Underwater: Strategic Trading and Risk Management in Bank Securities Portfolios

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Introduction

- US banks hold large quantities of investment securities
 - At start of recent tightening cycle: \$6.2tr; 26% of total assets
 - (Unrealized) securities losses key factor underlying March 2023 banking turmoil
- In principle, securities portfolio is key tool for managing risk
 - Interest rate risk: Can sell/hedge risky bonds to dial back risk (given loans are illiquid)
 - Liquidity: Sell/repo bonds to raise cash if needed (e.g., in response to deposit outflows)
- Today: Study bank portfolio risk management in practice [Focus: 2022-23 tightening]
 - 1. Do banks actively manage portfolio when risk changes? Which margins? How much?
 - 2. Do financial/regulatory frictions constrain active management?

Overview of the paper

- 1. Shift in interest rate risk in 2022-23, due to bonds with embedded options (esp. MBS)
 - Cross-bank heterogeneity in "risk shock" due to ex ante differences in portfolio mix
 - Not offset elsewhere on balance sheet (higher ex-ante callable share ightarrow more *total* losses)

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 - Not offset elsewhere on balance sheet (higher ex-ante callable share ightarrow more *total* losses)
- 2. Limited rebalancing (thus: change in risk closely tied to ex-ante asset mix)
 - Banks do not sell risky bonds to shorten duration: sales unusually low (pprox 1/2 "normal")
 - ightarrow Also limited adjustment of securities portfolio to deposit outflows (asymmetry)
 - Little increase in "qualified" interest rate hedging
 - Banks do shorten maturity of new purchases + classify risky bonds as "held-to-maturity"

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 - Little increase in "qualified" interest rate hedging
 - Banks do shorten maturity of new purchases + classify risky bonds as "held-to-maturity"
- 3. Evidence that financial frictions constrain active portfolio management
 - i. Selling risky bonds means crystallizing unrealized losses: we find banks averse to this
 - ii. Interest rate hedging constrained by "qualified hedging" rules (e.g., fixed costs)

Data

- Primary data: FR Y-14Q security-level data linked to bond characteristics
 - Quarterly snapshot for BHCs with >\$100bn in assets. (77% of securities as of 2021:Q4.)
 - Bonds classified as "available-for-sale" (AFS) and "held-to-maturity" (HTM)
 - Position-level detail on qualified hedges (Y-14Q schedule B.2).
 - Bond characteristics from IDC & MSCI (e.g., maturity, coupon, duration, paydown factor...)
 - Key point: maturity is a poor proxy for duration for significant share of portfolio
- Novel methodology to identify outright security sales at bond level from Y-14
 - Identify exits from bank portfolio where bond does not mature/amortize, not called etc.
 - Cross-validate against aggregate realized gains/losses reported in Y-9C
- Supplement Y-14 with public data (Call/Y-9C) + bank 10Ks + OCC EVE data etc.

I. Bank securities risk and portfolio management in 2022-23

Interest rate risk (IRR): key concepts

Interest rate risk: Risk that a shift in interest rates will reduce bank value or earnings

Measurement:

- For individual bond, *duration* = rate of change of value to a shift in rates
- For bank: rate sensitivity of economic value of equity [EVE = NPV(assets-liabilities)]
- Banks also estimate sensitivity of net interest income to interest rate shocks

Negative convexity:

- Banks have significant holdings of assets that extend in duration when rates rise
 - Especially agency mortgage-backed securities (MBS) (and whole mortgages)
 - Intuition: If rates rise, borrowers stop refinancing. Bond effectively now longer-term.
- Important in 2022-23 due to size of rate increases dynamic hedging?

