Monetary Transmission through Bank Securities Portfolios

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Motivation

- **2020/21:** SVB invested in long-term securities which were booked as Held-to-Maturity (HTM)
- **March 2023:** uninsured depositors withdrew their funds as they worried that they would not be repaid in full when SVB liquidated its security portfolio at market prices
- **Recent Chicago Booth Survey:** "For the purposes of capital regulation, banks should be required to mark their holdings of Treasury and Agency securities to market at all times (even though their loans are not marked to market)."
Motivation

- **2020/21**: SVB invested in long-term securities which were booked as Held-to-Maturity (HTM)

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- **Darrell Duffie (Stanford), Agree**: "Frequent marking to market for purposes of maintaining adequate capital buffers would lead to fewer sudden realizations of capital shortfalls and fewer catastrophic failures ..."
  
  → Fewer bank runs & more prudent behavior

- **Campbell Harvey (Duke), Disagree**: "... It is unfair to mark to market the HTM & not the liabilities ..."

  → Additional pressure on bank balance sheets
Question: How do policies marking securities to market in capital requirements influence monetary transmission from interest rates into bank lending?

Approach: Combine institutional bank data with structural model.

- Y14 stress test data: securities, hedges, and near-universe of C&I lending.
- Variation across bank type (AC vs. non-AC) and security allocation (AFS vs. HTM).
- Structural model designed to capture spillovers via capital requirements.

Main Findings:

- Changes in securities values impact bank lending to firms.
- But mainly when they are a type that affects capital requirements.
- Credit supply changes at the bank level pass through to investment at small firms.
Institutional Setting
AOCI ("accumulated other comprehensive income") $\approx$ AFS unrealized gains and losses

AC banks = AOCI-Capital banks; NC banks = Non-AOCI-Capital banks

Credit supply effect of security value losses: $p_{\text{Sec}} \downarrow \Rightarrow$ Loans $\downarrow$

Channels: (i) net worth, (ii) collateral, (iii) regulatory capital
Primer on Accounting: Available-for-Sale Securities

- **AOCI** ("accumulated other comprehensive income") ≈ AFS unrealized gains and losses
- **AC banks** = AOCI-Capital banks; **NC banks** = Non-AOCI-Capital banks
- **Credit supply effect** of security value losses: $P^{Sec} \downarrow \Rightarrow \text{Loans} \downarrow$
- **Channels:** (i) net worth, (ii) collateral, (iii) **regulatory capital**
Data: Most hedges are interest rate swaps (fair-value hedges against interest rate risk)

Spillover effect: collateral channel may still be present since hedges are less pledgeable
Spillover effect: collateral channel may still be present since value of securities matters
Data
Data

- Y-14Q data for large U.S. banks subject to stress tests
- We combine quarterly data from three schedules:
  1. B.1: Security level panel without size cutoff (investment portfolio)
  2. B.2: Designated accounting hedges matched to securities
  3. H.1: Corporate loan panel on universe of loan facilities > $1M
- Augment with Y-9C data for BHCs & Compustat data for public firms
- 2021:Q1-2023:Q1: focus on monetary tightening cycle & same length pre-sample
- Over this period, around 30 banks in the sample, 1/3 are AC banks
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Stylized Facts
Shares based on market values in 2021:Q4.
Identifying Credit Supply Effects
Identifying Credit Supply Effects

▶ When bank securities lose value, do lenders cut credit to firms?
  - Need to account for potential links between bank-firm selection and firm demand

▶ Following Khwaja and Mian (2008), estimate regression for firm $i$ and bank $j$:

$$
\frac{L_{i,j,t+2} - L_{i,j,t}}{0.5 \cdot (L_{i,j,t+2} + L_{i,j,t})} = \alpha_{i,t} + \kappa_j + \tau_{AC_j,t} + \beta \cdot \frac{\Delta Value_{j,t}^{AFS}}{Assets_{j,t}} + \gamma X_{j,t} + u_{i,j,t}
$$

▶ $\Delta Value_{j,t}^{AFS} = \sum^k \Delta P_k^t \cdot Q_{j,t}^k$ is the sum of all value changes of securities at bank $j$

