# Banking on Deposits:
## Maturity Transformation without Interest Rate Risk

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ECB Monetary Policy Conference
October 2019

# Textbook View of Banking and Maturity Transformation

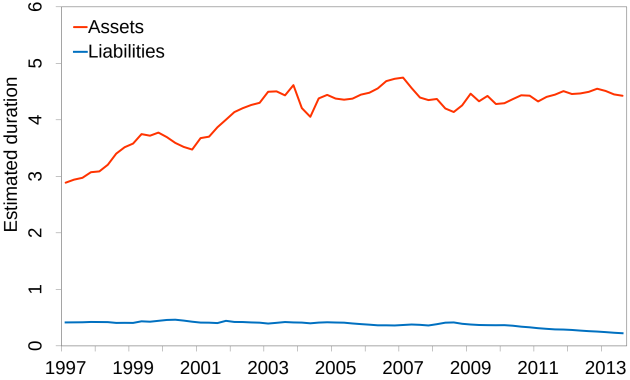
1. Banks borrow short term (issue deposits), lend long term (make loans, buy securities)
   - maturity/duration mismatch
   - pay short-term (floating) rate, receive long-term (fixed) rate

2. Earns term premium but creates exposure to interest rates
   - a rise in short rate $\rightarrow$ interest expenses go up $\rightarrow$ profits fall

     $\Rightarrow$ assets fall relative to liabilities, equity capital depleted
   - important at all times, not just in financial crises
   - different from run risk, applies to whole balance sheet

3. Seen as an important channel for monetary policy
   - "bank balance sheet channel" - idea that Fed impacts banks through their interest rate exposure

# Banks' Duration Mismatch



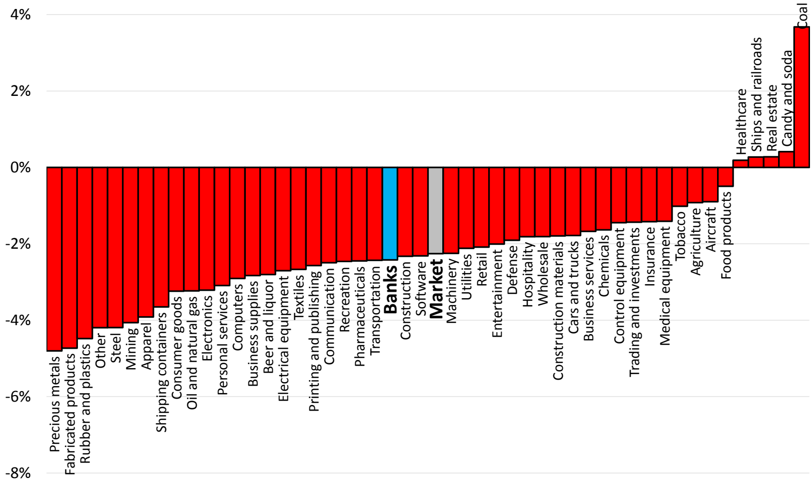

1. Aggregate duration mismatch is about 4 years

$\Rightarrow$ Under textbook view, a 100-bps level shift in rates leads to

- 4 years of 100-bps lower net income (as % of assets)
- in PV terms: a 4% drop in assets $\rightarrow$ a 40% drop in equity since banks are levered 10 to 1; stock price drops on impact
- shocks cumulative over time, 100 bps small by historical standards

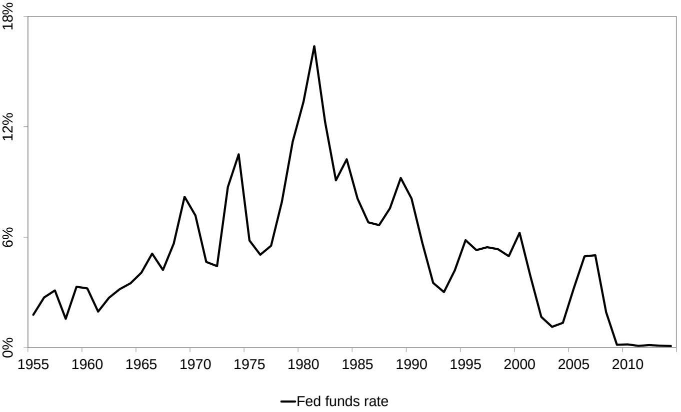
# How Exposed are Bank Stocks to Interest Rates?

