Interest Rate Risk in Banking

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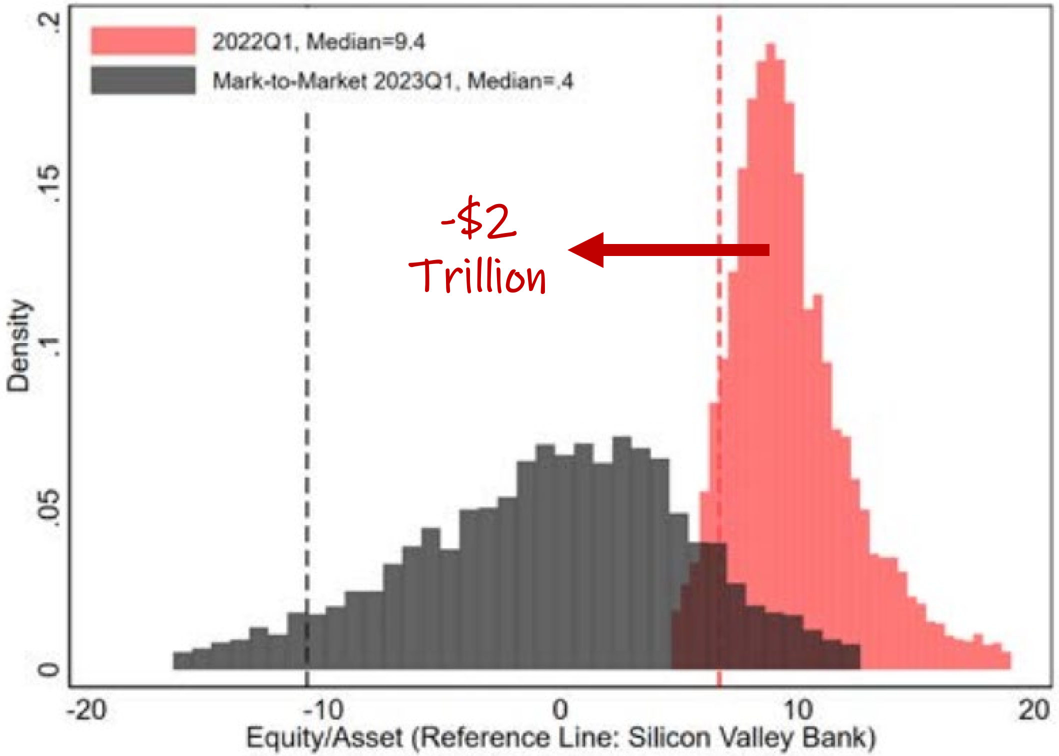
Asset Value vs Franchise Value?

- JMPS (March 2023)



Correct! But incomplete ...

- DSS (March 2023)

<u>How to value the deposit franchise</u>

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.

Incorrect! ... and commonly misinterpreted ...

Common “Intuition”…
Sticky, low beta deposits $\Rightarrow$ Dur < 0

E.g. Metrick (2024), Luck et al. (2023)…

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: **-4.5%** Assets
  - Franchise Losses: **-1.5%** Assets
- 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 and Run Risk

- Bank solvency as an ongoing concern:

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

- Short-term run risk:

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

Jiang et al.

Multiple Equilibria when both hold

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 – λ in T-period deposits, yield y^T

$$r_t^D = -\alpha^D + \lambda\beta_1^D r_t^* + (1-\lambda)\left[\frac{1}{T}\sum_{j=1}^{T}\beta_T^D y_{t-j}^T\right]$$

$$= -\alpha^D + \left[\lambda\beta_1^D + (1-\lambda)\beta_T^D\right] r_t^* + (1-\lambda)\beta_T^D\left[\frac{1}{T}\sum_{j=1}^{T}\left(y_{t-j}^T - r_t^*\right)\right]$$

$$= -\alpha^D + \hat{\beta}_1^D\, r_t^* + (1-\lambda)\beta_T^D\,\ell_t^T$$

Deposit Franchise Value: Implementation

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

- Let $d = D/A$: $$s_t^D = \frac{S_t^D}{A_t} = \left[\underbrace{d\alpha^D}_{\phi_0^D} + \underbrace{d\left(1-\hat{\beta}_1^D\right)}_{\phi_1^D} r_t^* \underbrace{-d\left(1-\lambda\right)\beta_T^D}_{\phi_T^D} \ell_t^T\right]$$

- Then Deposit Franchise Value = $A\left[\frac{\phi_0^D - c^D}{r_t^\infty} + \phi_1^D + \phi_T^D PV\left(\ell_t^T\right)\right]$

Total Franchise Value

- Loan rate modeled similarly: $r_t^L = \alpha^L + \hat{\beta}_1^L \, r_t^* + (1 - \lambda) \beta_T^L \, \ell_t^T$

- Value and sum with deposit franchise value:

$$PV(S - C) = A\left[\frac{\phi_0 - c}{r_t^\infty} + \phi_1 + \underbrace{\phi_T PV\left(\ell_t^T\right)}_{\approx 0}\right]$$

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

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


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
154,568
56,845
110,000
150,000

Data

Data

- U.S. Call Reports. Data from 1984Q1 to 2021Q2
    - We exclude banks that have the majority of their deposit liabilities in foreign offices.
    - We also exclude banks that obtain more than 30% of their interest income from credit cards.
    - We exclude the bottom 1% by assets.
- For banks that are publicly traded, we match the Call Report bank data to equity prices obtained from CRSP.

Deposit and Loan Spreads

- Deposits $r^D = \dfrac{\text{Interest expense on deposits}}{D}$
- Loans: $r^L = \dfrac{\text{Interest income on loans}}{L} - \rho$

  where $\rho = \dfrac{\text{Credit Loss Provisions}}{L} \times \dfrac{Q(Loss)}{P(Loss)}$

Berndt et al. (2018)

- Spreads: $s^D = \dfrac{D}{A}\left(r^* - r^D\right)$ and $s^L = \dfrac{L}{A}\left(r^L - r^*\right)$

