Bank Fragility when Depositors are the Asset

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The Return of Bank Runs?

- March 2023: massive deposit outflow and subsequent failure of Silicon Valley Bank, First Republic. Bank stock prices down 40% compared to S&P500

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- Why now? Why those banks?
  - *Uninsured deposits:* 90% at SVB but about 50% at other banks ... pretty typical historically
  - *Depressed asset values* due to high interest rates ... happened many times before

- This paper: **fragility of deposit relationships**
  - lower switching costs facilitate exit by depositors
  - precipitate run incentives when interest rates are high

The Story of the Deposit Relationship

The deposit relationship has its ups and down

- When the interest rate is low, the depositor gets cheap banking services.

- When the interest rate is high, deposit rates don't increase much, and the depositor pays a lot for the same banking services.

- Good times for the depositors are bad times for the bank, and vice versa, and the relationship balances out in the long run.

From the banks perspective:

- Deposit relationship is an asset: the deposit franchise.

- Sticky deposits can hedge the value of long term assets (Dreschler, Savov, Schnabl (2021)).

The Deposit Franchise is Fragile

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If a depositor believes the relationship will end at some point in the near future

- When the bad times arrive, she will immediately leave
- More likely to happen when rates are high and for banks with highly valuable franchise
- Deposit Franchise itself is valuable to both depositors and banks.
- Can lead to self-fulfilling runs even with liquid assets
- Provide conditions for runs, beyond just uninsured deposits

Some Related Literature

Deposit Taking and Value Creation: Drechsler, Savov, and Schnabl (2017, 2021), Hanson, Shleifer, Stein, and Vishny (2015), DeAngelo and Stulz (2015), Egan,Lewellen, and Sunderam (2022), Choi and Rocheteau (2023)

Runs: Diamond and Dybvig (1983), Goldstein and Pauzner (2005), Hortaçsu, Matvos, Shin, Syverson, and Venkataraman (2011), Egan, Hortaçsu, and Matvos (2017), Iyer and Puri (2016)

Recent Banking Crisis: Jiang, Matvos, Piskorski,and Seru (2023), Drechsler, Savov, Schnabl, and Wang (2023), Cookson, Gil-Bazo, Imbet, and Schiller (2023), Choi and Goldsmith-Pinkham (2023), ...

Model Setting

The Bank

- Has a measure D_0 of (relationship) depositors and E_0^b (book) equity

- Competes with a fringe of banks

- Invests in risk-free zero-coupon bonds.

Depositors

- Switching cost to leave bank

- Get utility from banking services

Asset pricing:

- Short rate: r_t.

- Price for a standard perpetuity at time t: $\pi(r_t)$

Banks

- Start with E_0^b in (book) equity, D_0 in deposits
- Pay depositors βr_t interest per dollar each period, $0 \leq \beta < 1$.
- Pay operating cost c per dollar each period to provide banking services to depositors

Deposit Franchise Value (NPV of the bank)

$$D_0(1 - \beta - c\pi(r_0))$$

- Only start bank if $1 - \beta - c\pi(r_0) > 0$
- Mkt value equity $E_0^m = E_0^b + D_0(1 - \beta - c\pi(r_0))$

Bank Balance Sheet

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Bank Risk Management

How does bank choose financial assets? To minimize risk (absent a run)

- Asset allocation

    - buy cD_0 units of perpetuity

    - put $E_0^b + D_0(1 - c\pi(r_0))$ in short-term bonds

- Implementation: hold long-term assets to offset duration of franchise value

- Equity has no risk because assets perfectly hedge liability: "maturity transformation without interest rate risk" Drechsler, Savov, and Schnabl (2021).

