Interest Rate Risk and Bank Equity Valuations

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Federal Reserve Board

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Management and Regulatory Implications
Federal Reserve Bank of Atlanta
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DISCLAIMER

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Introduction

What are the effects of changes in interest rates on bank profitability?

Conventional Wisdom: Banks benefit from a steep yield curve because they engage in maturity transformation.

- But rising longer-term rates can cause immediate capital losses on longer-term assets.
- Banks may hedge interest rate risk.
- Noninterest income/expense may change in response to changes in interest rates.

Empirical literature offers mixed evidence regarding the effects of changes in interest rates on profitability of banks.
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**Existing Evidence**

- **Analysis based on equity valuations:**

- **Analysis based on accounting measures of profitability:**
  - Mixed evidence that bank net interest margins respond to changes in short-term rates or in the slope of the yield curve. (Flannery [1981, 1983]; Hancock [1985]; English [2002]; Hanweck & Ryu [2005]; Den Haan et al. [2007]; Memmel [2011]; Begenau, Piazzesi & Schneider [2012])
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Our Paper

- Measure the response of bank stock returns to interest rate surprises associated with monetary policy actions:
  - These surprises are uncorrelated with other economic news.

- Examine how the reaction of bank stock returns to interest rate surprises varies with:
  - Degree of maturity mismatch between assets and liabilities.
  - Reliance on “core deposits.”
  - Usage of interest rate derivatives.
  - Bank size and other characteristics.

- Examine the mechanisms behind the reaction by looking at the accounting measures of profitability and the size and composition of bank balance sheets.
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- Examine the mechanisms behind the reaction by looking at the accounting measures of profitability and the size and composition of bank balance sheets.
Bank equity values decline in response to unanticipated increases in the level of interest rates:

- Greater reliance on core deposits ⇒ greater decline.
- Larger bank ⇒ greater decline.

Bank equity values decline in response to an unanticipated steepening of the yield curve.

- Larger repricing/maturity gap ⇒ smaller decline.

Results are robust to controlling for the usage of interest rate derivatives using available Call Report data.

Adjustments in quantities and interest margins are important for understanding the reaction of bank equity values to interest rate changes.
84 FOMC announcements between 7/2/97 and 6/28/07:

- Four intermeeting moves (10/15/98, 1/3/01, 4/18/01, 9/17/01).
For each FOMC announcement, decompose the change in the target federal funds rate:

\[
\Delta ff_t \equiv \Delta ff_t^e + \Delta ff_t^u
\]

- \( \Delta ff_t^e \) measured using federal funds futures quotes over the 30-minute window around the FOMC announcement (Kuttner [2001])
- **Target Surprise**: \( \Delta ff_t^u = \Delta ff_t - \Delta ff_t^e \)
  - Unexpected change in the federal funds target rate associated with a specific FOMC announcement.
NOTE: Excludes the 9/17/2001 intermeeting policy action.
**Slope Surprise**

- Unexpected steepening or flattening of the yield curve.
- **Slope Surprise**: \( (\Delta y_t^m - \Delta ff_t^u) \)
  - \( \Delta y_t^m \) = change in the \( m \)-year Treasury yield over a 30-minute window around the FOMC announcement
  - \( m = 2, 5, \) and 10 years
- Slope surprises can occur when FOMC communication alters the expected path of future short-term interest rates.
5-Year Slope Surprises

NOTE: Excludes the 9/17/2001 intermeeting policy action.
Stock Returns and Interest Rate Surprises

- **Intraday** stock price quotes for 355 BHCs (Obs. = 11,026).

- \( R_{it} \) = (simple) return for bank \( i \) over the 2-hour window around the FOMC announcement on day \( t \).