Interest rate environment: 2022-23

- Sharp upward shift in yield curve. Also higher interest rate volatility
 - 10y Tsy +250bp; implied IR vol x4 (Sarisoy 2023); \$700bn unrealized bank bond losses
 - Deposit outflows (e.g., to money funds)
- Shift in bank interest rate risk post-2022:
 - EVE more exposed to positive rate shocks (right)
 - Bank stocks react more negatively to positive rate surprises (Emin et al., 2025)
 - Supervisory downgrades related to IRR (Gopalan-Granja 2025)
- Drivers:
 - Assets with embedded options; e.g. agency MBS
 - Deposit beta "convexity" (Hirtle-Plosser 2025; Greenwald et al. 2023; Wang et al. 2022)



EVE sensitivity to +300bp rate shock

Higher duration in securities portfolio: reflects "callable" bonds

- Higher duration due to bonds with embedded call options (e.g., agency MBS; munis)
 - For noncallables (e.g., Tsy), duration *fell* as bonds replaced by shorter maturities
- Significant cross-bank heterogeneity in evolution of risk due to portfolio mix



How did banks respond to shift in risk environment?



Potential margins:

- i. Sell risky bonds?
- ii. Hedge more using "qualified" accounting hedges?
- iii. Shorten maturity of new bond purchases?
- iv. Classify risky bonds as "held to maturity"?

Related: did banks sell bonds in response to deposit outflows?

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Banks did not sell risky bonds to rebalance portfolio

- Purchases of securities fell sharply in 2022-23, reflecting low/negative deposit growth
- But surprisingly, bond sales also *fell*: volume pprox 1/2 (or less) of "regular" levels



Source: Author calculations based on Y-14Q data

Bank securities trading: Call reports evidence

Realized gain/loss tightly bunched around zero (even though bonds nearly all underwater)
Share of Y-14 banks with exactly zero gain/loss (i.e., no trading) spikes in 2022-23



Limited response of securities portfolio to deposit outflows

- Low propensity to actively sell bonds also seems evident in responses to deposit flows
- Binscatter (quarterly log changes): securities growth (at amortized cost) vs deposit growth in 2022/23
 - Consistent with high frequency evidence (Cipriani et al. 2024; Glancy et al. 2024)
 - Related: Drechsler et al. (2024) on MBS
- Regressions:
 - Asymmetry persists for 4+ quarters
 - Concentrated among large banks
 - "Ratcheting" also present in 1994-2023 sample



Based on Call reports; weighted by bank size.

SVB didn't sell bonds even as risk increased and deposits flowed out...







Source: Call report

Banks also did not offset rising risk through hedging

- Duration of portfolio \approx 0.5 years lower net of hedging
- But little expansion of hedging to offset rise in interest rate risk from 2020-23



Margins where banks *did* adjust

- 1. Banks significantly shortened duration of new bond purchases as rates rose
 - Duration fell from \approx 4 at end-2021 to \approx 2 by end-2023 \bigcirc line
 - Limitation: portfolio risk adjusts only gradually, esp. if existing bonds rolling off slowly
- 2. Disproportionately classified callable bonds as "held to maturity" (HTM)
 - As a result, rise in duration in 2022-23 concentrated in HTM portfolio 🕩 🔤
 - Accounting classification does not reduce risk, but makes losses less visible (e.g., not in TCE)

Change in interest rate risk driven by ex-ante asset mix

- Limited active management \rightarrow change in risk tightly linked to ex-ante asset mix [below]
- Rising securities risk seems to matter for bank as a whole (not offset by hedges elsewhere)
 - Finding: Larger total MTM losses for banks with high ex ante callable bond share et al.