When Interest Rates Increase

- Assets lose value ($\pi'(r) < 0$):

$$A_1^m = \underbrace{E_0^b + D_0}_{A_0} + cD_0 \underbrace{[\pi(r_1) - \pi(r_0)]}_{\text{loss on perpetuity}}$$

- Market value of deposit liability decreases:

$$D_1^m = D_0(\beta + c\pi(r_1)) = D_0^m + cD_0[\pi(r_1) - \pi(r_0)]$$

  - Deposit spread increases relative to operating costs

- Equity value doesn't change:

$$E_1^m = A_1^m - D_1^m = E_0^m$$

What if Depositors Leave?

- What does the bank do if the depositors all pull out their deposits?
  - Sell assets at market price to pay off depositors

$$D_1 = 0$$
$$A_1^m = E_0^b + cD_0[\pi(r_1) - \pi(r_0)]$$
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- Hedge is broken because the deposit franchise is gone
- Bank fails if $E_1 \leq 0$, or

$$\underbrace{\frac{D_0 + E_0^b}{E_0^b}}_{\text{Book Leverage}} \times \underbrace{\frac{-cD_0\pi'(r)}{D_0 + E_0^b}}_{\text{Asset Duration}} \times \Delta r \geq 1. \tag{1}$$

Multiple Equilibria when Rates Rise Enough

- Bad equilibrium: depositors leave, bank fails. Rational for depositors to leave if fear losses
  - Run is on franchise value, happens even though assets perfectly liquid (contrast with Diamond Dybvig, with illiquid assets and no access to funding)

- Good equilibrium: depositors stay, bank survives

Conditions Often Happen

Uninsured Share of Deposits

Source: FDIC.
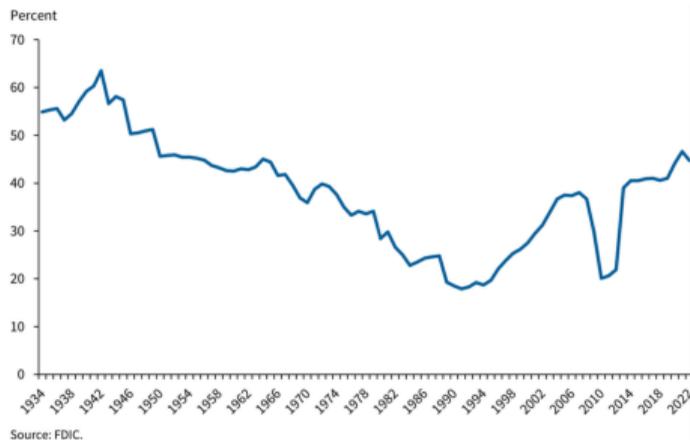
Interest Rates (T-bill)

Most of time and for most banks, good equilibrium obtains in real world, even though conditions for bad equilibrium to occur happen often (Jiang et al 2023, etc.)

What Does it Take to Move to Bad Equilibrium?

A missing layer: if the bad equilibrium *is possible*, how easily can depositors move into it?

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$\Rightarrow$ additional determinants of runs, e.g. how attached to the bank were depositors to start with?

Depositors

Each Depositor

- Has $1 to store indefinitely.

- Gets utility κ from banking services if she stores it at a bank.

- Consumes any interest payments βr_t. Per period utility from deposits:

$$u_t = \kappa + \beta r_t.$$

- Switching to a different bank that pays $\hat{\beta}$ (or the bond market) costs ϕ.
    - Switching cost microfounds the usual stickiness of depositor relationship

- Discount rate ρ.

- If bank fails: potential loss on deposit and pay switching cost, move to new bank

The Depositor's Problem

Consider single depositor i who leaves at a stopping time τ_i and fix her beliefs about

- The time τ_{bank} the bank will cease operations,
- Loss θ in PV terms if bank ceases operations before she leaves (e.g., if uninsured).

