockholders-Top 10 | | | | | 0.0599*** |
| | | | | | (0.0174) |
| Observations | 1994 | 1994 | 1994 | 1994 | 1994 |
| R-squared | 0.7898 | 0.7925 | 0.7905 | 0.7945 | 0.7919 |

▶ Monetary Policy Results

# Empirical Results

Consistent with the predictions of the model:

- Increased *Competition* increases bank risk (equity volatility),
- Increased leverage increases bank risk,
- Bigger banks have lower risk (consistent with geographic diversification),
- Better governance (informed institutional investors can compel bank execs to max long-run bank value) decreases bank risk,
- Leverage requirements and better governance are reinforcing (positive interaction effect in (col.4-5)).

Results are statistically significant and economically large. ▸ More

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- Today we focused on the interaction of agency frictions with leverage on risk taking consistent with our empirical results.
- The endogenous agency wedge at the heart of our model shapes the economic effects of **any** policy or condition that influences risk taking:
  - Monetary Policy
  - Too-big-to-fail
  - Contagion

▸ Wedge

# Social Planner's Problem

- To obtain the "socially efficient" level of risk taking and aggregate investment for our model economy, we solve the social planner's problem in a frictionless economy given by:

$$\max_{S,Z} p(S) \cdot A \cdot S \cdot Z - \widetilde{b}Z - \widetilde{\gamma}Z^2 \tag{9}$$

  where $\widetilde{b}Z + \widetilde{\gamma}Z^2$ is the cost of investment.

- It is evident from (1) that if $b = \frac{\widetilde{b}}{p(S^*)}$, $\gamma = \frac{\widetilde{\gamma}}{p(S^*)}$ and $\alpha = 0$, then the aggregate costs of funds in a symmetric decentralized equilibrium is the same as the planner's cost. ▸ Return Counterfactual

# Competition and Stability

Table: Variation in Market Structure

| | Planner | Less competitive | Benchmark (levels) | More competitive ** | Optimal entry barriers |
|---|---|---|---|---|---|
| N | NA | 1 | 3 | 5 | 2 |
| S | -5.4% | -35.8% | 0.61 | 3.5% | -15.2% |
| D | NA | 65.9% | 6678.48 | -37.7% | 23.7% |
| Z | -22.6% | -44.7% | 20035 | 3.9% | -17.5% |
| D/E | NA | -79.6% | 15.56 | 17.0% | -48.7% |
| p | 6.2% | 34.0% | 0.63 | -4.2% | 16.7% |
| R | NA | 2.6 bp | 0.04 | -0.2 bp | 1.0 bp |
| $r_D$ | NA | -5.3 bp | 0.006 | 0.5 bp | -2.1 bp |
| $\pi^*$ | NA | 271% | 167.95 | -43.3% | 78.5% |
| $E^*$ | NA | 713% | 429.25 | -46.7% | 141% |
| V | NA | 370% | 269.38 | -44.7% | 98.5% |
| F/Y | NA | -657% | 0.035 | 123% | -383% |
| $Y^*$ | -22.1% | -52.1% | 959.17 | 3.0% | -18.4% |
| cv(Y) | -34.4% | -85.4% | 569.21 | 15.0% | -49.7% |
| cv(E) | NA | -44.8% | 0.77 | 5.7% | -21.5% |

Except for benchmark, all columns are percent deviations from benchmark.

In millions. $Y = p(S) \cdot A \cdot S \cdot Z$. ** indicates leverage constraint binds.

Return

# Competition and Stability Details

- Leverage is monotonically increasing in the degree of competition (i.e. $\frac{D}{E}$ is $80\%$ lower ($17\%$ higher) in the less (more) competitive economy than in the benchmark).
- Interest margins are monotonically decreasing in the level of competition (i.e. $R$ is $2.6$ basis points higher ($0.2$ basis points lower) in the less (more) competitive economy than in the benchmark).
- Intermediated output and FDIC expenses (relative to output) are increasing in the level of competition.
- The economy is more volatile in competitive environments (the coefficient of variation of both output and equity value are increasing in the degree of competition).

▸ Return

# Regulatory Policy Counterfactuals

Table: Regulatory Policy Counterfactuals: Short-Run versus Long-Run

| | Mitigating agency SR | Mitigating agency LR | Tightening leverage SR ** | Tightening leverage LR ** | Agency and leverage SR ** | Agency and Leverage LR ** |
|---|---|---|---|---|---|---|
| N | 3 | 3.08 | 3 | 6.56 | 3 | 7.01 |
| S | -2.7% | -1.8% | -29.7% | -28.2% | -29.8% | -28.8% |
| D | -1.3% | -2.7% | -39.8% | -69.8% | -37.5% | -70.3% |
| Z | -1.3% | -0% | -39.8% | -34.0% | -37.5% | -32.3% |
| D/E | -6.7% | -2.7% | -71.1% | -71.1% | -69.0% | -70.3% |
| p | 3.2% | 2.1% | 30.0% | 28.8% | 27.6% | 27.6% |
| R | -0.05 bp | -0.1 bp | 2.5 bp | 1.9 bp | 2.2 bp | 1.7 bp |
| $r_D$ | -0.2 bp | -0.02 bp | -4.8 bp | -4.1 bp | -4.4 bp | -3.9 bp |
| $\pi^*$ | 0.5% | -3.3% | 27.4% | -42.4% | 24.8% | -45.4% |
| $E^*$ | 5.8% | 0% | 108.2% | 0% | 101.6% | 0% |
| V | 8.1% | 3.3% | 56.2% | -30.3% | 56.0% | -31.2% |
| F/Y | -29.5% | -8.4% | -462% | -411% | -571% | -409% |
| $Y^*$ | -0.9% | 0% | -45.0% | -39.0% | -44.0% | -38.5% |
| cv(Y) | -9.2% | -5.5% | -79.1% | -75.6% | -78.4% | -75.6% |
| cv(E) | -4.3% | -2.8% | -38.4% | -36.8% | -37.9% | -37.0% |

Percent deviations from benchmark. * In millions. $Y = p(S) \cdot A \cdot S \cdot Z$. Note here the entry cost $\kappa$ is held fixed and so in the short-run equity $E^* \neq \kappa$. ** indicates leverage constraint binds.

Return

# Regulatory Policy Counterfactuals

Better Governance

- Short Run (fixed $N$):
  - Less risk taking and lower leverage.
  - Volatility of bank equity drops as well.
  - Expected cost of funding bank failures falls.
- Long Run: Higher long run profits induces entry ($N$ rises by $3\%$) mitigating some short run effects.

