UNIVERSITY OF LJUBLJANA
SCHOOL OF ECONOMICS AND BUSINESS

MASTER'S THESIS

THE INTEREST RATE RISK OF US BANKS IN 2023 IN THE LIGHT OF THE FED'S TIGHTER MONETARY POLICY

Ljubljana, April 2025 ANJA OPEC

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LIST OF ABBREVIATIONS

AFS – Available-for-sale
ALCO - Asset-Liability Committee
ALM - Asset-Liability Management
ARM – Adjustable-Rate Mortgage
CD – Certificate of Deposit
CMO - Collateralized Mortgage Obligation
EVE – Economic Value of Equity
FDIC – Federal Deposit Insurance Corporation
FOMC – Federal Open Market Committee
FRA – Forward-Rate Agreement
FRB – First Republic Bank
GSIB - Global Systemically Important Banks
HTM – Held-to-maturity
IMF – Internation Monetary Fund
IORB – Interest on Reserve Balances
MBS - Mortgage-backed Securities
NII – Net Interest Income
NIM – Net Interest Margin
OCC - Office of the Comptroller of the Currency
OMO – Open Market Operations
ON RRP – Overnight Reverse Repurchase
OTC – Over the Counter
RMBS – Residential Mortgage-backed Securities
ROA – Return on Assets
RSA – Rate-sensitive Assets
RSL - Rate-sensitive Liabilities
SEC - Securities and Exchange Commission
SFR – Single Family Rental
SVB – Silicon Valley Bank

1 INTRODUCTION

Interest rate risk refers to a bank's financial exposure to adverse interest rate changes. It is standard practice in banking to accept this risk, which can be a significant source of revenue and shareholder value. Nevertheless, the bank's profits, economic value, and overall financial stability may be seriously jeopardized by excessive interest rate risk exposure. There exist five types of interest rate risk, namely repricing risk, basis risk, yield curve risk, optionality risk and price risk (FDIC, 2024).

Fifteen years of low interest rates, along with the 2020-2021 pandemic period, greatly increased U.S. banks' exposure to interest rate risk, as their portfolios held a higher share of long-term, low-yield securities (Abdymomunov et al., 2023). There are two reasons why the banking crisis of 2023 in the U.S. is of such great importance. First, the 2022/23 monetary tightening episode was one of the most aggressive ones ever seen, as the federal funds target range increased by 525 basis points in only 16 months. Second, because this crisis represents a record year for failed bank assets (Kliesen, 2023). First Republic Bank (FRB), Silicon Valley Bank (SVB) and Signature Bank mark the second, third and fourth largest bank failures ever in the U.S., respectively. The total assets of these three banks together with Heartland Tri-State Bank and Citizens Bank amounted to $552.54 billion, compared to 2008, where the total failed bank assets were $364.72 billion. These collapses exposed not only the weaknesses of the failed banks but also highlighted underlying issues of the entire U.S. banking system (Graf & Gull, 2023).

The key objective of my master's thesis is to understand why U.S. banks are so sensitive to interest rate risk and what factors contribute to their vulnerability. In this context, I want to focus my analysis on interest rate exposure of U.S. banks that collapsed in 2023, namely Silicon Valley Bank, Signature Bank and First Republic Bank, to fully understand the underlying causal factors of their downfall. Additionally, I want to explore if and to which extent the Federal Reserve’s aggressive monetary tightening played a role in causing the 2023 banking crisis and what other factors contributed to financial instability during that time.

My master's thesis is centred around answering the following research questions:

1. Why are U.S. banks vulnerable to interest rate risk, and what are the main drivers of this exposure?
2. What were the root causes and systemic factors that led to the banking crisis in the U.S. in 2023?
3. How exposed were the U.S. banks that collapsed in 2023 to interest rate risk?
4. How did the Federal Reserve’s aggressive monetary tightening contribute to the financial instability during the 2023 banking crisis?

In addition to the Introduction, the structure of my thesis is composed of five main chapters. The first chapter addresses interest rate risk in banking, covering its understanding,

management strategies, and challenges in hedging it. The second chapter covers the history of Federal Reserve's monetary cycles with emphasis on the 2022/2023 tightening cycle. The third chapter reviews the U.S. banking sector's exposure to interest rate risk, identifying key drivers and performance during tightening cycles. The fourth chapter provides an overview of the 2023 U.S. banking crisis and evaluates the interest rate risk and contributing factors that led to the failures of individual banks, including Silicon Valley Bank, Signature Bank and First Republic Bank. The last chapter discusses the relationship between aggressive monetary tightening and financial stability.

