Interest Rate Risk in Banking

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Rates & Prices 2022-2023

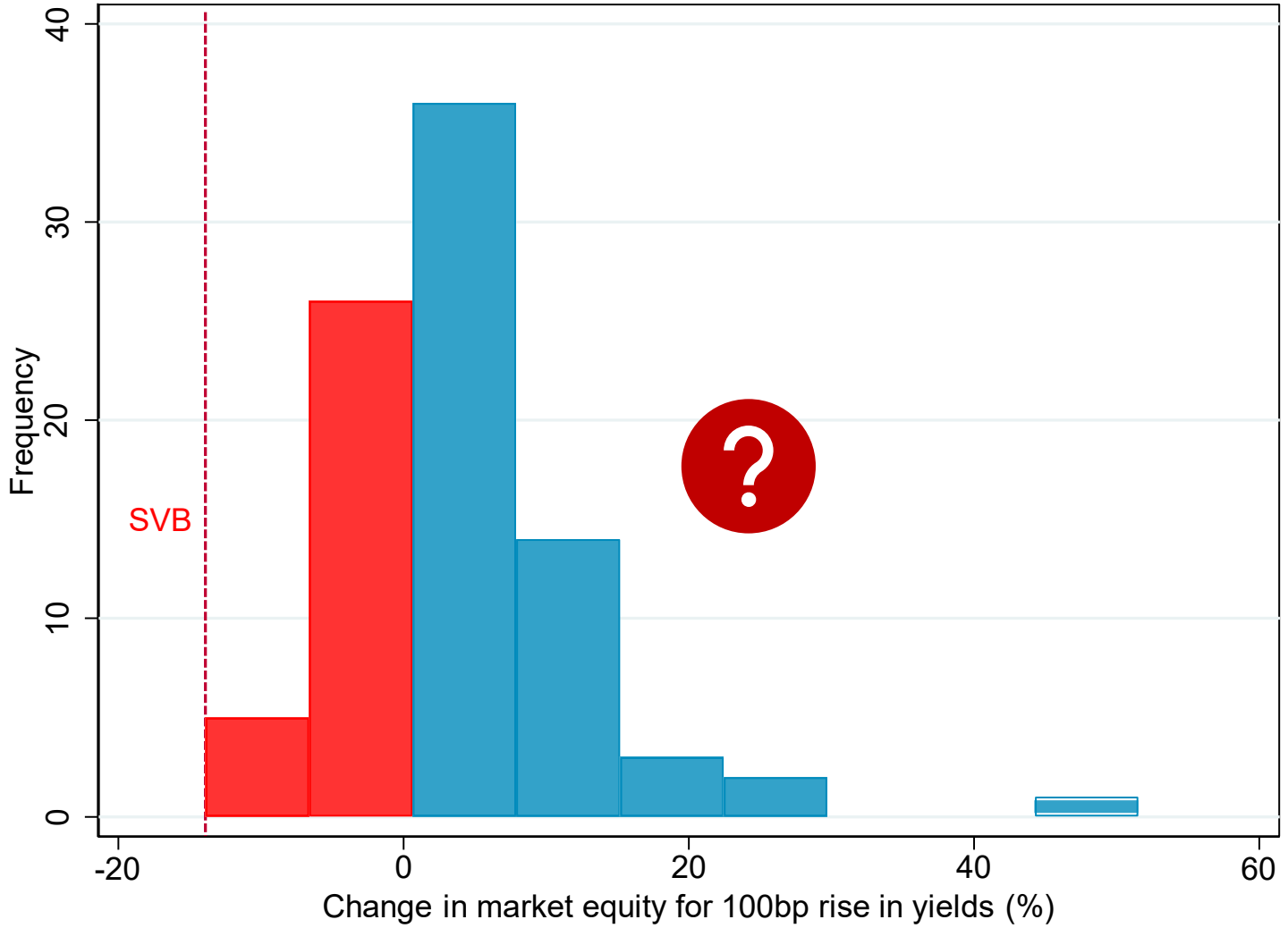
- As interest rates went up, bank market values fell substantially
- Banking 101: "Maturity Mismatch"
- But why?

  ST: Liquidity (run risk)

  versus

  LR: Solvency

Banks' estimated interest rate exposure (2021)

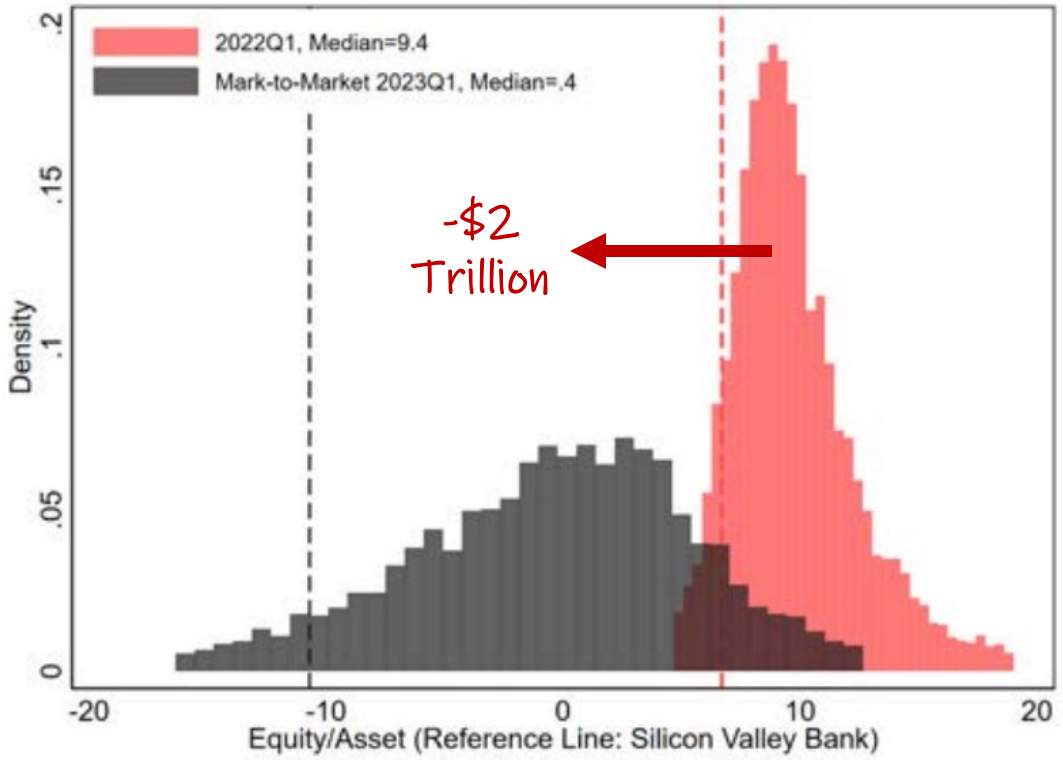


- Following regulatory guidelines, most banks anticipated a *positive* impact on **market value** (EVE) from an increase in rates
- Why did many banks estimate *negative* duration?

