Do Banks Hedge the Risk of Fixed-Income Security Holdings?*

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Abstract

Hedging comprises two key dimensions: adequacy and timing. In contrast to Silicon Valley Bank, findings indicate that derivative-using financial institutions time their discretionary hedging against losses in fixed-income securities and risks in unsecured deposits. However, the adequacy of these hedging strategies remains an open question. Banks asymmetrically manage risk by intensifying hedging activity as HTM and AFS portfolio losses accrue and reducing hedging activity as portfolio gains accrue. As funding risk increases, banks also intensify hedging activity, suggesting the mistakes of Silicon Valley Bank are idiosyncratic not systematic. Evidence suggests financial institutions incorporate forward interest rate guidance when managing and anticipating balance sheet risks.

JEL classification: G21, G24, E43, G32

Keywords: Hedging, Interest Rate Derivatives, Interest Rate Risk, Silicon Valley Bank, Held to Maturity, Available for Sale, Securities, Treasuries, Banks

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1 Introduction

When Silicon Valley Bank (SVB) and First Republic Bank (FRB) became two of the largest bank failures in American history, the speed of their collapse exposed a gap in understanding of whether banks hedge their risks in fixed-income securities and unsecured funding. SVB and FRB had significant losses on their fixed-income securities (Table 1) and high levels of uninsured deposits but curiously had zero interest rate hedges to mitigate those risks (Brown, 2023). Prior to their collapse, interest rates had risen the fastest since the 1980s. Given the inverse relationship between fixed-income security values and interest rates, losses in both held-to-maturity (HTM) and available-for-sale (AFS) fixed-income securities surged dramatically. After SVB sold its remaining interest rate hedges at the end of 2022, its $26 billion AFS and $91 billion HTM securities were left unhedged, and news of SVB's $1.8 billion losses on its bond sale alarmed depositors who attempted to withdraw $142 billion from March 9-10, 2023[1]. This triggered widespread deposit withdrawals as questions about whether SVB's lack of hedges against its fixed-income security losses and funding risks were systematic throughout the financial sector. This paper addresses whether banks, namely those less than $250 billion in assets, hedge against these risks and whether these risks are hedged asymmetrically during rising and falling interest rates. Symmetric hedging implies an indiscriminate response to any interest rate change, while asymmetric hedging implies banks use discretion to increase hedging when debt securities deteriorate and decrease hedging when debt securities gain value.

When banks hold HTM and AFS debt securities in their portfolio, they are exposed to interest rate risks from fluctuations in the fair value of these securities (Krainer and Paul, 2023). Banks can use interest rate derivatives (IRDs) as a hedging tool to mitigate this interest rate risk. Figure 1 shows how IRD use dramatically increased in 2021 Q2 when CPI reached 5%, three quarters before interest rates started to rise, leading to dramatic

[1] Brown (2023) and Son (2023)

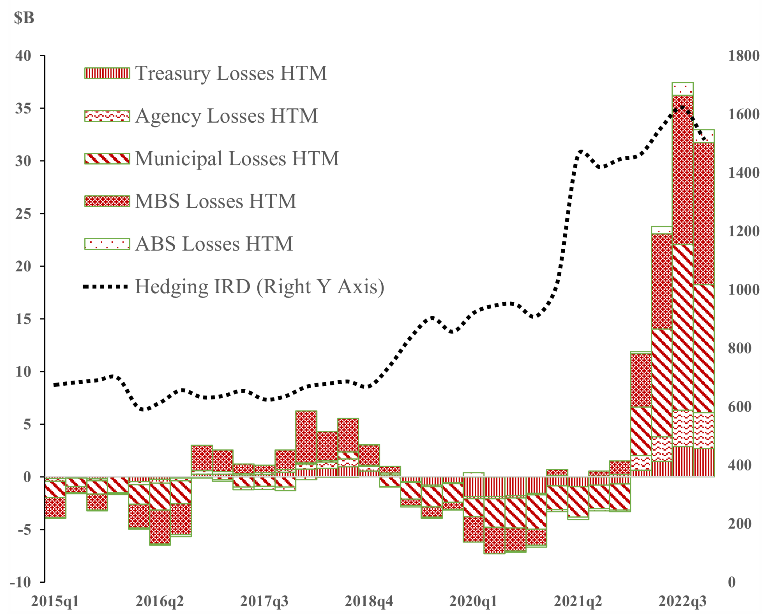
losses in HTM and AFS security holdings. Interest rate derivatives are financial instruments whose values are based on an underlying interest rate, such as the federal funds rate or the LIBOR. Some common types of IRDs used for hedging include interest rate swaps, interest rate futures, and options on interest rate futures.

Table 1. Bank Failures and Interest Rate Hedging
Data for individual banks are from the 2022 10Ks, while IRD Hedging (N=975) and Non-Hedging Banks (N=3768) are averages from 2022 Q4 Call Reports. All banks over $250 billion in assets are excluded. HTM and AFS losses are the sum of realized and unrealized losses. Uninsured deposits (% of deposits that are uninsured) are derived from the Call Reports. All other variables are divided by total assets, including CET1 Assets or Common Equity Tier 1 Assets divided by Total Assets.

	Assets $M	HTM Losses %	AFS Losses %	Unins. Dep. %	Total Securities %	IRD Hedging %	CET1 Assets %
Silicon Valley Bank	211,793	7.15	5.92	91.3	55.4	0.00	8.1
First Republic Bank	212,638	2.24	0.22	67.8	14.9	0.00	6.5
PacWest Bancorp	41,229	0.49	2.31	47.4	17.3	0.00	8.3
Western Alliance	67,734	0.25	1.30	71.1	12.4	0.70	8.5
IRD Hedging Banks	7,900	0.07	1.72	33.1	22.5	6.98	10.2
Non-Hedging Banks	670	0.03	2.06	26.4	27.7	0.00	12.9

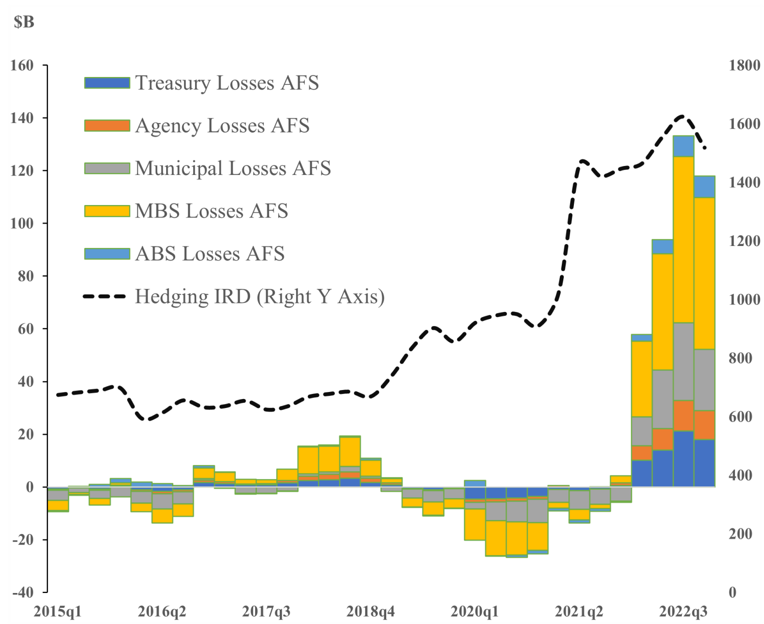
For example, if a bank wants to hedge its HTM and AFS securities using interest rate derivatives, it can enter into an interest rate swap with a counterparty to exchange fixed and floating interest rate payments. In a rising interest rate environment, banks can pay a fixed interest rate to the counterparty while receiving a floating interest rate in return. This swap would protect the bank from rising interest rates, as receive-floating swaps would increase in value, partially offsetting the reduced values of HTM and AFS securities.[2] A bank could also

[2] Kim (2022) demonstrates that banks are price-takers in the Treasury market, providing evidence that endogeneity, where bank demand drives Treasury prices, is unlikely.