1. Regress FF49 industry portfolios on Δ1-year rate around FOMC days



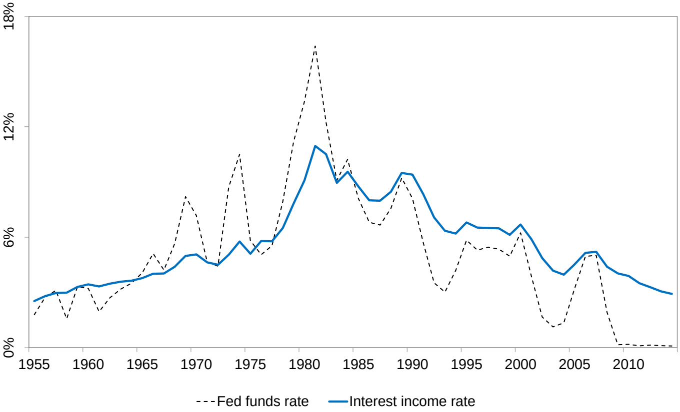

2. Bank stocks drop by just 2.4% per 100-bps rate shock ($\ll 40\%$)
   - no more exposed than average nonfinancial firm or overall market

# Bank Cash Flows and Interest Rates



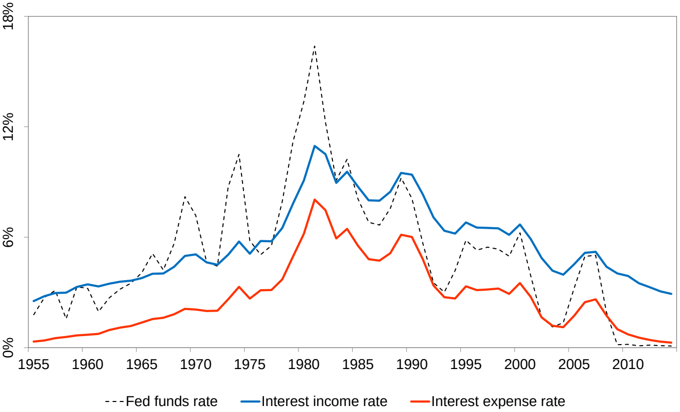

1. Interest rates have varied widely and persistently over past 60 years

# Bank Cash Flows and Interest Rates




1. Interest rates have varied widely and persistently over past 60 years
2. Banks' **interest income** much smoother, reflecting long-term assets
   $\Rightarrow$ would suffer frequent and sustained losses if funded at Fed funds rate

# Bank Cash Flows and Interest Rates




1. Interest rates have varied widely and persistently over past 60 years
2. Banks' **interest income** much smoother, reflecting long-term assets
   $\Rightarrow$ would suffer frequent and sustained losses if funded at Fed funds rate
3. Instead, banks' **interest expense** much lower and smoother than Fed funds rate, *even though liabilities are short-term*

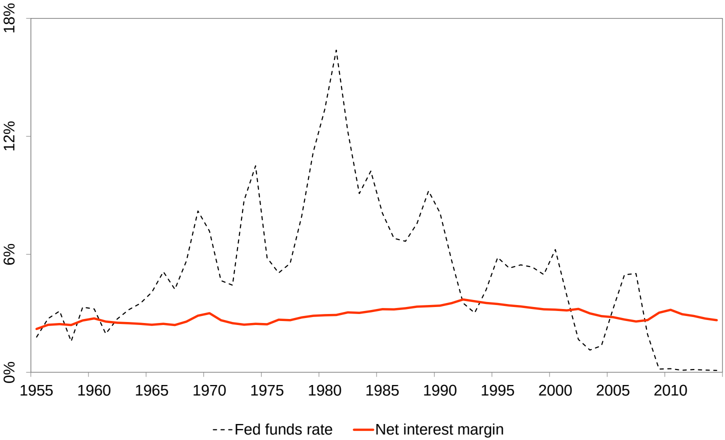
# Why Is Banks' Interest Expense so Low and Smooth?