Data: 2021 BHC 10Ks

Asset Value? vs Franchise Value?

- **Jiang, Matvos, Piskorski, Seru (JMPS, March 2023)**



- **Dreschler, Savov, Schnabl (DSS, March 2023)**

How to value the deposit franchise

Itamar Drechsler, Alexi Savov, and Philipp Schnabl

low rates, compared to their operating costs. So the change in the value of the deposit franchise is

$$\Delta DF = 1.7 - 0 = \$1.7 \; trillion.$$

Thus, banks have an unrealized gain of $1.7 trillion on their deposit franchise. This number is very similar to the unrealized losses of $1.75 trillion, especially compared to the value of bank capital, which was $2.2 trillion. The implied net loss to equity is thus rather small.

Common "Intuition"…
Sticky, low beta deposits ⟹ Dur < 0

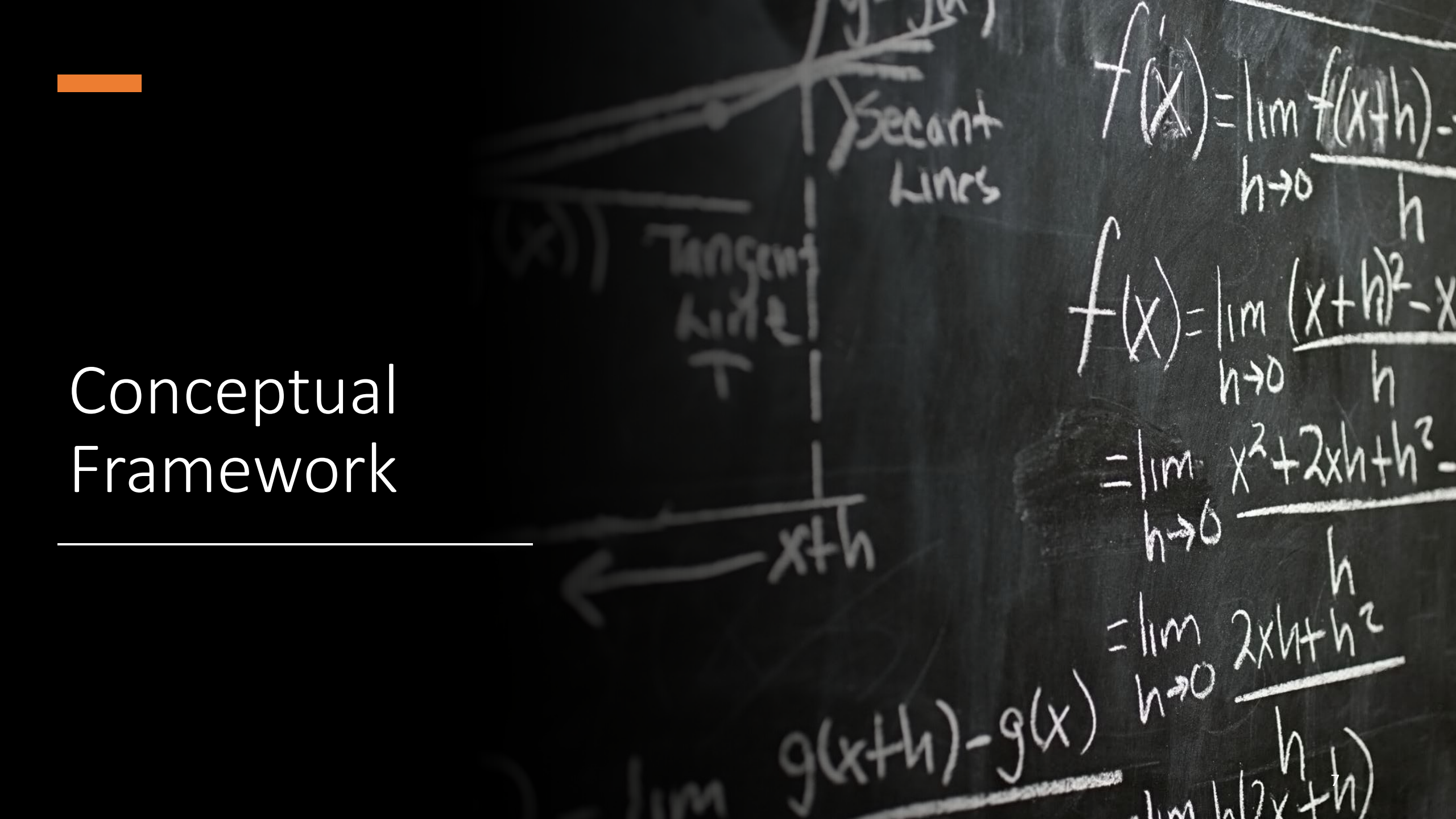
E.g. Metrick (2024)…

Silicon Valley Bank is not unusual in relying on the stability of its deposits. In an influential paper, Dreschler, Savov, and Schnabl (2021) demonstrate that profits from the deposit spread have been a remarkably good hedge for interest-rate risk for US banks. Their analysis shows that deposit rates are quite inelastic to market interest rates, so that an increase in market rates leads to an increase in deposit *spreads*. Banks build their business plans around this relationship, using marketing, branch networks, and personal service to maximize the stability of their deposit base. We can think of the net present value of this deposit spread like an additional asset for banks, the "franchise value of deposits," but one that is never included in any formal balance sheets. When interest rates rise, the deposit spread increases and this franchise value goes up, but not even "mark-to-market" accounting will capture this change.