(a) Total Held-to-Maturity Losses vs Hedging IRDs

Figure 1. Total Security Losses and Hedging Interest Rate Derivatives (IRD) Subfigure (a) represents held-to-maturity losses aggregated by fixed-income security type across all banks except for those over $250 billion in assets. Hedging interest rate derivatives (IRD) are scaled on the right Y axis and reported on the RC-L Derivatives and Off-Balance Sheet Items section of the Call Reports. Subfigure (b) represents available-for-sale losses aggregated by fixed-income security type across all banks except for those over $250 billion in assets. Fixed-income securities are US Treasuries, Non-MBS Agencies, Municipals, Mortgage-Backed Securities, and Asset-Backed Securities & Others. Losses are calculated as amortized cost minus fair value, as reported in the Schedule RC-B Securities section of the Call Reports.



(a) Total Available-for-Sale Losses vs Hedging IRDs use interest rate futures or options on interest rate futures to hedge its exposure to interest rate risk. For example, the company could short 10Y Treasury futures, and as interest rates rose, its gains in futures would offset losses in its HTM or AFS securities. While a complete hedge may be cost-prohibitive, a partial hedge can indicate to depositors and shareholders that management is actively aware of, and managing interest rate risks.

Existing research has yet to specifically address whether banks with assets below $250 billion engage in discretionary hedging activity to offset losses in their fixed-income securities. This gap in the literature is partially due to data limitations, a focus on larger financial institutions, and the novelty of the question being explored. For instance, the individual interest rate swap data utilized in studies by Hoffmann, Langfield, Pierobon, and Vuillemey (2019) and McPhail, Schnabl, and Tuckman (2023) does not distinguish between hedging and trading activities, and this omission complicates the analysis of bank-level hedging practices. This paper demonstrates that hedging and trading activities are fundamentally different, as trading activity seems to depend on macroeconomic factors, while bank hedging activity seems to be based on bank-level risks. Thus, conflating the two could lead to problematic interpretations of bank hedging activities. This paper addresses this gap in the literature by utilizing the Schedule RC-L (Derivative and Off-Balance Sheet Items) in the Call Reports. While the derivative notional values in the Call Reports lacks specific details such as maturity, direction, and swap rates, they offer a significant advantage by categorizing interest rate derivatives into hedging and trading activities. The FDIC and the Federal Reserve actively monitor banks to ensure they adhere to regulations on derivative reporting, making it unlikely banks would "misclassify" speculative trading with hedging (Purnanandam, 2007). However unlikely, these variables would be contaminated if banks actively engaged in fraud and reported trading activity as hedging activity.

Hedging comprises two key dimensions: adequacy and timing. Jiang, Matvos, Piskorski, and Seru (2023a) focuses on the former, pointing out that before the collapse of Silicon Valley Bank, only 6% of aggregated assets in the banking sector were hedged by interest rate swaps. Their paper does not explore the second dimension, specifically the timing of hedging activities in relation to fluctuations in fixed-income securities. Regarding adequacy, the goal of hedging can be to reduce risk, not eliminate it entirely as that can be cost-prohibitive. For instance, Bank One's long-standing policy is to hedge its asset-sensitive balance sheet so that earnings do not change more than 5% for a 1% change in interest rates (Esty, Tufano, and Headley, 1994). If this threshold was breached, Bank One could enter into a pay-floating swap, incurring a floating rate liability while investing in a fixed-rate asset, moving the bank away from being asset-sensitive to being liability-sensitive (or negative earnings-sensitive). As far as I know, this paper is the first to examine the timing of bank-level hedging activities against losses in fixed-income securities and funding risks from uninsured deposits. This focus offers invaluable insights into risk management practices in the banking sector, particularly in the context of the surrounding the collapse of Silicon Valley Bank.

This paper finds banks asymmetrically hedge the risks associated with their fixed-income portfolios. This asymmetric hedging indicates discretionary timing, as banks strategically intensify hedging activities as rises rise and decrease hedging activities as risks wane. An uptick in hedging is especially pronounced when banks face simultaneous risks in securities and funding, as the interaction between HTM losses and uninsured deposits is significantly positive in rising interest rate environments. Conversely, banks are more likely to reduce hedging in their AFS portfolios when interest rates fall and asset values rise, a trend less evident in their HTM portfolios. This nuanced, risk-sensitive timing starkly contrasts Silicon Valley Bank's 2022 decision to cease hedging activities as risks increased to their fixed-income portfolios. Overall, findings suggest that banks actively manage interest rate and funding risks, highlighting divergences from SVB's risk management practices.

These findings may be subject to endogeneity and sample selection bias, particularly if banks use interest rate derivatives to simultaneously increase risk through trading and decrease risk through hedging. Fortunately, the Call Reports mitigate these concerns by requiring banks to distinguish between interest rate derivatives used for hedging (RCON8725) and those used for trading (RCONA126).[3] Trading derivatives primarily aim for profit, while hedging derivatives mitigate bank-level risks to balance sheets. Importantly, hedging derivatives are acquired only after a bank has already incurred balance sheet risk, thereby establishing a clear sequential relationship between acquiring securities and interest rate derivatives used for hedging. Sample selection bias is also a notable concern, as hedging banks represent only 20% of all banks, potentially leading to biased estimates. A Heckman two-step selection model addresses this, and the results corroborate the study's primary findings.

The rest of this paper is organized as follows: Section 2 covers the literature on interest rate hedging in banks and the recent banking crisis of 2023, Section 3 and 4 go over the data and empirical results, and lastly, Section 5 outlines the conclusions of this paper.

2 Literature Review

This paper contributes to two strands of academic literature. The first consists of interest rate hedging in banks and the second consists of newer literature that studies the implications of the Silicon Valley Bank failure. The broader literature on hedging risk can be further narrowed to banks using interest rate derivatives to hedge interest rate risk. This paper addresses a gap within both strands of literature by using Silicon Valley Bank's failure as a framework to investigate whether similar issues systematically plague other banks. This framework focuses on whether banks hedge risk in their HTM and AFS fixed-income securities portfolio and funding risk from unsecured deposit liabilities, both individually and in conjunction. By applying these questions raised by the SVB failure to the broader banking industry, this paper addresses a gap in the existing body of literature.

[3] In Kim (2021), hedging IRDs are used to address mortgage rate risk during the origination process.

Interest Rate Hedging in Banks

As banks are repositories for interest rate risk (Gorton and Rosen, 1995), banks can optimally hedge this risk to improve its financial intermediation capabilities (Diamond, 1984) such as loan growth (Brewer III, Minton, and Moser, 2000; Landier, Sraer, and Thesmar, 2013)[4] and the acquisition of more interest-bearing assets. Hedging also mitigates frictions due to macroeconomic risk (Purnanandam, 2007; Bliss, Clark, and DeLisle, 2018; Kim, 2021), bankruptcy costs (Smith and Stulz, 1985), external financing risk (Froot, Scharfstein, and Stein, 1993), and mismatched maturity risk (Purnanandam, 2007). The use of interest rate derivatives in banks constitutes a specialized area within this body of literature.