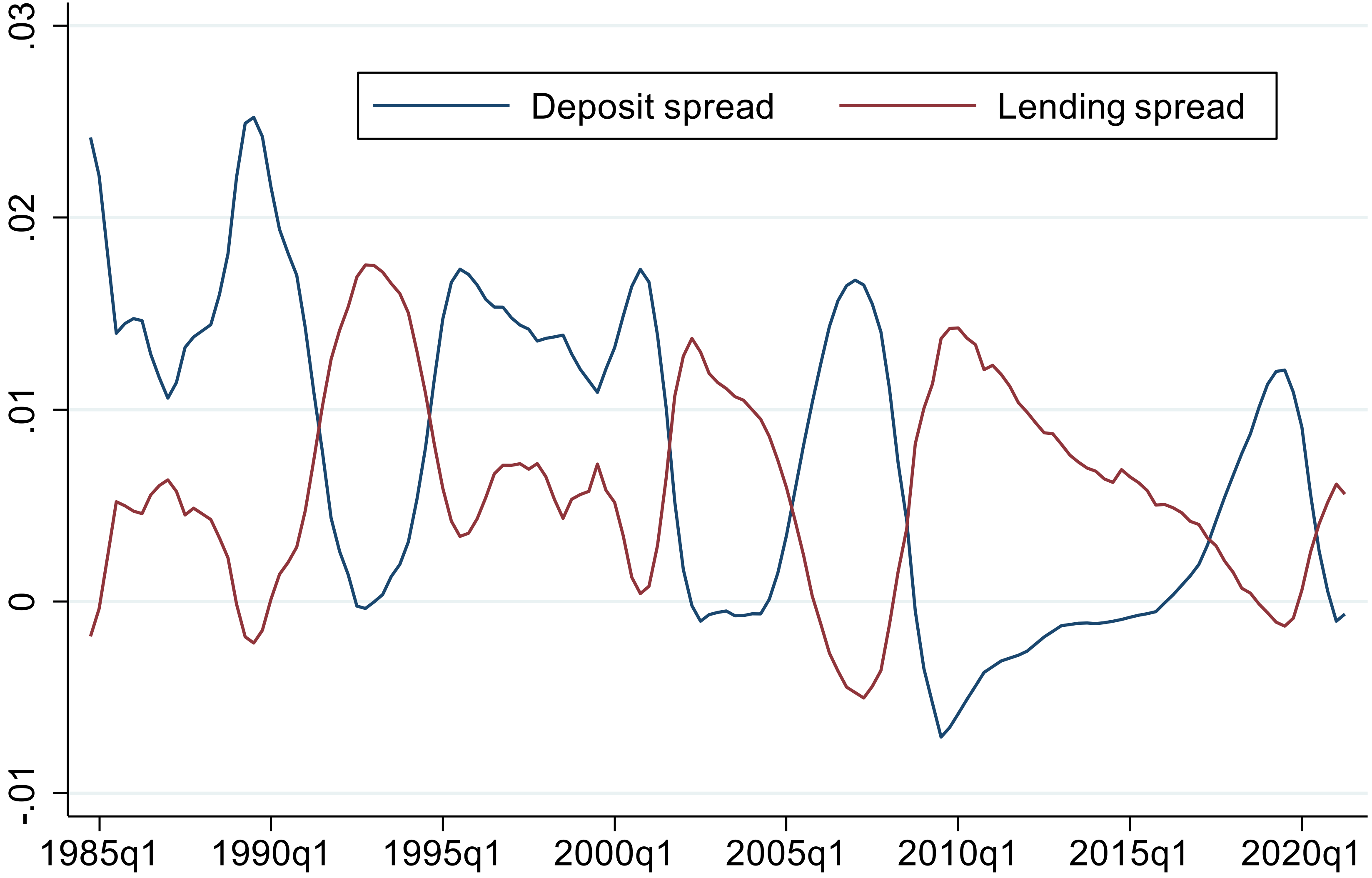
Franchise Cost

- Conceptually, measures net operating costs associated with running the lending and deposit-taking business.
  - Tangible Non-Interest Expense
    - salaries
    - expenses on premises
    - other non-interest expenses (tech, marketing)
  - Minus: Deposit service charges
- Adjustment 1: Exclude expenses from other business income (such as brokerage, etc.)*
- Adjustment 2: Deduct fee income from credit cards

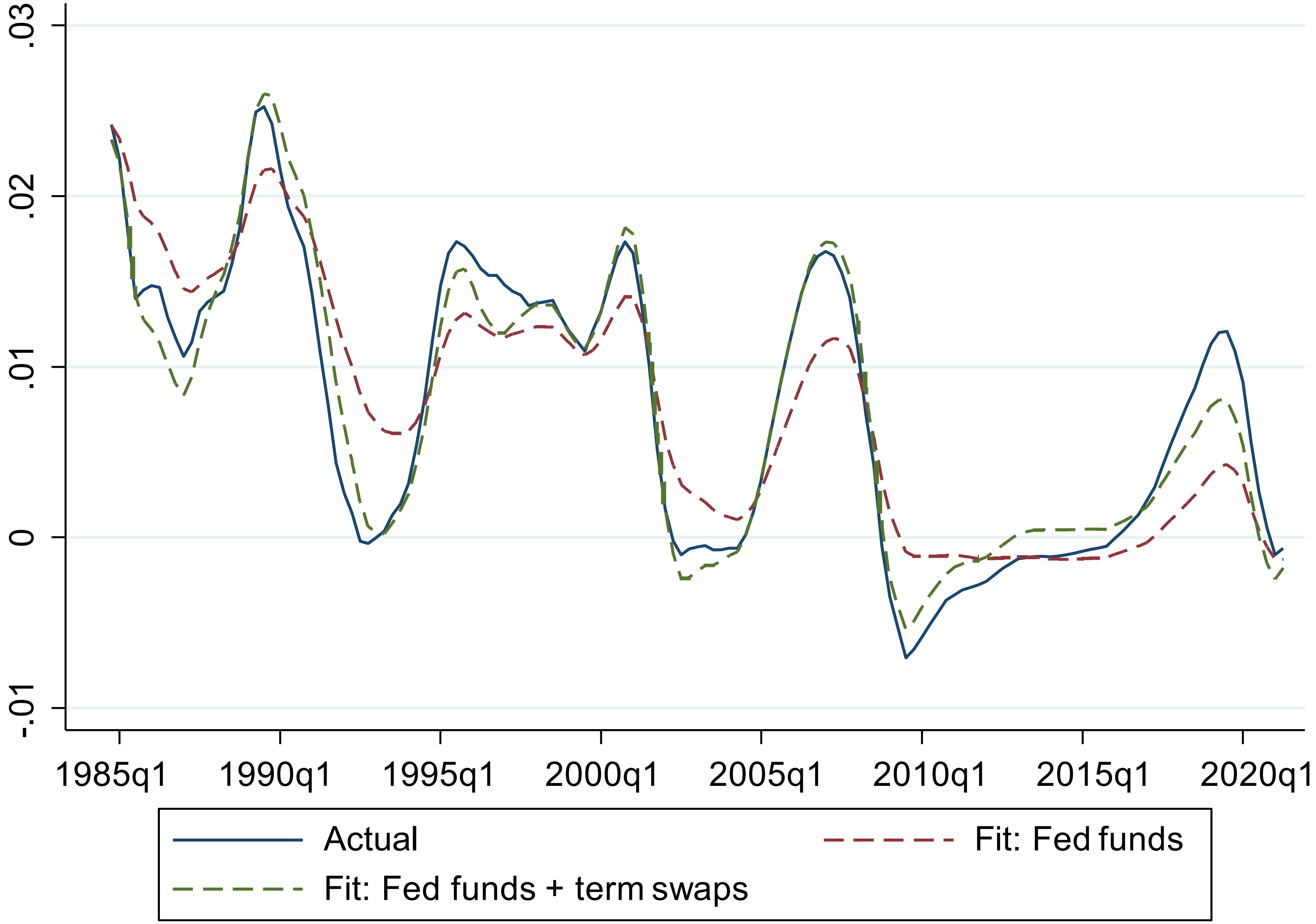
* For robustness we also exclude banks with significant OBI