Takeaways

- Sticky, low beta deposits do **not** hedge interest rate risk
- Bank franchise value arises from both **deposits *and* loans**…
  and has **positive**, not negative, **duration**
- In 2022-3, bank valuations fell due to
  - Securities Losses: **-3.6%** Assets
  - Franchise Losses: **-2.2%** Assets
- **Yet:** sufficient franchise value remains to support the **long-run solvency** of most banks

Conceptual Framework



Bank Balance Sheet

Value creation via
Loan-making
&
Deposit-taking

$NPV \approx 0$

ASSETS	LIABILITIES
Loans (L)	Deposits (D)
Securities	*LT Debt*
	Equity
Tangible Assets (A)	Liabilities and Equity

$$\text{Total Spread} = \overbrace{D \times \left(r_t^* - r_t^D \right)}^{\text{Deposit Spread}} + \overbrace{L \times \left(r_t^L - r_t^* \right)}^{\text{Lending Spread}}$$

$$\text{Franchise Value} = PV\left(\text{Total Spread} - \text{Franchise Costs}\right)$$

Solvency vs Run Risk

- Bank **solvency** as an ongoing concern:

Franchise Value

$$\text{Book Equity} + MTM_{\text{Sec}} + PV\left(S - C\right) > 0$$

Hedge?

- Short-term "**run risk**":

Fire sale losses

$$\text{Book Equity} + MTM_{\text{Sec}} + MTM_{L} - \theta L < 0$$

Jiang et al.

Multiple Equilibria when both are true

Deposit Spreads

- Suppose: $r_t^D = \underbrace{-\alpha^D}_{\text{fixed}} + \underbrace{\beta^D r_t^*}_{\text{floating}}$

Spread ↑ with r

- Deposit spread: $S_t^D = D\left(\alpha^D + \left(1-\beta^D\right) r_t^*\right)$

- Floating value: $PV\left(D\left(1-\beta^D\right) r_t^*\right) = D\left(1-\beta^D\right)$

- Floating rate ⇒ trades at par
- ***Zero*** duration

∴Deposit Beta does not directly impact duration

Deposit Franchise Value

- Deposit Franchise Costs: c^D per deposit

- Deposit Franchise Value:

$$PV\left(D\left(\alpha^D+\left(1-\beta^D\right)r_t^*-c^D\right)\right)=D\left(\frac{\alpha^D-c^D}{r_t^\infty}+\left(1-\beta^D\right)\right)$$

Duration +/- depending on whether fixed spread > franchise costs

General Model: Term Deposits

- Fraction λ in ST accounts, $1-\lambda$ in T-period deposits, yield y^T

$$r_t^D = -\alpha^D + \lambda\beta^D r_t^* + (1-\lambda)\left[\frac{1}{T}\sum_{j=1}^{T}\beta_T^D y_{t-j}^T\right]$$

Term Deposits

$$= -\alpha^D + \left[\lambda\beta^D + (1-\lambda)\beta_T^D\right] r_t^* + (1-\lambda)\beta_T^D\left[\frac{1}{T}\sum_{j=1}^{T}\left(y_{t-j}^T - r_t^*\right)\right]$$

$$= -\alpha^D + \hat{\beta}_r^D\, r_t^* + (1-\lambda)\beta_T^D\, \ell_t^T$$

Swaps

Deposit Franchise Value: Implementation

- Deposit Spread: $S_t^D = D\left(r_t^* - r_t^D\right)$

- Let $d = D/A$: $s_t^D = \frac{S_t^D}{A_t} = \left[\underbrace{d\alpha^D}_{\phi_0^D} + \underbrace{d\left(1-\hat{\beta}_r^D\right)}_{\phi_r^D} r_t^* \underbrace{-d\left(1-\lambda\right)\beta_T^D}_{\phi_T^D} \ell_t^T \right]$

Fixed + Floating + Swaps

- Then Deposit Franchise Value = $A\left[\frac{\phi_0^D - c^D}{r_t^\infty} + \phi_r^D + \phi_T^D PV\left(\ell_t^T\right)\right]$

Total Franchise Value

- Loan rate modeled similarly: $r_t^L = \alpha^L + \hat{\beta}_r^L \; r_t^* + (1-\lambda)\,\beta_T^L \; \ell_t^T$

- Value and sum with deposit franchise value:

$$PV(S-C) = A\left[\frac{\phi_0 - c}{r_t^\infty} + \phi_r + \phi_T PV\left(\ell_t^T\right)\right]$$

≈ 0

where $\phi = \phi^D + \phi^L$

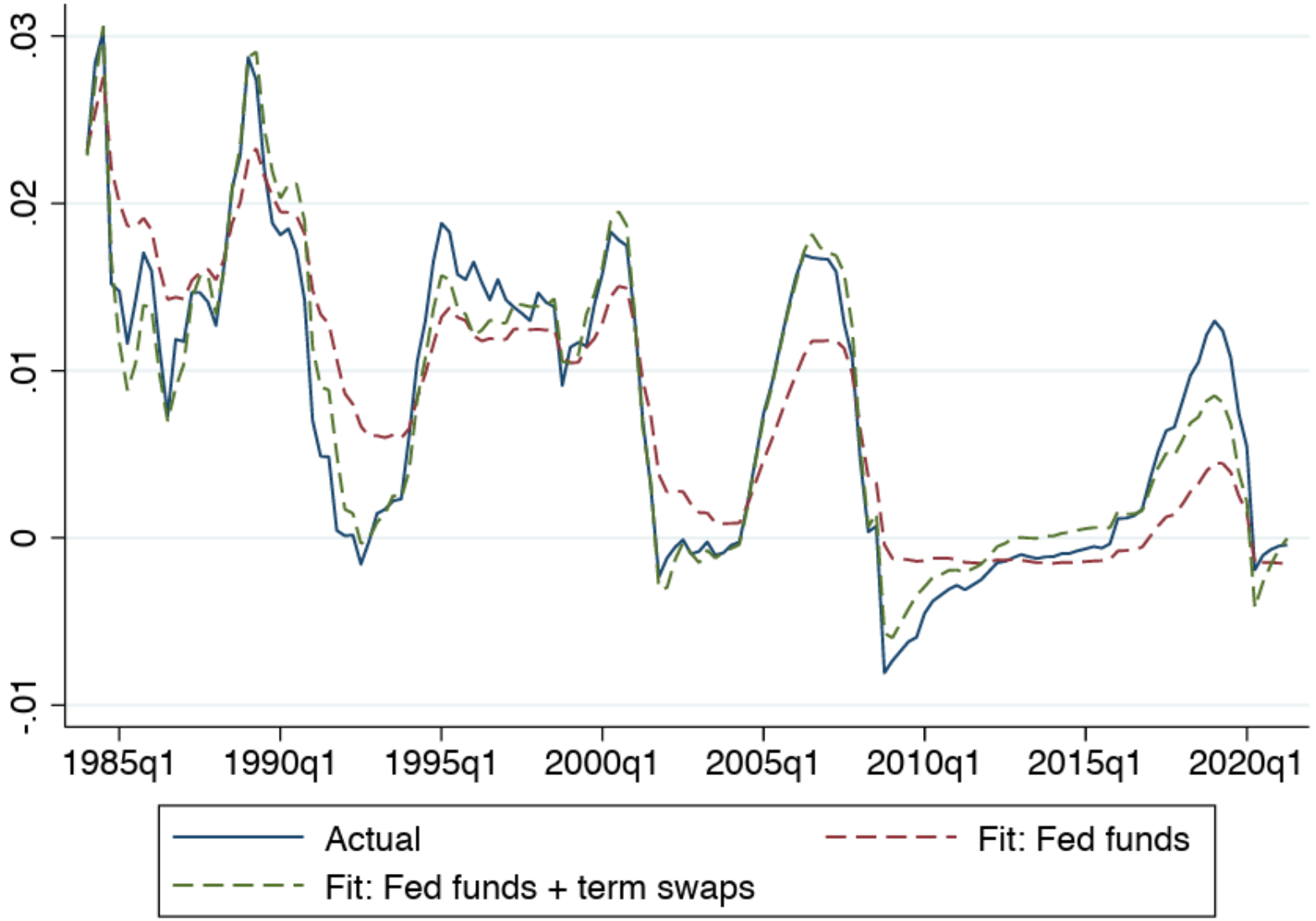
Franchise Value Duration
$\approx$ sign($\phi_0 - c$)