Bank Hedging During Rising Rate Environments. This paper fills two critical gaps in existing research. First, this paper investigates bank hedging activity against losses in their fixed-income security holdings in rising interest rate environments. While Hoffmann et al. (2019) also examines banks during rising interest rates, their research focuses on the impact of variable-rate mortgages on bank balance sheets without examining hedging activity that banks deploy for fixed-income securities in such conditions. While this paper shares a thematic similarity with McPhail et al. (2023) in that both investigate interest rate derivatives, their paper differs in two crucial respects. McPhail et al. (2023) uses individual interest rate swaps to examine net swap exposures in the 250 largest US banks, finding their net swap exposures mostly offset. The primary limitation of their data is that it does not distinguish between swaps used for trading and those used for hedging, resulting in an aggregated net exposure that does not accurately represent a bank's hedging activities. Also, larger banks such as dealers often use derivatives for trading more often than hedging (Begenau, Piazzesi, and Schneider, 2015), skewing the net interest rate exposure so that it is not a reliable gauge of actual hedging activities. In contrast, this paper focuses on a

[4] Brewer III et al. (2000) found that banks that use interest rate derivatives experience greater growth in their loan portfolios than banks that did not use them.

broader dataset encompassing all 1,884 commercial banks that deploy interest rate hedges. Importantly, the Call Report data not only distinguishes between interest rate derivatives used for hedging and those used for trading purposes, but this paper further underscores that trading and hedging activities are fundamentally different and should not be conflated.

Second, my paper contributes to the literature by exploring whether banks hedge funding risk from uninsured deposits, which behave like short-term liabilities. This extends the discussion beyond existing studies such as (Drechsler, Savov, and Schnabl, 2017, 2021), which focus on deposits that act as longer-term liabilities. In sum, my paper offers a nuanced understanding of both hedging strategies and the role of uninsured deposits in the broader context of banking risk management.

Silicon Valley Bank

The rapidly growing literature on the collapse of Silicon Valley Bank demonstrates that the U.S. banking system is susceptible to runs by uninsured depositors (Jiang, Matvos, Piskorski, and Seru, 2023b). Such runs are often driven by negative signaling from banks, such as the reclassification of unrealized security losses away from net income (Granja, 2023). Such behavior can pose systemic risk, necessitating further Federal Reserve interventions in the future (Metrick and Schmelzing, 2023).

Jiang et al. (2023a) argues that banks are not adequately hedged due to interest rate swaps making up only 6% of assets, and this paper corroborates those findings. This paper aims to fill a gap in the literature by using panel data to explore the timing of discretionary hedging activities in response to escalating HTM and AFS security losses, particularly when they hold significant uninsured deposits. While the unhedged portions of bank assets may still be significant, this paper finds HTM/AFS security losses explain the variability of within-bank hedging. These findings were not due to time-invariant bank characteristics or macroeconomic factors, but bank-level changes in security losses and funding risks. More importantly, these findings demonstrate that SVB's lack of hedging was not systematically found in banks below $250 billion in assets.

3 Data and Hedging Activity Variables

3.1 Data Sources

I obtained data from two primary sources: 1) the Federal Reserve's Call Reports, which contain quarterly accounting data of all FDIC-insured commercial banks in the United States and 2) the Chicago Board of Exchange, which has interest rate data for swaps. These data sources are supplemented by sources such as 10-K filings. Consolidated and domestic bank data were merged and duplicates were eliminated. Consistent time series were formed by looking at the Call Report forms and matching variables as they changed from quarter to quarter.

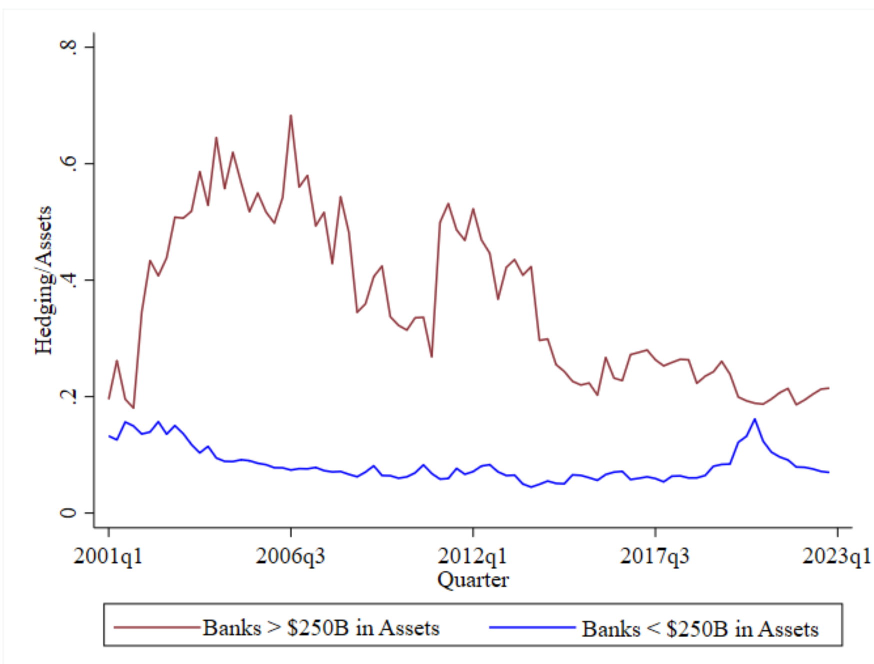


Figure 2. Hedging Interest Rate Derivatives in Banks Over and Under $250B
Hedging interest rate derivatives (RCFD8725) are scaled by total assets (RCFD2170). Banks greater (less than) than $250B represent the average hedging to asset ratio for all banks above (below) $250B in assets at quarter end.

This paper focuses on banks with less than $250 billion in assets such as Silicon Valley Bank, as institutions exceeding this threshold are already subject to substantial regulatory scrutiny, including annual stress tests from the Federal Reserve. Therefore, banks with total assets greater than $250 billion were dropped from the sample, as well as banks with missing bank identifiers (IDRSSD) and zero or missing total assets (RCFD2170). The estimation of the relationship between bank hedging and interest rate risk uses data from 2015 Q1 to 2022 Q4, as before February 20, 2015, smaller community banks did not engage in hedging as frequently. This lack of hedging was partly due to regulatory uncertainty from the Dodd-Frank Act (Kim, 2021). As Figure 2 shows, banks over $250 billion in assets use derivatives for hedging at a much greater level than banks below $250 billion in assets. This may be partly due to the greater interest rate risk due to trading found in market-making banks compared to "traditional banks" as shown in Begenau et al. (2015). All bank-level variables are winsorized at the 0.5% level every quarter.

3.2 Hedging Activity Variables

Data on derivatives is obtained from the Schedule RC-L (Derivatives and Off-Balance Sheet Items) and supported by sources such as 10-K filings. In the Call Reports, commercial banks report using interest rate derivatives for trading (RCFDA126) separately from their non-trading interest rate derivatives (RCFD8725). Trading interest rate derivatives are described as "contracts held for trading", which include dealing, trading and hedging those very trading activities. Trading interest rate derivatives are reported in gross notional amounts, which allows for the measurement of actual trading activity which may have otherwise been obscured by fluctuating market values. Interest rate derivatives used for hedging purposes are reported as "contracts held for non-trading purposes", following Purnanandam (2007). Hedging IRD are reported in gross notional amounts which measures hedging activity, not fluctuating market values. All bank level variables are scaled by total assets (RCFD2170) at quarter end. Interest rate derivatives include futures, forwards, written options, purchased options, over-the-counter options, and swaps.

Figure 2 reveals that banks with assets greater than $250 billion engage in significantly more hedging activity compared to those below $250 billion. This disparity leads to concerns that banks below $250 billion may not be adequately hedging their interest rate exposure, both in terms of the size of exposure and in recognizing where those exposures are located within specific assets. This disparity in hedging activity reaffirms the importance of isolating banks below $250 billion in total assets.