- Baseline specification:

\[
R_{it} = \beta_0 + \beta_1 \Delta ff^u_t + \beta_2 (\Delta y^m_t - \Delta ff^u_t) + \beta_3 \Delta ff^e_t + \epsilon_{it}
\]

- Estimated by OLS.
- Coefficient interpretation:

\[
\beta_1 = \left. \frac{\partial R}{\partial \Delta ff^u_t} \right|_{(\Delta y^m_t = \Delta ff^u_t)} \quad \text{(level surprise)}
\]

\[
\beta_2 = \left. \frac{\partial R}{\partial (\Delta y^m_t - \Delta ff^u_t)} \right|_{(\Delta ff^u_t = 0)} \quad \text{(slope surprise)}
\]
STOCK RETURNS AND INTEREST RATE SURPRISES

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(level surprise)

\[
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\]

(slope surprise)
## Reaction of Bank Stock Returns

All FOMC Announcements

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>$m = 2$-year</th>
<th>$m = 5$-year</th>
<th>$m = 10$-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level surprise: $\Delta ff^u$</td>
<td>$-8.166^{***}$</td>
<td>$-8.627^{***}$</td>
<td>$-10.20^{***}$</td>
</tr>
<tr>
<td></td>
<td>$(1.458)$</td>
<td>$(1.584)$</td>
<td>$(1.962)$</td>
</tr>
<tr>
<td>Slope surprise: $(\Delta y^m - \Delta ff^u)$</td>
<td>$-4.913^{***}$</td>
<td>$-4.819^{***}$</td>
<td>$-5.807^{***}$</td>
</tr>
<tr>
<td></td>
<td>$(1.694)$</td>
<td>$(1.446)$</td>
<td>$(1.854)$</td>
</tr>
<tr>
<td>Expected change: $\Delta ff^e$</td>
<td>$0.617$</td>
<td>$0.560$</td>
<td>$0.525$</td>
</tr>
<tr>
<td></td>
<td>$(0.478)$</td>
<td>$(0.422)$</td>
<td>$(0.426)$</td>
</tr>
<tr>
<td>Constant</td>
<td>$0.065$</td>
<td>$0.085$</td>
<td>$0.078$</td>
</tr>
<tr>
<td></td>
<td>$(0.080)$</td>
<td>$(0.082)$</td>
<td>$(0.083)$</td>
</tr>
<tr>
<td>Adj. $R^2$</td>
<td>$0.103$</td>
<td>$0.102$</td>
<td>$0.099$</td>
</tr>
</tbody>
</table>

**Note:** Robust standard errors in parentheses; *, **, *** denotes significance at the 10%, 5%, and 1% level, respectively.
Call Reports contain information on the repricing time and/or maturity of selected assets and liabilities:

\[
GAP_{it}^{RP} = \left[ \text{average \ repricing/maturity of assets} \right] - \left[ \text{average \ repricing/maturity of liabilities} \right]
\]

- Based on 26 asset and 11 liability categories
- Large \( GAP^{RP} \) implies more maturity transformation in the traditional sense.
- Demand, transactions, and savings deposits are included at their contractual maturity (i.e., zero years)
- \( GAP^{RP} \) is not a measure of duration.
Repricing/Maturity Gap

NOTE: All percentiles are weighted by interest-earning assets.
## Median Bank Balance Sheet Characteristics