# Regulatory Policy Counterfactuals

Better Governance

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- Long Run: Higher long run profits induces entry ($N$ rises by $3\%$) mitigating some short run effects.

Tighter Leverage Constraints

- Short Run:
  - Less risk taking and less leverage.
  - While interest margins rise the drop in lending leads to lower short run profitability. The increase in success probability however leads to higher long run profitability.
  - Volatility of bank equity drops.
  - Expected cost of funding bank failures falls.
- Long Run: Higher long run profits induces entry ($N$ rises by $119\%$).

Return

# Interaction Effects

- The interaction of tightening leverage (reducing $\lambda$) and governance policies aimed at decreasing agency conflicts (increasing $\beta$) can magnify the reduction in risk-taking.

- Under our benchmark calibration, we find that the percentage change in risk-taking from tighter leverage requirements is $-29.7\%$ while in an environment where there is no agency conflict the percentage change in risk-taking induced by the tightening of leverage requirements is $-29.8\%$.

- That is, we find a $0.1\%$ higher interaction effect when governance to deal with agency conflicts is combined with policies to curtail leverage relative to the benchmark.

- This finding motivates the interaction terms in our empirical analysis.

Return

# Regression Variables

- For BHC *b*, headquartered in state *s*, in year *t*, $Y_{bst}$ is either *Charter (Q) Value* - the natural logarithm of the market value of the bank divided by the book value of assets - or *Bank Risk* - the natural logarithm of the standard deviation of daily stock returns.

- $Competition_{bst}$ is the measure of regulatory-induced competitive pressures facing BHC *b* in state *s*, in year *t*.

- $\mathbf{X}_{bst-1}$ represents a vector of time-varying BHC traits, measured in period *t-1*, where *Log(Total Assets)–Lagged* equals the natural logarithm of the BHC's total assets one-year lagged, and *Leverage – Lagged* equals the BHC's debt to equity ratio one-year lagged.

- Bank ($\theta_b$) and state-year ($\theta_{st}$) fixed effects.

- We report heteroskedasticity-consistent standard errors, clustered at the state level.

▸ Return

# Monetary Policy Counterfactuals

## Table: Monetary Transmission Mechanism Across Market Structures

| | Benchmark less competitive (levels, N=2) | Contractionary Monetary Policy SR (N=2) | Contractionary Monetary Policy LR (N=2) | Benchmark (levels) | Contractionary Monetary Policy SR (N=3) | Contractionary Monetary Policy LR (N=3) | Benchmark more competitive (levels, N=4) ** | Contractionary Monetary Policy SR (N=4) ** | Contractionary Monetary Policy LR (N=4) ** |
|---|---|---|---|---|---|---|---|---|---|
| N | 2 | 2 | 1.9 | 3 | 3 | 2.88 | 4 | 4 | 3.84 |
| S | 0.52 | 2.0% | 0% | 0.61 | 1.5% | 0% | 0.63 | 0% | 0% |
| D | 8261.2 | -2.5% | 0% | 6678.5 | -2.4% | 0% | 5202.3 | -4.7% | 0% |
| Z | 16522 | -2.5% | -5.0% | 20035 | -2.4% | -4.2% | 20809 | -4.7% | -4.0% |
| D/E | 7.99 | 7.7% | 0% | 15.56 | 7.2% | 0% | 18.2 | 0% | 0% |
| p | 0.732 | -1.4% | 0% | 0.628 | -1.8% | 0% | 0.60 | 0% | 0% |
| R | 0.050 | -0.12 bp | 0 bp | 0.04 | -0.10 bp | 0 bp | 0.038 | 0.9 bp | 0 bp |
| $r_D$ | -0.015 | -0.25 bp | -0.5 bp | 0.006 | -0.3 bp | -0.5 bp | 0.011 | -0.6 bp | -0.5 bp |
| $Sp$ | 0.045 | 0.75 bp | 1.0 bp | 0.024 | 0.8 bp | 1.0 bp | 0.019 | 1.1 bp | 1.0 bp |
| $\pi^*$ | 299.77 | -6.3% | 0% | 167.95 | -6.5% | 0% | 119.08 | -2.5% | 0% |
| $E^*$ | 1034.1 | -9.5% | 0% | 429.25 | -9.0% | 0% | 285.84 | -4.7% | 0% |
| V | 534.59 | -7.1% | 0% | 269.38 | -7.2% | 0% | 186.31 | -1.0% | 0 |
| F/Y | -0.084 | -20.8% | -33.6% | 0.048 | -44.8% | -80.5% | 0.091 | -53.9% | -46.1% |
| $Y^*$ | 782.62 | -2.1% | -5% | 959.17 | -2.7% | -4.2% | 987.67 | -4.7% | -4% |
| cv(Y) | 286.43 | 3.3% | -5.0% | 569.21 | 2.0% | -4.2% | 654.46 | -4.6% | -4.0% |
| cv(E) | 0.61 | 2.7% | 0% | 0.77 | 2.4% | 0% | 0.81 | 0% | 0% |

Percent deviations of monetary policy contraction from $\alpha = 0.03$ to $\alpha = 0.035$ holding market size fixed at $N = 2$, $N = 3$, and $N = 4$ levels. ** indicates leverage constraint binds.

Return

# Monetary Policy Counterfactuals

Contractionary Policy

- Short Run (fixed $N$):
  - More risk taking and more leverage.
  - Volatility of bank equity increases as well.
  - Expected cost of funding bank failures rises.
- Long Run: Lower long run profits reduces entry ($N$ drops by $23\%$) which mitigates some short run effects ($S$ unchanged) while aggregate lending drops greatly.