Summary statistics in Table 2 show significant differences between hedging and non-hedging banks. Hedging banks are larger in size ($4.36 billion vs $481 million) and have larger loan portfolios due to greater lending capacity and the ability to spread their lending risk across a larger number of borrowers. Hedging banks only slightly differ from non-hedging banks in the size of its deposit base, but hedging banks have a higher percentage of uninsured deposits (26.56% vs. 20.44%). Non-hedging banks are more conservative in numerous ways, such as significantly higher equity, reserves, and common equity tier 1 ratios. Also, non-hedging banks have half the maturity gap risk as hedging banks (6.08% vs. 12.15%), but may also hold slightly more HTM+AFS portfolio interest rate risk (19.92% vs. 17.29%). Non-hedging banks may have a lower needs for hedging their interest rate risk due to more conservative balance sheets. Non-hedging banks also slightly underperform hedging banks regarding returns on HTM fixed income securities (-0.42% vs -0.49% in losses), and have relatively similar performance in returns for AFS fixed income securities. Interestingly enough, non-hedging banks outperform hedging banks in returns on MBS, which often make up the largest portion of a bank's fixed income securities portfolio. This may be partly due to the importance that smaller banks place on mortgage backed securities, as Kim (2021) also finds that mortgage securitization makes up a larger portion of community banking business than larger regional banks.[5]

[5]The Call Report RC-P Family Residential Mortgage Banking Activities documents the securitization, sale, and servicing operations of hedging and non-hedging banks.

Table 2. Summary Statistics for Hedging Banks vs. Non-Hedging Banks
Data is from Call Reports (2015Q1–2022Q4). Ratios are scaled by total assets and are represented as percentages. Held-to-Maturity Losses and Available-for-Sale Losses are calculated as percentage change in the underlying security.

	Hedging N=39,110		**Non-Hedging** N=136,583		Mean
Variables	Mean	SD	Mean	SD	Difference
Total Assets ($M)	4,360	12,000	481	2,500	3,879***
Hedging IRD (%)	6.00	10.66	0.00	0.00	6.00***
Trading IRD (%)	1.22	4.69	0.13	1.43	1.09***
Interest Rate Futures (%)	0.00	0.00	0.00	0.00	0.00***
Interest Rate Forwards (%)	0.84	2.87	0.01	0.33	0.83***
Interest Rate Swaps (%)	2.28	5.49	0.07	1.00	2.21***
Pay Fixed Swaps (%)	1.06	2.76	0.00	0.00	1.06***
Loans (%)	68.69	13.22	60.84	19.11	7.84***
Deposits (%)	82.60	6.86	82.72	13.41	-0.13**
Uninsured/Deposits (%)	26.56	14.51	20.44	13.16	6.12***
Reserves (%)	4.16	5.64	5.07	7.19	-0.91***
Total Equity (%)	10.85	2.70	13.02	10.88	-2.18***
Common Equity Tier 1 (%)	10.18	2.37	12.75	10.31	-2.57***
Maturity Gap Ratio (%,)	12.15	13.58	6.08	13.97	6.07***
Non Performing Assets (%)	0.06	0.20	0.08	0.23	-0.02***
HTM+AFS Securities (%)	17.29	12.27	19.92	16.50	-2.63***
Held to Maturity Losses					
Total (%)	-0.49	4.52	-0.42	3.98	-0.07**
Treasuries (%)	-0.65	6.42	0.30	3.72	-0.95***
Non-MBS Agencies (%)	0.94	4.52	0.75	3.58	0.19***
State (%)	-1.04	4.54	-0.68	4.01	-0.36***
MBS (%)	-0.77	6.57	-1.11	5.80	0.34***
ABS & Other (%)	-1.57	29.40	-0.49	12.00	-1.08***
Available for Sale Losses					
Total (%)	0.45	3.61	0.43	3.57	0.02
Treasuries (%)	0.85	3.21	0.86	3.30	-0.01
Non-MBS Agencies (%)	0.71	3.23	0.92	3.28	-0.21***
State (%)	-0.34	4.47	-0.08	4.25	-0.23***
MBS (%)	0.56	3.84	0.41	3.77	0.15***
ABS & Other (%)	1.31	6.24	0.96	6.51	0.35***

4 Empirical Model and Results

First, I examine interest rate derivatives used for hedging separately from those used for trading. The Call Reports provide an advantage over individual swap data by reporting notional amounts used for hedging (RCFD8725) separately from those used for trading (RCFDA126). This eliminates the most problematic issue with individual swap data: they are not classified for hedging or trading purposes. When interest rate derivatives are not classified separately, the calculated net exposure does not shed light on a bank's hedging activity, but instead conflates hedging activity with trading activity. When examining bank hedging activity, it is paramount to analyze whether banks target interest rate risk in specific assets for hedging. When hedging activity cannot be distinguished from trading activity, it creates a challenge that makes this analysis problematic and essentially impossible. By focusing solely on interest rate hedging activity, this paper eliminates the earlier problem when examining individual interest rate swaps.

Hypothesis 1. *Hedging IRD and Trading IRD have different approaches in how banks utilize them in response to changes in interest rates.*

Similar to the analysis found in Kim (2021), Table 3 explores the impact of 10-year swap rates on interest rate derivatives. Additionally, this table adds a new dimension by comparing the effects of 10-year swap rates on IRD used for trading versus those used specifically for hedging. (1) and (2) examines periods of rising interest rates, while (3) and (4) examine periods of falling interest rates. In (1) and (3), the dependent variable $\Delta IRD_{i,t}$ of bank i is the change in trading interest rate derivatives from $t-1$ to t. In (2) and (4), the dependent variable is the change in trading interest rate derivatives from $t-1$ to t. The independent variable $\sum_{\tau=0}^{3} \beta^{H} \Delta Rates_{t-\tau}$ is the change in 10Y swap rates over the past four periods, including the current one. Fixed effects are at the bank level, and standard errors are two-way clustered at the bank and quarter level.

When rates are rising, in (1) the trading coefficient on $\Delta IRD_{i,t}$ is -0.007***, suggesting

Table 3. How Interest Rates Impact Trading and Hedging IRD
The dependent variable is the change in interest rate derivatives from t-1 to t, scaled by total assets. In (1) and (3), ΔIRD are used for trading purposes (RCFDA126) while in (2) and (4) they are used for hedging purposes (RCFD8725). $\Delta Rates$ is the change in 10Y swap rates (Bloomberg) from t-1 to t. (1) and (2) consists of quarters where respective interest rates rose and (3) and (4) consist of quarters where the respective interest rates fell. Bank-level variables are winsorized at the 0.5% level. Quarterly bank data is from 2015Q1 to 2022Q4 and derived from the Call Reports. Fixed effects are at the bank level and standard errors are two-way clustered at the bank and quarterly level. T-statistics are reported in parentheses.

	Dependent Variable: $\Delta IRD_{i,t}$			
	Rising Rates$_t$		*Falling Rates*	
	Trading	*Hedging*	*Trading*	*Hedging*
	(1)	(2)	(3)	(4)
$\Delta Rates_t$	-0.007***	-0.002	-0.02***	-0.057***
	(-4.1)	(-0.35)	(-3.75)	(-9.31)
$\Delta Rates_{t-1}$	-0.002	0.003	-0.002	0.006
	(-0.76)	(0.6)	(-0.47)	(0.95)
$\Delta Rates_{t-2}$	0.007**	-0.004	-0.004	-0.022**
	(2.14)	(-0.48)	(-0.46)	(-2.05)
$\Delta Rates_{t-3}$	-0.003	0.003	0.001	0.005
	(-1.33)	(0.78)	(0.35)	(1.09)
Observations	4,632	23,114	2,837	14,482
Interest Rates	10Y Swap	10Y Swap	10Y Swap	10Y Swap
Bank FE	✓	✓	✓	✓
Bank Clusters	✓	✓	✓	✓
Time Clusters	✓	✓	✓	✓
Adjusted R^2	0.02	0.02	0.02	0.07
Within R^2	0.01	0.00	0.05	0.09

that banks sell 57.4% of their trading IRD[6] when 10Y swap rates increase by 100 basis points. An example of this trade is when interest rates rise, the value of pay-fixed/receive floating swaps will increase, enabling a bank to realize a profit by selling this swap. On the other hand, in (2) the hedging coefficient on $\Delta IRD_{i,t}$ is insignificant at -0.002, suggesting that bank hedging activity does not primarily depend on rising swap rates. Instead of macro-level risks, bank hedging may target bank-specific risk such as increasing HTM or AFS security losses or increasing funding risks from uninsured deposits.

