Banking on Uninsured Deposits

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Central Bank of Iceland
May 2024

2023 regional bank crisis

Between early 2022 and March 2023, the Fed raised short-term rates by 5%

- long-term rates up 2.5%

Banks held $17T of long-term loans and securities with average duration 4 years

- implied loss of 0.025 x 4 x 17 = $1.7T
- very large compared to $2.2T bank equity

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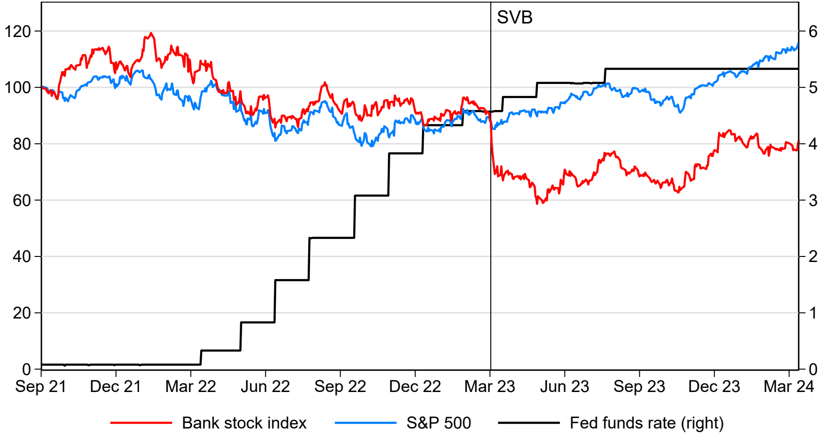
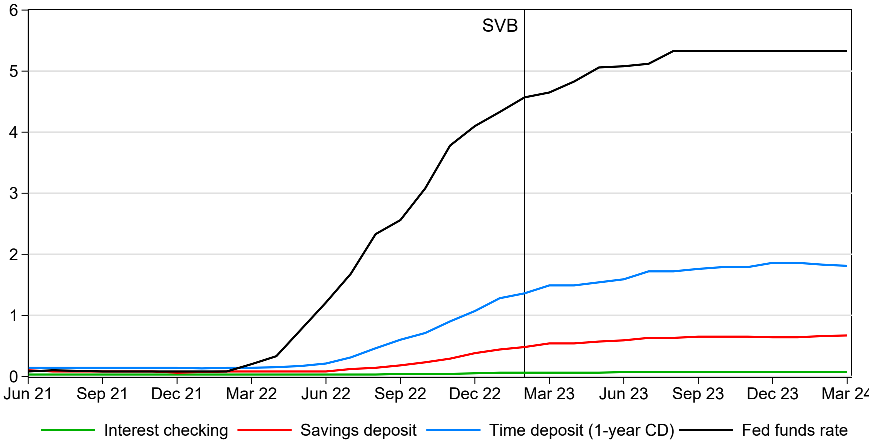
Lawrence H. Summers
@LHSummers

SVB committed one of the most elementary errors in banking: borrowing money in the short term and investing in the long term. When interest rates went up, the assets lost their value and put the institution in a problematic situation.

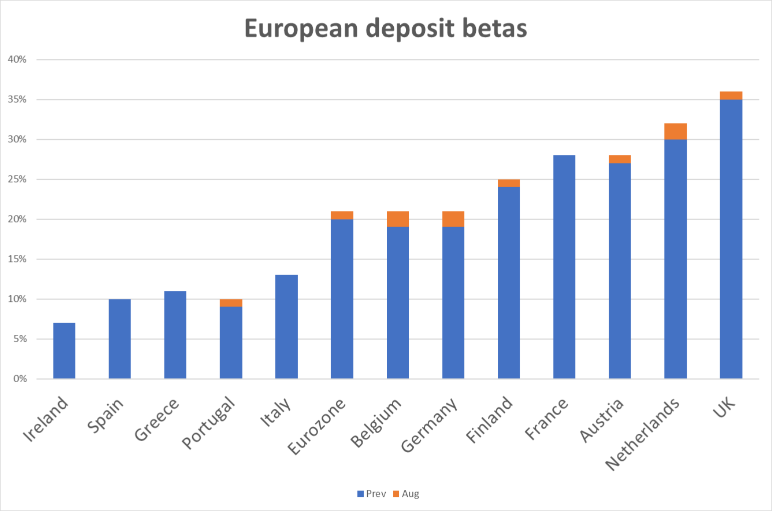
But why not earlier? Why not all banks?