# Monetary Policy Counterfactuals

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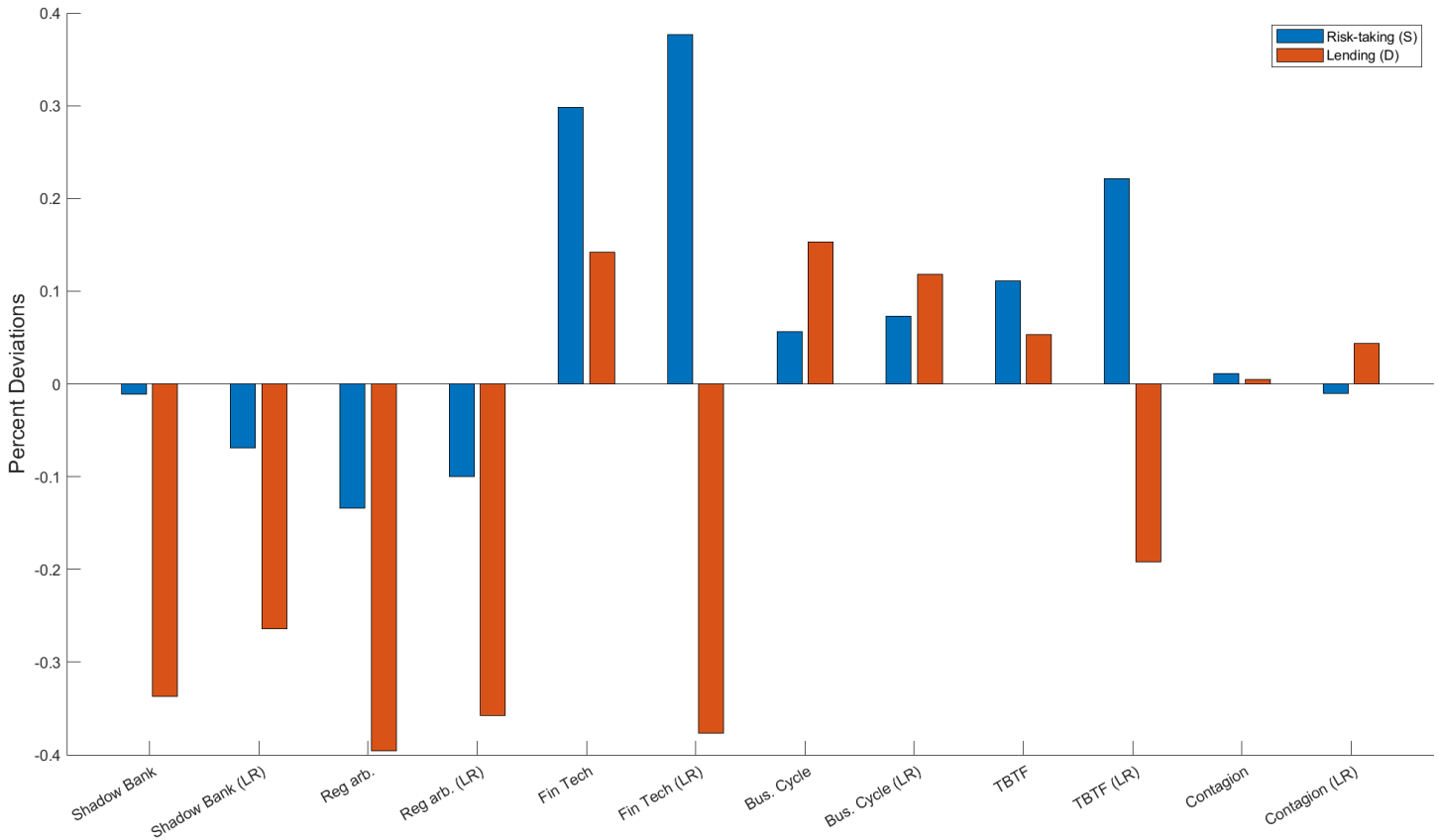
Contractionary Policy across Market Structure

- Consistent with the bank lending channel in Kashyap and Stein (2000), we find that an increase in $\alpha$ from $3\%$ to $3.5\%$ drops lending by smaller banks more than larger banks (i.e. $D$ decreases more when $N = 3$ than when $N = 2$).

Return

# Robustness




Return

# Robustness

Table: Robustness Table 1

| | Shadow Banking SR ($\gamma$) | Shadow Banking LR ($\gamma$) | Regulatory Arbitrage SR ($\gamma+\lambda$) ** | Regulatory Arbitrage LR ($\gamma+\lambda$) ** | Fintech SR ($\eta$) | Fintech LR ($\eta$) |
|---|---|---|---|---|---|---|
| N | 3 | 2.5 | 3 | 2.76 | 3 | 6.57 |
| S | -1.1% | -6.9% | -13.4% | -10% | 29.8% | 37.6% |
| D | -33.7% | -26.4% | -39.6% | -35.7% | 14.2% | -37.6% |
| Z | -33.7% | -38.6% | -39.6% | -40.9% | 14.2% | 36.5% |
| D/E | -2.7% | -26.4% | -35.7% | -35.7% | -80.7% | -37.7% |
| p | 1.3% | 7.9% | 14.9% | 11.3% | 43.8% | 31.4% |
| R | -0.02 bp | 0.4 bp | 0.1 bp | 0.6 bp | 0.6 bp | -1.5 bp |
| $r_D$ | -0.06 bp | -0.9 bp | -1.1 bp | -1.4 bp | 1.7 bp | 4.4 bp |
| $\pi^*$ | -33.2% | -12.3% | -28.8% | -17.6% | 87.5% | -48.9% |
| $E^*$ | -31.8% | 0% | -6% | 0% | 490% | 0% |
| V | -31.2% | -7.9% | -21.1% | -11.5% | 135% | -36.9% |
| F/Y | -17% | -201% | -227% | -276% | -56.8% | 160% |
| $Y^*$ | -33.6% | -38.3% | -39.9% | -40.9% | 113% | 147% |
| cv(Y) | -35.8% | -50.5% | -60.8% | -56.9% | -61.3% | -11.7% |
| cv(E) | -1.7% | -10.3% | -19.2% | -14.7% | -57.4% | -40.2% |

In the first two experiments, $\gamma$ is increased by 50%. The Fintech experiment corresponds to $\eta$ being increased from 2 to 10. ** indicates leverage constraint binds.

# Robustness

Table: Robustness Table 2

| | Business Cycle SR (A) | Business Cycle LR (A) | Too Big To Fail SR | Too Big To Fail LR | Contagion SR ($\psi = 0.05$) | Contagion LR ($\psi = 0.05$) |
|---|---|---|---|---|---|---|
| N | 3 | 3.16 | 3 | 4.47 | 3 | 2.81 |
| S | 5.7% | 7.3% | 11.1% | 22.1% | 1.1% | -1.0% |
| D | 15.3% | 11.8% | 5.3% | -19.2% | 0.5% | 4.3% |
| Z | 15.3% | 17.7% | 5.3% | 20.5% | 0.5% | -2.1% |
| D/E | 3.2% | 11.8% | -56% | -19% | 15.4% | 4.4% |
| p | -6.9% | -8.9% | -13.9% | -29% | -5.9% | -3.4% |
| R | 0.6 bp | 0.5 bp | 0.2 bp | -0.8 bp | 0 bp | 0.1 bp |
| $r_D$ | 1.8 bp | 2.1 bp | 0.6 bp | 2.4 bp | 0 bp | -0.3 bp |
| $\pi^*$ | 23.7% | 13.9% | -4.6% | -53.7% | -4.9% | 5.2% |
| $E^*$ | 11.7% | 0% | 141% | 0% | -12.9% | 0% |
| V | 18.2% | 8.1% | 18% | -41.6% | -7.6% | 3% |
| F/Y | 364% | 444% | 225% | 1042% | 23% | -56% |
| $Y^*$ | 41.7% | 81.6% | 0.7% | 4.2% | -4.4% | -6.4% |
| cv(Y) | 69.9% | 81.6% | 44% | 119% | 11.7% | 2.3% |
| cv(E) | 9.5% | 12.4% | 19.7% | 45.1% | 8.1% | 4.5% |