jul
aug
sep
oct
nov
dec
feb
mar
apr
may
jun
jul
aug
sep
oct
nov
dec
124,500
125,000
154,000
95,000
154,200
110,000
89,000
95,054
97,511
99,011
99,216
101,090
101,684
154,568
56,845
110,000
150,000

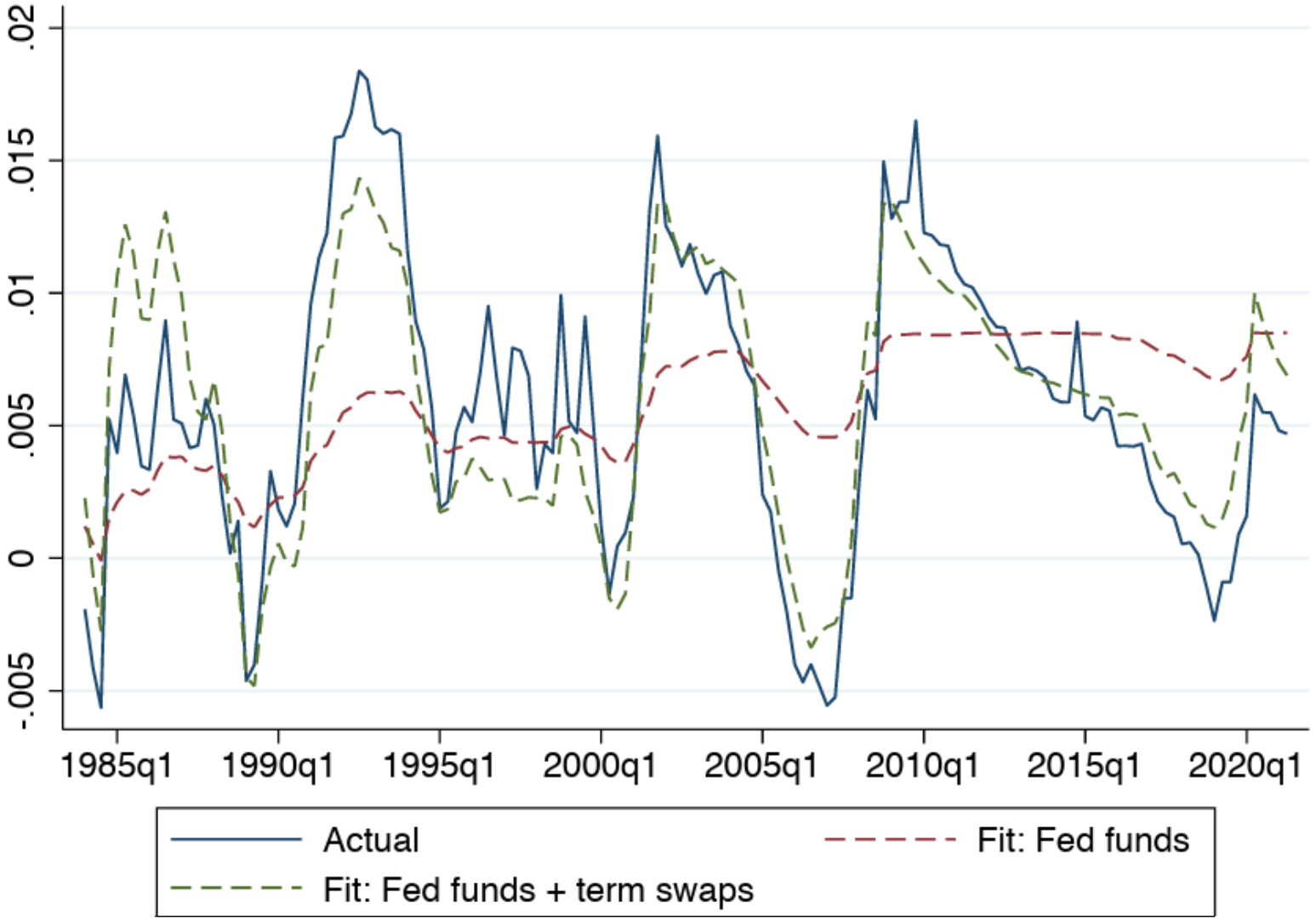
Data

Empirical Analysis

Deposit Spread Fit



Lending Spread Fit



Aggregate Spread Dynamics

	(1) Deposits	(2) Deposits	(3) Lending	(4) Lending	(5) Total
Panel A: Regression in levels					
r_t^*	0.257	0.241	-0.076	-0.055	0.186
	(12.97)	(18.41)	(-3.46)	(-2.53)	(11.93)
ℓ_t^1		-0.238		0.165	-0.073
		(-4.66)		(2.36)	(-1.32)
ℓ_t^5		-0.122		0.197	0.075
		(-4.68)		(4.49)	(1.86)
Intercept	-0.002	0.002	0.009	0.004	0.006
	(-1.56)	(2.27)	(5.85)	(2.96)	(5.94)
R^2	79.16	95.28	17.03	74.07	82.41
Obs.	150	150	150	150	150