A natural hedge: low deposit betas (DSS 2017)



Deposit betas in Europe



The deposit franchise hedge (DSS 2021)

1. \$17 trillion of bank deposits
   - with a deposit beta of 0.4, banks are earning $0.6 \times 5.5\% = 3.3\%$ deposit spread
   - $\$17 \times 3.3\% = \$561$ billion higher income per year

2. Gain on deposit franchise enough to offset asset losses in $\sim$3 years
   - deposits went from unprofitable to highly profitable
   - explains why bank stocks held up as rates rose

This paper

Deposit franchise hedges interest rate risk…

…**but only if depositors stay in the bank**

If they leave, deposit franchise is destroyed and hedge fails

$\rightarrow$ **deposit franchise is a runnable asset**

Main results

1. Uninsured deposit franchise is a runnable asset
   - $\rightarrow$ self-fulfilling runs even if loans/securities are fully liquid
2. Deposit franchise value rises with rates
   - $\rightarrow$ bank run risk increases with interest rates
3. Risk management dilemma:
   - $\rightarrow$ bank cannot hedge both interest rate risk and run risk
   - $\rightarrow$ requires additional capital
4. Empirical implementation:
   - $\rightarrow$ estimate bank values with deposit franchise
   - $\rightarrow$ predicts which banks exposed to deposit franchise runs (and which not)

Model

Model: deposit franchise with outflows

- Bank starts with assets A and deposit base $D_{-1} = D$.

- In period t, remaining deposits D_{t-1}
  - pay deposit rate $r_{d,t}$
  - require operating costs c per dollar
  - withdrawals $X_t = D_{t-1} - D_t$

- Date-0 bank value (EVE)

$$V = A - L$$

where L is PV of liabilities

$$L = \underbrace{\sum_{t\geq 1} q_t D_{t-1} \left(r_{d,t} + c \right)}_{\text{interest expenses and costs}} + \underbrace{X_0 + \sum_{t\geq 1} q_t X_t}_{\text{withdrawals}}$$

Simplifying assumptions

- Initial interest rate $r_{-1} = r$. One-time shock to $r_0 = r_1 = \cdots = r'$.
  $\rightarrow$ Deposit rate $r_d' = \beta r'$
- $t = 0$: endogenous outflows, focus on runs
  later: add rate-driven outflows $X_0 = w(r')D$
- $t \geq 1$: exogenous outflows

$$X_t = \delta D_{t-1}$$

  to capture natural decay of deposit base.

Deposit franchise value

Rewrite $V(r') = A(r') + \underbrace{DF(r') - D}_{-L(r')}$ where $DF =$ **deposit franchise value**

Proposition

Without outflows,

$$\begin{aligned} \textit{Vaue:} \quad DF(r') &= D\left[\frac{(1-\beta)\,r' - c}{r' + \delta}\right] \\ \textit{Dollar duration:} \quad DF'(r) &= D\left[\frac{c + (1-\beta)\delta}{(r+\delta)^2}\right] > 0 \end{aligned}$$

Calibration: U.S. banks in December 2022

- $\beta = 0.3$ (recently 0.2-0.4)
- $c = 1.5\%$ (between 1 and 2%)
- $r = 4\%$
- $D = \$17.5T$
- $1/\delta = 10$ years (FDIC: 10-15 y)

$\text{DF} = \$1.6\text{T} \approx$ **unrealized losses on assets**

Deposit Franchise Runs

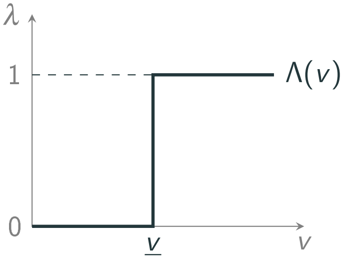
Uninsured deposits and runs

Exogenous share u of deposits uninsured: bank value

$$V = A - D + DF_I + \lambda DF_U$$

where λ: **endogenous** fraction of remaining uninsured depositors

$\lambda = \Lambda(v)$ increasing in $v = V/D$ (earnings, stock price):



