Banking on Deposits:
Maturity Transformation without Interest Rate Risk

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Textbook View of Banking and Maturity Transformation

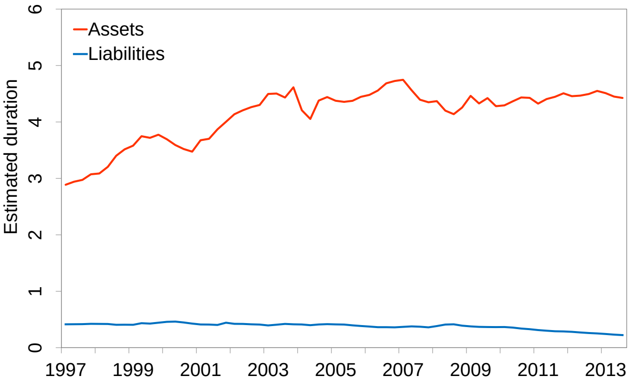
1. Banks borrow short term (issue deposits), lend long term (make loans, buy securities)
    - maturity/duration mismatch
    - pay short-term (floating) rate, receive long-term (fixed) rate

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



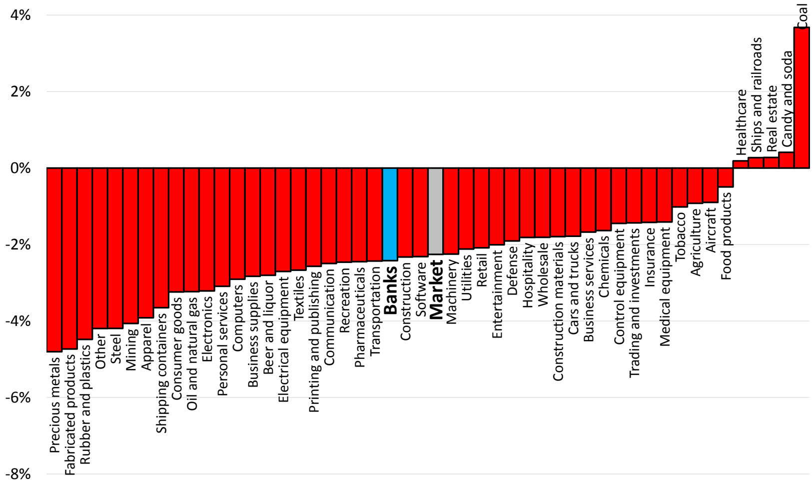
1. Aggregate duration mismatch is about 4 years

$\Rightarrow$ 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

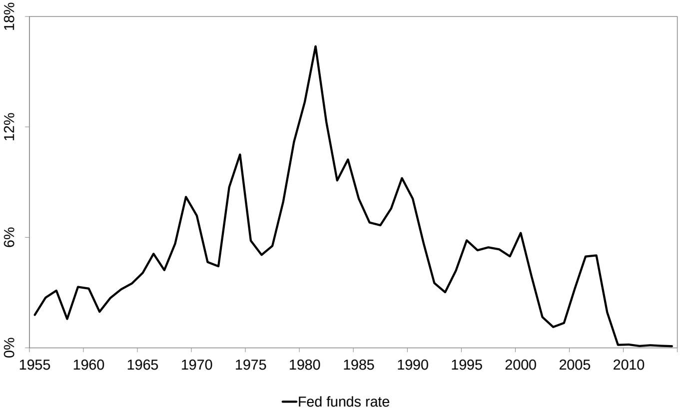
How Exposed are Bank Stocks to Interest Rates?