Bank Level Estimates (2001-2020)

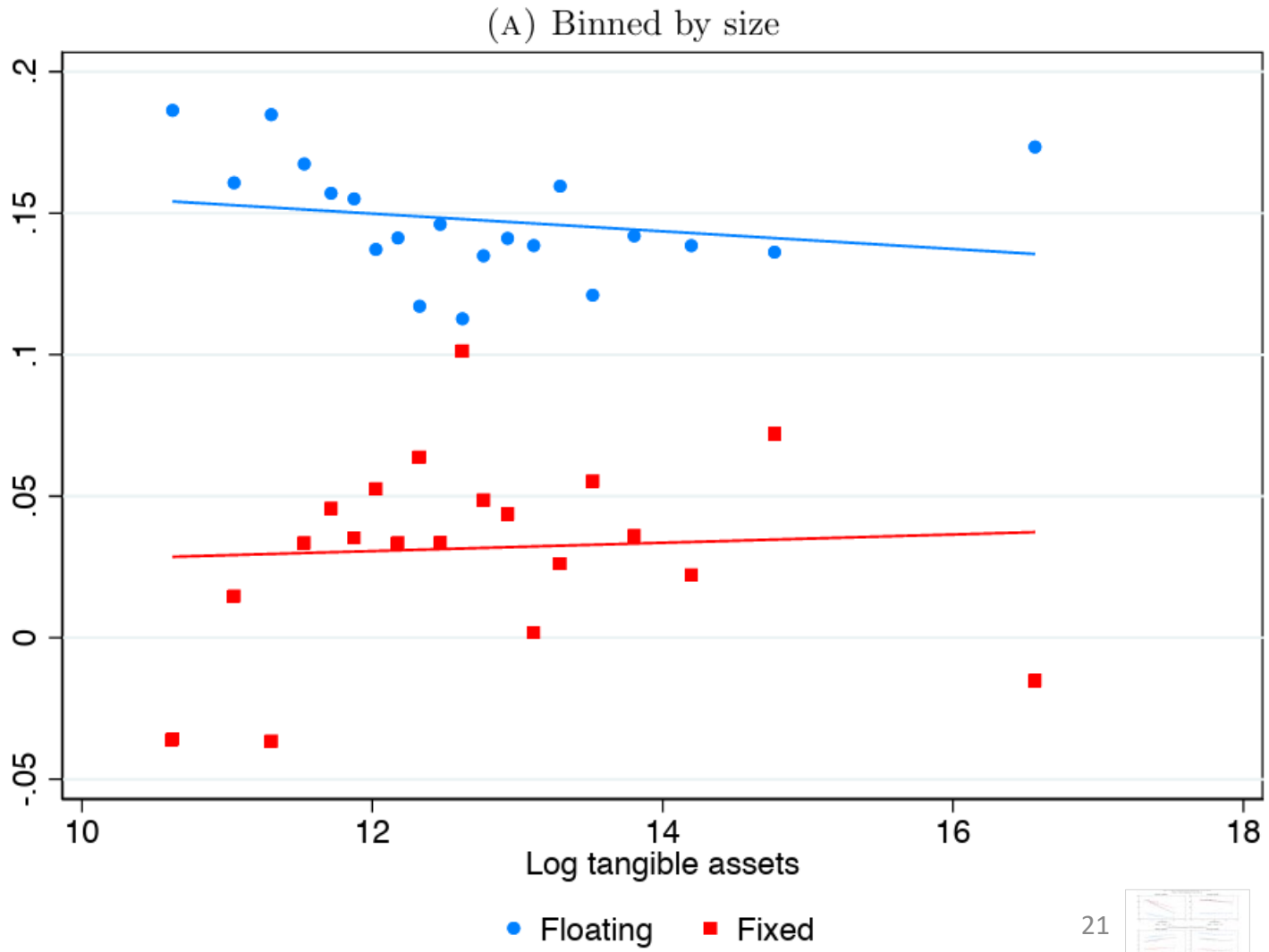
	(1) Intercept ϕ_0	(2) Fed Funds ϕ_r	(3) Term Swap ϕ_1	(4) Term Swap ϕ_5
		Panel A: Regression in levels		
		Deposit spread		
mean	0.002	0.26	-0.31	-0.27
p50	0.003	0.25	-0.31	-0.27
sd	0.003	0.13	0.12	0.12
		Loan spread		
mean	0.018	-0.11	0.13	0.30
p50	0.018	-0.10	0.13	0.31
sd	0.009	0.19	0.21	0.22
		Total spread		
mean	0.020	0.15	-0.18	0.031
p50	0.020	0.15	-0.17	0.034
sd	0.009	0.23	0.22	0.22

Bank Franchise Value Estimates (2021)

	(1) Mean	(2) Median	(3) S.E. of Mean
Panel A: Franchise value inputs			
ϕ_0	0.0206	0.0207	0.0001
ϕ_r	0.1475	0.1449	0.0029
Franchise cost/Assets	0.0198	0.0194	0.0001
Panel B: Franchise value components			
Floating FV	0.1475	0.1449	0.0029
Fixed FV	0.0317	0.0468	0.0055
Term inertia component	0.0022	0.0024	0.0003