By Repricing/Maturity Gap Quintile

<table>
<thead>
<tr>
<th>Variable</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total loans (shr. of assets)</td>
<td>0.71</td>
<td>0.69</td>
<td>0.69</td>
<td>0.67</td>
<td>0.61</td>
</tr>
<tr>
<td>C&amp;I loans (shr. of total loans)</td>
<td>0.20</td>
<td>0.19</td>
<td>0.18</td>
<td>0.14</td>
<td>0.13</td>
</tr>
<tr>
<td>CRE loans (shr. of total loans)</td>
<td>0.42</td>
<td>0.36</td>
<td>0.34</td>
<td>0.31</td>
<td>0.30</td>
</tr>
<tr>
<td>RRE loans (shr. of total loans)</td>
<td>0.17</td>
<td>0.25</td>
<td>0.26</td>
<td>0.32</td>
<td>0.37</td>
</tr>
<tr>
<td>Consumer loans (shr. of total loans)</td>
<td>0.05</td>
<td>0.07</td>
<td>0.10</td>
<td>0.10</td>
<td>0.09</td>
</tr>
<tr>
<td>Interest-bearing liabilities (shr. of liabilities)</td>
<td>0.83</td>
<td>0.83</td>
<td>0.85</td>
<td>0.86</td>
<td>0.86</td>
</tr>
<tr>
<td>Savings deposits (shr. of liabilities)</td>
<td>0.29</td>
<td>0.31</td>
<td>0.33</td>
<td>0.31</td>
<td>0.33</td>
</tr>
<tr>
<td>Demand &amp; trans. deposits (shr. of liabilities)</td>
<td>0.17</td>
<td>0.15</td>
<td>0.16</td>
<td>0.13</td>
<td>0.13</td>
</tr>
<tr>
<td>Total assets ($ billions)</td>
<td>1.43</td>
<td>1.54</td>
<td>2.26</td>
<td>2.45</td>
<td>1.98</td>
</tr>
</tbody>
</table>
Core Deposits

Core (demand, transactions, and savings) deposits are “special:”
- Evidence of sticky rates and quantities.
  (Hannan & Berger [1991]; Neumark & Sharpe [1992])
- Interest rates on core deposits are typically below short-term market rates.

Core deposits are a source of “rents:”
- Banks can benefit from an increase in short-term market rates.
  (Samuelson [1945])
- But if withdrawals are even moderately interest-sensitive, rents can also decline, implying negative duration.

We control separately for demand & transaction deposits (DTD) and savings deposits (SD).
**Stock Returns and Interest Rate Surprises**

By Bank Characteristics

- **Regression specification:**

\[
R_{it} = \beta_1 \Delta ff^u_t + \beta_2 (\Delta y^m_t - \Delta ff^u_t) + \\
gamma_1 \left[ GAP^R/M_{it} \times \Delta ff^u_t \right] + \gamma_2 \left[ GAP^R/M_{it} \times (\Delta y^m_t - \Delta ff^u_t) \right] + \\
\theta'_1 [X_{it} \times \Delta ff^u_t] + \theta'_2 [X_{it} \times (\Delta y^m_t - \Delta ff^u_t)] + \eta_i + \epsilon_{it}
\]

- **\(X_{it} = \) vector of bank-specific characteristics**
  - \(A^OTH_{it} = \) other assets (as a share of interest-earning assets) (mean = 9%)
  - \(L^OTH_{it} = \) other liabilities (as a share of liabilities) (mean = 17%)
  - \(DTD_{it} = \) demand + transaction deposits (as a share of liabilities)
  - \(SD_{it} = \) saving deposits (as a share of liabilities)
  - \(LNS_{it} = \) loans & leases (as a share of total assets)
  - \(\log A_{it} = \) log of (real) total assets
# Reaction of Bank Stock Returns

By Repricing/Maturity Gap

<table>
<thead>
<tr>
<th>Variable × Interest Rate Surprise</th>
<th>$m = 2$-year</th>
<th>$m = 5$-year</th>
<th>$m = 10$-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{GAP}^{R/M} \times \Delta ff^{u}$</td>
<td>0.500** 0.453* 0.598**</td>
<td>0.500** 0.453* 0.598**</td>
<td>0.500** 0.453* 0.598**</td>
</tr>
<tr>
<td></td>
<td>(0.238) (0.237) (0.256)</td>
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<td>(0.238) (0.237) (0.256)</td>
</tr>
<tr>
<td>$\text{GAP}^{R/M} \times (\Delta y^{m} - \Delta ff^{u})$</td>
<td>0.553** 0.426** 0.521**</td>
<td>0.553** 0.426** 0.521**</td>
<td>0.553** 0.426** 0.521**</td>
</tr>
<tr>
<td></td>
<td>(0.244) (0.217) (0.246)</td>
<td>(0.244) (0.217) (0.246)</td>
<td>(0.244) (0.217) (0.246)</td>
</tr>
</tbody>
</table>