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



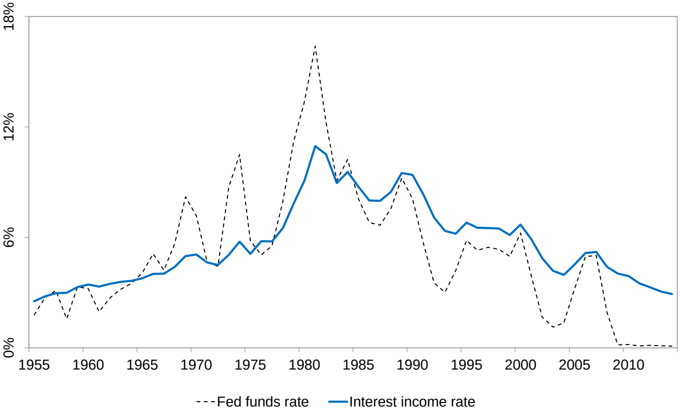
2. Bank stocks drop by just 2.4% per 100-bps rate shock ($\ll 40\%$)
    - no more exposed than average nonfinancial firm or overall market

Bank Cash Flows and Interest Rates



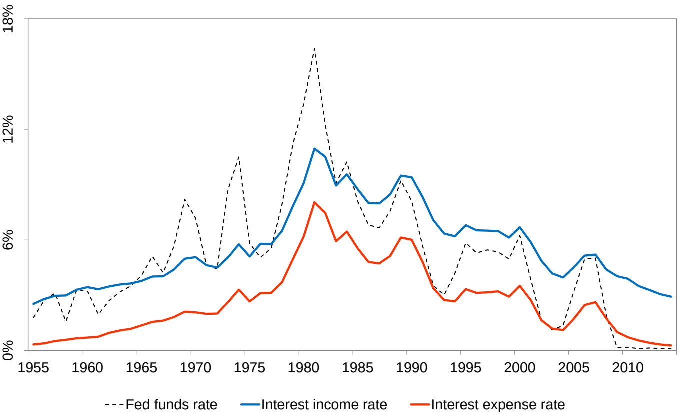
1. Interest rates have varied widely and persistently over past 60 years

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*

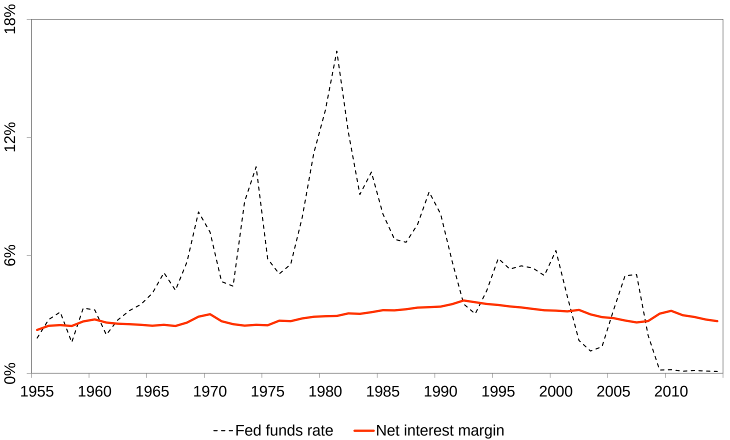
Why Is Banks' Interest Expense so Low and Smooth?

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

1. This is due to banks' market power in retail deposit markets
   - ⇒ 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
   - ⇒ banks' overall interest expense has a low sensitivity to interest rates

Banks' Net Interest Margin (NIM)

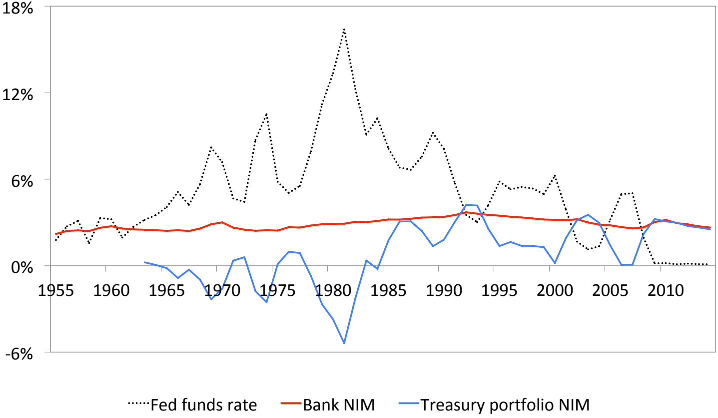
1. NIM = (Interest income - Interest expense)/Assets