		Gross Duration				Duration net of hedging				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)		
Post-2022 \times % Callable Bonds	1.753***			1.508***	1.919***			1.784***		
	(0.353)			(0.465)	(0.415)			(0.560)		
Post-2022 \times % HTM		0.876 (1.047)		0.660 (0.889)		0.805 (1.063)		0.450 (0.915)		
Post-2022 \times AOCI in capital			-0.690** (0.327)	-0.233 (0.297)			-0.684* (0.352)	-0.122 (0.344)		
Fixed effects	Bank, Time	Bank, Time	Bank, Time	Bank, Time	Bank, Time	Bank, Time	Bank, Time	Bank, Time		
Cluster	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank		
Time period	2020-2023	2020-2023	2020-2023	2020-2023	2020-2023	2020-2023	2020-2023	2020-2023		
Obs.	496	496	496	496	496	496	496	496		
DV average	3.8	3.8	3.8	3.8	3.5	3.5	3.5	3.5		

% Callable: mean 0.64, st.dev. 0.29. Nr banks: 35.

Summing up

- Our interpretation: Inertia in bank portfolios on two key margins
 - Banks reluctant to sell risky bonds outright (to manage risk / deposit outflows)
 - Qualified hedging activity unresponsive to "risk shock"
- Alternative stories (may be complementary):
 - i. Banks just *wanted* higher duration? Maybe ... but why Δ risk so correlated with portfolio mix? Why *reduce* duration of purchases? Why does trading fall? Why reclassify to HTM?
 - ii. Banks just focused on managing *income* risk? MBS and other callable bonds still problematic low coupon is locked in for long time if rates go up
 - ightarrow Interest income on MBS rose much more slowly than other bonds post-2021 ightarrow link
- Next: "micro" evidence on frictions that can help account for limited active management
 - 1. Incentives to trade underwater bonds
 - 2. Costs / constraints on "qualified" hedging

III. Underwater bonds and strategic trading

Underwater bonds and "strategic" trading

- One story for low trading: banks averse to crystallizing unrealized bond losses?
 - 1. Impact on regulatory capital depends on whether bank utilizes "AOCI filter"
 - 2. Immediate hit to net income (but gradual "payback" once reinvested at higher yields)
 - 3. Sale may draw attention to losses (e.g., SVB sale highly salient; triggered run)
 - 4. Behavioral factors? (version of "disposition effect")

"Most institutions seem hesitant to sell underwater bonds, even for restructuring" [S&P, 1/16/2023]

"The news from Truist and other banks points to a clear interest in reducing duration and possibly the hard-to-manage negative convexity of MBS ... [but] For now, significant selling of MBS by banks is constrained by an unrealized mark-to-market loss of nearly \$200 billion" [Santander, 3/2/2024]

"We are constantly thinking about the logic of restructuring the securities portfolio," said David Rosato, chief financial officer of Berkshire Hills Bancorp in Boston. "We're very similar to a lot of banks where the whole portfolio is underwater." Reinvesting into higher-yielding options would "create a much better run rate going forward," but the capital hit would be significant." [American Banker, 11/7/2023]

Banks highly averse to trading underwater bonds in 2022-23

Within-bank test based on bond-level AFS holdings: bank $b \times \text{CUSIP} c \times \text{time } t$

 $P(sale_{cbt}) = f(mkt \ value/amort. \ cost)_{cbt} + \delta_{bt} + \Gamma X_{ct} + \epsilon_{cbt}$



Patterns not due to "fundamentals" or composition effects

	(1)	(2)	(3)	(4)	(5)	(6)
$FV/AC \in [.99\text{-}1.01]$	0.034***	0.030***	0.032***	0.030***	0.025***	0.021*
	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)	(0.012)
${\sf FV}/{\sf AC}>1.01$	0.035***	0.079***	0.085***	0.077***	0.072***	0.102**
	(0.010)	(0.018)	(0.019)	(0.017)	(0.017)	(0.043)
Obs.	467,728	467,728	467,728	467,728	467,728	69,563
Fixed effects	No	No	Time	Bank x Time	Bank x Time	Bank x Time
						Cusip x Time
Controls	No	No	No	No	Yes	No
Weights	No	Yes	Yes	Yes	Yes	Yes
P(sale) for FV/AC < 0.99	.015	.012	.012	.012	.012	.0083

Dep. var. =1 if security sold in next quarter. Linear model.