Empirical Analysis

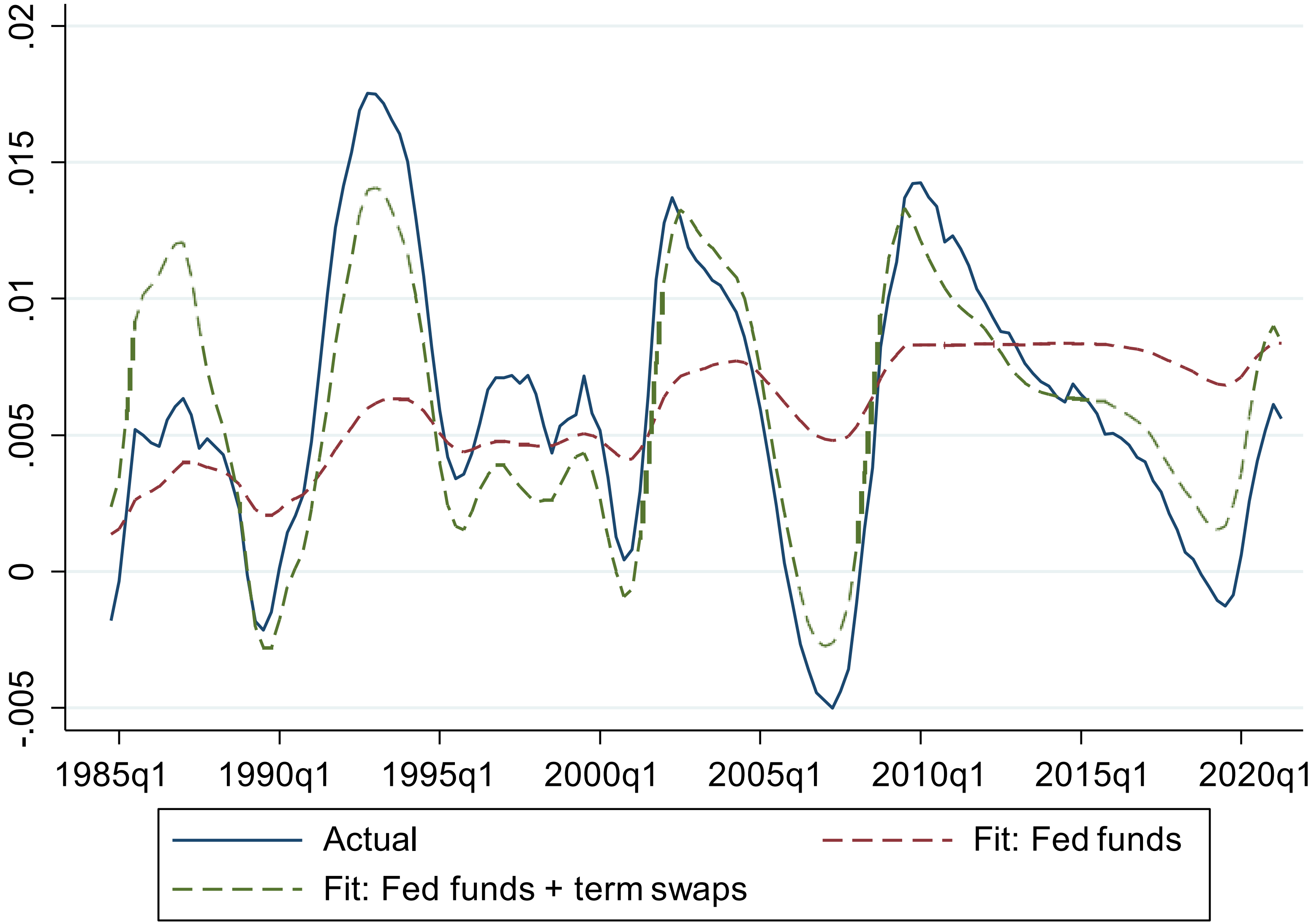
Aggregate Spreads



Aggregate Deposit Spread Fit



Aggregate Lending Spread Fit



Aggregate Spread Dynamics

	(1) Deposits	(2) Deposits	(3) Lending	(4) Lending	(5) Total
Panel A: Regression in levels					
r_t^*	0.251	0.239	-0.069	-0.053	0.186
	(11.88)	(17.22)	(-3.03)	(-2.41)	(11.33)
ℓ_t^2		-0.195		0.159	-0.036
		(-3.80)		(2.44)	(-0.60)
ℓ_t^5		-0.069		0.147	0.078
		(-1.73)		(2.61)	(1.40)
Intercept	-0.001	0.002	0.008	0.004	0.006
	(-1.34)	(1.83)	(5.69)	(3.09)	(5.61)
R^2	79.18	95.10	14.86	75.41	83.16
Obs.	147	147	147	147	147

Bank Level Estimates (2001-2020)

	(1)	(2)	(3)	(4)
	ϕ_0 fixed	ϕ_1 float	ϕ_2 term	ϕ_5 term
Panel A: Regression in levels				
Deposit spread				
mean	0.0019	0.25	-0.23	-0.22
p50	0.0023	0.25	-0.23	-0.22
s.d.	0.0029	0.13	0.096	0.13
Loan spread				
mean	0.018	-0.10	0.090	0.28
p50	0.018	-0.098	0.093	0.29
s.d.	0.0089	0.18	0.20	0.22
Total spread				
mean	0.020	0.15	-0.14	0.068
p50	0.020	0.15	-0.13	0.070
s.d.	0.0089	0.22	0.20	0.22