The business cycle experiment increases A by 25%. The TBTF experiment moves bailout probability from 0 to $B = 0.8$ with $\theta = .72$. The contagion experiment moves the externality of other banks risk-taking on a given individual banks success probability from $\psi = 0$ to $\psi = .05$.

Return

# Too-Big-To-Fail ($B = 0$ to $B = 0.8$ with $\theta = 0.72$)

The problem of an incumbent manager is now

$$V_i(N) = \max_{S_i, D_i} \pi_i(N) + \beta \left\{ \begin{array}{c} p(S_i) V_i(N') \\ +(1 - p(S_i)) \left[ B \cdot \theta V(N') + (1 - B) \cdot 0 \right] \end{array} \right\}$$

Short Run (fixed $N$):

- Increases risk taking as well as bank lending, and so average output also rises.
- Volatility of bank equity increases.
- Expected cost of funding bank failures also increases.

Long Run(endogenous $N$):

- Higher expected long run profits from government support induces entry ($N$ rises by $49\%$) which generates even more risk taking and "over" lending.

Return

# Shadow Banking ($\gamma$ rises 50%)

Short Run (fixed $N$):

- Competition from other nonbank sources for funding decreases individual and aggregate bank lending, lowers risk taking and interest margins.
- The drop in lending induces lower short run profits and equity value.

Long Run (endogenous $N$):

- Decreased profitability leads to exit ($N$ drops by $16\%$).
- Less competition induces less risk taking and lower leverage.
- Smaller banking industry implies expected cost of funding bank failures falls.

Return

# Regulatory Arbitrage ($\lambda$ drops by 45% and $\gamma$ rises 50%)

Short Run (fixed $N$):

- Competition from other nonbank sources for funding and tighter regulation decreases individual and aggregate bank lending further. Risk taking however drops and interest margins rise.

Long Run (endogenous $N$):

- Decreased profitability leads to more entry ($N$ decreased by $28\%$).
- More competition offsets less risk taking from tighter leverage constraints.
- Expected cost of funding bank failures falls substantially.

Return

# Fintech ($\eta = 2$ to $\eta = 10$)

Short Run (fixed $N$):

- Risk taking increases and as does lending.
- Due to the improved technology, despite the increased risk taking the probability of success also rises.
- The drop in failure rates induces a large rise in long run profitability.

Long Run (endogenous $N$):

- Increased profitability leads to a large increase in entry ($N$ roughly doubles).
- Expected cost of funding bank failures falls.

Return

# Business Cycle ($A$ increased by 25%)

Short Run (fixed $N$):

- Risk taking increases and lending rises along with intermediated output.
- Interest margins, short run profits, and equity values are all procyclical
- The expected cost of deposit insurance increases.
- While variability of output and the variability of equity is countercyclical.

Long Run (endogenous $N$):

- In the long run, entry rises (i.e. procyclical entry).
- Long run leverage is procyclical.

Return

# Contagion & Runs ($\psi = 0$ to $\psi = 0.05$)

- Contagion modeled as $p(S_i, \overline{S}) = (1 - S_i^{\eta})(1 - S_{-i})^{\psi}$ with $S_{-i} = \overline{S}$ (e.g. reduced form network externality).

- That is, bank $i$'s choice of risk depends explicitly on what all other banks' choice of risk ($S_{-i}$) is, similar to how we model the funding technology $r_D(Z)$.

- This specification nests our benchmark when $\psi = 0$.

- The best response function exhibits strategic complementarity and can exhibit runs.
  - If all other banks are choosing $S_{-i} = 1$, then $p(S_i, \overline{S}) = 0$ and hence bank $i$ (weakly) chooses $S_i = 1$.
  - This is very similar to the equilibrium in Diamond-Dybvig.

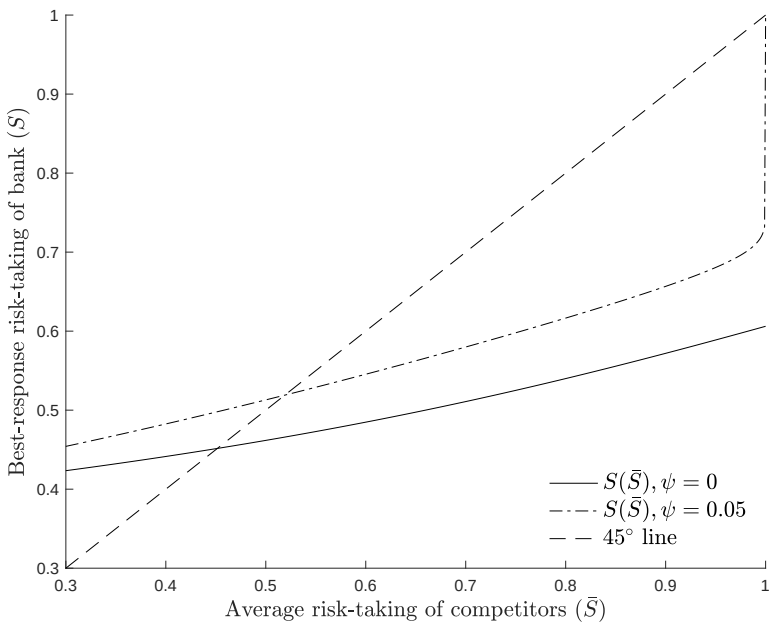
- Stronger externality generates more risk taking and lending.