Note: Robust standard errors in parentheses; *, **, *** denotes significance at the 10%, 5%, and 1% level, respectively.
**REACTION OF BANK STOCK RETURNS**

By Repricing/Maturity Gap

**Level Surprise**

**Slope Surprise**

NOTE: Slope surprise is measured using a 2-year Treasury yield.
# Reaction of Bank Stock Returns

By Reliance on Demand/Transactions Deposits

<table>
<thead>
<tr>
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<th>$m = 2$-year</th>
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<th>$m = 10$-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>$DTD \times \Delta ff^u$</td>
<td>$-14.27^{**}$</td>
<td>$-17.80^{***}$</td>
<td>$-18.58^{***}$</td>
</tr>
<tr>
<td></td>
<td>$(5.644)$</td>
<td>$(5.522)$</td>
<td>$(6.928)$</td>
</tr>
<tr>
<td>$DTD \times (\Delta y^m - \Delta ff^u)$</td>
<td>$-4.516$</td>
<td>$-8.046$</td>
<td>$-8.002$</td>
</tr>
<tr>
<td></td>
<td>$(6.349)$</td>
<td>$(5.882)$</td>
<td>$(6.863)$</td>
</tr>
</tbody>
</table>

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**REACTION OF BANK STOCK RETURNS**

By Reliance on Demand/Transactions Deposits

**Level Surprise**

**Slope Surprise**

*NOTE*: Slope surprise is measured using a 2-year Treasury yield.
# Reaction of Bank Stock Returns

By Reliance on Savings Deposits

<table>
<thead>
<tr>
<th>Variable × Interest Rate Surprise</th>
<th>$m = 2$-year</th>
<th>$m = 5$-year</th>
<th>$m = 10$-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>$SD \times \Delta ff^u$</td>
<td>-7.793*</td>
<td>-8.750</td>
<td>-7.937</td>
</tr>
<tr>
<td></td>
<td>(4.637)</td>
<td>(5.467)</td>
<td>(6.309)</td>
</tr>
<tr>
<td>$SD \times (\Delta y^m - \Delta ff^u)$</td>
<td>-11.02**</td>
<td>-11.32**</td>
<td>-9.004*</td>
</tr>
<tr>
<td></td>
<td>(4.437)</td>
<td>(4.401)</td>
<td>(5.366)</td>
</tr>
</tbody>
</table>

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**REACTION OF BANK STOCK RETURNS**

By Reliance on Savings Deposits

**Level Surprise**

**Slope Surprise**

**NOTE:** Slope surprise is measured using a 2-year Treasury yield.
# Reaction of Bank Stock Returns

By Bank Size

<table>
<thead>
<tr>
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<th>( m = 2)-year</th>
<th>( m = 5)-year</th>
<th>( m = 10)-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \log A \times \Delta ff^u )</td>
<td>-1.714***</td>
<td>-1.766***</td>
<td>-2.035***</td>
</tr>
<tr>
<td></td>
<td>(0.340)</td>
<td>(0.347)</td>
<td>(0.460)</td>
</tr>
<tr>
<td>( \log A \times (\Delta y^m - \Delta ff^u) )</td>
<td>-0.111</td>
<td>-0.123</td>
<td>-0.394</td>
</tr>
<tr>
<td></td>
<td>(0.429)</td>
<td>(0.390)</td>
<td>(0.447)</td>
</tr>
</tbody>
</table>

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Reaction of Bank Stock Returns

By Bank Size

**Level Surprise**

- Diagram showing the percentage change in bank stock returns by level surprise, with the x-axis representing total assets ($billions, log scale) and the y-axis representing the percent change.