Runs on the deposit franchise

Bank solvency ratio given λ: $\quad v(\lambda, r') = v(0, r') + \lambda \times u \overbrace{\frac{(1-\beta^U)r' - c^U}{r' + \delta}}^{= DF_U(r')/D}$

Equilibrium given $A(r')$: $\quad \lambda$ s.t. $\quad \boxed{\Lambda\left(v(\lambda, r')\right) = \lambda}$

Runs on the deposit franchise

$$\text{Bank solvency ratio given } \lambda: \quad v(\lambda, r') = v(0, r') + \lambda \times u \overbrace{\frac{(1-\beta^U)r' - c^U}{r' + \delta}}^{=DF_U(r')/D}$$

$$\text{Equilibrium given } A(r'): \quad \lambda \text{ s.t. } \quad \boxed{\Lambda\left(v(\lambda, r')\right) = \lambda}$$

Proposition

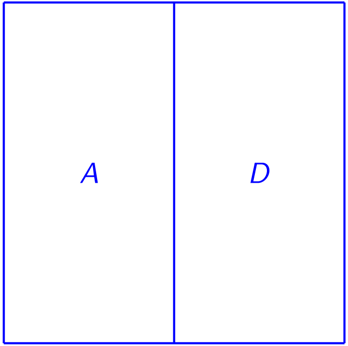
If $v(0, r') < \underline{v}$: run equilibrium $\lambda = 0$ exists (though A is fully liquid).

Given no-run value $v(1, r')$, the larger is $DF_U(r')$, the more likely a run equilibrium exists. This is when:

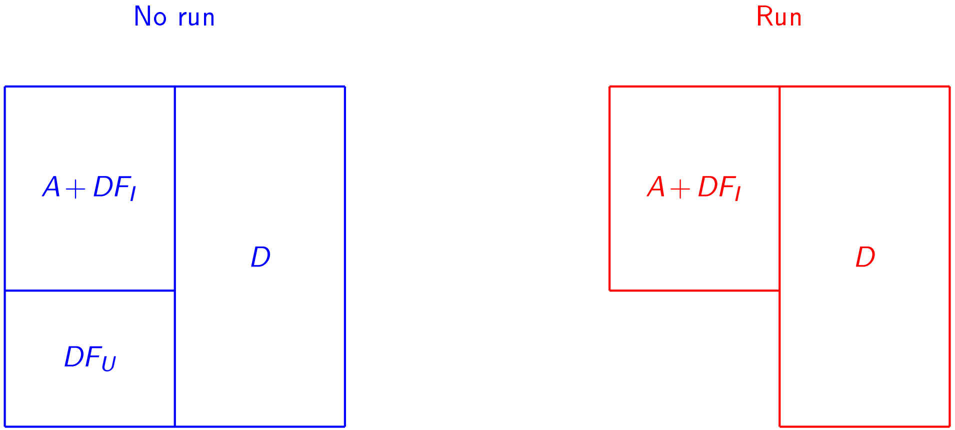
- *the share of uninsured deposits u is higher*
- *the uninsured deposit beta β^U is lower*
- ***the interest rate r' is higher***

Balance sheet: unique equilibrium at r

No run



Balance sheet: two equilibria at $r' > r$



Risk management

Optimal durations

Proposition

Hedging interest rate risk for all r' in good (no-run) equilibrium requires:

$$T_A = (1-u)\frac{(1-\beta^I)\delta + c^I}{(r+\delta)^2} + u \times \frac{(1-\beta^U)\delta + c^U}{(r+\delta)^2}$$

Optimal durations

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Hedging liquidity/run risk for all r' requires:

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No dilemma as $\beta^U \to 1, c^U \to 0$: dilemma caused by **low-beta uninsured deposits**

$\to$ retail uninsured and corporate checking, **not** competitive wholesale funding

Adding rate-driven outflows

- Even without runs, **rate-driven outflows** for both insured and uninsured:

$$X_0 = w(r')D$$

  where elasticity $w' \geq 0$ captures strength of "deposits channel" (Drechsler Savov Schnabl 2017)

- Equivalent to previous model with **effective beta**

$$\tilde{\beta} \;=\; \beta + w'(r)\left[(1-\beta)r - c\right](1 + r/\delta)$$

Empirical Implementation

Estimating bank values

- Goal: detect banks at risk of deposit franchise runs
  $\rightarrow$ requires estimating bank values with and without deposit franchise