▸ Comparative Statics

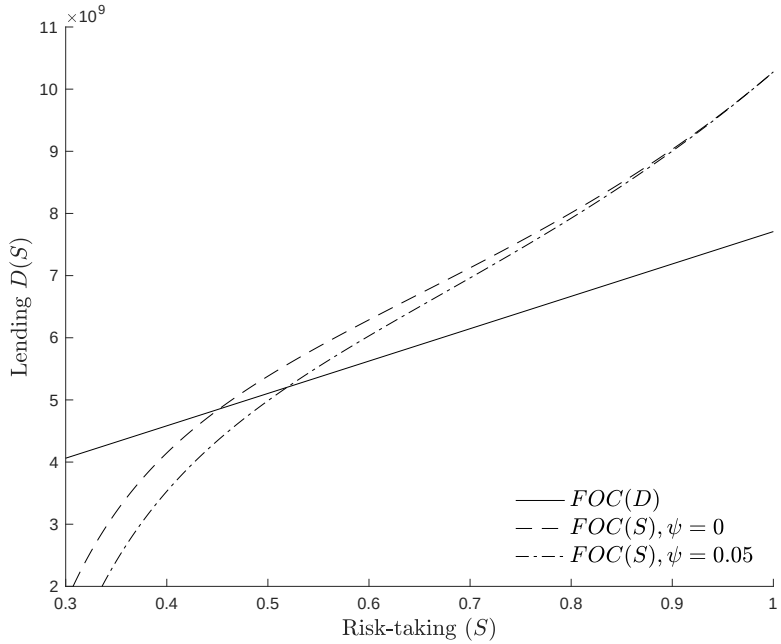
▸ Return

# Strategic Complementarity

Figure: Contagion and Runs




(a) Best Response Function




(b) Comparative Statistics

Return

# Contagion Results($\psi = 0$ to $\psi = 0.05$)

Short Run (fixed $N$):

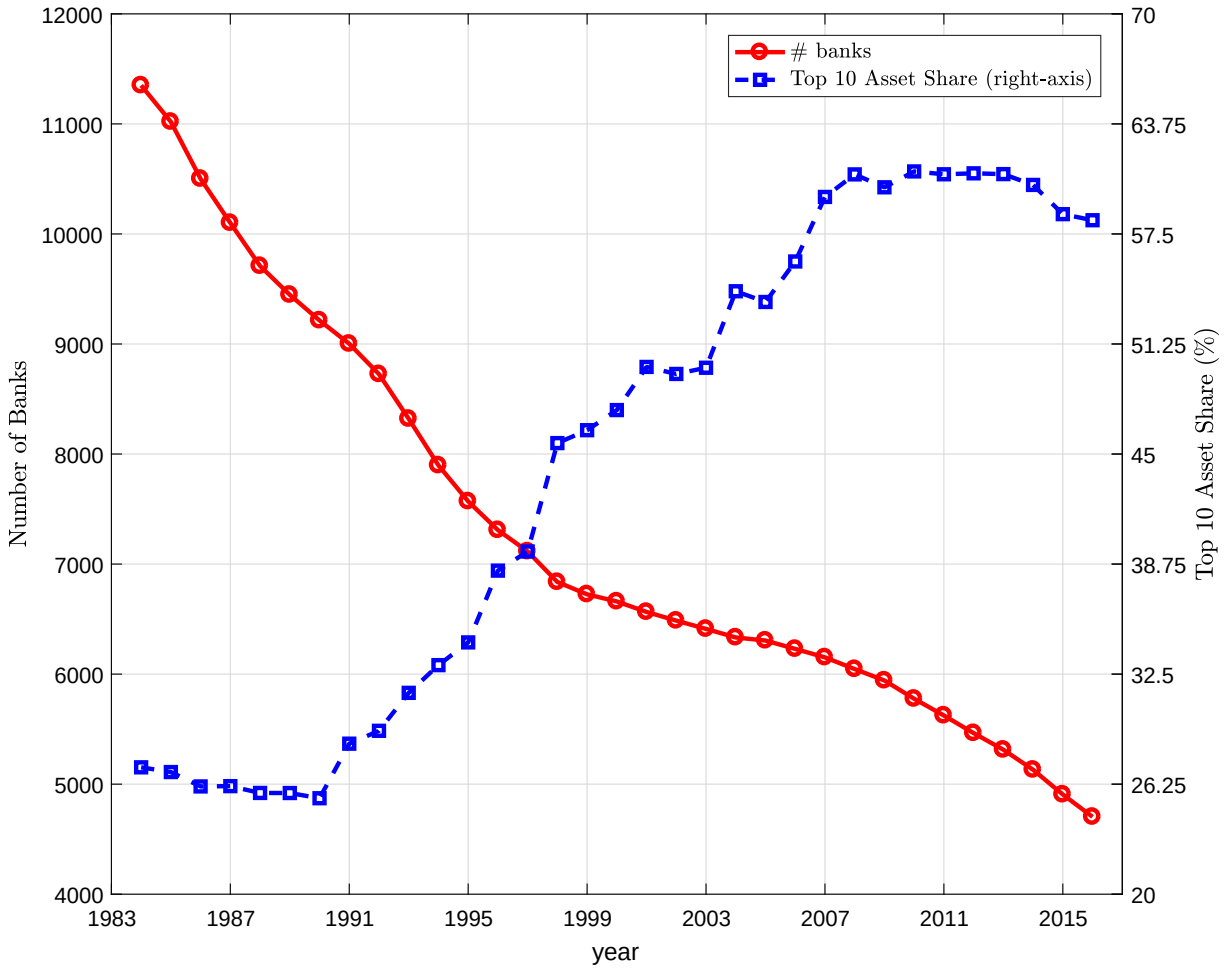
- Risk taking and lending rise (strategic complementarities).
- While interest margins rise slightly, profits and equity values fall due to the decrease in success probability.
- Output falls, but expected costs of deposit insurance rise tremendously.
- More variability in output and equity values.

Long Run (endogenous $N$):

- In the long run, firms exit due to the decrease in charter value.
- Decreasing competition weakens the risk-taking effect, but individual bank lending rises even further.
- Output falls even further.

Return

# U.S. Banking Industry Concentration




Return

# First Order Conditions

- At the time the $(S_i, D_i)$ choice is taken, entry has already occurred so $E_i = \kappa$ and $N$ is taken as given.