2 INTEREST RATE RISK IN BANKING

2.1 Types of Interest Rate Risk

Interest rate risk is the exposure of a bank's earnings and capital to adverse changes in interest rates. While this risk is inherent to banking and can enhance profitability, excessive exposure can threaten capital, earnings, liquidity, and solvency (FDIC, 2024). Feldman & Schmidt (2000) compared interest rate risk to blood pressure—it changes without obvious signs and can cause failures, yet it is vital to the financial system. Though banks and regulators monitor and mitigate this risk, they do not eliminate it, as it is essential for survival.

Banks face five main types of interest rate risk: repricing risk, yield curve risk, basis risk, optionality risk, and price risk. The most significant is repricing risk, arising from mismatches in the timing of asset and liability repricing. Since banks borrow short and lend long, they are vulnerable to rate changes. For instance, funding fixed-rate loans with short-term deposits can reduce net interest income (NII) if deposit costs rise (FDIC, 2024).

Yield curve risk results from unexpected shifts in the yield curve, impacting profitability, risk-taking decisions and lending strategies. The Fed influences the yield curve through forward guidance. There are three yield curve types: normal, flat, and inverted. An inverted yield curve, where short-term rates exceed long-term rates, signals an economic downturn and can tighten lending conditions. In such environment, banks' profit margins squeeze, posing liquidity risks. A flat yield curve suggests uncertainty, which can compress net interest margins (NIM) and lower NII of banks (Hayes, 2023). However, during the 2015/18 tightening, U.S. banks increased profitability by holding down deposit rates and relying more on core deposits than volatile wholesale funding (King & Yu, 2018). A normal yield curve slopes upward, reflecting expectations of economic growth. The slope of the yield curve holds significant relevance for bank profitability. The steeper the slope, the greater the potential profits for banks. This holds true especially in the United States where bank loans are often tied to long-term interest rates (Reserve Bank of Australia, n.d.).

Basis risk occurs when rates on similar financial instruments adjust differently. For instance, imagine that the 1-month Treasury Bill rate rises by 1% while the 1-month LIBOR

increases by 2%. A bank funding a loan, repricing monthly based on the 1-month Treasury Bill rate, with a deposit, repricing monthly based on the 1-month LIBOR, would face unexpected spread changes, affecting profitability (FDIC, 2024).

Optionality risk arises from embedded options in assets and liabilities, exposing banks to interest rate shifts. Borrowers often exercise options to their advantage, negatively impacting bank earnings. For example, if a bank holds a 30-year callable bond at a fixed interest rate of 10% and rates drop to 8%, the issuer may call the bond, forcing the bank to reinvest at a lower rate and earn less interest income (Federal Reserve Board, 1998).

Unlike the other four types of risk tied to the banking book, price risk affects the trading book, as interest rate fluctuations alter trading asset values. Trading portfolios, held-for-sale loan portfolios, and mortgage servicing assets are exposed to price risk. For example, mortgage servicing rights decline in value when rates fall, as homeowners refinance their loans, reducing servicing fees. These fair value changes are reflected in bank's earnings immediately, making price risk a critical factor in financial performance (FDIC, 2024).

2.2 Implications of Interest Rate Risk

Interest rate risk is crucial for banks as it affects both their balance sheet and income statement. Rising rates can reduce a bank's net worth if liabilities retain value while assets decline due to the maturity gap. On the income statement, profits may fall because asset yields adjust to new rates more slowly than funding costs. While income is affected in the short term, net worth changes occur over time as asset and liability values shift. The exposure to interest rate risk impacts profitability, opportunity costs, capital adequacy, and financial stability (Bednar & Elamin, 2014).

Profitability: Interest rate fluctuations affect NII and profitability by altering the spread between asset yields and funding costs (Basel Committee, 2016). The relationship between interest rates and profitability metrics like NII and NIM is complex, influenced by repricing mismatches, balance sheet composition, and market conditions. While borrowing short and lending long is generally profitable, higher rates do not always increase NII and NIM. Although banks can adjust interest rate spreads, they are constrained by depositor behaviour and market conditions (Ennis et al., 2016). In 2022, rising rates boosted NII for smaller U.S. banks, but by early 2023, persistently high rates led to declining NII as funding costs outpaced asset yields (Federal Reserve Bank of Kansas City, 2023). Historical data shows no consistent correlation between rate hikes and NIM expansion; in some cases, NIM shrank despite rising rates. There is some evidence that rate cuts can even increase NIM (Ennis et al., 2016).

Opportunity Cost: Interest rate risk can lock banks into lower-yielding investments. For instance, if a bank holds a 30-year mortgage at 3.5% with 28 years remaining and new mortgage rates rise to 4.5%, the bank loses the additional 1% it could have earned. By

contrast, an adjustable-rate mortgage (ARM) would minimize opportunity costs since its rate adjusts periodically with current market rate (Bednar & Elamin, 2014).