**Slope Surprise**

- Diagram showing the percentage change in bank stock returns by slope surprise, with the x-axis representing total assets ($billions, log scale) and the y-axis representing the percent change.

**Note:** Slope surprise is measured using a 2-year Treasury yield.
Banks may hedge interest rate risk using derivatives.

Call Report information on interest rate derivatives:

- By type of purpose: trading vs. non-trading (i.e., hedging)
  - Notional outstanding amounts.
  - Positive and negative fair (i.e., market) values.
- Notional amounts by contract type (i.e., swaps, futures, etc.)
NOTIONAL AMOUNT OF INTEREST RATE DERIVATIVES
By Type of Purpose

Trading purposes

Quarterly
- Sample banks
- All banks

Non-trading purposes

Quarterly
- Sample banks
- All banks

NOTE: Deflated by the GDP price deflator (2005 = 100).
NOTIONAL AMOUNT OF INTEREST RATE DERIVATIVES

By Contract Type

NOTE: Deflated by the GDP price deflator (2005 = 100).
FAIR VALUE OF INTEREST RATE DERIVATIVES

By Type of Purpose

Trading purposes

Non-trading purposes

Quarterly

$ Billions

Positive fair value

Negative fair value

Quarterly

$ Billions

Positive fair value

Negative fair value

NOTE: Deflated by the GDP price deflator (2005 = 100).
# Interest Rate Derivatives

By Size Quintile

<table>
<thead>
<tr>
<th>Valuation</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Notional Value</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.09</td>
<td>0.01</td>
<td>0.06</td>
<td>0.32</td>
<td>133.1</td>
</tr>
<tr>
<td>Median</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1.37</td>
</tr>
<tr>
<td>Max</td>
<td>72.2</td>
<td>14.8</td>
<td>10.5</td>
<td>29.6</td>
<td>4608</td>
</tr>
<tr>
<td><strong>Net Fair Value</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>-0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.03</td>
</tr>
<tr>
<td>Min</td>
<td>-0.05</td>
<td>-0.03</td>
<td>-0.07</td>
<td>-0.05</td>
<td>-21.6</td>
</tr>
<tr>
<td>Median</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Max</td>
<td>0.08</td>
<td>0.03</td>
<td>0.70</td>
<td>0.09</td>
<td>2.00</td>
</tr>
</tbody>
</table>
## Interest Rate Derivatives

By Size Quintile

### Non-Trading Purposes (percent of assets)

<table>
<thead>
<tr>
<th>Valuation</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Notional Value</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>1.87</td>
<td>0.79</td>
<td>2.11</td>
<td>6.53</td>
<td>19.8</td>
</tr>
<tr>
<td>Median</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.21</td>
<td>8.54</td>
</tr>
<tr>
<td>Max</td>
<td>146.8</td>
<td>20.1</td>
<td>94.8</td>
<td>760.9</td>
<td>430.2</td>
</tr>
<tr>
<td><strong>Net Fair Value</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.07</td>
</tr>
<tr>
<td>Min</td>
<td>-0.66</td>
<td>-0.63</td>
<td>-1.14</td>
<td>-0.94</td>
<td>-1.22</td>
</tr>
<tr>
<td>Median</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.01</td>
</tr>
<tr>
<td>Max</td>
<td>2.46</td>
<td>0.53</td>
<td>0.99</td>
<td>1.23</td>
<td>2.69</td>
</tr>
</tbody>
</table>
Stock Returns and Interest Rate Surprises