2. NIM is *uncorrelated* with short rate ⇒ 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)

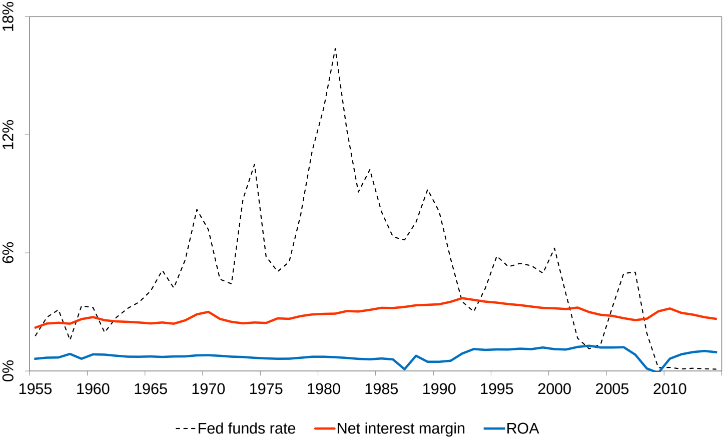
1. NIM = (Interest income - Interest expense)/Assets



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

Related literature

1. Coexistence of deposit-taking and lending
   - *Diamond and Dybvig (1983), Gorton and Pennacchi (1990), Calomiris and Kahn (1991), Diamond and Rajan (2001), Kashyap, Rajan, and Stein (2002), Hanson, Shleifer, Stein, and Vishny (2015)*
   - these papers focus on liquidity transformation/runs. We provide an explanation for maturity transformation

2. Interest rate risk and the balance sheet channel of monetary policy
   - *Bernanke and Gertler (1995), Brunnermeier and Sannikov (2014, 2017), Begenau, Piazzesi, and Schneider (2015), Hanson and Stein (2015), Gomez, Landier, Sraer, and Thesmar (2016), Brunnermeier and Koby (2017), English, Van den Heuvel, and Zakrajsek (2018)*
   - our results suggest interest rate exposure is very small

3. Deposit pricing and market power
   - *Hannan and Berger (1991), Neumark and Sharpe (1992), Driscoll and Judson (2013), Drechsler, Savov, and Schnabl (2017)*
   - we focus on asset-side implication for maturity transformation

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 β^{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:
   - β^{Exp} share of assets in short-term 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

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

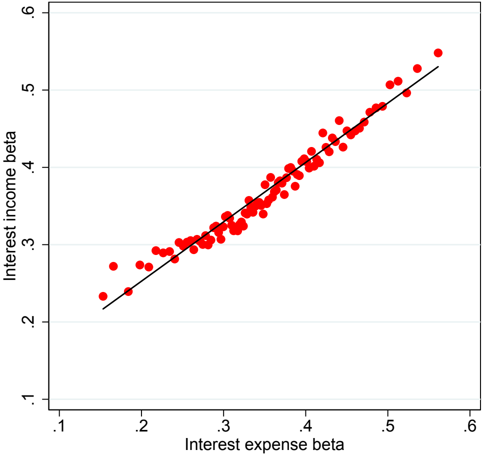
$$\Delta IntInc_{i,t} = \alpha_i + \sum_{\tau=0}^{3} \beta_{i,\tau}^{Inc} \Delta FF_{t-\tau} + \varepsilon_{it}$$

   - $IntExp$ = Interest expense/Assets
   - $IntInc$ = Interest income/Assets
   - 4 quarterly lags of ΔFF 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)

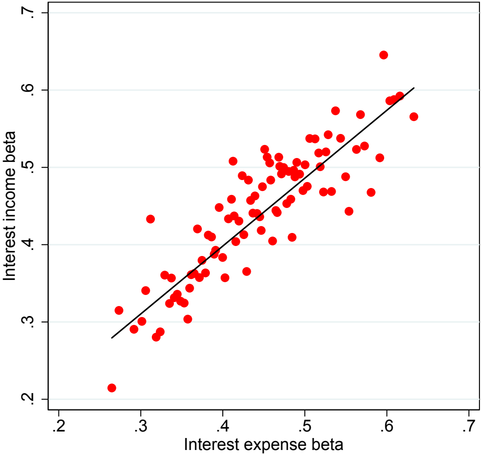
1. Bin scatter plot of β_i^{Inc} versus β_i^{Exp}; 100 bins, $\approx$ 168 banks per bin