When rates are falling, the coefficient for $\Delta IRD_{i,t}$ for trading and hedging are -0.02*** and -0.057***, respectively. This suggests banks significantly increase trading and hedging activity during periods of falling rates. Begenau et al. (2015) finds trading IRD values gain when interest rates fall and the results in (3) suggest bank trading activity also increases when rates fall. This implies banks don't just benefit from asset appreciation but also proactively capitalize on profitable opportunities. A 100 bps decrease in swap rates is associated with a 164% increase in trading and a 95% increase in hedging activity.[7] Over 4 years, a reduction of 100 basis points in the swap rate is expected to increase hedging interest rate derivatives by 132%. Across all four specifications, the adjusted R^2 for Table 3 is low, suggesting that interest rates are not the only explanation for trading and hedging activity.

Overall, results suggest that hedging IRD and trading IRD are used differently by banks in response to changes in interest rates. These strategies diverge when interest rates are rising, and exhibit similarities when interest rates are falling. When interest rates are rising, banks that trade IRD tend to sell them in order to take profits. Conversely, banks that engage in hedging IRD do not appear to base their hedging activities on changes in interest rates. This differentiation emphasizes that trading and hedging IRD serve unique purposes and strategies within banks. On the other hand, when interest rates are falling, banks significantly increase both hedging and trading IRD. Around 70% of bank loans are floating

[6] In Table 2, hedging banks have trading IRD that average 1.22% of total assets. 0.007/0.0122 = 57.4%

[7] In Table 2, hedging banks have trading IRD that average 1.22% of total assets. 0.02/0.0122 = 164%. Hedging banks have hedging IRD that average 6% of assets. 0.057/0.06=95%. The sum of significant interest rate betas $\sum_{\tau=0}^{3} \beta^H \Delta Rates_{t-\tau}$ is equal to -0.079. 0.079/0.06=132%.

rate (Vickery, 2008; Faulkender, 2005) which has reduced income when interest rates fall. Banks hedge floating rate loans by entering into pay floating/receive fixed swaps to lock in higher interest rate income, ensuring a fixed rate even as interest rates fall further.

Having established that bank hedging practices differ from trading practices, we now introduce our next hypothesis in addressing the issues surrounding Silicon Valley Bank.

Hypothesis 2. *Banks increase hedging activity to mitigate losses in their fixed-income portfolios.*

As a corollary, if banks increase hedging activity when losses increase, banks may also decrease hedging activity when gains increase.

Hypothesis 3. *Banks reduce hedging activity when there are gains in their fixed-income portfolios.*

If both are true, this suggests that banks practice discretionary hedging by applying asymmetrical strategies during periods rising and falling interest rates. Prior literature has fallen short in specifically addressing these questions because the issues surrounding SVB were unexpected and not contemplated within academic research. Additionally, the use of individual swap data could not answer this question because individual swap data was not classified according to their use for hedging or trading purposes. The Schedule RC-L provides this information, highlighting a significant gap in previous studies and underscoring the need for this present analysis. Table 4 examines IRDs used to internally hedge interest rate risk on a bank's balance sheet using the following empirical model:

$$\begin{aligned}\frac{\textit{Hedging IRD}_{it}}{\textit{Assets}_{it}} = \alpha_i + \lambda_t + \frac{\textit{Held-to-Maturity Security Losses}_{i,t}}{\textit{Assets}_{it}} \\ + \frac{\textit{Available-for-Sale Security Losses}_{i,t}}{\textit{Assets}_{it}} + \frac{\textit{Maturity Gap}_{it}}{\textit{Assets}_{it}} + X'\beta + \varepsilon_{it}\end{aligned} \tag{1}$$

This model incorporates time-fixed effects γ_t to account for time-varying swap rates that impact bank utilization of hedging IRD, in line with the findings of Table 3. Bank fixed

Table 4. Hedging Portfolio Interest Rate Risk

The dependent variable is hedging interest rate derivatives which are non-trading interest rate derivatives used to hedge the interest rate risk of bank balance sheets. Quarter data is from the 2015Q1 to 2022Q4 Call Reports, and variable definitions are found in Appendix A. (1) consists of all quarters while (2) adds mortgage originations as a control variable. (3) consist only of quarters where the 10Y Treasury rate rose while (4) consists only of quarters where the 10Y Treasury rate fell. Control variables include the maturity gap ratio, log(assets), and deposits. All variables are winsorized at 0.5%. All specifications use two-way fixed effects at the bank and quarter levels and standard errors are two-way clustered at the bank and quarter levels. T-statistics are reported in parentheses.

	Dependent Variable: Hedging$_{i,t}$			
	All Periods (1)	*All Periods* (2)	*Rising Rates* (3)	*Falling Rates* (4)
HTM Losses$_{i,t}$	0.78***	2.36***	0.768***	1.104
	(3.35)	(3.82)	(2.98)	(1.19)
AFS Losses$_{i,t}$	0.665***	1.383***	0.66***	1.572***
	(3.72)	(2.73)	(3.1)	(3.78)
Maturity Gap$_{i,t}$	0.082***	0.022	0.113***	0.035
	(4.35)	(1.01)	(4.99)	(1.7)
Mortgage Originations$_{i,t}$		0.237***		
		(4.32)		
Log (Assets)$_{i,t}$	0.021**	-0.005	0.025**	0.027**
	(2.22)	(-0.46)	(2.26)	(2.29)
Deposits$_{i,t}$	-0.11***	-0.07	-0.114***	-0.12***
	(-2.81)	(-1.59)	(-2.7)	(-2.73)
Observations	37,763	7,919	20,967	15,502
Bank FE	✓	✓	✓	✓
Time FE	✓	✓	✓	✓
Bank Clusters	✓	✓	✓	✓
Time Clusters	✓	✓	✓	✓
Adjusted R^2	0.78	0.92	0.76	0.80
Within R^2	0.02	0.10	0.03	0.02

effects α_i account for time-invariant bank characteristics that impact hedging practices. I investigate the losses in held-to-maturity and available-for-sale fixed-income security holdings that were identified as problematic factors in the March 2023 failure of SVB and other banks. Purnanandam (2007) finds the 12-month maturity gap (Flannery and James, 1984) is a proxy for interest rate risk stemming from loan assets, demonstrating its importance as a control variable. Log of assets and deposits are also included as control variables due to differences in derivative use due to bank size and deposit base (Purnanandam, 2007). I expect that banks would protect against losses when the value of securities declines and reduce hedging intensity when the values of securities increase. In (1), the positive coefficients on HTM and AVS Losses (0.78*** and 0.665*** respectively) support the expectations of discretionary hedging. The maturity gap is also positive and significant (0.082***) as found in the prior literature. In (2), I add mortgage originations as a control variable as Kim (2021) finds banks hedge mortgage rate risk during the securitization process. The maturity gap is no longer significant and mortgage originations have a positively significant coefficient of 0.237***. However, the inclusion of mortgage originations as a control variable decreases observations from 37,763 to 7,919. So I drop mortgage originations as a control variable going forward. As interest rates rise in (3) and the value of securities declines, the coefficient on HTM Losses (0.768***) and AFS Losses (0.660***) indicate that banks increase hedging activity to reduce losses on HTM and AFS securities. As market rates fall (4) and security values increase, the insignificant coefficient on HTM Losses (1.104) indicates that hedging activity for HTM securities is less aggressive in falling rate environments. As time-fixed effects would account for derivative activity due to changes in interest rates and the maturity gap accounts for derivative activity due to interest rate risk, this coefficient on AFS Losses (1.572***) represents banks reducing hedges as its fixed-income securities rise in value. Regarding the maturity gap, results continue to support prior research that banks hedge interest rate risk from mismatched maturities. (Purnanandam, 2007; Kim, 2021). Overall, findings support that banks use discretionary hedging to address potential losses in its fixed-income securities.