▶ Fixed effects: firm-time FE $\alpha_{i,t}$, bank FE $\kappa_j$, AC-banks-time FE $\tau_{AC_j,t}$

▶ Sample restricted to term loans only & 2021:Q1-2023:Q1 episode
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Security Valuation & Firm Credit Supply

- Banks with larger losses on AFS securities extend less credit: around 20 cents per $

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<td>$\Delta$ Value AFS</td>
<td>6.08***</td>
<td>7.31***</td>
<td>6.15***</td>
<td>7.37***</td>
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<td>(1.85)</td>
<td>(1.91)</td>
<td>(1.78)</td>
<td>(1.88)</td>
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<td>$\Delta$ Value HTM</td>
<td>1.93</td>
<td>1.31</td>
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<td></td>
<td>(1.47)</td>
<td>(1.23)</td>
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Fixed Effects

- Firm $\times$ Time: ✓ ✓
- Firm $\times$ Time $\times$ Purpose: ✓ ✓ ✓ ✓
- Bank & AA $\times$ Time: ✓ ✓ ✓ ✓
- Bank Controls: ✓ ✓ ✓ ✓

R-squared 0.57 0.55 0.57 0.55
Observations 13,038 11,093 13,038 11,093
Number of Firms 1,289 1,105 1,289 1,105
Number of Banks 27 26 27 26

... but such spillover effects do not exist for valuation changes of HTM securities

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- Bank & AA × Time ✓ ✓ ✓ ✓
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Extensions & Robustness

- Extended sample
- Asymmetric effects
- Omitting firm-time fixed effect
- Fixed effect extensions
- Credit lines
- Placebo regression
- Excluding 2023:Q1
- Extensive margin
- Dynamic response
- Interest rates
Exploring the Mechanism
Exploring the Mechanism

- To investigate channels, consider ...
- ... (i) interaction with AC-banks indicator

\[
\frac{L_{i,j,t+2} - L_{i,j,t}}{0.5 \cdot (L_{i,j,t+2} + L_{i,j,t})} = \beta_1 \cdot \frac{\Delta \text{Value}_{t}^{AFS}}{\text{Assets}_{j,t}} + \beta_2 \cdot \frac{\Delta \text{Value}_{t}^{AFS}}{\text{Assets}_{j,t}} \cdot AC_j + \ldots + u_{i,j,t}
\]

- ... (ii) differentiate between hedged and unhedged securities

\[
\frac{L_{i,j,t+2} - L_{i,j,t}}{0.5 \cdot (L_{i,j,t+2} + L_{i,j,t})} = \beta_1 \cdot \frac{\Delta \text{Value}_{t}^{AFS, unhedged}}{\text{Assets}_{j,t}} + \beta_2 \cdot \frac{\Delta \text{Value}_{t}^{AFS, hedged}}{\text{Assets}_{j,t}} + \ldots + u_{i,j,t}
\]

- ... (iii) interaction with bank capital positions
- ... (iv) shock to one-year treasury × AFS portfolio as instrument
- ... (v) control for simultaneous cash-flow and deposit channels
AC versus NC Banks

- Effects are more pronounced for AOCI-Capital (AC) banks

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<tr>
<td>Δ Value AFS</td>
<td>4.83**</td>
<td>5.65**</td>
<td>-2.08</td>
<td>-2.53</td>
</tr>
<tr>
<td></td>
<td>(2.14)</td>
<td>(2.37)</td>
<td>(4.81)</td>
<td>(4.92)</td>
</tr>
<tr>
<td>Δ Value AFS × AC</td>
<td>7.55**</td>
<td>9.26***</td>
<td>12.95*</td>
<td>15.18**</td>
</tr>
<tr>
<td></td>
<td>(3.50)</td>
<td>(3.14)</td>
<td>(6.94)</td>
<td>(6.39)</td>
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Fixed Effects
- Firm × Time
- Firm × Time × Purpose
- Bank
- Bank Controls
- Bank Controls × Δ Value AFS

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R-squared 0.57 0.55 0.57 0.55
Observations 13,038 11,093 13,038 11,093
Number of Firms 1,289 1,105 1,289 1,105
Number of Banks 27 26 27 26