Controlling for the Usage of Interest Rate Derivatives

Regression specification:

\[ R_{it} = \beta_1 \Delta ff_{t}^u + \beta_2 (\Delta y_{t}^m - \Delta ff_{t}^u) + \gamma_1 \left[ GAP_{it}^{R/M} \times \Delta ff_{t}^u \right] + \gamma_2 \left[ GAP_{it}^{R/M} \times (\Delta y_{t}^m - \Delta ff_{t}^u) \right] + \theta_1' \left[ X_{it} \times \Delta ff_{t}^u \right] + \theta_2' \left[ X_{it} \times (\Delta y_{t}^m - \Delta ff_{t}^u) \right] + \lambda_1' \left[ Z_{it} \times \Delta ff_{t}^u \right] + \lambda_2' \left[ Z_{it} \times (\Delta y_{t}^m - \Delta ff_{t}^u) \right] + \eta_i + \epsilon_{it} \]

- \( Z_{it} \) = vector of interest rate derivative controls (all available contract types).
- Use \( \log \left( 1 + \frac{\text{Notional Amount}}{\text{Total Assets}} \right) \) transformation.
# Reaction of Bank Stock Returns

By Usage of Interest Rate Derivatives

<table>
<thead>
<tr>
<th>Interest Rate Surprise</th>
<th>Level</th>
<th>Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median Bank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>With median</td>
<td>-7.234***</td>
<td>-4.279**</td>
</tr>
<tr>
<td>interest rate</td>
<td>(1.407)</td>
<td>(1.717)</td>
</tr>
<tr>
<td>derivatives position</td>
<td></td>
<td></td>
</tr>
<tr>
<td>With large</td>
<td>-6.278**</td>
<td>-2.480</td>
</tr>
<tr>
<td>interest rate</td>
<td>(3.169)</td>
<td>(3.518)</td>
</tr>
<tr>
<td>derivatives position</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** Robust standard errors in parentheses; *, **, *** denotes significance at the 10%, 5%, and 1% level, respectively.

*Estimated effects of all other bank characteristics are the same.*
**REACTION OF BANK STOCK RETURNS**

By Usage of Interest Rate Derivatives

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<td></td>
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</tr>
<tr>
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</tr>
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**NOTE:** Robust standard errors in parentheses; *, **, *** denotes significance at the 10%, 5%, and 1% level, respectively.

- Estimated effects of all other bank characteristics are the same.
**INSPECTING THE MECHANISM**

Interest Rates and Accounting Measures of Profitability

- Use accounting measures of profitability and balance sheets to further understand the mechanisms behind the reaction of equity values to interest rate shocks.

INSPECTING THE MECHANISM

Interest Rates and Accounting Measures of Profitability

- Dynamic fixed effects specification:

\[
\pi_{it} = \sum_{k=1}^{4} \rho_k \pi_{i,t-k} + \beta_1 y_t^{3m} + \beta_2 (y_t^{10y} - y_t^{3m}) +
\gamma_0' X_{i,t-1} + \gamma_1' [X_{i,t-1} \times y_t^{3m}] + \gamma_2' [X_{i,t-1} \times (y_t^{10y} - y_t^{3m})] +
\lambda' m_t + \eta_i + \epsilon_{it}
\]

- \( \pi_{it} = \) accounting measure of profitability
- \( X_{it} = \) vector of bank-specific characteristics
- \( m_t = \) vector of macroeconomic controls

(real GDP growth, unemployment gap, inflation, S&P 500 return, 10-year BBB credit spread, VIX)

- Estimated by OLS with Driscoll-Kraay robust standard errors.
## Interest Rates, Profitability, and Asset Growth