In Drechsler, Savov, Schnabl (2017, QJE) we show that:

1. This is due to banks' market power in retail deposit markets
   - $\Rightarrow$ allows banks to keep deposit rates low even as the short rate rises
2. On average, deposit rates increase by just 40 bps per 100-bps Fed funds rate increase
   - exploit differences in competition across branches of the same bank
3. Deposits represent over 70% of aggregate bank liabilities
   - $\Rightarrow$ banks' overall interest expense has a low sensitivity to interest rates

# Banks' Net Interest Margin (NIM)

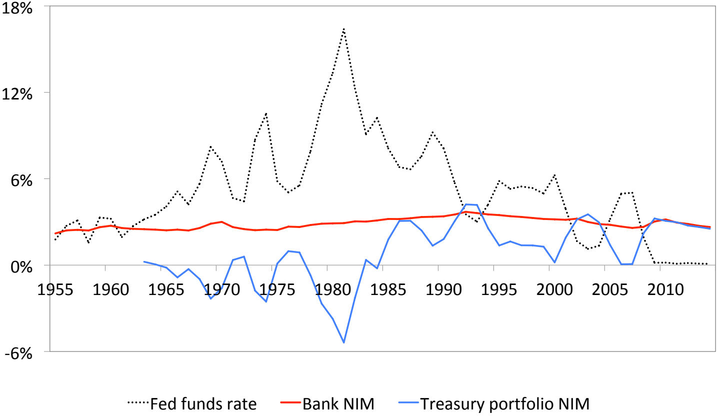
1. NIM = (Interest income - Interest expense)/Assets




2. NIM is *uncorrelated* with short rate $\Rightarrow$ goes against textbook view
   - $corr(\Delta\text{NIM}, \Delta\text{FF rate}) \approx 0$; $\sigma(\Delta\text{NIM}) = 0.13\%$ (*annual*)

# Banks' Net Interest Margin (NIM)

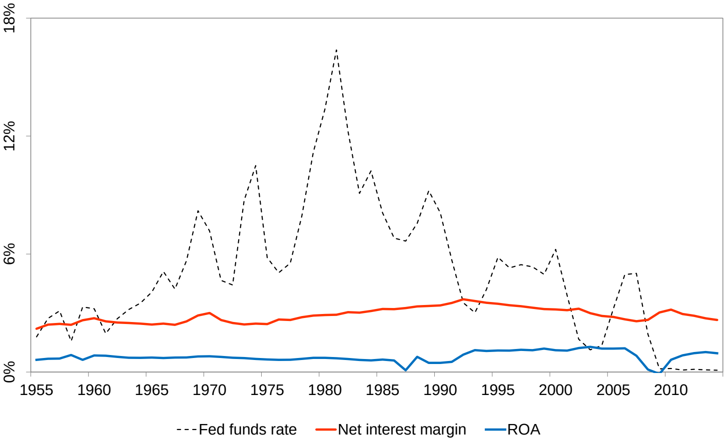
1. NIM $=$ (Interest income - Interest expense)/Assets




2. Construct NIM for Treasury portfolio with same duration mismatch as banks (but no deposit market power)
   - Treasury portfolio NIM much more sensitive to rates than bank NIM

# Banks' Net Interest Margin (NIM) and ROA

1. ROA = NIM + Fee income - Operating costs - Loan losses




2. Like NIM, ROA is also uncorrelated with the short rate
   - well below NIM, reflecting substantial operating costs, 2-3% of assets

# Model

1. Time $t \geq 0$, short rate process $f_t$
2. An infinitely-lived bank runs a deposit franchise
   - per-dollar operating cost $c$ (branches, salaries, marketing, etc.)
   - paying $c$ gives the bank market power:

     $$\text{deposit rate} = \beta^{Exp} f_t, \text{ where } \beta^{Exp} < 1$$

   - Drechsler, Savov, and Schnabl (2017) provide microfoundations
3. Bank invests deposit dollars to maximize PV of future profits
   - no equity or long-term debt (for simplicity)
   - asset markets are complete, stochastic discount factor $m_t$

# Setup

Bank solves:

$$V_0 \;=\; \max_{INC_t} \; E_0 \left[ \sum_{t=0}^{\infty} \frac{m_t}{m_0} \left( INC_t - \beta^{Exp} f_t - c \right) \right]$$

$$\text{s.t. } E_0 \left[ \sum_{t=0}^{\infty} \frac{m_t}{m_0} INC_t \right] = 1$$

$$\text{and } INC_t \geq \beta^{Exp} f_t + c$$

Risks:

1. Need to cover interest expenses, sensitivity $\beta^{Exp}$ to $f_t$
   - ⇒ *income must be sensitive enough to $f_t$ in case $f_t$ is high*
   - yet $\beta^{Exp} < 1$ is low because of market power
2. Also need to cover insensitive operating cost $c$
   - ⇒ *income must be insensitive enough in case $f_t$ is low*
   - must hold sufficient long-term (fixed-rate) assets

# Result

Under ex-ante free entry (zero rents):

1. $V_0 = 0$, income is pinned down: $INC_t^\star = \beta^{Exp} f_t + c$
2. Sensitivity matching:

$$\text{Income beta} \equiv \beta^{Inc} = \frac{\partial INC_t^\star}{\partial f_t} = \beta^{Exp} \equiv \text{Expense beta}$$

   - aggregate time series shows tight sensitivity matching
   - test in cross section

3. Bank can implement optimal policy by investing:
   - $\beta^{Exp}$ share of assets in short-term (floating-rate) assets
   - $1 - \beta^{Exp}$ in long-term (fixed-rate) assets

# Empirical Analysis

1. Call reports, all U.S. commercial banks, 1984 to 2013
   - we've posted cleaned data on our websites

2. For each bank $i$, estimate interest expense and income betas

$$\Delta IntExp_{i,t} = \alpha_i + \sum_{\tau=0}^{3} \beta_{i,\tau}^{Exp} \Delta FF_{t-\tau} + \varepsilon_{it}$$

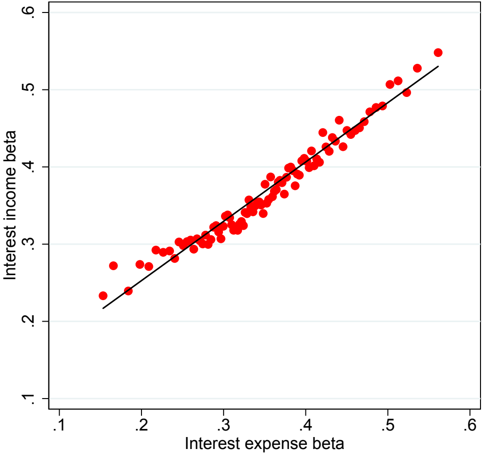
$$\Delta IntInc_{i,t} = \alpha_i + \sum_{\tau=0}^{3} \beta_{i,\tau}^{Inc} \Delta FF_{t-\tau} + \varepsilon_{it}$$

   - $IntExp$ = Interest expense/Assets
   - $IntInc$ = Interest income/Assets
   - 4 quarterly lags of $\Delta FF$ capture adjustment over a full year

3. Plot $\beta_i^{Exp} = \sum_{\tau=0}^{3} \beta_{i,\tau}^{Exp}$ versus $\beta_i^{Inc} = \sum_{\tau=0}^{3} \beta_{i,\tau}^{Inc}$

# Income versus Expense betas (all banks)

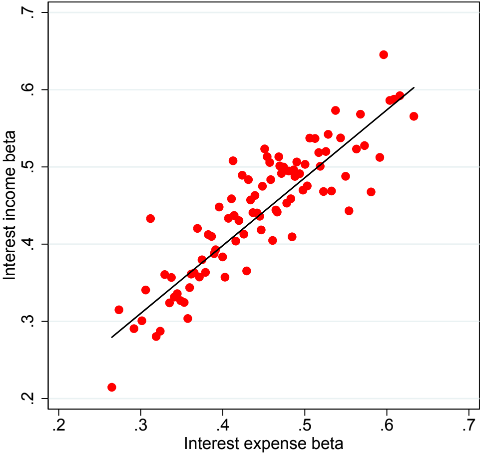
1. Bin scatter plot of $\beta_i^{Inc}$ versus $\beta_i^{Exp}$; 100 bins, $\approx$ 168 banks per bin




2. Strong matching: tight linear relationship between income and expense betas, slope is close to 1

# Income versus Expense betas (top 5% of banks)

1. Bin scatter plot of $\beta_i^{Inc}$ versus $\beta_i^{Exp}$

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# Sensitivity matching (panel regression)