Hedged & Unhedged Securities

- Results seem to be driven by AFS securities that are not hedged to interest rate risk

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<tr>
<td>∆ Value AFS Unhedged</td>
<td>7.08** (2.93)</td>
<td>8.09*** (2.71)</td>
<td>7.35** (2.81)</td>
<td>8.35*** (2.70)</td>
</tr>
<tr>
<td>∆ Value AFS Hedged</td>
<td>4.75 (5.58)</td>
<td>4.16 (5.33)</td>
<td></td>
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Fixed Effects
- Firm × Time ✓ ✓
- Firm × Time × Purpose ✓ ✓ ✓ ✓
- Bank & AC × Time ✓ ✓ ✓ ✓
- Bank Controls ✓ ✓ ✓ ✓
- Derivatives ✓ ✓ ✓ ✓
- R-squared 0.57 0.55 0.57 0.55
- Observations 13,027 11,093 13,027 11,093
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Exploring the Mechanism

To investigate channels, consider ...

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\frac{L_{i,j,t+2} - L_{i,j,t}}{0.5 \cdot (L_{i,j,t+2} + L_{i,j,t})} = \beta_1 \cdot \frac{\Delta \text{Value}^{\text{AFS}}_{j,t}}{\text{Assets}_{j,t}} + \beta_2 \cdot \frac{\Delta \text{Value}^{\text{AFS}}_{j,t}}{\text{Assets}_{j,t}} \cdot AC_j + \ldots + u_{i,j,t}
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\]

... (iii) interaction with bank capital positions

... (iv) shock to one-year treasury × AFS portfolio as instrument

... (v) control for simultaneous cash-flow and deposit channels
Effects at the Firm Level
Effects at the Firm Level

- Do these effects persist at the firm level, affecting total debt and investment?

- Estimate regression for firm $i$ at annual frequency:

$$
\frac{y_{i,t+4} - y_{i,t}}{0.5 \cdot (y_{i,t+4} + y_{i,t})} = \alpha_i + \kappa_t + \beta \cdot \Delta \text{Value}_{i,t}^{AFS} + \gamma X_{i,t} + u_{i,t}
$$

- Firm outcomes: $y$ is either total debt, fixed assets ("investment"), or cash

- $\Delta \text{Value}_{i,t}^{AFS} = \sum_j (\Delta \text{Value}_{j,t}^{AFS} / \text{Assets}_{j,t}) \cdot (L_{i,j,t} / \text{Debt}_{i,t})$
  - Weights change in AFS value at bank level by share of firm debt from that bank.

- Fixed effects: firm-FE $\alpha_i$ and time-FE $\kappa_t$
AFS value changes translate into changes of firm outcomes, but only for small firms

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<thead>
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<th>Δ Total Debt (i)</th>
<th>Investment (iii)</th>
<th>Δ Cash (v)</th>
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<tbody>
<tr>
<td>Value AFS</td>
<td>6.17** (3.09)</td>
<td>5.31** (2.67)</td>
<td>10.46** (4.48)</td>
</tr>
<tr>
<td>Value AFS × Small</td>
<td>6.27** (3.10)</td>
<td>5.36** (2.67)</td>
<td>10.48** (4.49)</td>
</tr>
<tr>
<td>Value AFS × Large</td>
<td>-11.37 (13.12)</td>
<td>-4.32 (9.31)</td>
<td>7.65 (18.39)</td>
</tr>
</tbody>
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Fixed Effects

- Firm: ✓ ✓ ✓ ✓ ✓ ✓
- Time: ✓ ✓ ✓ ✓ ✓ ✓
- Firm Controls: ✓ ✓ ✓ ✓ ✓ ✓
- R-squared: 0.73 0.73 0.72 0.72 0.66 0.66
- Observations: 69,934 69,934 82,472 82,472 81,900 81,900
- Number of Firms: 19,046 19,046 22,162 22,162 22,116 22,116
- Number of Banks: 29 29 30 30 30 30

Structural Model
Model Overview

▶ **DSGE model** featuring households, firms, banks, government

- Smaller *"constrained" firms* only have access bank term loans → market spread
- Larger *"unconstrained" firms* have access to credit lines & corporate bonds → fixed spreads