- Attaching a multiplier $\mu$ to constraint (3), the first order conditions from problem (2)-(3) are given by

$$S_i : p(S_i) \cdot A \cdot D_i + p'(S_i) \cdot R_i \cdot D_i + p'(S_i) \cdot \beta \cdot V_i(N') = 0, \quad (10)$$

$$D_i : p(S_i) \cdot R_i - p(S_i) \cdot r'_D(Z) \cdot D_i - \frac{\mu_i}{\kappa_i} = 0. \quad (11)$$

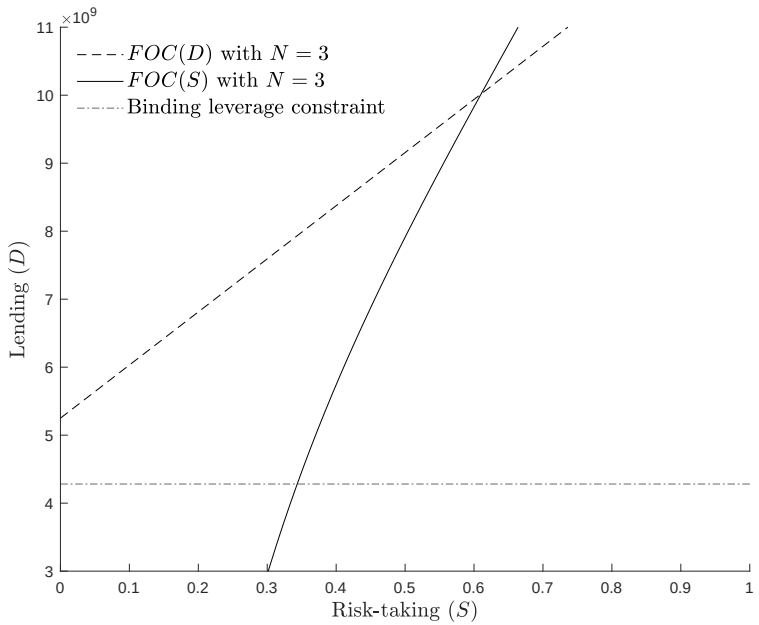
Return

# Compensation

- There are a large number of managers who take compensation as given.
- Managers receive a constant fraction $f$ of the earnings of the bank while equity holders receive a fraction $1 - f$.
- Static preferences of the manager are given by $u(c_M) = \psi_M c_M$ while preferences of equity holders are given by $u(c_E) = \psi_E c_E$.
- For simplicity we take $\psi_M = f^{-1}$ and $\psi_E = (1 - f)^{-1}$.

Return

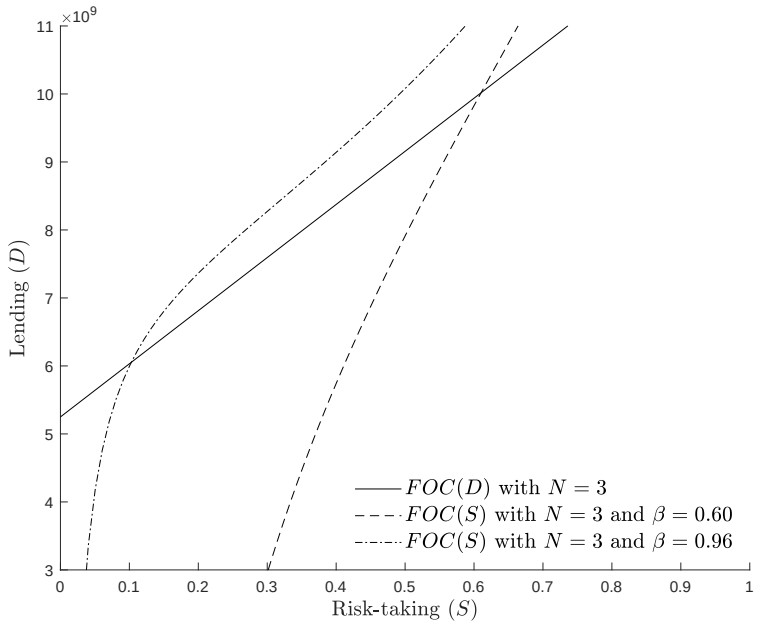
# Leverage Unconstrained versus Constrained FOCs




- Tightening leverage (lowering $\lambda$) shifts foc for $D$ not $S$, decreasing $S$ and $D$.

▶ Return

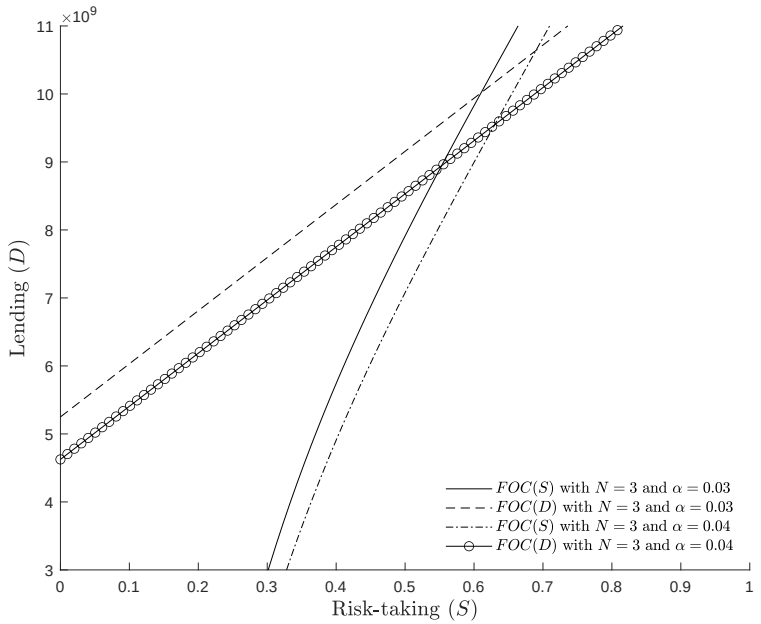
# Agency Conflict Effects on FOCs




- Mitigating agency conflicts (raising $\beta = \delta$) shifts foc for $S$ (not $D$) leftward, decreasing $S$ and $D$.

▶ Return

# Contractionary Policy Effects on FOCs




- Contractionary monetary policy (raising $\alpha$) shifts foc for $S$ and $D$ rightward, increasing $S$ and decreasing $D$.

▶ Return

# Empirical Results

An intensification of competition reduces charter value and increases bank risk.

- As shown in column (1), *Competition* enters negatively and significantly in the *Charter Value* regression.
- The estimated economic impact of competition on BHC profits and franchise value is large.
  - A BHC that experiences a change in *Competition* from the $25^{th}$ percentile to the $75^{th}$ percentile of the sample distribution finds its *Charter Value* would fall by about $50\%$.

- As shown in column (4), a regulatory-induced intensification of competition increases the riskiness of the bank (*Bank Risk*).
- The estimated impact is economically large.
  - A BHC that experiences a change in *Competition* from the $25^{th}$ percentile to the $75^{th}$ percentile of the sample distribution finds its *Bank Risk* would be about $50\%$ higher in the more highly competitive environment.