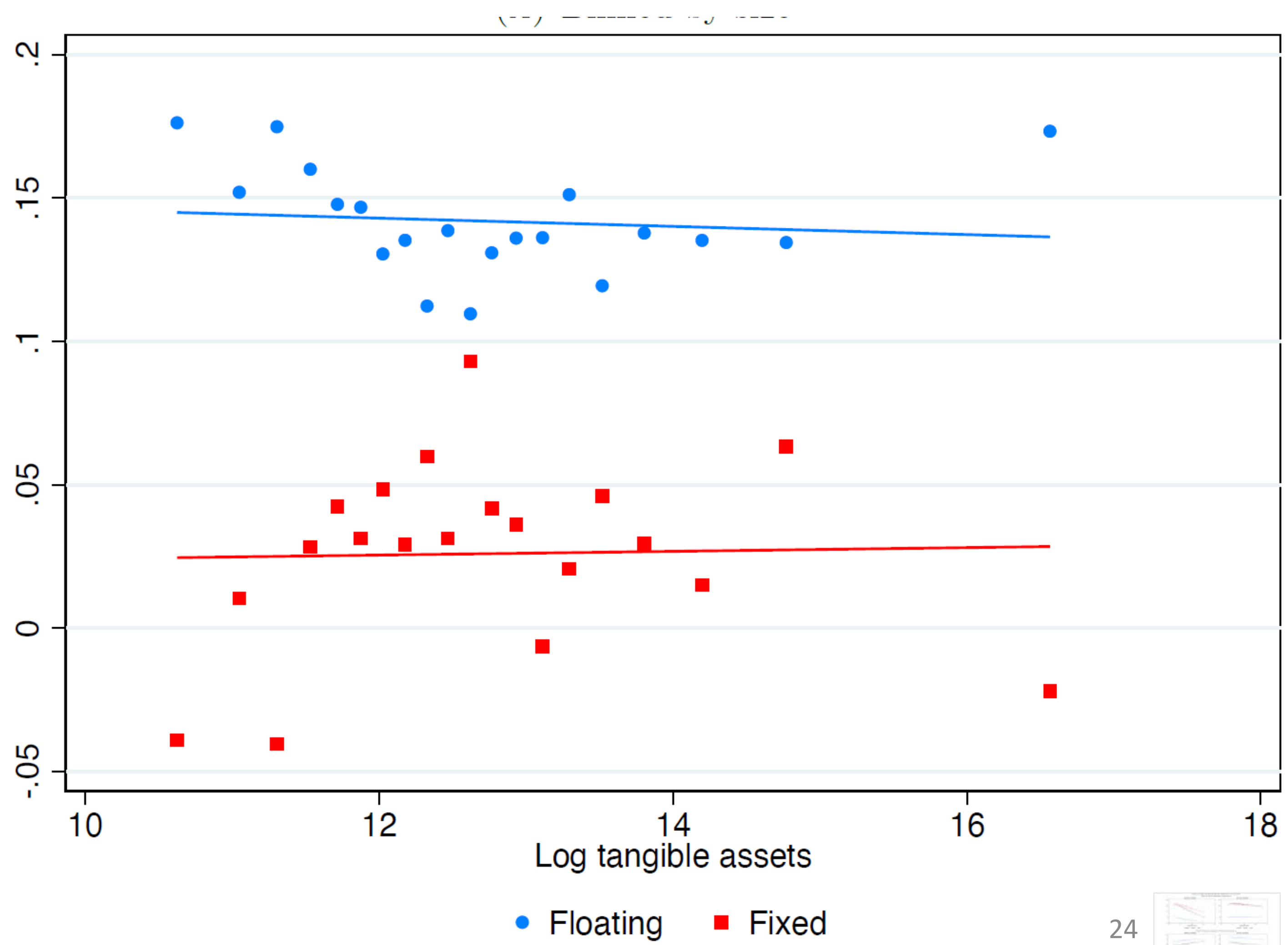
Non-linearities:

Table 4: Total spread

	Total spread		
	(1)	(2)	(3)
r_t^*	0.166***	0.268***	0.168***
	(0.009)	(0.015)	(0.009)
r_t^{*2}		−2.069***	
		(0.145)	
$\max(\Delta r_t^*, 0)$			0.193***
			(0.018)
$\min(\Delta r_t^*, 0)$			0.068***
			(0.004)
l_t^2	−0.132***	−0.150***	−0.094***
	(0.004)	(0.003)	(0.006)
l_t^5	0.077***	0.080***	0.056***
	(0.008)	(0.008)	(0.007)
Bank FE	Yes	Yes	Yes
Obs.	380,376	380,376	380,376
No. of banks	4,834	4,834	4,834
Adj-R^2	0.8873	0.8874	0.8873

Bank Franchise Value Estimates (2021)

	(1) Mean	(2) Median	(3) S.E. of Mean
Panel A: Franchise value inputs			
ϕ_0	0.0205	0.0206	0.0001
ϕ_1	0.1419	0.1396	0.0028
Franchise cost/Assets	0.0198	0.0194	0.0001
Panel B: Franchise value components			
Floating FV	0.1419	0.1396	0.0028
Fixed FV	0.0259	0.0405	0.0055

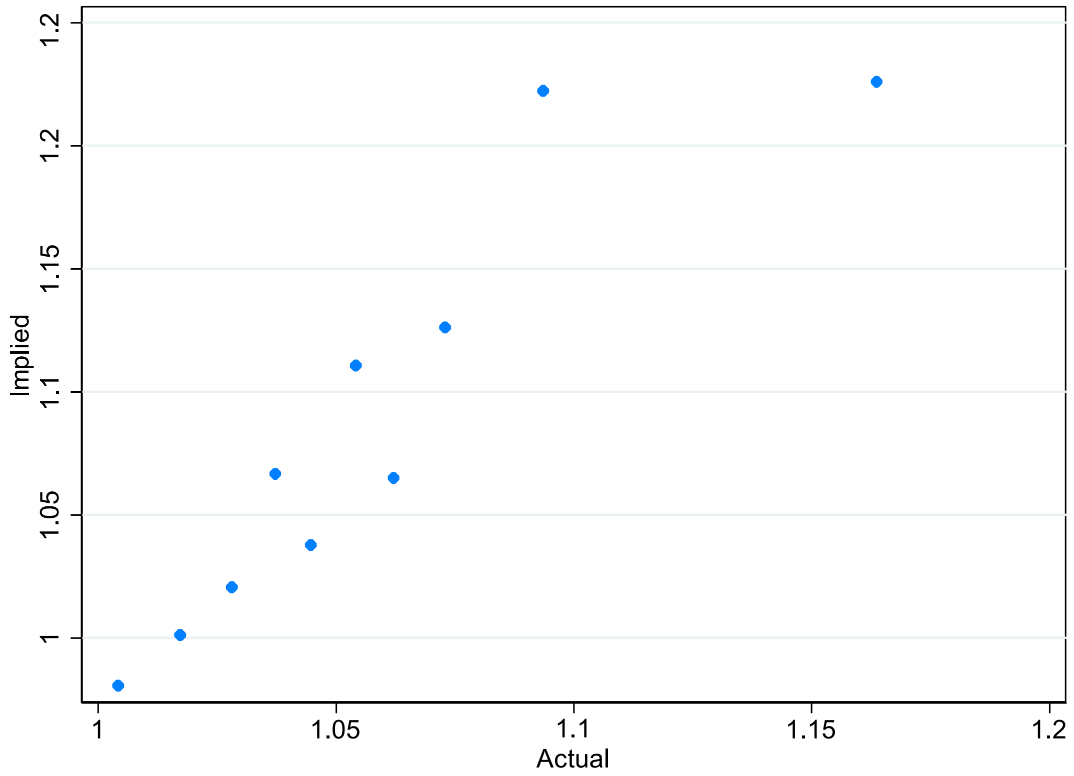


$$PV\left(S-C\right)=A\left[\frac{\phi_0-c}{r_t^{\infty}}+\phi_1+\phi_T PV\left(\ell_t^T\right)\right]$$