By Selected Bank Characteristics

<table>
<thead>
<tr>
<th>Variable $\times$ Interest Rate</th>
<th>$NII$</th>
<th>$NNI$</th>
<th>$ROA$</th>
<th>$\Delta \log A$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level effect (median)</td>
<td>0.088***</td>
<td>-0.015</td>
<td>0.051***</td>
<td>-2.139**</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.011)</td>
<td>(0.010)</td>
<td>(0.879)</td>
</tr>
<tr>
<td>Slope effect (median)</td>
<td>0.071***</td>
<td>-0.005</td>
<td>0.037***</td>
<td>-1.830***</td>
</tr>
<tr>
<td></td>
<td>(0.011)</td>
<td>(0.008)</td>
<td>(0.008)</td>
<td>(0.618)</td>
</tr>
<tr>
<td>$GAP^{R/M} \times y^{3m}$</td>
<td>-0.001</td>
<td>0.000</td>
<td>-0.000</td>
<td>0.105*</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.060)</td>
</tr>
<tr>
<td>$GAP^{R/M} \times (y^{10y} - y^{3m})$</td>
<td>0.007***</td>
<td>-0.001</td>
<td>0.007***</td>
<td>0.291***</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.059)</td>
</tr>
<tr>
<td>$DTD \times y^{3m}$</td>
<td>0.110***</td>
<td>-0.144***</td>
<td>0.015</td>
<td>-2.883***</td>
</tr>
<tr>
<td></td>
<td>(0.035)</td>
<td>(0.024)</td>
<td>(0.022)</td>
<td>(0.920)</td>
</tr>
<tr>
<td>$DTD \times (y^{10y} - y^{3m})$</td>
<td>-0.020</td>
<td>-0.126***</td>
<td>-0.106***</td>
<td>-2.670**</td>
</tr>
<tr>
<td></td>
<td>(0.045)</td>
<td>(0.032)</td>
<td>(0.030)</td>
<td>(1.365)</td>
</tr>
<tr>
<td>$R^2$ (within)</td>
<td>0.690</td>
<td>0.321</td>
<td>0.258</td>
<td>0.104</td>
</tr>
</tbody>
</table>

**Note:** Robust standard errors in parentheses; *, **, *** denotes significance at the 10%, 5%, and 1% level, respectively.
Net Income and Interest Rate Shocks
By Type of Shock and Selected Bank Characteristics

Level Surprise
By reliance on demand/transaction deposits

Slope Surprise
By repricing/maturity gap
## Interest Rates and Balance Sheet Composition

<table>
<thead>
<tr>
<th>Growth Contribution</th>
<th>Level</th>
<th>Slope</th>
<th>$R^2$</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>$(\Delta LNS)/A$</td>
<td>0.973*</td>
<td>-0.836**</td>
<td>0.116</td>
<td>0.637</td>
</tr>
<tr>
<td></td>
<td>(0.514)</td>
<td>(0.384)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$(\Delta SEC)/A$</td>
<td>0.823</td>
<td>0.464</td>
<td>0.110</td>
<td>0.234</td>
</tr>
<tr>
<td></td>
<td>(1.267)</td>
<td>(0.899)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$(\Delta FFSRRP)/A$</td>
<td>-3.646***</td>
<td>-3.540***</td>
<td>0.215</td>
<td>0.033</td>
</tr>
<tr>
<td></td>
<td>(1.019)</td>
<td>(0.560)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$(\Delta BALDEP)/A$</td>
<td>-0.556***</td>
<td>-0.499***</td>
<td>0.118</td>
<td>0.012</td>
</tr>
<tr>
<td></td>
<td>(0.149)</td>
<td>(0.099)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$(\Delta COREDEP)/A$</td>
<td>-2.152**</td>
<td>-0.729</td>
<td>0.116</td>
<td>0.432</td>
</tr>
<tr>
<td></td>
<td>(1.045)</td>
<td>(0.748)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$(\Delta TIMEDEP)/A$</td>
<td>0.037</td>
<td>-0.721***</td>
<td>0.121</td>
<td>0.281</td>
</tr>
<tr>
<td></td>
<td>(0.321)</td>
<td>(0.192)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$(\Delta MNGLIAB)/A$</td>
<td>0.465</td>
<td>0.447*</td>
<td>0.085</td>
<td>0.167</td>
</tr>
<tr>
<td></td>
<td>(0.366)</td>
<td>(1.717)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Note:** Robust standard errors in parentheses; *, **, *** denotes significance at the 10%, 5%, and 1% level, respectively.
CONCLUSION