FV: fair value. AC: amortized cost. Omitted dummy = underwater: FV/AC < 0.99. Standard errors are clustered at the bank-quarter and cusip levels. *** p < 0.01, ** p < 0.05, * p < 0.1.

Heterogeneity: What drives strategic trading?

Findings: Aversion to trading underwater bonds in 2022-23 related to:

- 1. Regulatory capital management. Larger fx if unrealized losses ("AOCI") not in capital
- 2. Market pressure. Larger fx if bank is trading at discount to book value

				- · · · · · · · · · · · · · · · · · · ·			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FV/AC > 0.99	3.168***	2.129**	1.727**	4.293***	1.764**	3.672***	2.079*
	[1.9, 5.2]	[1.1, 4.1]	[1.0, 2.9]	[1.9, 9.8]	[1.1, 2.9]	[2.0,6.7]	[0.9,4.6]
FV/AC > 0.99	2.366**	2.824***	3.765***	2.406**	1.562	2.295**	3.202**
imes AOCI not in capital	[1.1, 5.2]	[1.4,5.8]	[1.8,8.0]	[1.1,5.3]	[0.6,4.1]	[1.0, 5.2]	[1.3,8.2]
FV/AC > 0.99		1.610					1.200
imes CET1 Buffer $<$ Median		[0.8,3.4]					[0.5,2.8]
FV/AC > 0.99			3.973***				3.182***
imes PB Ratio $<$ Median			[1.7, 9.1]				[1.5,6.8]
FV/AC > 0.99				0.646			0.529
imes YoY Stock Ret $<$ Median				[0.3,1.6]			[0.2,1.4]
FV/AC > 0.99					3.588***		1.975
imes Reserves/Securities < Median					[1.4,9.3]		[0.7,5.5]
FV/AC > 0.99						0.750	0.798
\times Uninsured Deposits/Deposits > Median						[0.3, 1.7]	[0.4,1.8]
Obs.	467,025	467,025	467,025	467,025	467,025	467,025	467,025
Fixed effects	Bank, Time	Bank, Time	Bank, Time	Bank, Time	Bank, Time	Bank, Time	Bank, Time
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Weights	Yes	Yes	Yes	Yes	Yes	Yes	Yes
P(sale) for $FV/AC < 0.99$.012	.012	.012	.012	.012	.012	.012

Logit. Dependent variable: =1 if security sold in following qtr

Note: uninteracted terms also included (but not shown). Odds ratios reported; numbers in square brackets are 95% conf. intervals.

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Fixed effects	Bank, Time						
Controls	Yes						
Weights	Yes						
P(sale) for $FV/AC < 0.99$.012	.012	.012	.012	.012	.012	.012

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III. Hedging Frictions

Why didn't banks hedge more?

- Why didn't banks use derivatives to hedge IRR as duration of callable bonds extended?
- We find evidence that accounting frictions constrain hedging at least for some banks
 - Separate from hedging frictions emphasized in literature: margin requirements/collateral constraints; transaction costs (Rampini-Sufi-Viswanathan, 2014; Purnanandam 2007 etc.)
- Related: other recent work documenting limited bank IRR hedging via derivatives
 - See McPhail-Schnabl-Tuckman (2024); Granja et al. (2024)

Hedge accounting: institutional details

- Advantageous for bank to elect "hedge accounting" when hedging using derivatives
 - Basic idea: Gains/losses on hedge and underlying instrument are netted out
 - Otherwise, hedge generates costly (and misleading) volatility in income & reg. cap. due to mismatch in accounting treatment of derivatives vs securities
- Must establish hedge meets qualifications (e.g., correlation with underlying bond)
 - Not costless to do, and requires ongoing monitoring. Carries some compliance risk.