Positive Fixed FV ⇒ Positive Duration

Comparison to Market Values (2021)

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

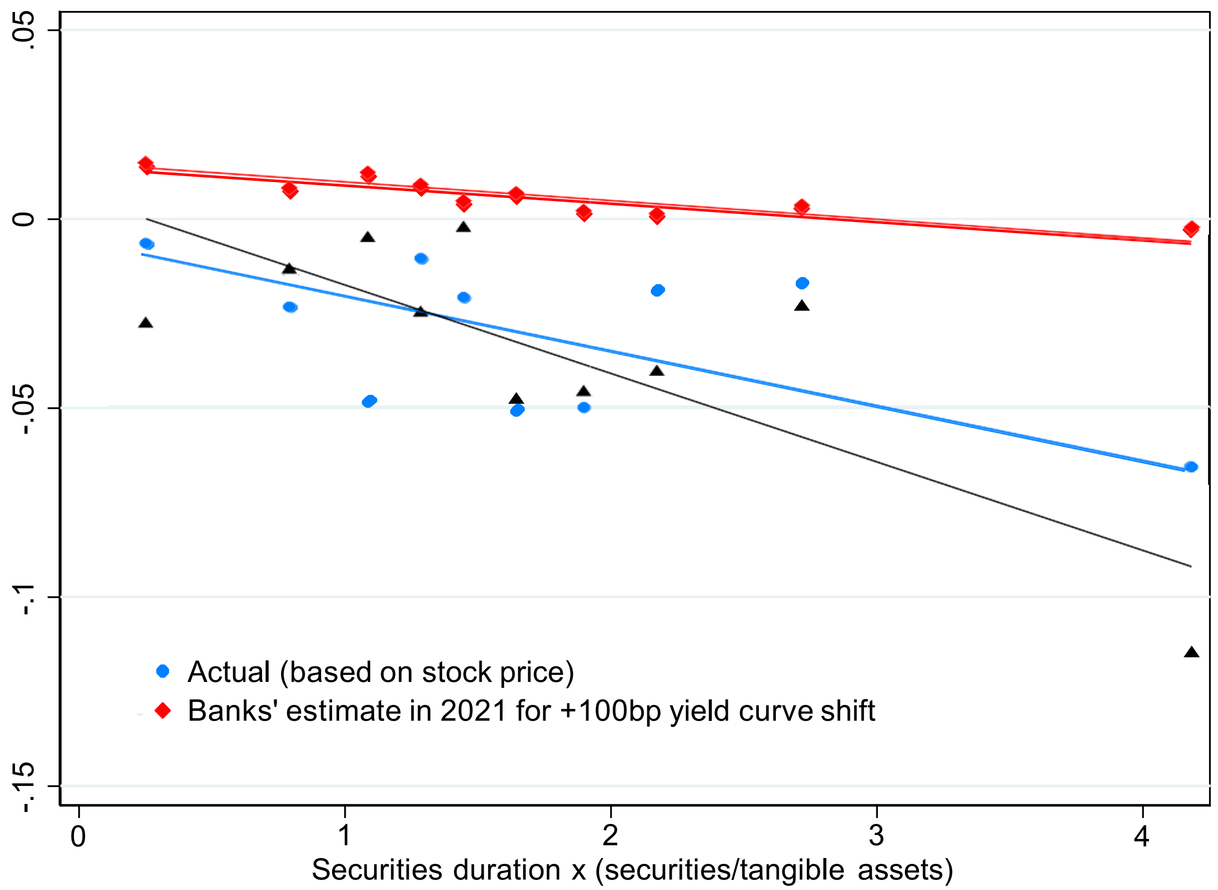


$$PV\left(S-C\right)=A\left[\frac{\phi_0-c}{r_t^{\infty}}+\phi_1+\phi_T PV\left(\ell_t^T\right)\right]$$

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

Losses: Bank's View vs Actuals vs Model

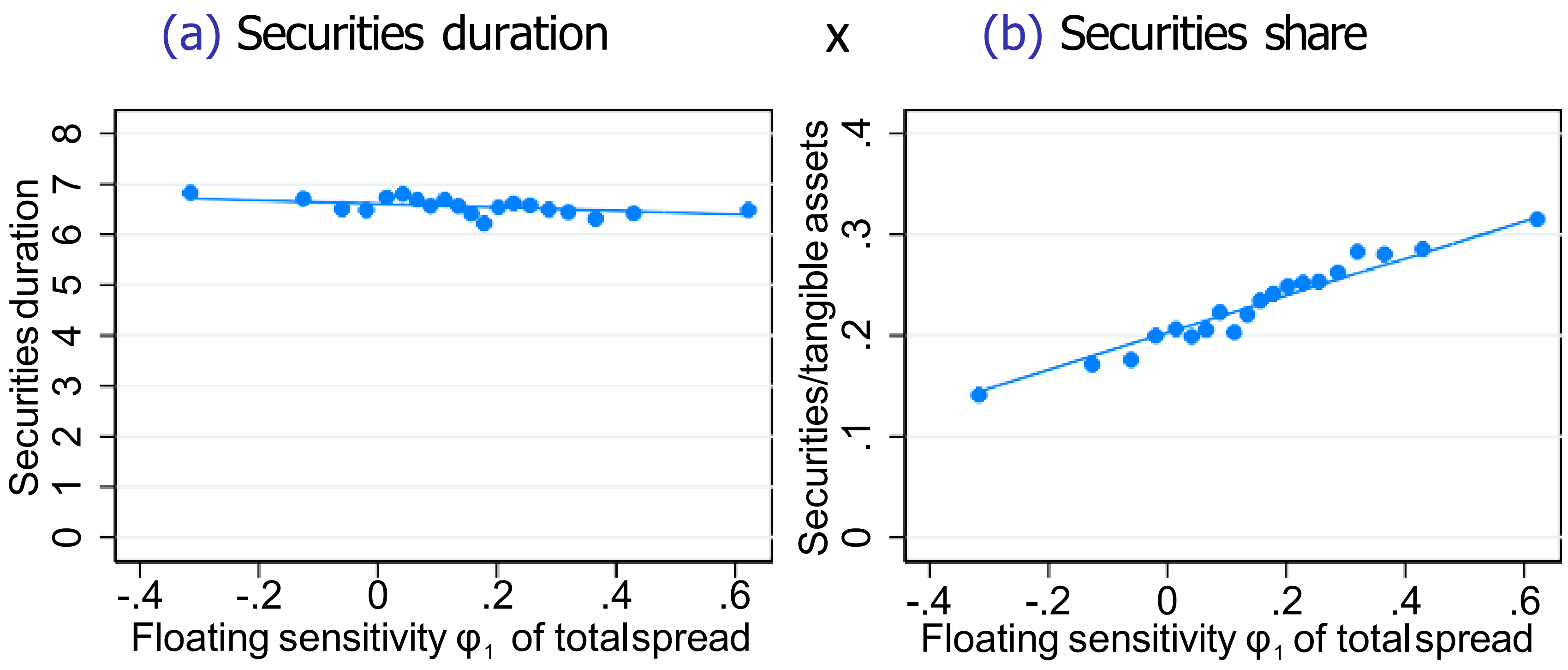
- 2021 BHC 10K
    - + market value change for +1% shift in yield curve
    - Despite security duration
- Actuals: 2021-23
    - Bank values fell
    - Security duration ↑ decline
- Our model (all banks)
    - Securities ↓ 4-5%
    - Franchise value ↓ 1-1.5%