- Required bank-level inputs:
  1. Asset losses due to interest rate increase
  2. Insured and uninsured deposit betas
  3. Cost of insured and uninsured deposits
  4. Run-off rate of deposits

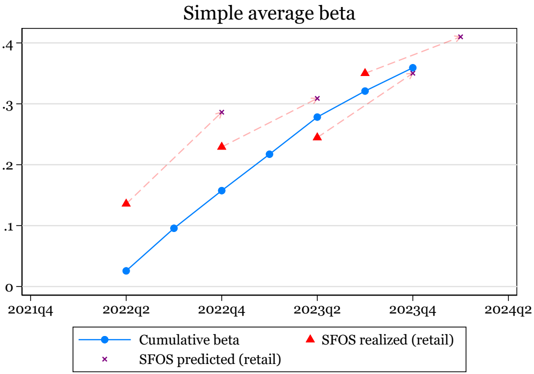
- Results:
  1. Evaluate whether banks hedge asset losses with deposit franchise
  2. Assess whether banks are in multiple equilibrium region

Data and Sample

- US call reports (Federal Reserve)
  1. Assets: Asset holdings by refinancing maturity
  2. Deposits: deposit expense, non-interest expense, uninsured deposits
- Total sample of 715 banks
  1. US commercial banks: $\geq$ \$1B assets, $\geq$ 65% deposits as of Dec 2021 (pre rate hike)
  2. Drop foreign banks, custodian banks, credit card banks
  3. Time periods: Feb 2023 (pre SVB) and Feb 2024 (most recent)
- Treasury and MBS indices by maturity (Bloomberg) for asset losses

Deposit betas in 2022/23

$$\text{Cumulative Beta}_{t,21} = \Delta_{t,21}\ \text{Deposit Rate} \ / \ \Delta_{t,21}\ \text{Fed Funds rate}$$



1. Deposit betas increase over hiking cycle (lagged adjustment, SVB crisis)
2. Consistent with historical betas and Senior Financial Officer Survey (SFOS)

Bank-level deposit beta

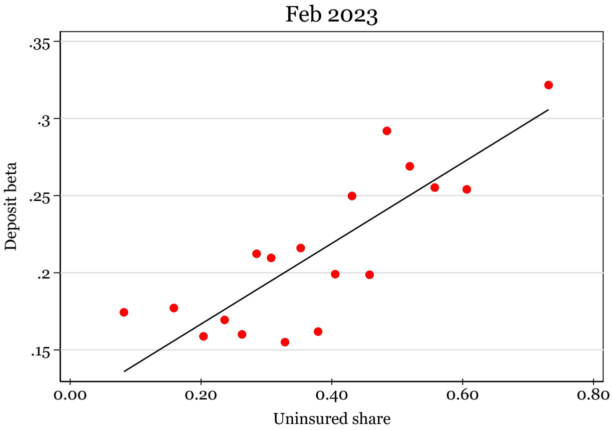
$$\text{Cumulative Beta}_{t,21} = \Delta_{t,21} \text{ Deposit Rate } / \ \Delta_{t,21} \text{ Fed Funds rate}$$

	Dec 2021	Feb 2023	Feb 2024
	(1)	(2)	(3)
Deposit beta	0.254	0.213	0.421
(s.d.)	(0.139)	(0.162)	(0.163)
Obs.	710	715	690

1. Significant variation in deposit betas across banks (e.g., brand, service, uninsured, etc.)
2. Large increase in deposit betas from Feb 23 to Feb 24

Estimating insured and uninsured beta

Binscatter plot: Deposit beta and uninsured deposit share



→ 10% increase in uninsured share raises beta by 0.03

Results: insured and uninsured beta

1. Assume uninsured beta minus insured beta is constant across banks
2. Compute betas based on observed deposit beta and uninsured share

	Dec 2021	Feb 2023	Feb 2024
	(1)	(2)	(3)
Insured deposit beta	0.211	0.108	0.329
(s.d.)	(0.122)	(0.131)	(0.142)
Uninsured deposit beta	0.341	0.370	0.581
(s.d.)	(0.122)	(0.131)	(0.142)
Obs.	711	715	690

Example: Insured 2023 deposit beta of Citibank (0.48) vs. Wells Fargo (0.19)