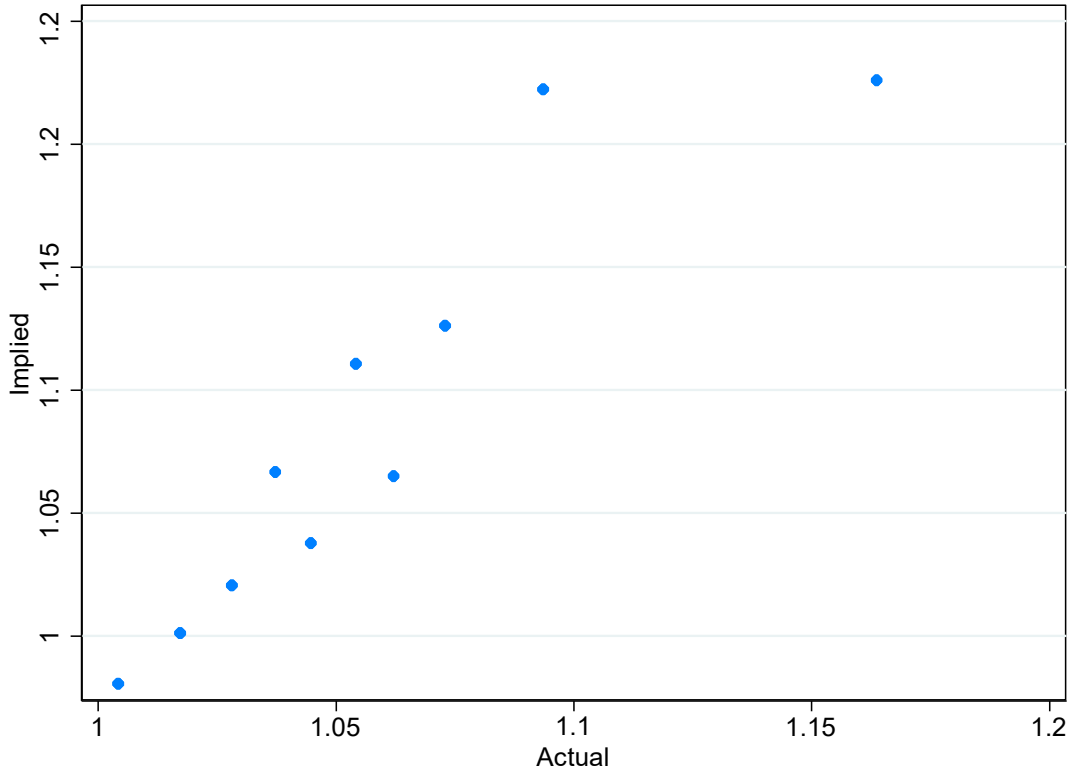
$$PV\left(S-C\right)=A\left[\frac{\phi_0-c}{r_t^{\infty}}+\phi_r+\phi_T PV\left(\ell_t^T\right)\right]$$

Positive Fixed FV ⇒ Positive Duration



Check: Comparison to Market Values (2021)

- Publicly Traded Banks
  - Implied vs
    Actual Asset M/B

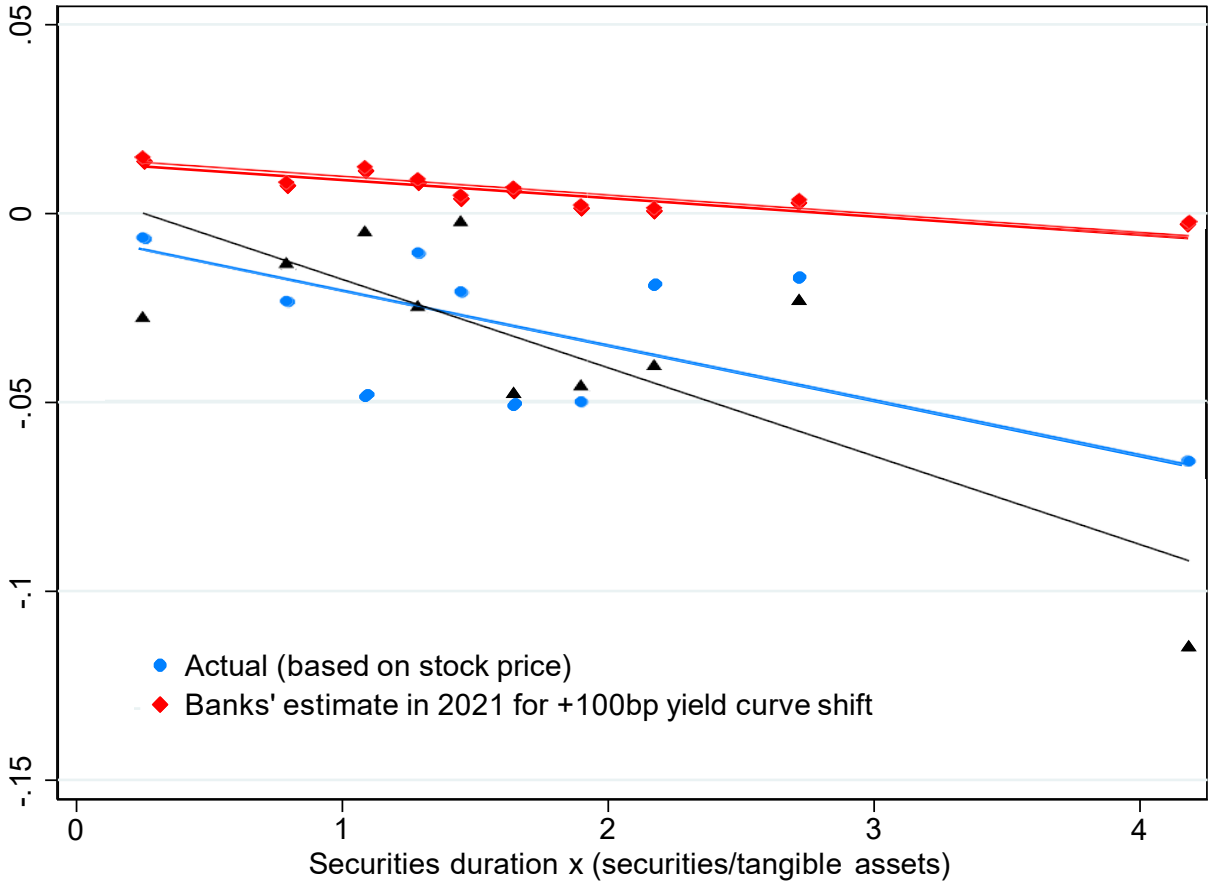


$$PV\left(S-C\right)=A\left[\frac{\phi_0-c}{r_t^{\infty}}+\phi_r+\phi_T PV\left(\ell_t^T\right)\right]$$

$$\text{Asset } M/B=1+\frac{\left(1-\tau\right)\left(MTM_{\text{Sec}}+PV\left(S-C\right)\right)-\tau\,\text{Book Equity}}{A}$$