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 β_i^{Inc} versus β_i^{Exp}



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Sensitivity matching (panel regression)

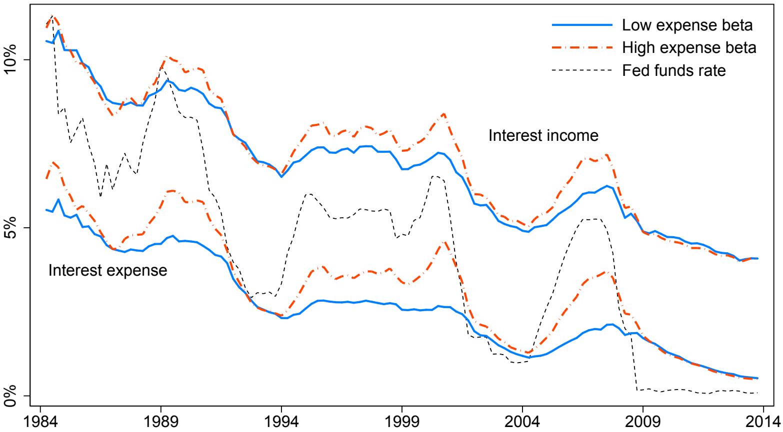
$$Stage1 : \Delta IntExp_{i,t} = \alpha_i + \sum_{\tau=0}^{3} \beta_{i,\tau}^{Exp} \Delta FedFunds_{t-\tau} + \epsilon_{i,t}$$

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

	All banks		Top 5%		Top 1%	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \widehat{IntExp}$	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

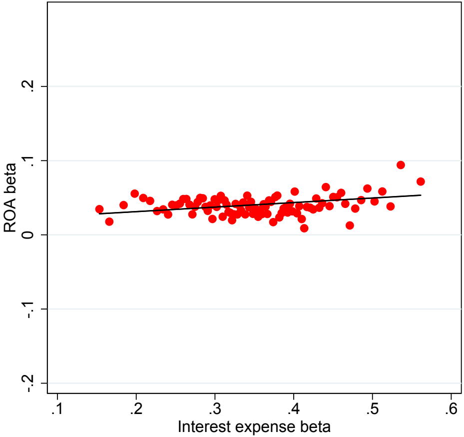
1. Matching coefficient δ close to 1, especially for large banks
   - $\Rightarrow$ a bank with no market power (expense beta $= 1$) predicted to hold only short-term assets (income beta $= 1$) $\rightarrow$ a money market fund

Time Series of Interest Income and Expense Rates



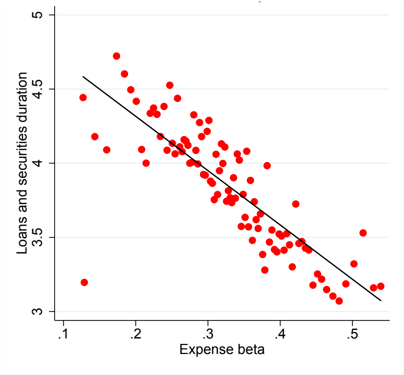
1 Average interest income and interest expense rate by expense beta (top vs. bottom 5%)
   - a non-parametric way to see matching in the cross section

ROA Betas vs. Expense Betas



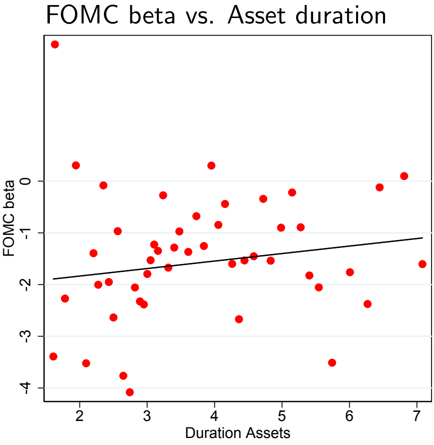
1. No relationship between expense beta and ROA beta
   - ⇒ matching unaffected by non-interest income (e.g., fees) and costs
2. Similar result for expense beta vs. NIM beta (by construction)