However, questions exist about whether these findings are due to sample selection bias, which is addressed in the next section.

4.0.1 Heckman Two-Step Selection Model.

Table 4 is estimated using only bank that hedge using interest rate derivatives, and studies such as Sinkey Jr and Carter (2000) and Minton, Stulz, and Williamson (2009) indicate that derivative-using and non-using banks have different characteristics. This raises concerns that the panel data in Table 4 is subject to selection bias when hedging IRD is the dependent variable. Similar to Bliss et al. (2018); Purnanandam (2007); Kim (2021), I deploy a Heckman (1979) two-stage model that uses maximum likelihood estimation to correct for any sample selection bias. Using this approach, I obtain similar overall findings as Table 4, confirming this paper's findings are not driven by sample selection bias. The first stage in Eq. 2 is a Probit model where the independent variables are motivated by Sinkey Jr and Carter (2000); Purnanandam (2007); Bliss et al. (2018); Kim (2021) specified as:

$$\begin{aligned} Pr(Hedger_{i,t}=1) = \phi\big[\alpha + \gamma_1 log(Assets) + \gamma_2 \frac{Loans_{i,t}}{Assets_{i,t}} + \gamma_3 \frac{NPA_{i,t}}{Assets_{i,t}} + \gamma_4 \frac{Deposits_{i,t}}{Assets_{i,t}} \\ + \gamma_4 \frac{\textit{[HTM Losses, AFS Losses, Maturity Gap]}_{i,t}}{Assets_{i,t}} + \varepsilon_{i,t}\big] \end{aligned} \tag{2}$$

In this first stage of the two-step Heckman selection model, *Hedger* equals one for banks that use interest rate derivatives to hedge and zero otherwise, as reported in the Schedule RC-L of the quarterly Call Reports. The association of the independent variables with interest rate derivative usage is consistent with the previous findings of related literature. In Eq. 2 and Table 5 Panel A (1), bank size $Log(Assets)$ and loan ratios $\frac{Loans}{Assets}$ have positive and significant coefficients (0.494***, 1.009***), as larger banks with more loans are associated with hedging IRD use. Non-performing loans, a proxy for credit risk, have a negative and significant coefficient (-3.603***), suggesting that banks with greater credit risk are more likely to use non-trading interest rate derivatives. Deposits also have a negative and significant coefficient (-0.129**), indicating that banks with more deposits are less likely to be hedgers. Interestingly, losses on held-to-maturity securities also have a negative and significant coefficient (-4.768***), suggesting that banks with more HTM losses are less likely to use IRD for hedging purposes. Next, in Column (2), losses on Available-for-Sale securities also have a negative and significant coefficient (-1.561***), suggesting that banks with more AFS losses are less likely to use IRD for hedging purposes. Lastly, in Column (3), the maturity gap, a proxy for interest rate risk stemming from loan assets, has a positive and significant coefficient (0.623***). This suggests that banks with more maturity gap interest rate risk on their balance sheet are more likely to use hedging IRDs. Findings are similar when all three interest rate risk indicators are in the same specification in Column (4).

Eq. 2's Probit estimation uses explanatory variables Z and estimated parameters γ to construct an inverse mills ratio $\lambda(Z\gamma)$ to correct for sample selection bias in the 2nd stage of the Heckman selection model. The 2nd stage estimation in Table 5 examines three sources of interest rate risk to estimate its impact on the outcome variable, hedging interest rate derivatives. In Column (1), the coefficient on HTM losses is 2.579***, supporting Table 4 which finds when banks have more HTM losses, banks hedge more using interest rate derivatives. The Wald χ^2 is 990.13, which rejects the null hypothesis that the coefficients in the 2nd stage are equal to zero, justifying these specifications for the Heckman two-step selection model. In Columns (2) and (3), coefficients for AFS Losses and Maturity Gap are 1.509*** and 0.118***, respectively, further supporting Table 4's findings that greater AFS losses and maturity gaps are hedged with greater use of interest rate derivatives. Using the Heckman two-step selection model shows similar results as Table 4 estimations based on Eq. 1, suggesting that selection bias does not alter this paper's main findings.

After establishing that HTM and AFS losses in fixed-income security holdings can drive bank hedging activities, Table 6 and 7 examine these securities in closer detail. Given that fixed-income securities lose value when interest rates rise, I examine how bank hedging activity differs when the 10Y Treasury rate rises compared to periods when the 10Y Treasury rate falls. Like Table 4, I expect banks to increase hedging activity during rising interest

Table 5. Heckman Two-Stage Selection

The dependent variable is Hedging Interest Rate Derivatives which are Non-Trading Interest Rate Derivatives used to hedge interest rate risk for bank balance sheets. In the first stage, *User of Hedging Interest Rate Derivatives* is an indicator that equals 1 if the bank holds interest rate derivatives for hedging, 0 otherwise. In the second stage, control variables include log(assets), deposits, and 10-year Treasury rates. Quarter data is from the 2015Q1 to 2022Q4 Call Reports, and variable definitions are found in Appendix A. All variables are winsorized at 0.5%. T-statistics are in parenthesis.

	User of Hedging Interest Rate Derivatives = 1			
Panel A: 1st Stage Probit	(1)	(2)	(3)	(4)
Log (Assets)$_{i,t}$	0.494***	0.488***	0.46***	0.476***
	(142.27)	(155.65)	(152.32)	(149.9)
Loans$_{i,t}$	1.009***	1.045***	1.027***	0.973***
	(39.1)	(41.11)	(40.90)	(38.04)
Non Performing Loans$_{i,t}$	-3.603***	-3.466***	-3.367***	-4.045***
	(-3.86)	(-3.72)	(-3.74)	(-4.47)
Deposits$_{i,t}$	-0.129***	0.132***	0.23***	0.104**
	(-4.13)	(2.57)	(4.74)	(2.08)
HTM Losses$_{i,t}\times$	-4.768***			-4.397***
	(-3.78)			-3.40
AFS Losses$_{i,t}\times$		-1.561***		-1.355***
		(-3.95)		-3.38
Maturity Gap$_{i,t}$			0.623***	0.695***
			(22.47)	(24.62)

	Hedging Interest Rate Derivatives			
Panel B: 2nd Stage Regression	(1)	(2)	(3)	(4)
HTM Losses$_{i,t}$	2.579***			2.546***
	(3.01)			(2.99)
AFS Losses$_{i,t}$		1.509***		1.585***
		(5.40)		(5.65)
Maturity Gap$_{i,t}$			0.118***	0.154***
			(7.01)	(8.37)
Selected Obs	34,944	34,944	36,097	34,944
Nonselected Obs	138,572	138,572	139,596	138,572
Controls	✓	✓	✓	✓
Wald χ^2	990.13	973.03	884.35	1,020.51

rate environments as HTM and AFS losses increase. I also expect hedging to be subdued during falling interest rate environments when HTM and AFS gains are realized.

In Table 6 column (1), the coefficient on HTM Losses on Municipal Bonds and HTM Losses on MBS are positive and significant (1.063** and 1.581***). Column (2) demonstrates these findings are robust with coefficients of 1.112** and 1.335*** after controlling for interest rate risk, size, and deposits. When interest rates rise in (3), banks increase hedging activity in munis and MBS with coefficients of 1.395*** and 1.105** respectively. In (4) as interest rates fall, the coefficient on munis is negative and barely significant at -2.019* while the coefficient on MBS is positive and barely insignificant at 3.959. Overall, when HTM values increase during periods of rising interest rates, hedging activity appears to be less than when HTM lossses increase.