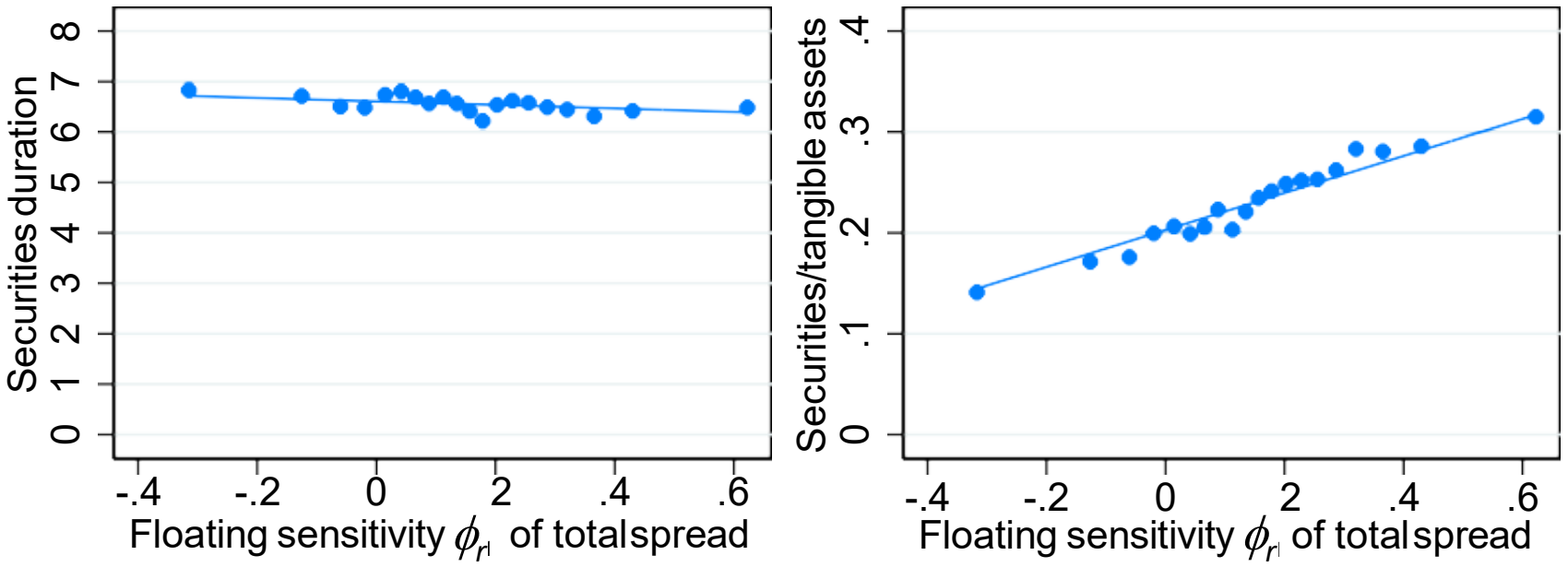
Losses: Bank's View vs Actuals vs Model

- 2021 BHC 10K
  - + market value change for +1% shift in yield curve
  - Despite security duration
- Actuals: 2021-23
  - Bank values fell
  - Security duration ↑ decline
- Our model (public banks)
  - Securities ↓ 4.5%
  - Franchise value ↓ 1.5%



Security Holdings & Duration

(a) Securities duration x (b) Securities share



- Total Securities Duration largely driven by floating spread
- Low deposit beta banks *take on* interest rate risk
  - Yet they don't report that risk
- Why?

Motivation 1: Deposit Runoff?

- Regulatory guidance
  - Treat non-maturing deposits based on "avg. life" assumption
  - E.g. 5 or 10-year runoff
- Floating Franchise Value:

$$\phi_r \left(\frac{r}{r+\delta} \right)$$

where δ is the "runoff rate"

- Key assumption in DSS, DSSW 2023

FEDERAL DEPOSIT INSURANCE CORPORATION

Scenario	PV of Deposits at 20% Decay Rate	PV of Deposits at 50% Decay Rate
Up 300 bps	$83	$93
Base Case	$89	$96
Down 100 bps	$90	$97

Notes: Book Value = $100. Beta in Up 300 bps scenario: 25%. Beta used in Down 100 bps scenario: 75%. Dollar figures in thousands.

$\phi_r \approx 16\% \Rightarrow$ Hedge: 20% in 5yr securities

But this calculation is fundamentally incorrect (no *net* runoff)

Motivation 2: Cash Flow (NIM) Hedging?

- To hedge cash flow exposure to interest rates:

⇒ Swap floating-rate securities for fixed-rate securities

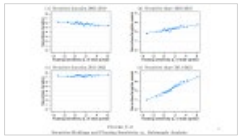
- With 10% equity and $\phi_r \approx 15\%$

⇒ Hedge with 25% long-term fixed-rate securities

- Suppose all security holdings are floating rate

$$CF = (1-d)r^* + (s-c)$$
$$= \underbrace{(1-d+\phi_r)}_{\text{Total Exposure}} r^* + (\phi_0 - c)$$

Matches population mean (≈ 26%) …
But also *increases* bank duration risk (BPS 2015)