Results: Deposit costs

1. Estimate overall cost using hedonic cost regression (Hanson et al. (2015))
2. Regress cost of deposits on uninsured share
3. Assume insured cost minus uninsured cost is constant across banks

	Insured	Uninsured
	(1)	(2)
Cost of deposit provision	1.433	0.723
(s.d.)	(0.529)	(0.529)
Obs.	715	715

Estimating asset losses

1. Match asset holdings (Dec 21) to asset index by asset type and repricing maturity
2. Estimate losses as Δ asset index $\times$ asset holdings

	All banks			Large banks		
	Dec 2021	Feb 2023	Feb 2024	Dec 2021	Feb 2023	Feb 2024
	(1)	(2)	(3)	(4)	(5)	(6)
Asset loss	0.00	8.22	7.36	0.00	6.75	5.98
(s.d.)	(0.00)	(2.41)	(2.38)	(0.00)	(1.84)	(1.42)
Obs.	717	715	690	17	17	14

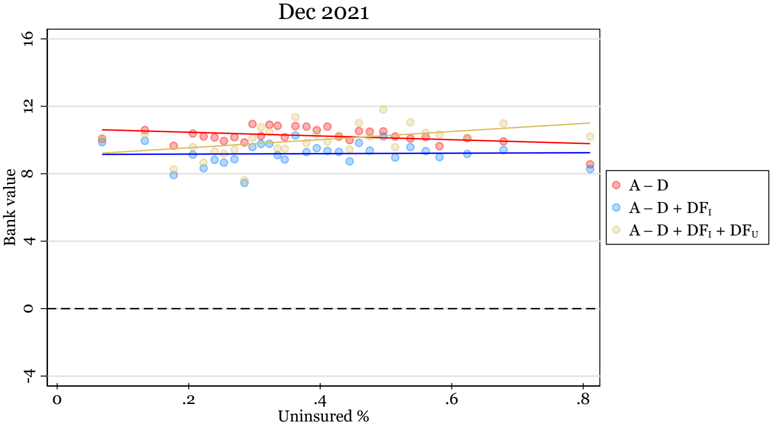
Results: Bank Value

Bank Value	Dec 2021	Feb 2023	Feb 2024
	(1)	(2)	(3)
$A-D$	10.26	2.03	2.91
	(2.08)	(3.22)	(3.22)
% Negative	0.00%	26.43%	17.10%
$V(0,r)=A-D+DF_I$	9.19	9.98	8.35
	(3.08)	(4.19)	(3.93)
% Negative	0.14%	0.70%	1.16%
$V(1,r)=A-D+DF_I+DF_U$	9.99	13.92	10.54
	(4.21)	(4.73)	(4.68)
% Negative	0.84%	0.00%	0.58%
Obs.	717	715	690

1. If we ignore DF, large decline in value, $\approx 1/4$ banks negative value
2. With DF, average bank hedged, almost no negative value

Results: Bank Value, Dec 21

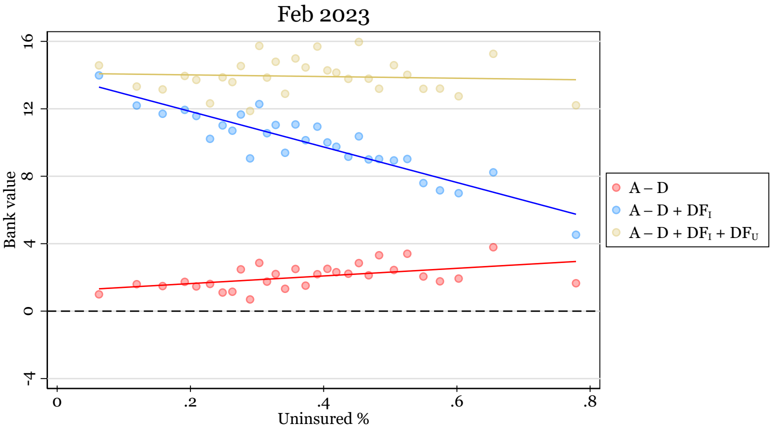
Binscatter plot: Banks Value and uninsured deposit share