Determinants of Total Security Duration

	(1)	(2)	(3)
Fixed FV component	-0.636	-0.139	-0.141
	(-6.12)	(-1.55)	(-1.56)
Floating FV component		3.151	3.144
		(15.99)	(15.95)
Log tangible assets			-0.052
			(-2.74)
Intercept	2.177	1.713	2.373
	(70.23)	(51.93)	(9.64)
R^2	0.01	0.09	0.09
Obs.	3772	3772	3772

Security Holdings & Duration



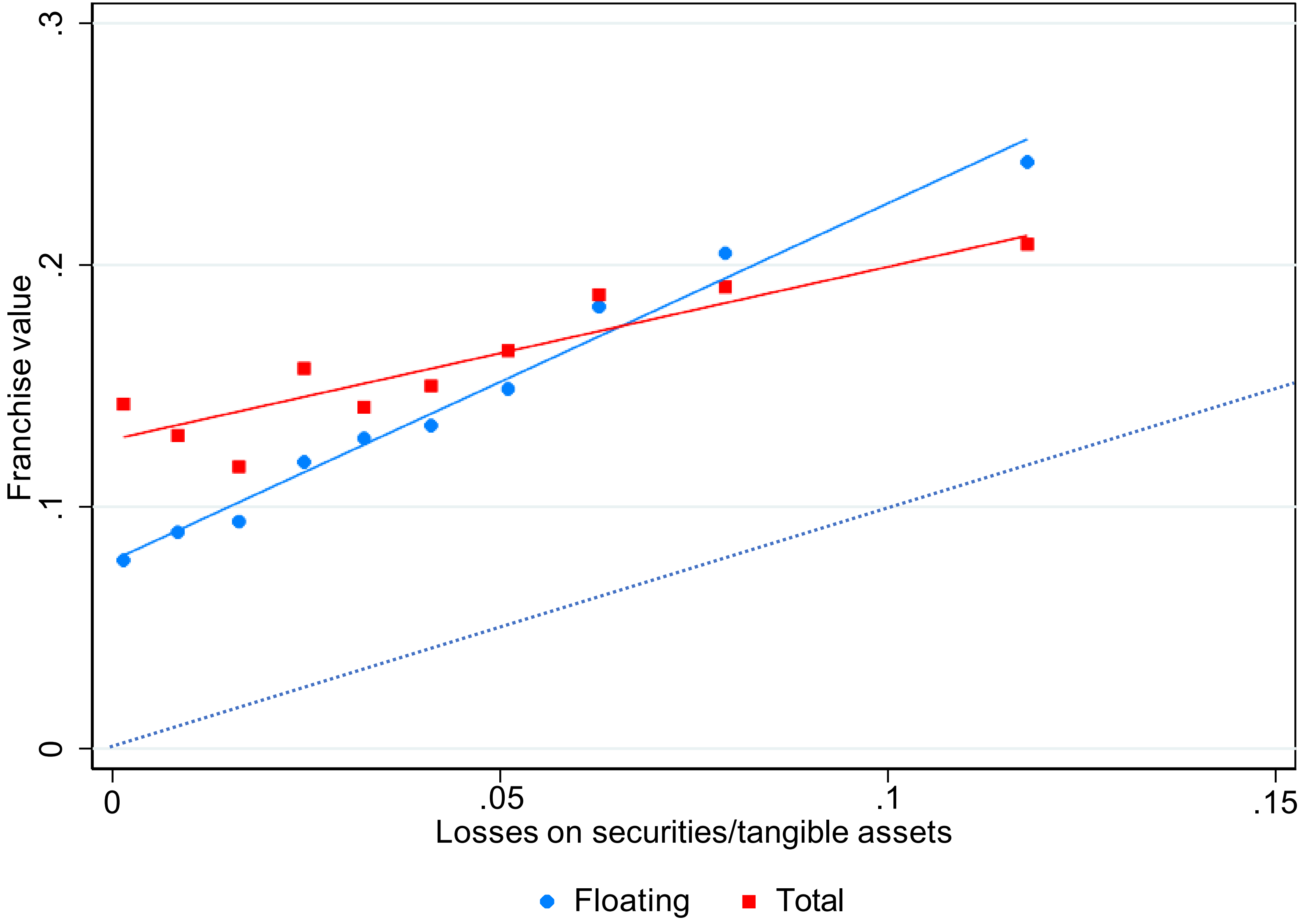
- Total Securities Duration largely driven by floating spread
- Low deposit beta banks *take on* interest rate risk
- Why?
  - Deposit “bucketing”?
  - NIM hedging?