▶ Bank provides credit lines and term loans to firms, maximizing

\[
v_t = \frac{d_t}{\text{dividends}} - \left( \frac{\eta_k}{\bar{\kappa}^L} \right) \frac{k_t^{1+\zeta_L}}{1 + \zeta_L} + E_t \left[ \Lambda_{S,t+1} v_{t+1} \right]
\]

\[
s.t. \quad k_t + \left( P_t - \bar{P} \right) \times b^{LT} \geq AOCI_t \quad \chi^B \left( B_{C,t}^{\text{loan}} + B_{U,t}^{\text{loan}} \right) \quad \chi^L \left( \bar{L} - B_{U,t}^{\text{loan}} \right)
\]

▶ **Experiment**: Shocks to inflation, real rate & investment demand to mimic 2022-episode → calibrate \( \zeta_L \) to match regression evidence on debt response of smaller firms
Model Overview

- **DSGE model** featuring households, firms, banks, government
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\]

subject to

\[
k_t + (P_t - \bar{P}) \times b_{LT}^{\text{AOCl}_t} \geq \chi^B \left( B_{C,t}^{\text{loan}} + B_{U,t}^{\text{loan}} \right) + \chi^L \left( \bar{L} - B_{U,t}^{\text{loan}} \right)
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- **Experiment**: Shocks to inflation, real rate & investment demand to mimic 2022-episode → calibrate $\zeta_L$ to match regression evidence on debt response of smaller firms
Aggregate Responses

![Graphs showing various financial metrics over time: Risk-Free Rate (Q), Security Value, Required Bank Capital ($k_t$), Term Loan Spread (Q), Bank Loans, Investment, Cash, Dividends (Payouts) / $\hat{Y}$, and Mark-to-Market Book Value. Each graph plots the metrics against time (quarters), with a range from 0 to 10 quarters.]
Responses by Type

- Debt (U)
- Investment (U)
- Cash (U)
- Dividends (Payouts) / \( \hat{Y} (U) \)

- Debt (C)
- Investment (C)
- Cash (C)
- Dividends (Payouts) / \( \hat{Y} (C) \)

Mark-to-Market
Book Value

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MP Transmission Bank Securities
November 2023
Aggregate Responses (Revisited)

![Graphs of various financial metrics over time]

- Risk-Free Rate (Q)
- Security Value
- Req. Bank Capital ($k_t$)
- Term Loan Spread (Q)
- Bank Loans
- Investment
- Cash
- Dividends (Payouts) / $\hat{Y}$

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MP Transmission Bank Securities

November 2023
Conclusion

- Detailed data on bank securities and lending shows importance of regulatory accounting framework on transmission via the banking system.
  - Changes in securities values have large impact on lending.
  - But mainly when their gains/losses impact capital requirements (unhedged AFS at AC banks).
  - Little impact of gains/losses absent regulatory channel (NC banks, hedged AFS, HTM).

- Regulatory capital channel passes through into firm outcomes.
  - Reductions in borrowing, investment, and cash holdings.
  - But only for small firms.

- Model: much stronger transmission from real + nominal rates to bank lending when banks have AFS securities marked to market.
Policy Debate

- **Questions**: (1) Should banks always mark their long-term securities to market? (2) Should unrecognized value changes of securities pass through to regulatory capital?

1. **Concern**: Fair-value accounting may exacerbate downturns → not the case for interest rate-sensitive securities

2. **Concern**: Volatility in securities markets passes through to real economy → but banks may also raise more equity + generally act more prudent

3. **Concern**: Distorted prices affect balance sheets when marking to market → less applicable to Treasuries and agency MBS

4. **Concern**: Liabilities are not marked to market → reason for documented spillover effect

5. **Concern**: Lower demand for securities, raises costs for government & HHs → costs that banks account for interest rate risk
Policy Debate

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Reclassification of Securities

Shares based on market values in 2021:Q4.
Security Composition: NC Banks

Shares based on market values in 2021:Q4.
Hedging Composition: AC Banks

- Interest Rate Risk: 86%
- Change FV: 1%
- FX: 13%
- Treasuries: 74%
- Agency MBS: 6%
- Other: 3%
- Municipal Bonds: 2%
- Sovereign Bonds: 15%