→ Deposit franchise value close to zero at low interest rates

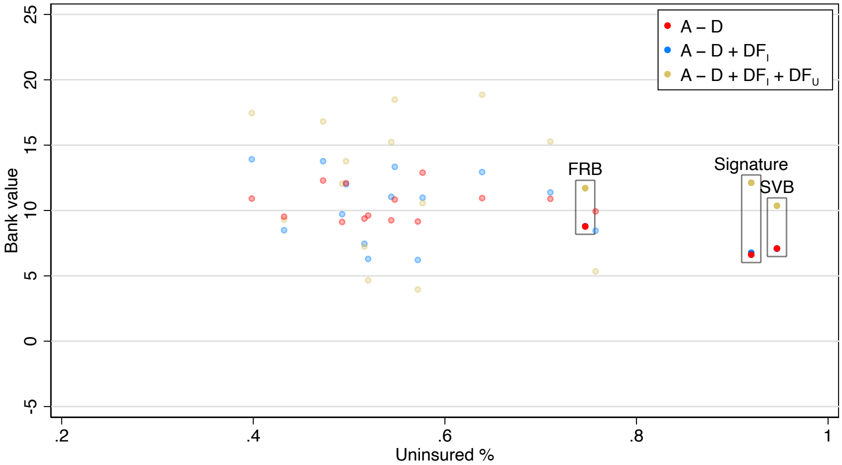
Results: Bank Value, Feb 23

Binscatter plot: Bank Value and uninsured deposit share



→ Banks with high uninsured share vulnerable to deposit franchise run

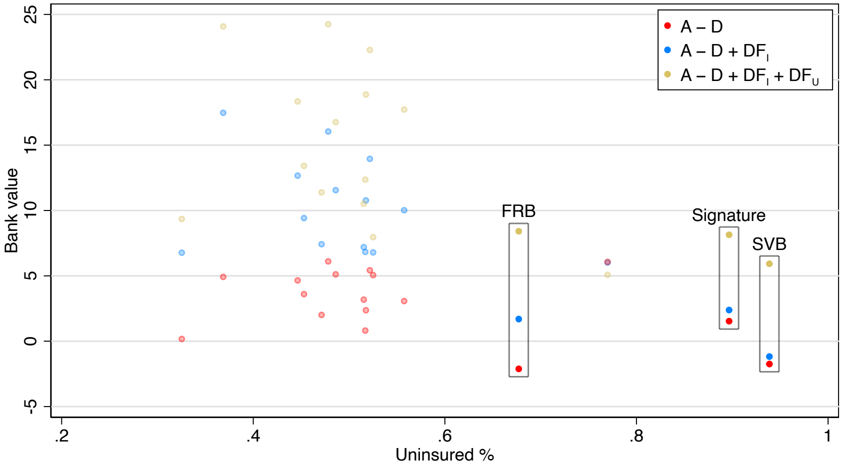
Results: Large Bank Value, Dec 21



→ SVB, Signature, First Republic look similar to other large banks pre rate hike

→ values > 5% → no deposit franchise run equilibrium

Results: Large Bank Value, Feb 23



→ SVB value <0 without uninsured DF → run equilibrium (Signature, FRB similar)

→ Other large banks value $>5\%$ of assets → no run equilibrium

Solutions

Solution 1: Capital

Proposition

Runs can be prevented if

$$v(r') \;\geq\; \underline{v} + DF_U/D \;=\; \underline{v} + u\frac{(1-\beta^U)r' - c^U}{r'+\delta}$$

- To protect against any $r' > r$, need $v(r') \;\geq\; \underline{v} + u\left(1 - \beta^U\right)$

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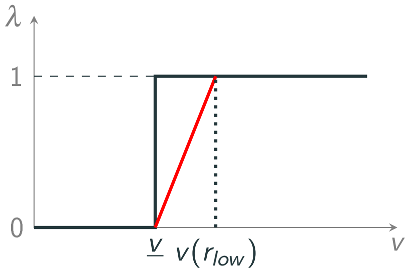

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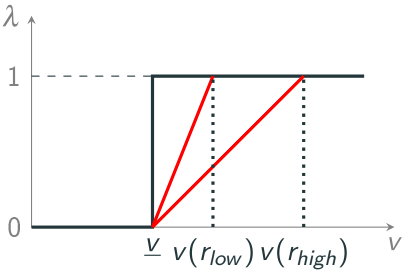

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Conclusion

1. An uninsured deposit franchise is a runnable asset
    - deposit franchise runs can occur even if loans/securities fully liquid