"The qualifying criteria for hedge accounting are rigorous and require a commitment of time and resources. To avoid the cost and the risk of misapplication of the rules, reporting entities may choose to not elect hedge accounting even though they have a risk management strategy that involves entering into derivatives." [PWC 2024]

Empirical tests

- 1. Fixed costs & scale economies to establish/manage qualified hedge program?
 - Banks at corner solution of 0 qualified hedging? Persistence? Participation increasing in size?

- 2. Are some securities harder to hedge than others? Does this bind?
 - Hedge accounting not permitted for HTM securities (majority of duration)
 - Easier to elect hedge accounting for "plain vanilla" Treasuries than other bonds?
 - Agency MBS: "portfolio layer" method due to prepayment; corp/sov/muni: IRR + credit risk

Empirical tests

- 1. Fixed costs & scale economies to establish/manage qualified hedge program? Yes
 - Banks at corner solution of 0 qualified hedging? Persistence? Participation increasing in size?
 - Hedging = 0 for 52% of bank-qtr obs. (despite sample of large banks)
 - Persistence of hedging vs non-hedging = 95%
 - Participation highly positively correlated with log bank assets [next slide]
- 2. Are some securities harder to hedge than others? Does this bind?
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 - Persistence of hedging vs non-hedging = 95%
 - Participation highly positively correlated with log bank assets [next slide]

2. Are some securities harder to hedge than others? Does this bind? Yes; binds for subset

- Hedge accounting not permitted for HTM securities (majority of duration)
- Easier to elect hedge accounting for "plain vanilla" Treasuries than other bonds?
 - Agency MBS: "portfolio layer" method due to prepayment; corp/sov/muni: IRR + credit risk
 - Hedge accounting much less common for non-Treasuries ($\approx\!50\%$ vs $<\!10\%$ in AFS)
 - Banks with high HTM share hedge less (in duration terms)
 - Top quartile of hedgers "max out" AFS Tsy hedging (hedge >88% of portfolio)
 - Banks hedge more if unrealized securities losses counted in reg. capital

Determinants of hedging: bank-level regressions

Dependent variable $=$ duration removed by hedging (years)							
	(1)	(2)	(3)	(4)			
Duration [years]	0.036**	0.037**	0.010	0.011			
	(0.016)	(0.017)	(0.020)	(0.022)			
HTM [share of portfolio]	-0.142***	-0.145**	-0.227***	-0.231***			
	(0.054)	(0.056)	(0.053)	(0.055)			
US Treasury [share of portfolio]	0.082	0.084	0.033	0.032			
	(0.063)	(0.064)	(0.056)	(0.056)			
AOCI not in capital $[0/1]$			-0.073***	-0.074***			
			(0.028)	(0.028)			
Log(Assets)			0.055***	0.055***			
			(0.011)	(0.012)			
Obs.	263	263	263	263			
Fixed effects	No	Time	No	Time			
DV average	.13	.13	.13	.13			

Less hedging if more HTM; AOCI not in regulatory capital; smaller bank

Conclusions

- Banks do use securities portfolio to manage risk & deposit flows...
- ...but active management constrained by low propensity to **sell bonds outright** or **increase hedging** as bond duration extended in 2022-23
 - i. Banks averse to selling underwater bonds. In part due to design of capital regulation
 - ii. Constraints on qualified hedging shape IRR hedging
- Broader issues / questions:
 - i. Banks have large MBS/mtg holdings; extension risk. Appropriate? Distorted incentives?
 - ii. Regulatory changes to encourage active portfolio risk management?
 - E.g., should securities losses be included in bank capital?

Appendix: Additional slides

Banks shortened duration of new bond purchases

back



Weighted by market value of purchase. Source: FR Y-14Q; IDC; MSCI.

Banks lowered measured risk by classifying callable bonds as HTM

▶ back



- HTM losses not recorded on balance sheet; excluded from "tangible common equity" etc.

- See also Kim, Kim and Ryan (2023); Granja et al. (2024); Greenwald et al. (2024).