Expense Betas and Asset Duration



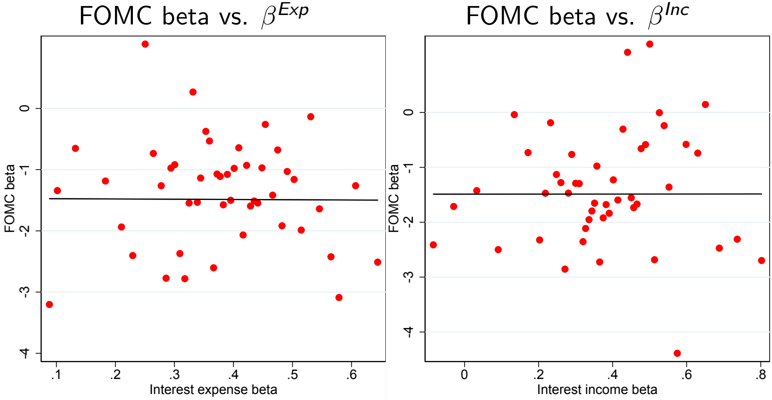
1. Lower expense beta ⇒ higher asset duration (repricing maturity)
   - slope coefficient $= -3.66$ years
   - large relative to aggregate asset duration of 4.4 years

Cross Section of Bank Equity FOMC Betas



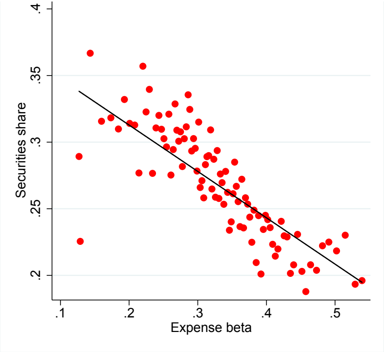
1. No relationship with asset duration
   ⇒ explained by matching of long-term assets with deposit market power

Cross Section of Bank Equity FOMC Betas



1. No relationship with either expense or income betas
   - ⇒ explained by sensitivity matching

Is Matching Driven by Liquidity (Run) Risk?



1. Perhaps high-β^{Exp} banks hold more short-term assets to insure against liquidity risk?
   - does not predict matching coefficient of one
2. High-β^{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

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

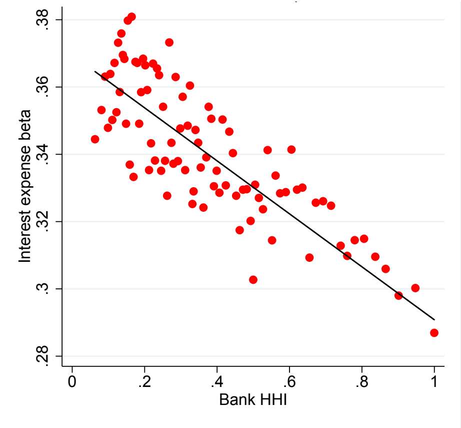
$$Stage2 : \Delta IntIncTreasuries_{i,t} = \alpha_i + \sum_{\tau=0}^{3} \gamma_\tau \Delta FedFunds_{t-\tau} + \delta \Delta \widehat{IntExp}_{i,t} + \varepsilon_{i,t}.$$

	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

β^{Exp} and Bank HHI



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)
$\Delta \widehat{IntExp}$	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 δ 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 β^{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 β^{Exp} purged of bank characteristics

Stage 1:	Retail β^{Exp}		Within-bank retail β^{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:	**Δ Interest income**		**Δ 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

$\Rightarrow$ 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

APPENDIX

Textbook view in Freixas and Rochet (2008)

1. On interest rate risk
   - "**interest rate risks** *are generated by the activity of* **maturity transformation** *of short-term deposits into long-term loans*"

2. On the transmission of monetary policy

   "*1. Monetary policy* **increases interest rates.**"
   "*2. Because of* **maturity mismatch**, *this generates a loss.*"
   "*3. This, in turn, produces a* **capital decrease**."
   "*4. The capital requirement leads to a* **reduction in lending**."