2. Risk of deposit franchise runs increases during monetary tightening

3. Risk management dilemma: banks need assets with
    - long duration to hedge interest rate risk
    - short duration to avoid run risk
    - solution: requires additional capital

4. Estimation: detect banks at risk (or not) of deposit franchise runs

Appendix

Solution 2: Options

Ex ante, to hedge against runs when rates $\uparrow$ and interest rate risk when rates $\downarrow$ need

$$v(0, r') \geq \underline{v} \qquad \textbf{and} \qquad v(1, r') \geq \bar{v}$$

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Banks must hold puttable LT bonds: combination of LT assets + call options on r':

$$A^*(r') = \underbrace{(1+v^*)D - DF_I\left(r'\right) - DF_U\left(\lambda=1,r'\right)}_{\textit{LT assets}} + \underbrace{\max\left\{0, DF_U\left(\lambda=1,r'\right) - (v^* - \underline{v})D\right\}}_{\textit{payer swaptions}}$$

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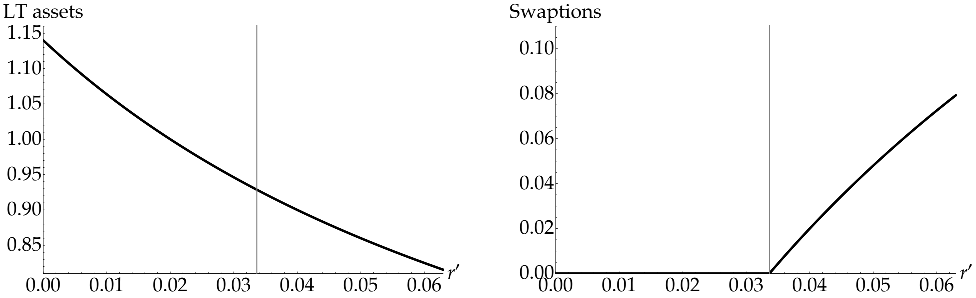
Banks already hold swaptions to hedge MBS negative convexity...

need more to hedge run risk: keep uninsured DF from exceeding bank's equity

Solution 2: Options



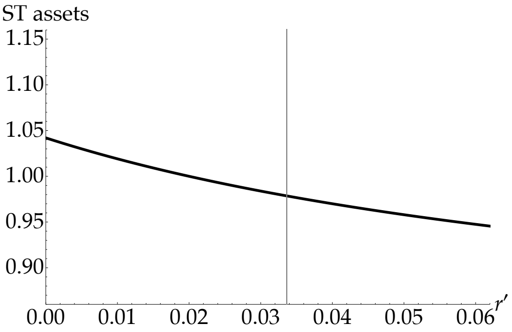
Solution 2: Options

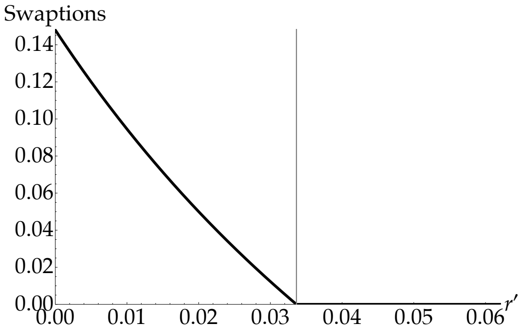
Fed 4/28 report on SVB:

> *In early 2022, at a time when rates were rising rapidly, SVBFG became increasingly concerned with decreasing NII if rates were to decrease, rather than with the impact of rates continuing to increase. (...)* ***The bank began positioning its balance sheet to protect NII against falling interest rates but not rising ones.*** *(...) The bank began a strategy to remove hedges in March 2022, which were designed to protect NII in rising rate scenarios but also would have served to constrain NII if rates were to decrease.*

Solution 2: Options

Alternatively: hold ST assets but need **put options** on r' (receiver swaptions)





Solution 3: Lender of Last Resort

Proposition

Suppose that a bank facing an uninsured deposit run $1-\lambda$ can borrow at par

$$B(\lambda, r') = (1-\lambda)\left[A(r) - A(r')\right]$$

from the Fed. Then $\lambda = 1$ is the unique equilibrium.

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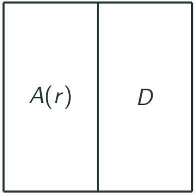

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