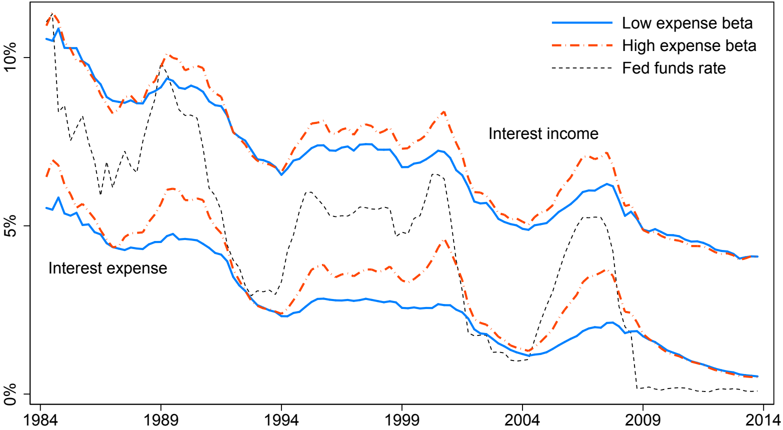
$$Stage1 : \Delta IntExp_{i,t} = \alpha_i + \sum_{\tau=0}^{3} \beta_{i,\tau}^{Exp} \Delta FedFunds_{t-\tau} + \epsilon_{i,t}$$

$$Stage2 : \Delta IntInc_{i,t} = \alpha_i + \sum_{\tau=0}^{3} \gamma_\tau \Delta FedFunds_{t-\tau} + \delta \Delta \widehat{IntExp}_{i,t} + \varepsilon_{i,t}.$$

| | All banks | | Top 5% | | Top 1% | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $\widehat{\Delta IntExp}$ | 0.765*** | 0.766*** | 1.114*** | 1.111*** | 1.096*** | 1.089*** |
| | (0.033) | (0.034) | (0.099) | (0.099) | (0.068) | (0.076) |
| $\sum \gamma_\tau$ | 0.093** | | −0.053 | | −0.065 | |
| | (0.031) | | (0.050) | | (0.050) | |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Time FE | No | Yes | No | Yes | No | Yes |
| $N$ | 1126023 | 1126023 | 44584 | 44584 | 9833 | 9833 |
| R-sq. | 0.089 | 0.120 | 0.120 | 0.153 | 0.109 | 0.150 |

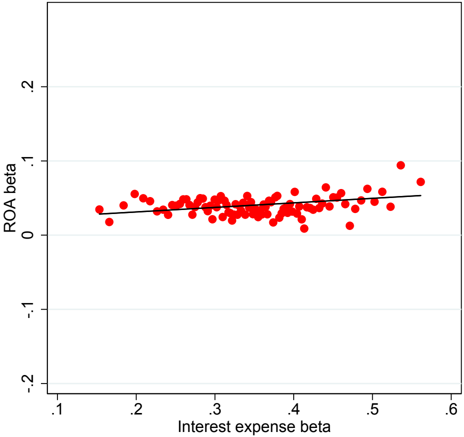
1. Matching coefficient $\delta$ close to 1, especially for large banks
   $\Rightarrow$ a bank with no market power (expense beta $= 1$) predicted to hold only short-term assets (income beta $= 1$) $\rightarrow$ a money market fund

# Time Series of Interest Income and Expense Rates



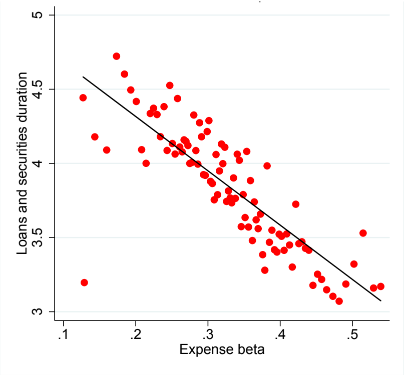

1 Average interest income and interest expense rate by expense beta (top vs. bottom 5%)
   - a non-parametric way to see matching in the cross section

# ROA Betas vs. Expense Betas



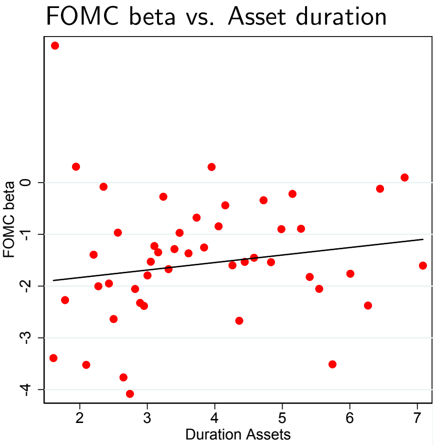

1. No relationship between expense beta and ROA beta
   - ⇒ matching unaffected by non-interest income (e.g., fees) and costs
2. Similar result for expense beta vs. NIM beta (by construction)