Next, Table 7 examines how banks hedge interest rate risk in their AFS portfolio. Like Table 6, I examine each portfolio of securities in a rising and falling interest rate environment. In (1), non-MBS agencies, munis, MBS, and ABS have positive and significant coefficients. After adding control variables in (2), it appears that ABS loses its significance while non-MBS agencies, munis, and MBS are still positive and significant at 1.053***, 0.507***, and 0.862*** respectively. If banks are discretionary and asymmetric, hedging will increase as AFS securities lose value, and hedging will decrease as AFS securities gain value. As interest rates rise in (3), AFS hedging activity appears to be more aggressive than HTM hedging activity across a wider range of securities as coefficients on non-MBS agencies, municipals, and MBS are all positive and significant (0.94**, 0.521**, and 0.881*** respectively). Recall that in Table 6 (3), hedging is present for only municipals and MBS. When rates fall and AFS securities increase in value (4), the coefficients on treasuries and non-MBS agencies (4.382* and 3.814**) indicate banks decrease hedging, suggesting banks practice discretionary and asymmetric strategies when hedging interest rate risk.

The evidence suggests that banks practice discretionary hedging regarding the components of its AFS securities portfolio. However, it is unclear whether banks increase hedging

Table 6. Hedging the Components of Held-to-Maturity Portfolios

The dependent variable is Hedging Interest Rate Derivatives which are Non-Trading Interest Rate Derivatives used to hedge interest rate risk for bank balance sheets. Quarter data is from the 2015Q1 to 2022Q4 Call Reports, and variable definitions are found in Appendix A. (1) and (2) consist of all quarters, while (3) consist of quarters where the 10Y Treasury rate rose while (4) consist of quarters where the 10Y Treasury rate fell. Control variables include the maturity gap ratio, log(assets), and deposits. All variables are winsorized at 0.5%. All specifications use two-way fixed effects at the bank and quarter levels and standard errors are two-way clustered at the bank and quarter levels. T-statistics are reported in parentheses.

	Dependent Variable: Hedging IRD$_{i,t}$			
	All Periods	*All Periods*	*Rates Rising*	*Rates Falling*
	(1)	(2)	(3)	(4)
HTM Losses on Treasuries$_{i,t}$	1.600	1.199	0.882	-4.244
	(0.74)	(0.56)	(0.4)	(-0.34)
HTM Losses on Non-MBS Agencies$_{i,t}$	-1.126	-1.175	-1.19	-1.801
	(-1.15)	(-1.26)	(-1.22)	(-0.83)
HTM Losses on Munis$_{i,t}$	1.063**	1.112**	1.395***	-2.019*
	(2.46)	(2.45)	(3.26)	(-1.80)
HTM Losses on MBS$_{i,t}$	1.581***	1.335***	1.105**	3.959
	(3.18)	(2.68)	(2.11)	(1.77)
HTM Losses on ABS & Other$_{i,t}$	-1.407	-0.466	-3.54	35.262
	(-0.34)	(-0.11)	(-0.91)	(1.49)
Maturity Gap$_{i,t}$		0.079***	0.108***	0.038*
		(4.22)	(4.95)	(1.81)
Log (Assets)$_{i,t}$		0.02**	0.023**	0.027**
		(2.1)	(2.12)	(2.24)
Deposits$_{i,t}$		-0.097***	-0.098**	-0.115***
		(-2.52)	(-2.37)	(-2.63)
Observations	37,763	37,763	20,967	15,502
Bank FE	✓	✓	✓	✓
Time FE	✓	✓	✓	✓
Bank Clusters	✓	✓	✓	✓
Time Clusters	✓	✓	✓	✓
Adjusted R^2	0.78	0.78	0.76	0.80
Within R^2	0.00	0.02	0.03	0.02

Table 7. Hedging the Components of Available-for-Sale Portfolios
The dependent variable is Hedging Interest Rate Derivatives which are Non-Trading Interest Rate Derivatives used to hedge interest rate risk for bank balance sheets. Quarter data is from the 2015Q1 to 2022Q4 Call Reports, and variable definitions are found in Appendix A. (1) and (2) consist of all quarters, while (3) consists of quarters where the 10Y Treasury rate rose while (4) consists of quarters where the 10Y Treasury rate fell. Control variables include the maturity gap ratio, log(assets), and deposits. All variables are winsorized at 0.5%. All specifications use two-way fixed effects at the bank and quarter levels and standard errors are two-way clustered at the bank and quarter levels. T-statistics are reported in parentheses.

	Dependent Variable: Hedging $IRD_{i,t}$			
	All Periods (1)	*All Periods* (2)	*Rates Rising* (3)	*Rates Falling* (4)
AFS Losses on $Treasuries_{i,t}$	-0.026	0.185	0.215	4.382*
	(-0.05)	(0.33)	(0.38)	(1.78)
AFS Losses on Non-MBS $Agencies_{i,t}$	0.783*	1.053***	0.94**	3.814***
	(1.93)	(2.56)	(2.08)	(2.7)
AFS Losses on $Munis_{i,t}$	0.357**	0.507***	0.521**	1.107
	(1.98)	(2.64)	(2.21)	(1.33)
AFS Losses on $MBS_{i,t}$	0.766***	0.862***	0.881***	1.372
	(3.11)	(3.54)	(3.44)	(1.48)
*AFS Losses on ABS % * $Other_{i,t}$	1.391*	1.283	1.452	0.048
	(1.7)	(1.56)	(1.57)	(0.04)
Maturity $Gap_{i,t}$		0.081***	0.111***	0.035*
		(4.3)	(4.94)	(1.7)
Log $(Assets)_{i,t}$		0.021**	0.024**	0.027**
		(2.2)	(2.23)	(2.32)
$Deposits_{i,t}$		-0.107***	-0.111***	-0.117***
		(-2.77)	(-2.65)	(-2.67)
Observations	37,763	37,763	20,967	15,502
Bank FE	✓	✓	✓	✓
Time FE	✓	✓	✓	✓
Bank Clusters	✓	✓	✓	✓
Time Clusters	✓	✓	✓	✓
Adjusted R^2	0.78	0.78	0.76	0.80
Within R^2	0.00	0.02	0.03	0.02

intensity due to funding risk from unsecured deposits. This brings us to our last hypothesis.

Hypothesis 4. *Banks increase hedging activity due to funding risks from unsecured deposits.*

Since unsecured deposits are typically short-term and can be withdrawn by customers at any time, this represents a liability that can lead to a liquidity crisis. To address this concern stemming from Silicon Valley Bank's implosion, Table 8 examines portfolio losses in relation to a bank's percentage of uninsured deposits, defined as the percentage of deposits that are uninsured.

The main variables of interest are the interactions between HTM Losses and uninsured deposits and AFS Losses and uninsured deposit, especially while interest rates are rising. In (1) and (2), the coefficient on *HTM Losses* $\times$ *% Uninsured Deposit* is positive and significant at 3.107** while the coefficient on *AFS Losses* $\times$ *% Uninsured Deposit* is positive and insignificant at 0.652. The coefficient on uninsured deposits is positive and significant at 0.038**, suggesting that banks increase hedging activity as funding risks increase. The coefficient on the interaction between HTM Losses and uninsured deposits appear to originate during periods of rising rates as found in (3). The coefficient on this interaction is positive and significant at 3.408**. This suggests banks generally understand how funding risks can lead to a liquidity crisis. Interaction terms for AFS losses and uninsured deposits are positive but insignificant 0.535, suggesting that banks instead prioritize hedging HTM losses over AFS. Neither interaction is significant when rates are falling in (5) and (6), which is expected as losses are not accruing during periods of falling interest rates.