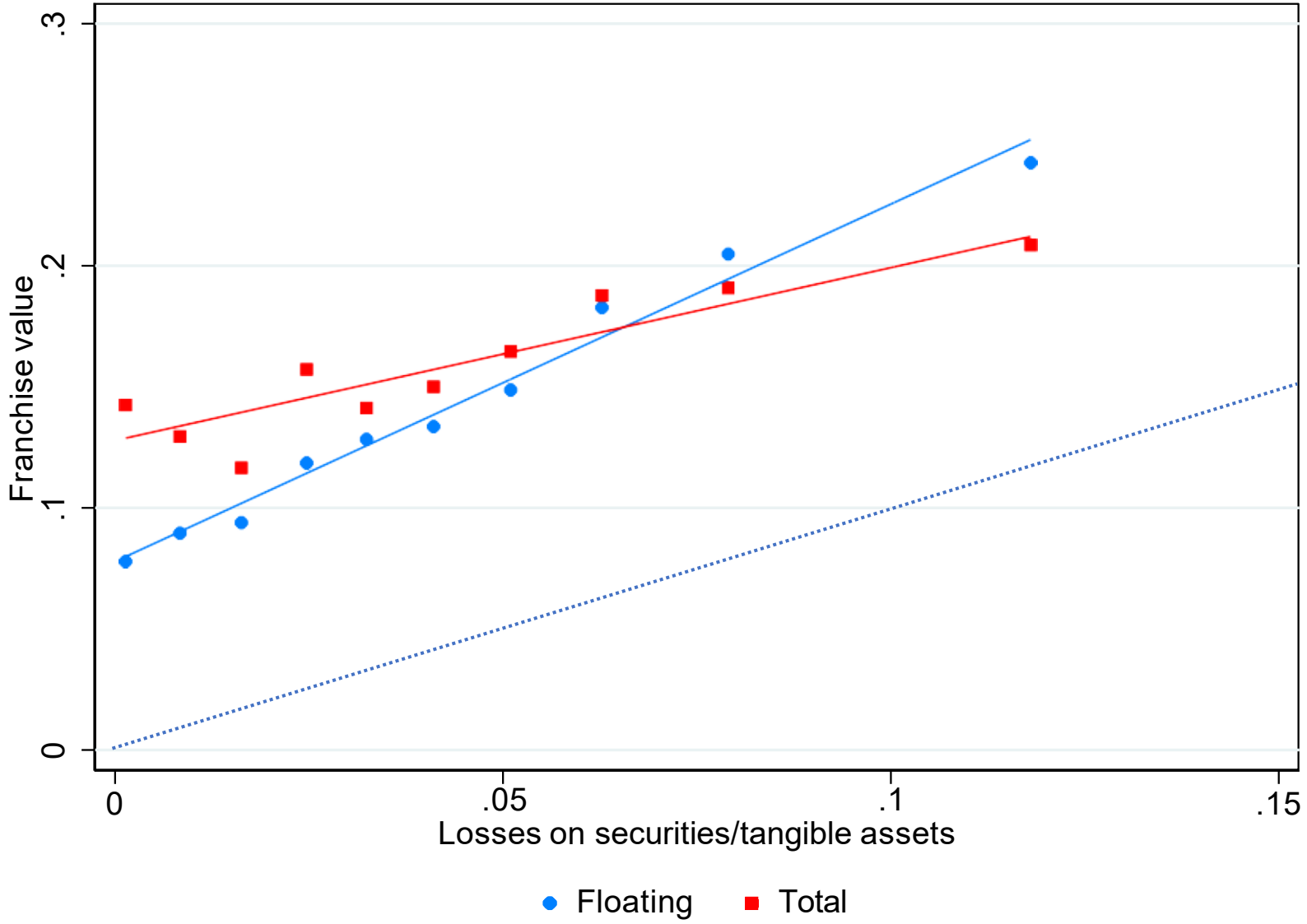


Remaining Franchise Value Exceeds Losses

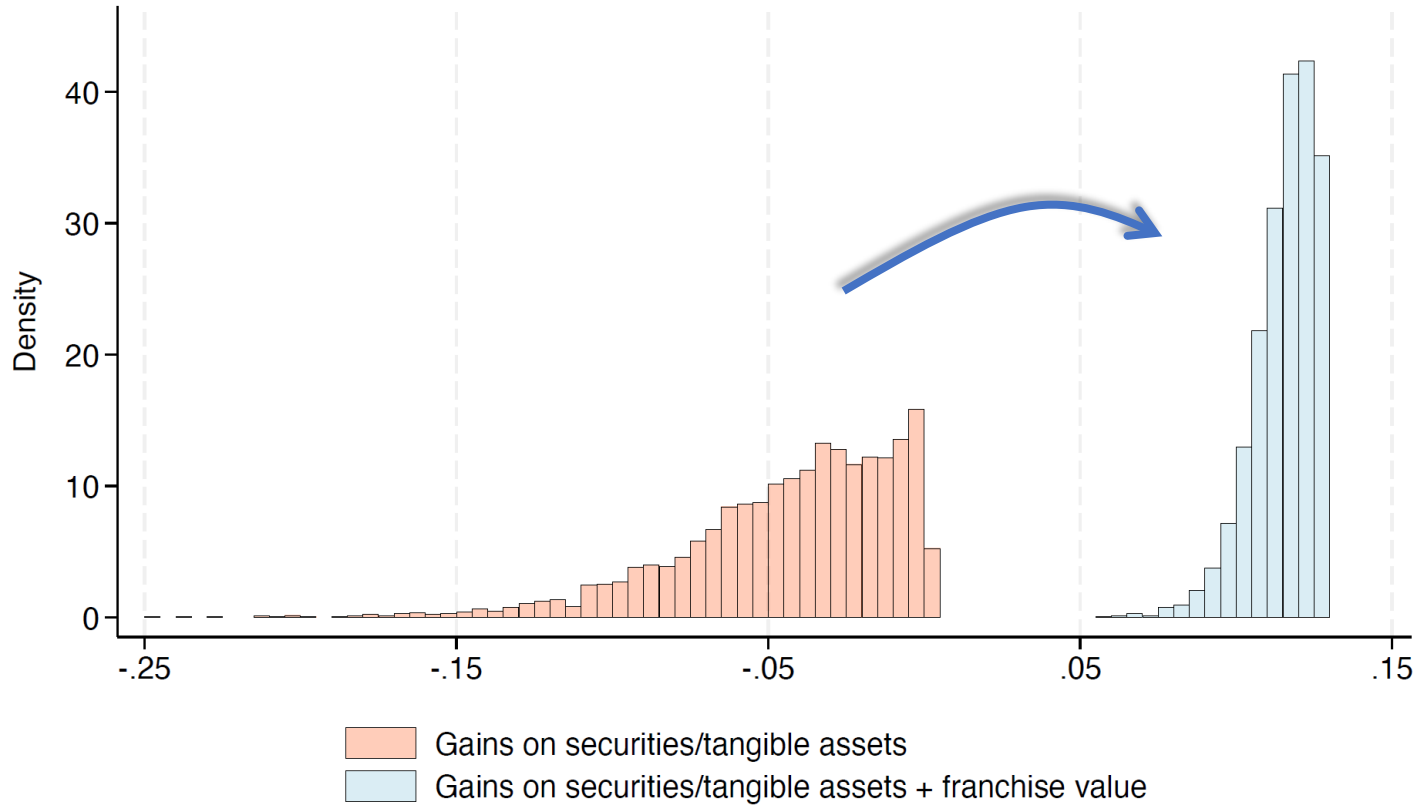
- Banks with higher security losses

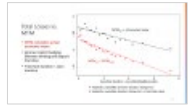
  … tended to have higher floating spreads (low deposit betas)

  … and thus have similar remaining franchise value



Most banks remain solvent as ongoing concerns





Conclusions

- Banks with sticky, low beta deposits hold more long-term securities, which
  - stabilizes NIM
  - improves *regulatory* interest rate risk (EVE)
  - But increases ***actual*** duration
- Deposit + Lending Franchise
  - Has positive duration (but << loan duration)
- In 2022-3, bank valuations fell due to
  - Securities Losses: **-3.6%** Assets
  - Franchise Losses: **-2.2%** Assets
- Most banks retain sufficient franchise value to support **long-run solvency**
  - Significant risk of *structural change*
  - Should push to restore lost *economic* capital