Shares based on market values in 2021:Q4.
Hedging Composition: NC Banks

Change FV: 6%  FX: 7%
Interest Rate Risk: 87%
FX: 7%
Treasuries: 42%
Agency MBS: 36%
Other: 10%
Municipal Bonds: < 1%
Sovereign Bonds: 11%

Shares based on market values in 2021:Q4.
Results are weaker but hold for an extended sample

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<td>(1.49)</td>
<td>(1.77)</td>
<td>(1.53)</td>
<td>(1.79)</td>
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<td>∆ Value HTM</td>
<td>1.24</td>
<td>0.60</td>
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<td></td>
<td>(0.94)</td>
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Fixed Effects
- Firm × Time ✓ ✓ ✓ ✓
- Firm × Time × Purpose ✓ ✓ ✓ ✓
- Bank & AA × Time ✓ ✓ ✓ ✓
- Bank Controls ✓ ✓ ✓ ✓
- R-squared 0.56 0.55 0.56 0.55
- Observations 41,541 33,269 41,541 33,269
- Number of Firms 2,301 1,896 2,301 1,896
- Number of Banks 34 34 34 34

Asymmetric Effects

Results are stronger for negative AFS value changes

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<td>(4.06)</td>
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Fixed Effects

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Bank Controls

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<td>Number of Banks</td>
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Credit Supply: Omitting Firm-Time FE

Results remain when omitting firm-time FE

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<td>6.09**</td>
<td>3.47**</td>
<td>5.45**</td>
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<td></td>
<td>(1.91)</td>
<td>(2.31)</td>
<td>(1.51)</td>
<td>(2.32)</td>
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<tr>
<td>∆ Value HTM</td>
<td></td>
<td></td>
<td>-4.59**</td>
<td>-3.15</td>
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<td>(2.05)</td>
<td>(2.04)</td>
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Fixed Effects
- Location × Size × Time: ✓ ✓
- Location × Size × Time × Industry: ✓ ✓ ✓ ✓
- Bank & AC × Time: ✓ ✓ ✓ ✓
- Bank Controls: ✓ ✓ ✓ ✓

- R-squared: 0.25 0.46 0.26 0.46
- Observations: 51,242 25,906 51,242 25,906
- Number of Firms: 12,544 7,719 12,544 7,719
- Number of Banks: 28 28 28 28

Extending firm-time FE by loan characteristics does not affect results

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<td>Δ Value AFS</td>
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<td>(1.85)</td>
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Fixed Effects

- Firm × Time ✓
- Firm × Time × Syn. ✓
- Firm × Time × Mat. ✓
- Firm × Time × Float. ✓
- Firm × Time × All ✓
- Bank & AA × Time ✓ ✓ ✓ ✓ ✓ ✓

Bank Controls ✓ ✓ ✓ ✓ ✓ ✓

R-squared 0.57 0.53 0.54 0.54 0.53
Observations 13,038 11,606 12,523 11,376 10,277
Number of Firms 1,289 1,165 1,242 1,142 1,035
Number of Banks 27 27 27 27 25

Results remain when including credit lines into sample

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Fixed Effects

- Firm × Time ✓ ✓ ✓ ✓
- Firm × Time × Purpose ✓ ✓ ✓ ✓
- Bank & AC × Time ✓ ✓ ✓ ✓
- Bank Controls ✓ ✓ ✓ ✓
- R-squared 0.62 0.62 0.62 0.62
- Observations 35,884 29,988 35,884 29,988
- Number of Firms 2,718 2,359 2,718 2,359
- Number of Banks 28 28 28 28

Placebo Regression

Results not present for dependent variable from t – 2 to t

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<tr>
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Results remain when excluding period of financial turmoil in 2023:Q1

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<td>(2.70)</td>
<td>(2.66)</td>
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<td>( \Delta ) Value HTM</td>
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<td>2.52*</td>
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<td>(1.36)</td>
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<td></td>
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<tr>
<td>Bank &amp; AC × Time</td>
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<tr>
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<td>0.56</td>
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Results intensify when considering extensive margin