Boivin, Kiley, and Mishkin (2010)

"Expansionary monetary policy can lead to improved bank balance sheets in two ways. First, lower short-term interest rates tend to increase net interest margins and so lead to higher bank profits which result in an improvement in bank balance sheets over time. Second, expansionary monetary policy can raise asset prices and lead to immediate increases in bank capital. In the bank capital channel, expansionary monetary policy boosts bank capital, lending, and hence aggregate demand by enabling bank-dependent borrowers to spend more."

Summary Stats

	All banks		Top 5%	Low beta	High beta
	Mean	St.Dev.	Mean	Mean	Mean
Interest expense beta	0.360	0.096	0.448	0.283	0.436
Asset repricing maturity	3.360	1.580	4.001	3.588	3.088
Liabilities repricing maturity	0.441	0.213	0.400	0.462	0.416
Core deposits/Assets	0.732	0.115	0.646	0.751	0.713
Observations	18,552		860	9,276	9,276

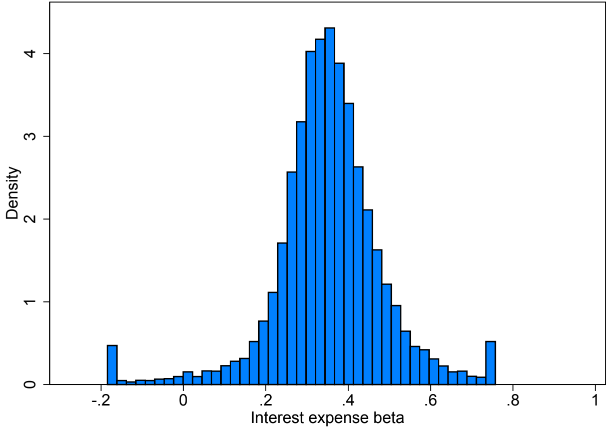
- Expense beta does not correlate with liability repricing maturity
- But correlates strongly with asset repricing maturity

Post-ZLB Evidence

1. *Wall Street Journal*, March 19, 2018
   - *"With Fed poised to raise interest rates a sixth time,* **savers so far have seen few rewards***"*
   - *"In the last tightening cycle, the average yield on a one-year CD rose 1.15 percentage points during the Fed's first five rate moves ... In this cycle,* **CD rates have risen just 0.27 points.***"*
2. *Wall Street Journal*, March 22, 2018

   "But the biggest chunk of **deposits is held in the banks' retail units** *... These deposits, which are considered* **sticky***, or less likely to leave, have become even more important..."*

Distribution of Estimated Expense Betas β_i^{Exp}

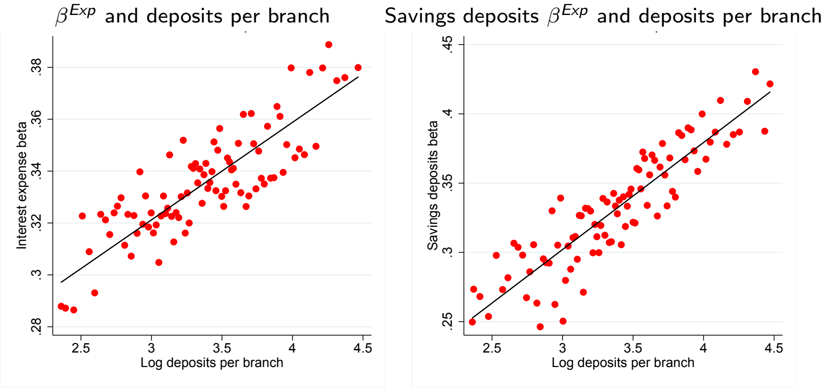


1. Avg. β^{Exp} is 0.35 (for large banks: 0.44) with significant variation
2. Avg. banking sector size: \$6.763 trillion, net income: \$59.5 billion

$\Rightarrow$ 1% increase in FF rate raises revenues from bank liabilities by $(1 - 0.436) \times \$6,763 = $ \$38 billion **per year**

3. Banking sector size in 2015: \$14.8 trillion

Expense Betas and Branch Operating Costs



1. Fewer deposits per branch → higher operating cost per deposit dollar, larger investment in acquiring retail deposits

⇒ As in model, banks that pay higher operating costs have lower β^{Exp}, especially true for savings deposits (largest type of retail deposits)