# Expense Betas and Asset Duration




1. Lower expense beta ⇒ higher asset duration (repricing maturity)
   - slope coefficient $= -3.66$ years
   - large relative to aggregate asset duration of 4.4 years

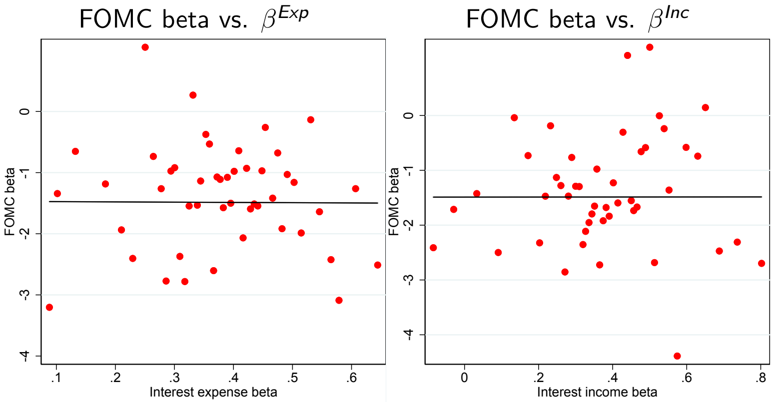
# Cross Section of Bank Equity FOMC Betas




1. No relationship with asset duration

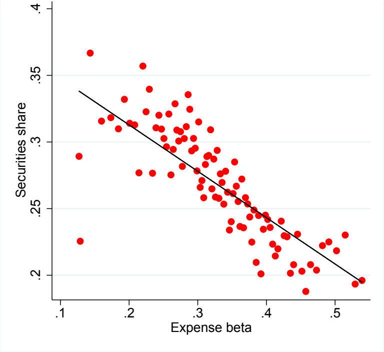
   ⇒ explained by matching of long-term assets with deposit market power

# Cross Section of Bank Equity FOMC Betas




1. No relationship with either expense or income betas
   $\Rightarrow$ explained by sensitivity matching

# Is Matching Driven by Liquidity (Run) Risk?




1. Perhaps high-$\beta^{Exp}$ banks hold more short-term assets to insure against liquidity risk?
   - does not predict matching coefficient of one
2. High-$\beta^{Exp}$ banks hold more loans and fewer securities
   - but loans are *illiquid* $\rightarrow$ inconsistent with liquidity risk explanation
   - consistent with matching: securities have higher duration than loans

# Matching within Securities portfolio

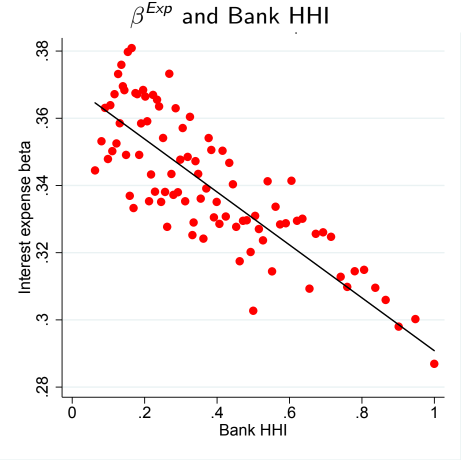
$$Stage1 : \Delta IntExp_{i,t} = \alpha_i + \sum_{\tau=0}^{3} \beta_{i,\tau}^{Exp} \Delta FedFunds_{t-\tau} + \epsilon_{i,t}$$

$$Stage2 : \Delta IntIncTreasuries_{i,t} = \alpha_i + \sum_{\tau=0}^{3} \gamma_\tau \Delta FedFunds_{t-\tau} + \delta \Delta \widehat{IntExp}_{i,t} + \varepsilon_{i,t}.$$

| | All banks | | | Top 5% | | |
|---|---|---|---|---|---|---|
| | (1) Total | (2) Treasuries | (3) MBS | (4) Total | (5) Treasuries | (6) MBS |
| $\Delta \widehat{IntExpRate}$ | 0.570*** | 0.429*** | 0.489*** | 0.933*** | 0.792*** | 1.347*** |
| | (0.045) | (0.054) | (0.082) | (0.142) | (0.218) | (0.364) |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes | Yes | Yes | Yes |
| $N$ | 1115149 | 322147 | 279794 | 44382 | 8877 | 9333 |
| R-sq. | 0.012 | 0.033 | 0.01 | 0.034 | 0.041 | 0.038 |