Depositor i's lifetime utility is

$$U(\tau_i, \tau_{bank}) = E_0 \left[\int_0^\tau e^{-\rho t}(\beta r_t + \kappa) dt \right] + E_0 \left[\int_\tau^\infty e^{-\rho t}(\hat{\beta} r_t + \kappa) dt \right] - E_0 \left[e^{-\rho \tau}(\phi + \mathbb{1}_{\tau_i = \tau_{bank}} \theta) \right]$$

where $\tau = \min\{\tau_i, \tau_{bank}\}$

Supporting Long-Term Relationships

Assume the bank never fails, $\tau_{bank} = \infty$.

Optimality for depositors to never switch corresponds to :

$$E_0 \left[\int_0^\infty e^{-\rho t} \beta(r_t + \kappa) dt \right] \geq E_0 \left[\int_0^\infty e^{-\rho t} \hat{\beta}(r_t + \kappa) dt \right] - \phi, \quad \text{for all } r_0.$$

Verified if switching cost ϕ big enough and r_t bounded above.

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E.g., suppose $r_t \in \{0, r^H\}$

- When $r_t = r^H$, depositor is giving up $(\hat{\beta} - \beta) r^H$.

- Leaving the relationship now requires a switching cost

- Would be a waste if $r_{t+\Delta} = 0$.

Depositor willing to weather the bad times because she believes the relationship will last long enough to return to the good times.

Quitting Short-Term Relationships

Suppose depositor believes that the bank will cease operations at some finite τ_{bank}. Do they stay until the end?

$$\Delta U = U(\tau_i, \tau_{bank}) - U(\tau_{bank}, \tau_{bank})$$
$$= E_0 \left[\int_{\tau_i}^{\tau_{bank}} e^{-\rho t} (\hat{\beta} - \beta) r_t \right] - \phi E_0 \left[e^{-\rho \tau_i} - e^{-\rho \tau_{bank}} \right] + E_0 [\theta e^{-\rho \tau_{bank}}]$$

Leave early if $\Delta U \geq 0$ for $\tau_i < \tau_{bank}$

- if bank closes when r low and $\theta = 0$: stay until the last minute to delay the switching cost $\tau_i = \tau_{bank}$
- if bank closes when r high enough: better off jumping ship ahead $\tau_i < \tau_{bank}$

Quitting Short-Term Relationships

To get simple closed form expression, assume:

- r_t follows a Vasicek process with speed of mean reversion b and mean r^*
- Depositor believes τ_{bank} is exponentially distributed with probability λ,
- Depositor believes they will lose a constant amount θ if they stay until the bank fails

Depositor will leave immediately if

$$\rho\phi \leq (\hat{\beta} - \beta)\left(\left(1 - \frac{b}{b + \rho + \lambda}\right)r + \left(\frac{b}{b + \rho + \lambda}\right)r^*\right) + \lambda\theta$$

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Leave sooner when: θ high, λ high, ϕ low, r_t high, b low (slow mean reversion), β low