▸ Return

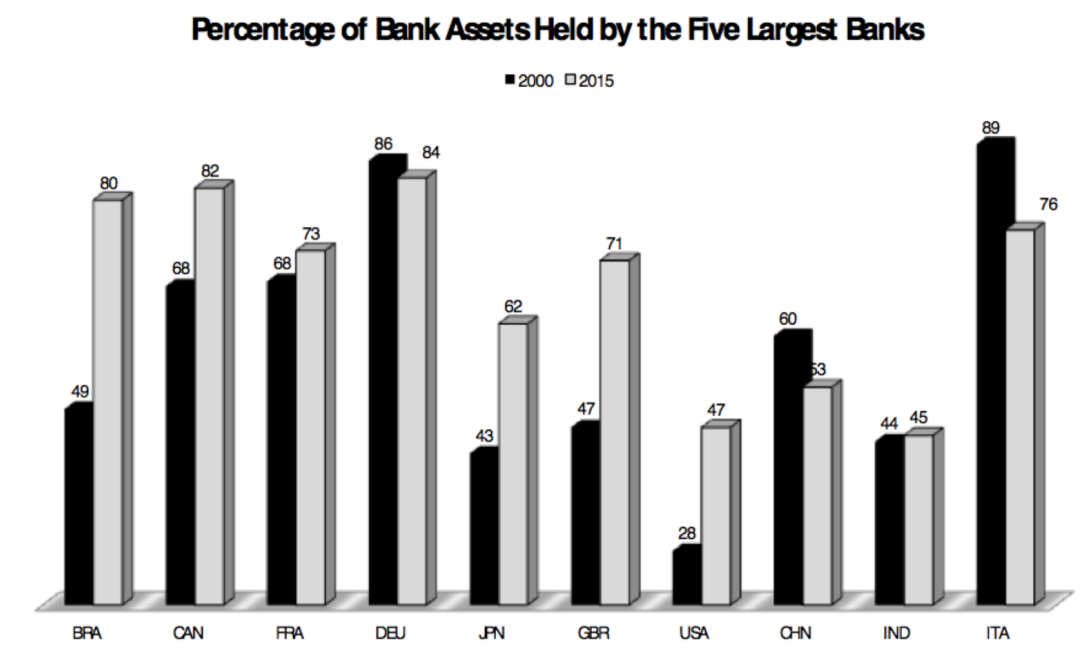
# Policy Shock Definitions

Four time-varying, BHC-specific measures of monetary policy based on the assumption that banks that rely more on deposits are more sensitive to changes in the FFR, because they have less access to elastic financing sources if, for example, the FFR increases.

1. FFR_1 is the FFR averaged over the year interacted with the degree to which the BHC relies on non-wholesale deposits, lagged one year: $\text{FFR}_t$=[(total deposits - wholesale deposits)/bank liabilities]$_{t-1}$.
2. FFR_2 is defined similarly, except rather than measuring the FFR over the year, it is measured during the first quarter of the year.
3. FFR_3 is the FFR averaged over the year interacted with the degree to which the BHC funds itself with deposits, lagged one year: $\text{FFR}_t$=[(bank liabilities - non-deposit liabilities)/bank liabilities]$_{t-1}$.
4. FFR_4 is defined similarly to FFR_3, except that rather than measuring the FFR over the year, it is measured during the first quarter of the year.

return

# International Banking Concentration




- 6 out of the 10 largest economies had *5 Bank Concentration* greater than 70% in 2015.
- *5 Bank Concentration* grew by over 50% in Brazil, GB, and US and shrunk by over 10% in China and Italy from 2000 to 2015. ▸ US

# Literature

- Builds on the applied theory papers on risk taking and competition by:
  - Allen and Gale (2000)
  - Boyd and DeNicolo (2005)
  - Martinez-Miera and Repullo (2010)
  - Hellmann, Murdock, and Stiglitz (2000)
- Adds free entry condition which endogenizes market structure so policy determines market structure in the long run.

return

# Competition Measure Challenges

- Statistical: endogeneity and omitted variable bias.
  - For example, more stable banking markets might attract new banks to enter those markets generating a positive correlation between stability and competition while there may be omitted variables that drive both competition and stability.
- Measurement: concentration does not gauge the contestability.
  - There were over 30,000 banks in the 1970s reflecting regulations that protected local monopolies; the low bank concentration metrics did not reflect intense competition. That is, regulations produced low concentration and low competition.
- Measurement: bank risk
  - Accounting-based measures can be manipulated and vary across regulatory jurisdictions and time as accounting rules change.
  - We use market-based risk measures since securities prices are more likely to reflect immediately the EPDV of regulatory-induced changes.

return

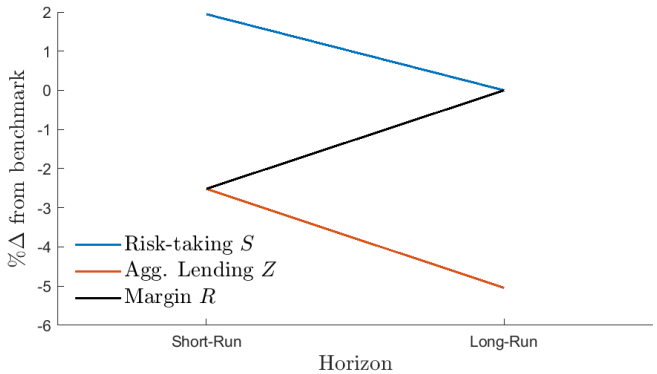
# JLL Contestability Measure

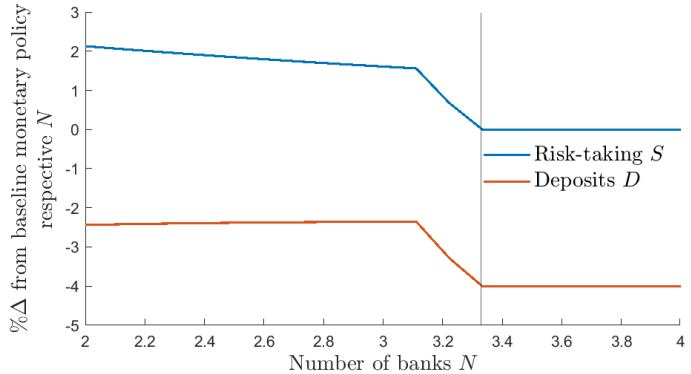
JLL strategy for computing exogenous, regulatory-induced changes in contestability:

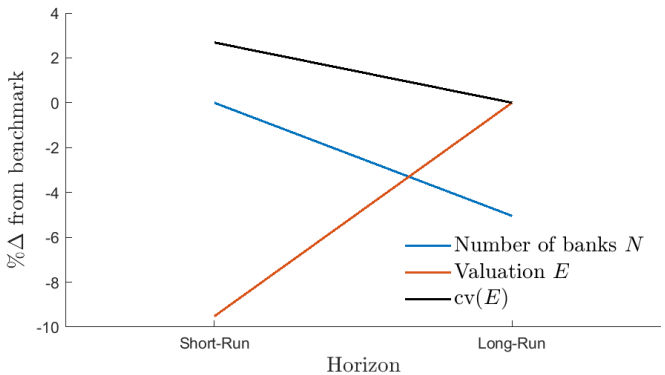
- Time and State Variation: Idiosyncratic process of interstate bank deregulation continued until the Riegle-Neal Act.
- Bank Level Variation: Gravity model assumes costs to a bank of establishing and effectively managing an affiliate increase with the geographic distance between the BHC's headquarters and the affiliate.
- JLL combine these building blocks to create time-varying measures of the competitive pressures facing each BHC.
  - First, for each bank subsidiary in each year, identify those states banks that can enter the subsidiary's state and calculate the distance between the subsidiary and those states.
  - Second, use the inverse of this distance as an indicator of the competitive pressures facing the subsidiary.
  - Finally, calculate the competitive pressures facing each BHC by weighting these subsidiary-level competition measures by the percentage of each subsidiary's assets in the BHC.

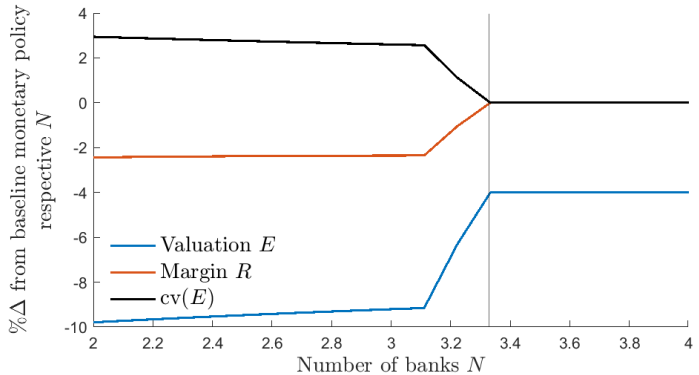
return

# Monetary Policy Counterfactuals




- Short run: Contractionary policy increases risk taking and decreases lending. Long run: Lower profitability lowers competition.
- Contractionary policy drives banks closer to binding leverage constraint with more competition.

▸ Table ▸ Return

# Empirical Results - Contractionary Monetary Policy

Competition, Monetary Policy, and Bank Risk

| | *Bank Risk* | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| *Bank Competition* | 0.6221** | 0.6988** | 0.5963** | 0.7011** |
| | (0.2623) | (0.2934) | (0.2716) | (0.2847) |
| *Leverage-Lagged* | 0.0300*** | 0.0307*** | 0.0297*** | 0.0308*** |
| | (0.0051) | (0.0050) | (0.0049) | (0.0049) |
| *Ln(Bank Assets)-Lagged* | -0.1645* | -0.1615* | -0.1580* | -0.1619* |
| | (0.0900) | (0.0889) | (0.0897) | (0.0867) |
| *FFR_1* | 1.0835** | | | |
| | (0.4301) | | | |
| *FFR_1*Bank Competition* | -0.4177* | | | |
| | (0.2136) | | | |
| *FFR_2* | | 2.2895*** | | |
| | | (0.5305) | | |
| *FFR_2*Bank Competition* | | -0.9277*** | | |
| | | (0.3384) | | |
| *FFR_3* | | | 1.3956*** | |
| | | | (0.4059) | |
| *FFR_3*Bank Competition* | | | -0.4701*** | |
| | | | (0.1614) | |
| *FFR_4* | | | | 2.0084*** |
| | | | | (0.7139) |
| *FFR_4*Bank Competition* | | | | -0.6102** |
| | | | | (0.2777) |
| Observations | 1518 | 1518 | 1518 | 1518 |
| R-squared | 0.8183 | 0.8182 | 0.8188 | 0.8175 |

Return

# Empirical Results - Contractionary Monetary Policy

- Consistent with the predictions of the model, as shown in column (1),
  - The bank specific measure of sensitivity to the Fed Funds rate (*FFRb*) - those with less access to non-deposit finance - enters positively and statistically significantly in the *Bank Risk* regression.
  - The interaction term *FFRb x Comp* enters negatively and statistically significantly.
- That is, tighter monetary policy increases bank risk which interacts with market structure (increased bank risk from contractionary policy is lower in more competitive environments).

▸ FFR Definitions ▸ Return

# Agency Wedge

- The agency wedge is given by:

$$w(S) \equiv \frac{[1 - \delta p(S)]}{[1 - \beta p(S)]} \leq 1. \tag{12}$$

- Hence any increase in success rate due to a decrease in risk taking lowers the wedge (i.e. mitigates the agency problem) since

$$\frac{dw(S)}{dp(S)} = \frac{\beta - \delta}{[1 - \beta p(S)]^2} \leq 0$$

where $\frac{dp(S)}{dS} < 0$.

Return

# Risk Taking with Binding Leverage

$$p(S_b^C) = -\frac{p'(S_b^C)}{p(S_b^C)} \cdot \frac{w(S_b^C)}{A\lambda}. \tag{13}$$

- As in the non-binding case, (13) shows that ceteris paribus a tight leverage requirement can increase the probability of success while agency conflicts decrease the probability of success.
- Note, however, that (13) implies that the probability of failure is independent of market structure $N$ when leverage requirements are binding.

▸ Return

# Policy

Government Budget Constraint:

- Expected inflows to deposit insurance equals expected outflows:

$$F = (1 - p(S)) \cdot r_D(Z) \cdot Z. \tag{14}$$

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Policy Problem:

- The policymaker chooses policy parameters $\Theta = (\kappa, \beta, \alpha, \lambda)$:
  - Entry barriers $\kappa$
  - Governance $\beta$
  - Leverage $\lambda$
  - Monetary $\alpha$

  to minimize the weighted distance between the decentralized level of risk taking from the efficient level (with weight $1 - \phi$) as well as deviations in expected output (with weight $\phi$):

$$\min_{\{\kappa,\beta,\alpha,\lambda\}} (1 - \phi) \cdot |S - S^*| + \phi \cdot |Y - Y^*| \tag{15}$$

  where $Y = p(S) \cdot A \cdot S \cdot Z$. Back