Risks of callable bonds mattered for aggregate losses

back

- MTM equity ratio = (fair value of assets liabilities) / assets [10K-10Qs via SNL]
- Below: banks with high share of agency MBS \rightarrow larger MTM losses as rates rose
 - Robust to controlling for post imes deposit beta, or interest expenses directly ho link

	(1)	(2)	(3)	(4)
Post-2022	-0.0335*** (0.002)	-0.0204*** (0.004)	-0.0194*** (0.004)	
${\sf Post-2022}\times{\sf Securities}/{\sf Assets}$		-0.0815*** (0.023)	-0.0241 (0.029)	-0.0235 (0.029)
Post-2022 \times MBS/Assets			-0.1156** (0.045)	-0.1161** (0.045)
Obs.	2681	2681	2681	2681
FEs	Bank	Bank	Bank	Bank, Quarter
DV average	0.100	0.100	0.100	0.100
DV Standard Dev	0.036	0.036	0.036	0.036

Notes: Sample period 2020Q1-2023Q3. Standard errors clustered at the bank level. Both total securities and agency MBS measured as (HTM+AFS) at amortized cost. Securities, MBS and total assets measured as of 2019:Q4. Std deviations: Securities/Assets: 0.15; MBS/Assets: 0.08.

Risks of callable bonds mattered for aggregate losses

back

- MTM equity ratio = (fair value of assets liabilities) / assets [10K-10Qs via SNL]
- Below: banks with high share of agency MBS \rightarrow larger MTM losses as rates rose
 - Robust to controlling for post imes deposit beta, or interest expenses directly ho link

	(1)	(2)	(3)	(4)
Post-2022	-0.0335*** (0.002)	-0.0204*** (0.004)	-0.0194*** (0.004)	
Post-2022 \times Securities/Assets		-0.0815*** (0.023)	-0.0241 (0.029)	-0.0235 (0.029)
Post-2022 \times MBS/Assets			-0.1156** (0.045)	-0.1161** (0.045)
Obs. FEs DV average DV Standard Dev	2681 Bank 0.100 0.036	2681 Bank 0.100 0.036	2681 Bank 0.100 0.036	2681 Bank, Quarter 0.100 0.036

Notes: Sample period 2020Q1-2023Q3. Standard errors clustered at the bank level. Both total securities and agency MBS measured as (HTM+AFS) at amortized cost. Securities, MBS and total assets measured as of 2019:Q4. Std deviations: Securities/Assets: 0.15; MBS/Assets: 0.08.

Income yield by securities type

▶ back



Securities income and dividend yield: by securities type

Interest and dividend income scaled by average amortized cost (measured as average of amortized cost at time t and time t-1). Source: Call reports.

MTM equity regressions – robustness

back

Contemporaneous Fair Value of Equity/Current Total Assets.								
	(1)	(2)	(3)	(4)	(5)	(6)		
Post-2022	-0.0335*** (0.002)	-0.0204*** (0.004)	-0.0194*** (0.004)					
${\sf Post-2022}\times{\sf Securities}/{\sf Assets}$		-0.0815*** (0.023)	-0.0241 (0.029)	-0.0235 (0.029)	-0.0359 (0.032)	-0.0270 (0.029)		
Post-2022 $ imes$ MBS/Assets			-0.1156** (0.045)	-0.1161** (0.045)	-0.1201** (0.048)	-0.1160** (0.045)		
Post-2022 $ imes$ Deposit Beta					0.0465** (0.020)			
Deposit Expense						-0.0018 (0.001)		
Obs.	2681	2681	2681	2681	2303	2666		
Bank FEs	Yes	Yes	Yes	Yes	Yes	Yes		
Quarter FEs	No	No	No	Yes	Yes	Yes		
DV average	0.100	0.100	0.100	0.100	0.099	0.100		
DV Standard Dev	0.036	0.036	0.036	0.036	0.035	0.036		

Time period runs from 2020q1-2023q3. Standard errors clustered by bank.