Quitting Short-Term Relationships
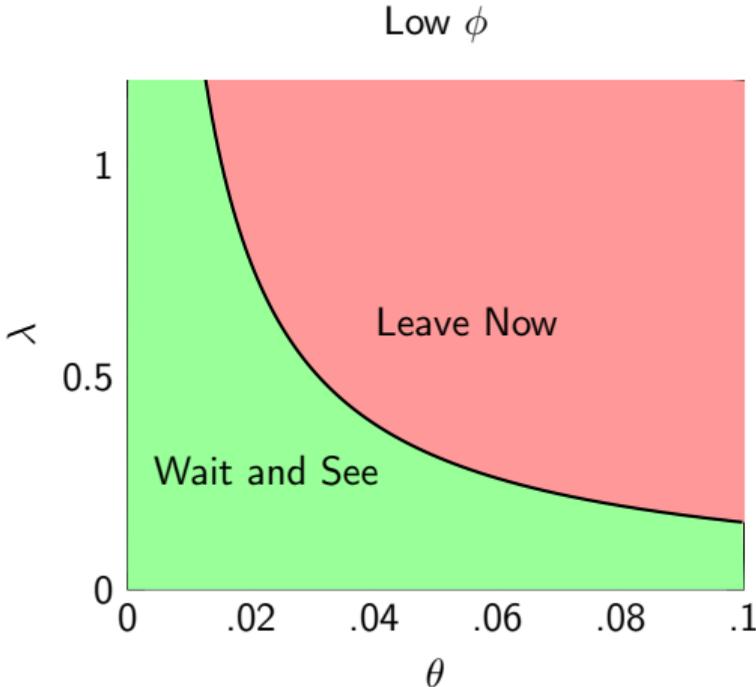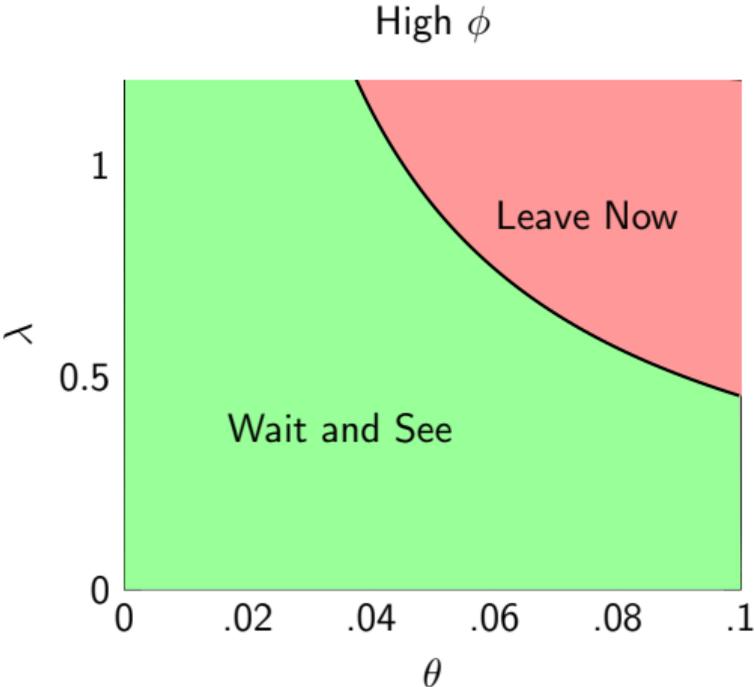
Why Now? Why Those Banks?

Low switching costs overall

- App based banking services and payments
- Cookson et. al. (2023) social media effects

Low switching costs for those banks

- Very high growth of deposits over previous few years = lots of clients that have been willing to switch, and willing to switch again

Low interest rates for 10+ years

- No incentive to switch in good times
- Switching costs hard for banks to estimate.

The On-off Switch of Interest Rate Risk

Put simple structure on the model to get valuation of bank:

- r_t follows Vasicek process (with reflection)
- Bank follows the simple static hedging policy given earlier
- Show most pessimistic case: depositors leave as soon as bank would be insolvent without deposit franchise
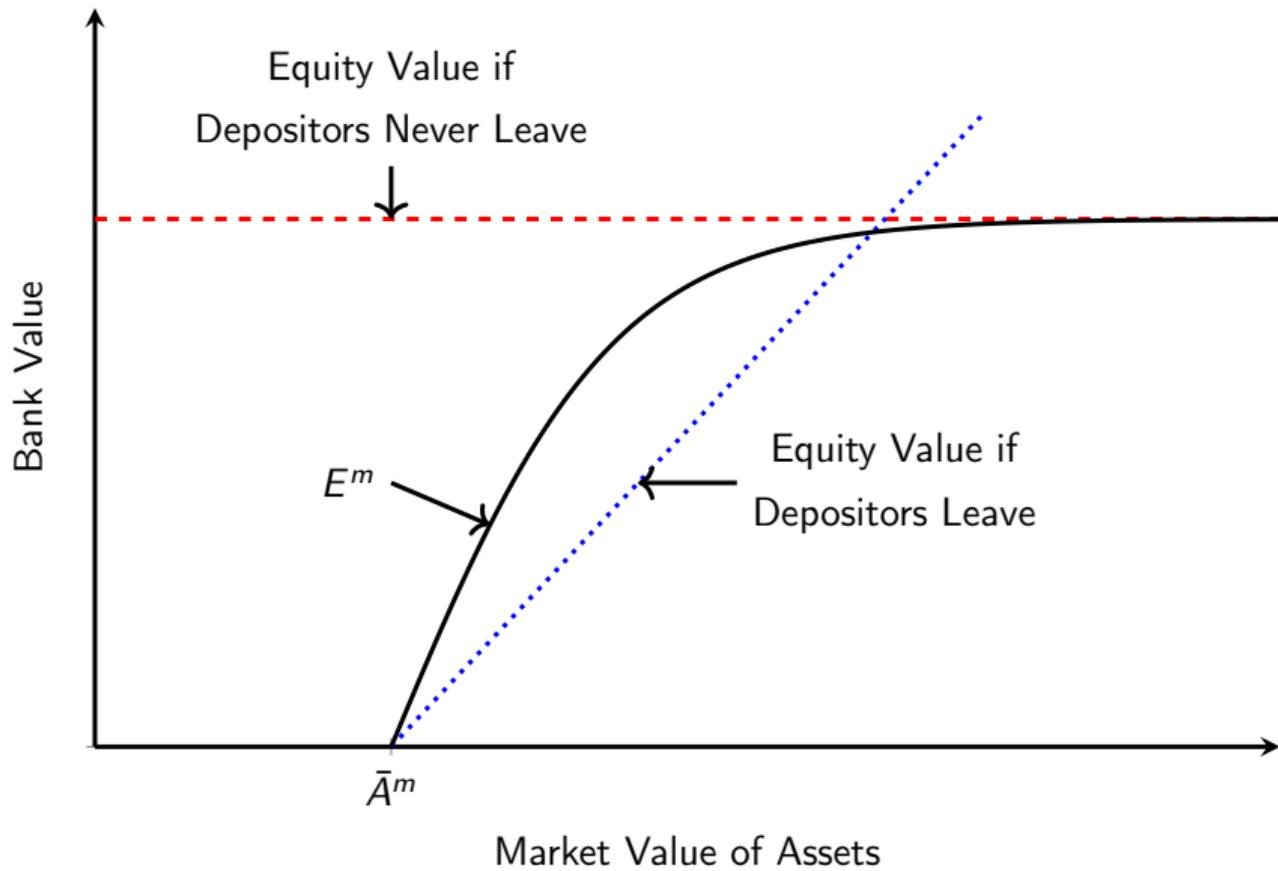
Intuition

Duration risk changes radically across the "run" (bad) and "no run" (good) equilibrium

Good equilibrium (no runs)