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<td>43.70***</td>
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<td>(11.57)</td>
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<td>Δ Value HTM</td>
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<td>1.89</td>
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<tr>
<td></td>
<td>(11.82)</td>
<td>(9.14)</td>
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Fixed Effects

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<td>✓</td>
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<td>Firm × Time × Purpose</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Bank &amp; AC × Time</td>
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<td>✓</td>
<td>✓</td>
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<td>Bank Controls</td>
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<td>✓</td>
<td>✓</td>
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<tr>
<td>R-squared</td>
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<td>0.71</td>
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<td>19,744</td>
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<td>Number of Banks</td>
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<td>28</td>
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### Dynamic response

- Effects already present within the same quarter
- Strongest at three-quarter horizon

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<td>6.82**</td>
<td>11.80***</td>
<td>12.56***</td>
<td>9.91*</td>
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<td>(3.80)</td>
<td>(4.11)</td>
<td>(5.17)</td>
<td>(4.04)</td>
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**Fixed Effects**
- Firm × Time ✓ ✓ ✓ ✓ ✓ ✓
- Bank & AC × Time ✓ ✓ ✓ ✓ ✓ ✓
- Bank Controls ✓ ✓ ✓ ✓ ✓ ✓

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Interest Rates

- Effects are weaker for interest rates
- Possibly explained by balance sheet space

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<td>(0.05)</td>
<td>(0.06)</td>
<td>(0.11)</td>
<td>(0.13)</td>
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Fixed Effects

- Firm × Time ✓ ✓ ✓ ✓ ✓
- Bank & AC × Time ✓ ✓ ✓ ✓ ✓
- Bank Controls ✓ ✓ ✓ ✓ ✓
- R-squared 0.6 0.81 0.89 0.91 0.92
- Observations 5,017 5,017 5,017 5,017 5,017
- Number of Firms 765 765 765 765 765
- Number of Banks 27 27 27 27 27

Effects are more pronounced for low-capitalized banks

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<td>Δ Value AFS</td>
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<td></td>
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<td>(4.90)</td>
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<td>Δ Value AFS × CET1</td>
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<td>(0.58)</td>
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<td>Δ Value AFS × Tier1</td>
<td>-1.19*</td>
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<td>(0.67)</td>
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<tr>
<td>Δ Value AFS × Total</td>
<td>-1.52**</td>
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<td>(0.70)</td>
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<td>Firm × Time FE; Bank FE</td>
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<td>✓</td>
<td>✓</td>
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<td>Bank Controls</td>
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<tr>
<td>Bank Controls × Δ Value AFS</td>
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<td>0.57</td>
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<td>13,038</td>
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<td>Number of Banks</td>
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# Interest Rate Risk Channel: IV-Estimation

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<td>$\Delta$ Value AFS</td>
<td>6.19*** (1.65)</td>
<td>7.71*** (1.47)</td>
<td>14.05** (6.12)</td>
<td>6.81*** (1.84)</td>
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<tr>
<td>$\Delta$ Net Income</td>
<td>0.37 (2.84)</td>
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<td>$\Delta$ Deposits</td>
<td>-0.05 (0.19)</td>
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<td>$\Delta$ Probability Default</td>
<td>42.33 (44.99)</td>
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<td>$\Delta$ Provision Losses</td>
<td>6.20 (6.33)</td>
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Firm × Time FE: ✓ ✓ ✓ ✓
Bank FE; AC × Time FE: ✓ ✓ ✓ ✓
Bank Controls: ✓ ✓ ✓ ✓
Trading Book Securities: ✓
Estimator: OLS OLS IV OLS
First Stage F-Stat.: 45
R-squared: 0.57 0.57 0.57 0.57
Observations: 13,038 13,027 13,038 13,038

### Effects at the Firm-level - Credit Line Space

Changes of firm outcomes similarly for firms without CL space

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<th>Investment (ii)</th>
<th>Δ Cash (iii)</th>
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<td>10.46**</td>
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<td>6.81** (3.10)</td>
<td>6.69** (2.65)</td>
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<td>-3.16 (8.69)</td>
<td>-16.49** (7.23)</td>
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**Fixed Effects**

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