Remaining Franchise Value Exceeds Losses

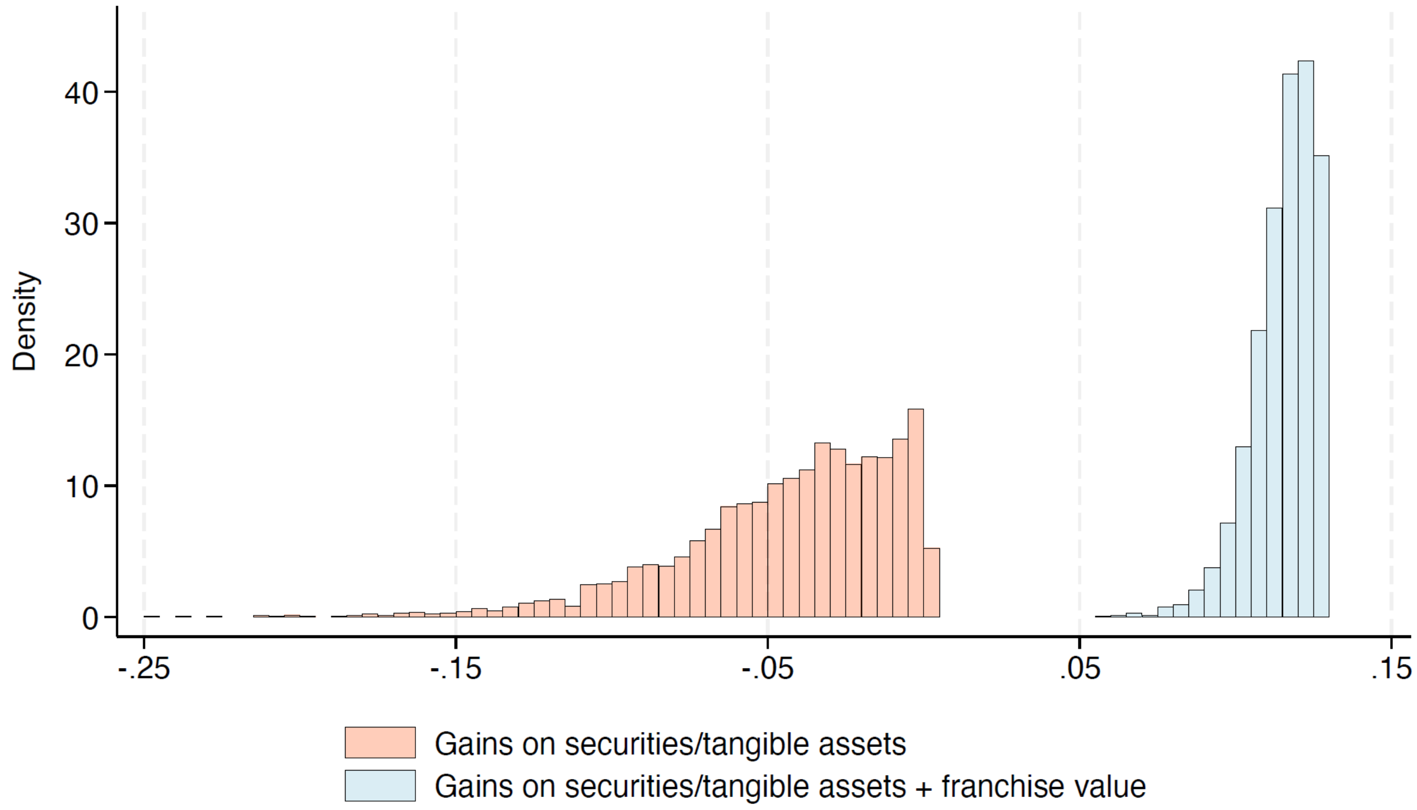
- Banks with higher security losses

  … 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: **-4.5%** Assets
  - Franchise Losses: **-1.5%** Assets

Appendix

Motivation 1: Deposit Runoff?

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

$$\phi_1\left(\frac{r}{r+\delta}\right)$$

where δ is the "runoff rate"

- Floating Duration

$$Dur\left[\phi_1\left(\frac{r}{r+\delta}\right)\right] = -\frac{\delta/r}{r+\delta}$$

  - E.g. r = 3%, δ = 9% $\Rightarrow$ **-25 yrs**
- With $\phi_1 \approx$ 16%
  - 1% rise in rates
    $\Rightarrow$ 1% increase Bank Value (Assets)

Hedge: 20% securities x 5 yr duration …

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

FDIC Guidance for EVE

Decay Rate Example

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

- Reflects the impact of deposit decay rates and average life assumptions on EVE results
- Illustrates a sensitivity analysis of a critical assumption
- Is the NMD deposit premium reasonable given customer behavior and deposit lives?

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

FEDERAL DEPOSIT INSURANCE CORPORATION

DSS (2023), DSSW (2023)

"sticky").[3] Based on the FDIC study, a reasonable estimate is that they remain in the bank for $T = 10$ years on average. The value of the deposit franchise in this case is equal to the value calculated above minus the present discounted terminal value beyond T years:

$$DF = DF^{\infty} - \frac{DF^{\infty}}{(1+r^p)^T} = D \times \left(1 - \beta - {}^{c}/_{r^p}\right) \times \left[1 - \frac{1}{(1+r^p)^T}\right].$$

Motivation 2: Cash Flow (NIM) Hedging?

- Suppose all security holdings are floating rate

$$CF = (1-d)r^* + (s-c)$$
$$= \underbrace{(1-d+\phi_1)}_{\text{Total Exposure}} r^* + (\phi_0 - c)$$

- To hedge cash flow exposure to interest rates:

$\Rightarrow$ Swap floating-rate securities for fixed-rate securities

- With 10% equity and $\phi_1 \approx 15\%$

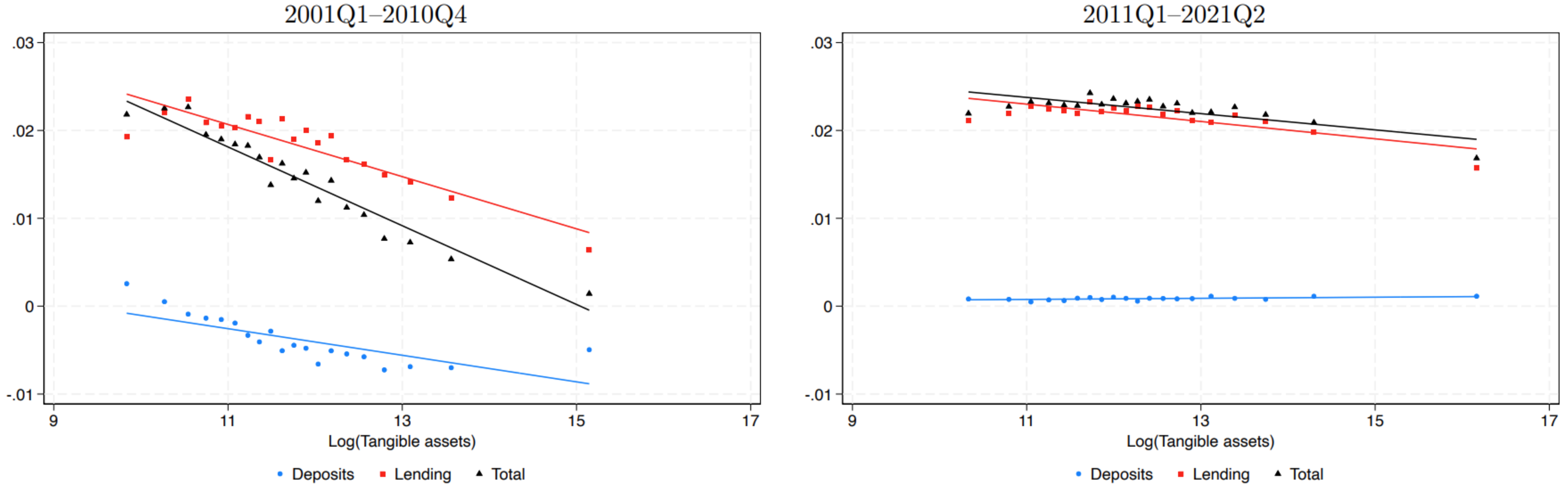
$\Rightarrow$ Hedge with 25% long-term fixed-rate securities