- Mkt equity duration is zero, even though securities you own have duration
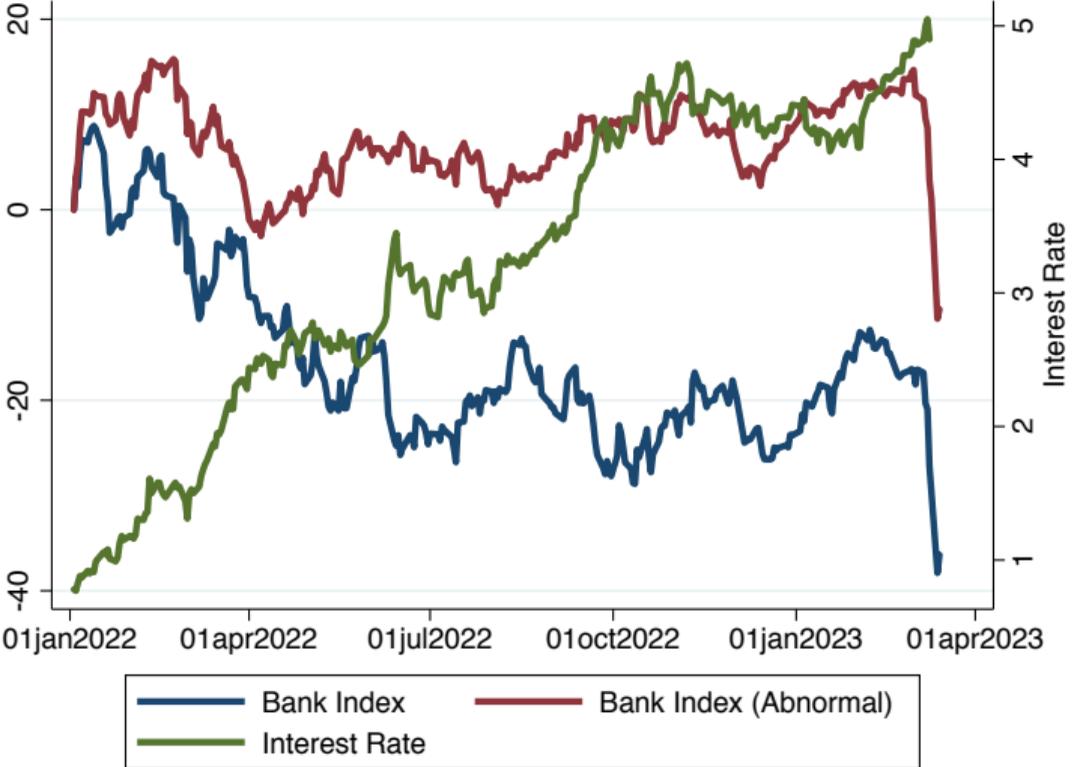- Duration risk in securities offset by duration of deposit liability

Bad equilibrium (runs)

- Duration risk accumulates.
- Losses on assets suddenly show up in value.
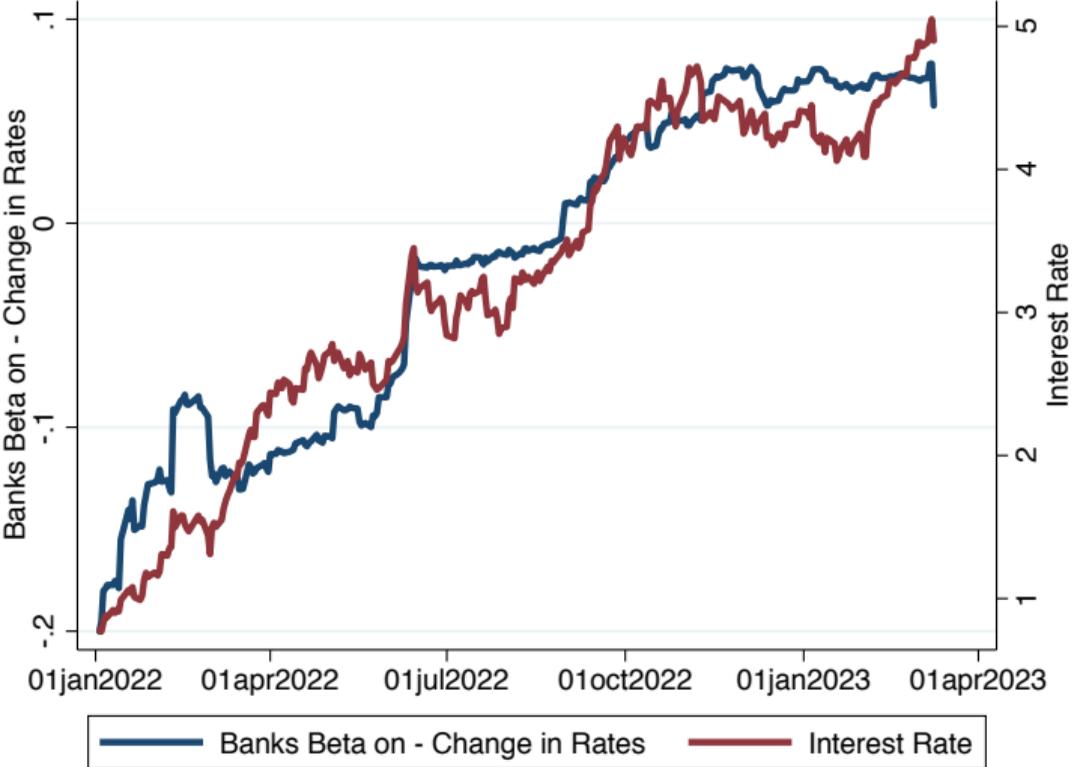
Loss pass-through can exceed 1