1. Banks match sensitivities even within Treasury and MBS portfolio
    - highly liquid/integrated markets ⇒ not driven by segmentation
2. Implications for asset pricing

# Expense Betas and Market Concentration




1. Bank HHI is the average Herfindahl of all zip codes where the bank has branches

$\Rightarrow$ Banks that face less local competition for deposits (high Bank HHI) have lower expense betas, especially for retail (e.g. savings) deposits

# Expense Betas and Market Concentration (HHI)

$$\Delta IntExp_{i,t} = \alpha_i + \sum_{\tau=0}^{3} \left( \beta_\tau^0 + \beta_\tau^1 HHI_{i,t} \right) \Delta FedFunds_{t,t-\tau} + \epsilon_{i,t} \qquad \text{[Stage 1]}$$

$$\Delta IntInc_{i,t} = \alpha_i + \sum_{\tau=0}^{3} \gamma_\tau \Delta FedFunds_{t,t-\tau} + \delta \Delta \widehat{IntExp}_{i,t} + \epsilon_{i,t}. \qquad \text{[Stage 2]}$$

| Stage 1: | (1) | (2) |
|---|---|---|
| $\sum \beta_\tau^1$ | $-0.047$*** | $-0.059$*** |
| | (0.021) | (0.016) |
| $R^2$ | 0.196 | 0.237 |

| Stage 2: | Δ Interest income | |
|---|---|---|
| | (1) | (2) |
| $\widehat{\Delta IntExp}$ | 1.264*** | 1.278*** |
| | (0.186) | (0.154) |
| Bank FE | Yes | Yes |
| Time FE | No | Yes |
| $N$ | 624,204 | 624,204 |
| $R^2$ | 0.088 | 0.122 |

1. Less competition → less sensitive interest expense (Stage 1)
2. Matching coefficient $\delta$ close to 1 (Stage 2)

# Retail Deposit Betas and Within-Bank Estimation

1. Use retail-deposit betas to hone in on market power mechanism
2. Within-bank retail $\beta^{Exp}$:
   - compute county-level retail betas using differences in deposit rates across branches of *same* bank, average across each bank's counties

   $\Rightarrow$ gives us geographic variation in $\beta^{Exp}$ purged of bank characteristics

| Stage 1: | Retail $\beta^{Exp}$ | | Within-bank retail $\beta^{Exp}$ | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| $\sum \beta_\tau^1$ | 0.550*** | 0.565*** | 0.109*** | 0.110** |
| | (0.057) | (0.056) | (0.013) | (0.013) |
| $R^2$ | 0.214 | 0.264 | 0.210 | 0.258 |
| **Stage 2:** | **$\Delta$ Interest income** | | **$\Delta$ Interest income** | |
| | (1) | (2) | (3) | (4) |
| $\Delta\widehat{IntExp}$ | 1.259*** | 1.264*** | 1.185** | 1.186** |
| | (0.136) | (0.136) | (0.114) | (0.119) |
| Bank FE | Yes | Yes | Yes | Yes |
| Time FE | No | Yes | No | Yes |
| $N$ | 492862 | 492862 | 446862 | 446862 |
| $R^2$ | 0.093 | 0.121 | 0.091 | 0.126 |

1. Strong first stage, matching coefficient again close to one

# Takeaways

1. Despite a large duration mismatch, banks are largely unexposed to interest rate risk
2. This is due to market power over deposits, which lowers the interest rate sensitivity of banks' expenses
3. Banks invest in long-term assets to hedge their deposit franchise

⇒ Deposits are the foundation of banking, drive maturity transformation

- explains why deposit taking and long-term lending coexist under one roof
- implies that "narrow banking" could make banks unstable, reduce long-term lending
- implies that banks are largely insulated from the "balance sheet channel" of monetary policy