- Bank stock returns react **negatively** to
  - Unexpected increase in the **level** of interest rates.
  - Unexpected steepening of the **slope** of the yield curve.
- A large maturity mismatch between assets and liabilities mitigates the negative reaction of stock returns to slope surprises.
- Reliance on core deposits is associated with greater sensitivity.
- The reaction of stock returns is consistent with the adjustments of interest margins *and* the size and composition of banks’ balance sheets in response to interest rate changes.
Interest rate surprises induced by monetary policy actions have large effects on the aggregate stock market. (Bernanke & Kuttner [2005])

Do our results represent a departure from standard empirical asset pricing models?
**Our Approach: Step I**

- Estimate a dynamic CAPM using daily data:

  \[(R_{i\tau} - r^{f}_{\tau}) = \alpha_{i\tau} + \beta_{i\tau}(R^{M}_{\tau} - r^{f}_{\tau}) + \epsilon_{i\tau},\]

- Idiosyncratic return for FOMC announcement day \(t\):

  \[(R_{it} - r^{f}_{t}) - \left[0.31\hat{\alpha}_{i,t-1} + \hat{\beta}_{i,t-1}(R^{M}_{t} - r^{f}_{t})\right]\]

- **Result**: Level and slope surprise have no effect of idiosyncratic returns.

- **Implication**: Reaction of bank stock returns to changes in interest rates induced by FOMC announcements is in line with their usual comovement with the market.
Our Approach: Step II

- Bank-specific characteristics determining the magnitude and direction of the reaction to policy-induced interest rate surprises should be correlated with the market beta.

- Estimate:

\[ \hat{\beta}_{it} = \theta'X_{i,t-1} + \eta_i + \epsilon_{it}, \]

\[ \hat{\beta}_{it} = \text{estimate of market beta for bank } i \text{ in quarter } t \]

\[ X_{i,t-1} = \text{vector of “fundamental” bank characteristics} \]
## Bank Characteristics on the Market Beta

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Coef.</th>
<th>S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maturity gap: $GAP^{R/M}$</td>
<td>-0.067***</td>
<td>0.012</td>
</tr>
<tr>
<td>Other assets: $A^{OTH}$</td>
<td>-0.589***</td>
<td>0.208</td>
</tr>
<tr>
<td>Other liabilities: $L^{OTH}$</td>
<td>1.242***</td>
<td>0.310</td>
</tr>
<tr>
<td>Savings deposits: $SD$</td>
<td>2.090***</td>
<td>0.408</td>
</tr>
<tr>
<td>Demand deposits: $DTD$</td>
<td>1.930***</td>
<td>0.410</td>
</tr>
<tr>
<td>Loans/Assets: $LNS/A$</td>
<td>-0.014</td>
<td>0.177</td>
</tr>
<tr>
<td>Size: log $A$</td>
<td>0.561***</td>
<td>0.052</td>
</tr>
<tr>
<td>Swaps</td>
<td>-0.752***</td>
<td>0.090</td>
</tr>
<tr>
<td>OTC options (written)</td>
<td>-0.295*</td>
<td>0.163</td>
</tr>
<tr>
<td>OTC options (purchased)</td>
<td>0.207</td>
<td>0.133</td>
</tr>
<tr>
<td>ET options (written)</td>
<td>0.217</td>
<td>0.178</td>
</tr>
<tr>
<td>ET options (purchased)</td>
<td>-0.123</td>
<td>0.147</td>
</tr>
<tr>
<td>Futures</td>
<td>0.027</td>
<td>0.099</td>
</tr>
<tr>
<td>Forwards</td>
<td>0.168**</td>
<td>0.073</td>
</tr>
</tbody>
</table>

*Memo: $R^2$ (within) = 0.175*