- Direct effect of loss pass through
- Increased probability of run, previous asset losses can add up

Aggregate Evidence: Bank Valuations and Interest Rates

Aggregate Evidence: Bank Stock Duration Increased

Cross Sectional Evidence: The On-Off Switch and Loss Pass-Through

VARIABLES	(1) Stock Ret '22	(2) Stock Ret '23	(3) Stock Ret '23	(4) Cumulative Ret
$Losses_{2022}$	-3.09 (2.08)		-6.91*** (2.26)	
$Losses_{2023}$		-55.71*** (18.19)		
$Losses_{Cumulative}$				-5.92*** (1.78)
Observations	44	44	44	44
R-squared	0.13	0.31	0.31	0.27

Which banks are most at risk?

- Low β
  - High franchise value, more destruction *if* depositors leave

  - All else equal, depositors have more incentive to leave when β low

- Low ϕ, depositors switch more easily
  - Proxy using past deposit growth

- Higher uninsured share θ

- Larger losses ΔA, higher leverage A/E

Cross Sectional Evidence: Uninsured Deposits and Deposit Growth

	(1) 2023	(2) 2023	(3) 2023	(4) 2023	(5) 2023	(6) 2023	(7) 2023	(8) 2023
Uninsured	-0.34		-0.36**	-0.22		-0.28*		
	(0.23)		(0.18)	(0.16)		(0.16)		
$Loss_{22}$				-6.24**	-5.98**	-4.48**		
				(2.57)	(2.26)	(2.08)		
Leverage (Lev)				-0.04	0.10	-0.21		
				(0.37)	(0.36)	(0.32)		
$Dep.Growth$		-0.37*	-0.38**		-0.23	-0.27*		
		(0.21)	(0.17)		(0.15)	(0.15)		
$Lev \times Loss_{22} \times Uninsured$							-0.68***	
							(0.14)	
$Lev \times Loss_{22} \times Dep.Growth$								-0.40**
								(0.20)
Observations	44	44	44	44	44	44	44	44
R-squared	0.10	0.19	0.30	0.35	0.38	0.44	0.42	0.30

Low β and The Franchise Value Paradox

Prediction: lowest deposit rate banks (low β) most at risk

VARIABLES	(1) Losses	(2) HTM Sec	(3) Stock Ret '23	(4) Stock Ret '23	(5) Stock Ret '22	(6) Stock Ret '22
Deposit Rate	-2.11***	-9.31***	20.59***	17.65***	-7.16	-9.41
	(0.53)	(2.73)	(4.06)	(5.33)	(6.70)	(7.08)
Uninsured				-0.28		-0.21
				(0.23)		(0.14)
Observations	44	44	44	44	44	44
R-squared	0.21	0.11	0.13	0.20	0.03	0.12

Conclusion

- Lower switching costs make depositors overall less sticky, but also foster fragility

- Banks can fail when the deposit franchise is the most valuable