Matches population mean ($\approx$ 26%) …

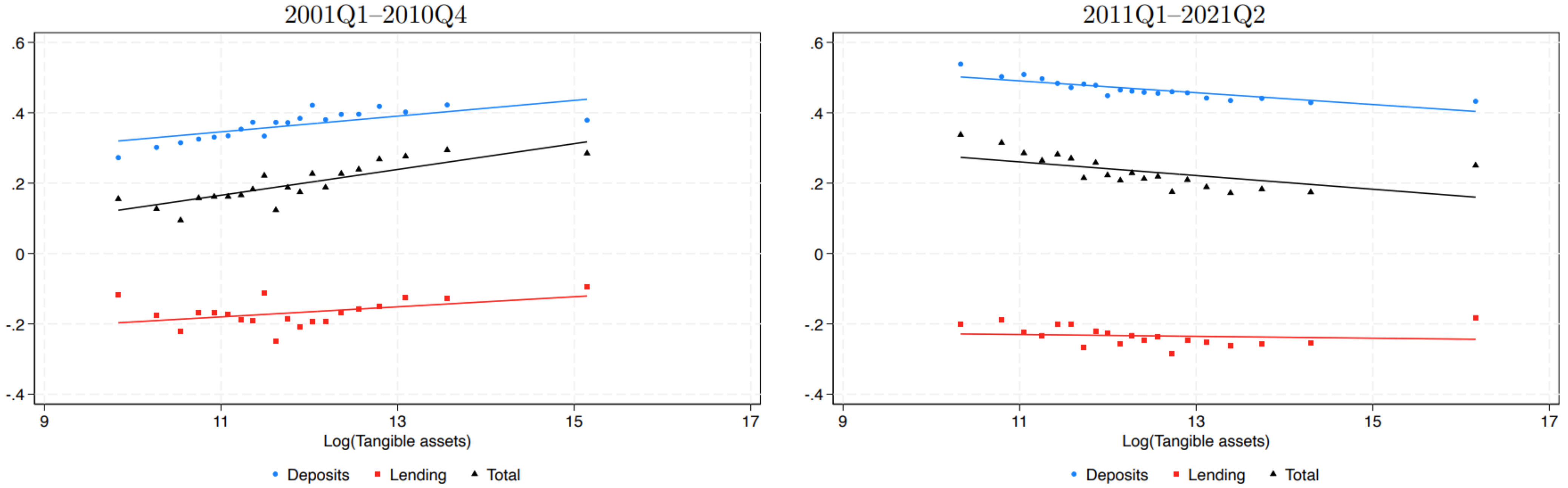
But also *increases* bank duration risk (BPS 2015)

Figure 2: Fixed and Floating Spread Sensitivities, by Log Assets

Panel A: Fixed component: Intercept ϕ_0



Panel B: Floating component: Fed funds sensitivity ϕ_1



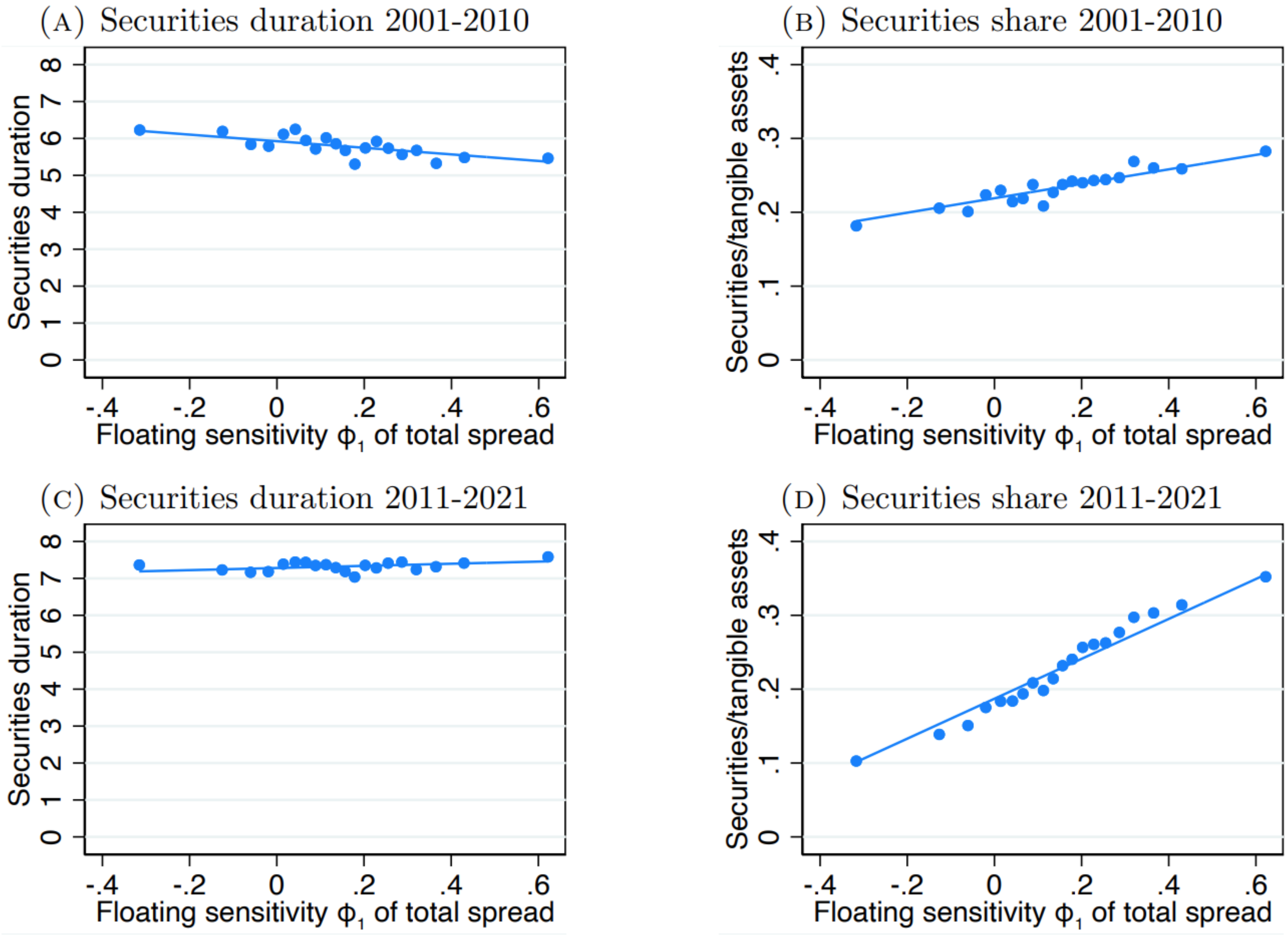


Figure C.2
Securities Holdings and Floating Sensitivity ϕ_1, Subsample Analysis

THE END