Table 8. Hedging of Interest Rate and Funding Risk
The dependent variable is Hedging Interest Rate Derivatives which are Non-Trading Interest Rate Derivatives used to hedge interest rate risk and funding risk for bank balance sheets. Quarter data is from the 2015Q1 to 2022Q4 Call Reports, and variable definitions are found in Appendix A. (1) and (2) consist of all quarters, while (3) and (4) are quarters where the 10Y Treasury rate rose while (5) and (6) are quarters where the 10Y Treasury rate fell. Control variables include the maturity gap ratio, log(assets), and deposits. All variables are winsorized at 0.5%. All specifications use two-way fixed effects at the bank and quarter levels and standard errors are two-way clustered at the bank and quarter levels. T-statistics are reported in parentheses.

	Dependent Variable: Hedging$_{i,t}$					
	All Periods		*Rates Rising*		*Rates Falling*	
	(1)	(2)	(3)	(4)	(5)	(6)
HTM Losses$_{i,t}\times$ *Uninsured Deposit %*$_{i,t}$	3.107**		3.408**		-0.757	
	(2.38)		(2.53)		(-0.14)	
AFS Losses$_{i,t}\times$ *Uninsured Deposit %*$_{i,t}$		0.652		0.535		1.299
		(1.36)		(1.06)		(0.79)
HTM Losses$_{i,t}$	-0.454		-0.6		1.246	
	(-0.91)		(-1.17)		(0.73)	
AFS Losses$_{i,t}$		0.456**		0.48*		1.225**
		(1.99)		(1.84)		(2.3)
% Uninsured Deposits$_{i,t}$	0.038**	0.038**	0.047**	0.048**	0.009	0.012
	(2.00)	(2.00)	(2.35)	(2.32)	(0.34)	(0.46)
Observations	33,979	33,979	18,907	18,907	13,841	13,841
Controls	✓	✓	✓	✓	✓	✓
Bank FE	✓	✓	✓	✓	✓	✓
Time FE	✓	✓	✓	✓	✓	✓
Bank Clusters	✓	✓	✓	✓	✓	✓
Time Clusters	✓	✓	✓	✓	✓	✓
Adjusted R^2	0.78	0.78	0.76	0.76	0.80	0.80
Within R^2	0.02	0.02	0.03	0.03	0.01	0.02

5 Conclusion

The rapid collapse of Silicon Valley Bank and First Republic Bank demonstrated the need for further academic research into bank hedging activity against losses in debt securities, notably when banks are faced with sizable unsecured deposits. While the existing literature has identified various risks that hedging can mitigate, such as maturity gaps (Purnanandam, 2007) and mortgage origination risk (Kim, 2021), the collapse of SVB underscores the urgent need for research in bank hedging of interest rate risk from HTM and AFS fixed-income securities.

This paper finds that banks below $250 billion in assets asymmetrically increase hedging activity when HTM and AFS losses accrue, and reduce hedging activity as AFS portfolios increase in value, a trend less evident in HTM portfolios. Notably, this paper also finds that banks generally increase hedging when they have HTM losses and uninsured deposits. This discretionary approach to hedging starkly contrasts Silicon Valley Bank's 2022 decision to eliminate hedging amid rising interest rates. Heckman's two-step selection model also suggests these findings are not due to sample selection bias. This paper fills two critical gaps in existing research by utilizing data on interest rate derivatives used specifically for hedging purposes and exploring whether banks hedge funding risks from uninsured deposits that behave like short-term liabilities. Hedging comprises of two dimensions, adequacy and timing. Although the adequacy of hedging remains an open question (Jiang et al., 2023a), the timing of hedging activity is in line with banks being cognizant of security losses and funding risks, which in itself may assuage concerned depositors and investors. The elimination of SVB's interest rate swaps in the fourth quarter of 2022 shifted its derivatives from hedging to trading activities, likely raising concerns among depositors. This paper's findings indicate that this signal was idiosyncratic to SVB rather than systemic in banks below $250 billion in assets, contributing to our understanding of contemporary bank runs in rising interest rate environments.

Appendices

A Variable Definitions

Variables are derived from 2015Q1 - 2022Q4 Call Reports. All variables are scaled by total assets, except for Uninsured Deposits which are scaled by Deposits.

1. **AFS Losses on ABS**: (RCONC989 + RCONHT60 + RCON1739 + RCON1744 + RCONG338 + RCONG342 + RCONG346)-(RCONC027 + RCONHT61 + RCON1741 + RCON1746 + RCONG339 + RCONG343 + RCONG347)
2. **AFS Losses on Non-MBS Agencies**: RCON1291-RCON1293 or RCON1297-RCON1298 or RCONHT52-RCONHT53
3. **AFS Losses on MBS**: (RCON1701 + RCON1706 + RCON1711 + RCON1716 + RCON1731 + RCON1735)-(RCON1702 + RCON1707 + RCON1713 + RCON1717 + RCON1732 + RCON1736) or (RCOG302 + RCOG306 + RCONG310 + RCONG314 + RCOG318 + RCONG322 + RCONK144 + RCONK148 + RCONK152 + RCONK156)-(RCOG303 + RCOG307 + RCONG311 + RCONG315 + RCOG319 + RCONG323 + RCONK145 + RCONK149 + RCONK153 + RCONK157)
4. **AFS Losses on Munis**: RCON8498-RCON8499
5. **AFS Losses on Treasuries**: RCON1286-RCON1287
6. **CET Assets**: RCOAP859
7. **Deposits**: RCON2200
8. **Hedging IRD**: RCON8725
9. **HTM Losses on ABS**: (RCONC026 + RCONHT58 + RCON1737 + RCON1742 + RCONG336 + RCONG340 + RCONG344)-(RCONC988 + RCONHT59 + RCON1738 + RCON1743 + RCONG337 + RCONG341 + RCONG345)
10. **HTM Losses on Non-MBS Agencies**: RCON1289-RCON1290 or RCON1294-RCON1295 or RCONHT50-RCONHT51

11. **HTM Losses on MBS**: (RCON1698 + RCON1703 + RCON1709 + RCON1714 + RCON1718 + RCON1733)-(RCON1699 + RCON1705 + RCON1710 + RCON1715 + RCON1719 + RCON1734) or (RCOG300 + RCOG304 + RCONG308 + RCONG312 + RCOG316 + RCONG320 + RCONK142 + RCONK146 + RCONK150 + RCONK154)-(RCOG301 + RCOG305 + RCONG309 + RCONG313 + RCOG317 + RCONG321 + RCONK143 + RCONK147 + RCONK151 + RCONK155)
12. **HTM Losses on Munis**: RCON8496-RCON8497
13. **HTM Losses on Treasuries**: RCON0211-RCON0213
14. **Maturity Gap Ratio**: (RCONA570 + RCONA571 + RCONA564 + RCONA565) + (RCONA549 + RCONA550 + RCONA555 + RCONA556)-(RCONA579 + RCONA580 + RCONA584 + RCONA585) + RCONB987-RCONB993
15. **Non Performing Assets**: RCONF174 + RCONF175 + RCON3494 + RCON5399 + RCONC237 + RCONC239 + RCON3500 + RCONF180 + RCONF181 + RCONB835 + RCON1607 + RCON5390 + RCON5460 + RCON1227 + RCON3506
16. **Pay Fixed Swaps**: RCONA589
17. **Total Equity**: RCON3210, RCONG105
18. **Total Securities**: RCONJJ34 or RCON1773
19. **Trading Interest Rate Derivatives**: RCONA126
20. **Uninsured Deposits**: (RCONF051 + RCONF047)-(RCONF052 + RCONF048)*250 for banks below $1B in assets; RCON5597 for banks above $1B in assets, divided by Deposits (RCON2200)
21. **Unrealized Gains on AFS Securities**: RCON1772-RCON1773
22. **Unrealized Gains on HTM Securities**: RCON1754-RCON1771 or RCONJJ34-RCON1771

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