Economic Value and Capital: Interest rate risk impacts capital adequacy, measured by regulatory ratios like Basel III framework. Rate changes affect the economic value of banks' assets and liabilities, leading to capital fluctuations. In the short run, higher rates reduce the value of fixed-rate assets recorded at fair value, shrinking available capital. In the long run, banks with assets more sensitive to rate changes than liabilities face a positive maturity gap, meaning rising rates lower their net worth. A decline in economic value of equity (EVE) reduces earnings potential and weakens capital adequacy. Without effective hedging, prolonged exposure to rate risk threatens regulatory compliance and financial stability. Thus, managing interest rate risk is critical for maintaining capital levels and long-term resilience (Enria, 2022).

2.3 Drivers of Interest Rate Changes

When talking about interest rate risk, one must first understand what drives interest rates. Ultimately, interest rates are determined by the supply and demand of money. In times of high credit demand, lenders raise rates to seize higher returns. Conversely, during low borrowing demand, lenders lower rates to attract borrowers (Tamplin, 2023).

Economic conditions shape money demand. In a booming economy, individuals borrow more for homes, cars, and consumer goods. Strong economic growth leads central banks to raise rates to limit inflation. In downturns, borrowing declines, prompting central banks to lower rates to encourage spending and investment. Political instability also affects rates as uncertainty drives investors toward safe assets like U.S. Treasuries, causing rates to drop. Stability encourages risk-taking, leading to higher rates. A real-life example is the Brexit vote in 2016, which created UK uncertainty, devaluing the Pound and lowering interest rates (Tamplin, 2023).

Government borrowing also strongly impacts money demand. When running a fiscal deficit, the government borrows to cover shortfalls. As a major borrower, its borrowing levels shape interest rates. Higher deficits lead to increased rates, often reflected in bond markets with rising yields (“Explainer: Six factors that influence interest rates in an economy”, 2019).

Inflation, or inflation expectations, is one of the most significant factors affecting interest rates. When inflation rises, people expect future price increases, influencing their behaviour today – spending more and demanding higher wages. Wage increases drive businesses to raise prices, creating a self-fulfilling cycle. Lenders demand higher rates to offset money's declining purchasing power. Central banks respond to high inflation by raising rates to reduce money circulation, thereby limiting demand and lowering prices. In contrast, they lower rates to boost borrowing and investment during low inflation. Inflation also reduces

currency purchasing power, which can decrease bond demand. In such cases, the Fed may raise interest rates to attract investors (Tamplin, 2023).

Money supply is controlled by central banks through monetary policy tools. By adjusting reserve requirements, setting discount rates, and conducting open market operations, such as buying or selling government securities, the central bank regulates money circulation. Lowering reserve requirements or buying securities increases bank reserves, allowing more lending and expanding the money supply. These actions help central banks achieve economic goals, such as controlling inflation, stimulating growth, or stabilizing the financial system (Tamplin, 2023).

2.4 Measuring Interest Rate Risk

Measuring the possible effects of interest rate changes on a bank's performance and financial condition can be done in various ways. The following are the most common types of interest rate exposure measurement methods used by risk management (FDIC, 2024):

- Gap analysis,
- Duration analysis,
- Earnings Simulation analysis,
- Economic Value of Equity analysis.

Gap analysis measures mismatches in repricing between rate-sensitive assets (RSA) and rate-sensitive liabilities (RSL). It assesses whether a bank's NII will be positively or negatively impacted by changes in interest rates. The analysis groups assets and liabilities based on repricing characteristics and calculates the gap ratio as the difference between RSA and RSL divided by average earning assets. A positive gap occurs when RSA exceed RSL, indicating that rising rates increase NII, making the bank asset sensitive. Conversely, a negative gap happens when RSL exceed RSA, suggesting that rising rates decrease NII, making the bank liability sensitive. Despite its benefits, such as simplicity and clarity, gap analysis has drawbacks, including its focus on repricing risk, assumptions of parallel rate movements, and inability to capture embedded options or measure economic value changes. Thus, it may not be sufficient as the only interest rate risk measurement tool, especially for banks with complex balance sheets (FDIC, 2024).

Duration analysis assesses how shifts in interest rates affect asset and liability values. It considers both the size and timing of cash flows before maturity. The duration gap is the difference between the average maturity of assets and liabilities. A positive duration gap occurs when a bank’s assets have a longer duration than its liabilities. In this case, asset values increase when interest rates decline, raising net worth. However, if rates rise, asset values drop more than liabilities, exposing the bank to losses and reducing equity value. A zero-duration gap occurs when liabilities and assets have matching durations, protecting the bank from interest rate risk but limiting profitability (Ailani, 2024).

In earnings simulation analysis, banks use stress-testing models to predict how changes in interest rates affect NII. A baseline balance sheet performance under static rate conditions is compared to shock scenarios. The greater the difference between the baseline and scenario results, the higher the interest rate risk (Trefethen, 2020). Interest rate risk exposures are more precise when projected over at least two years. Institutions with products containing embedded options often conduct 5 to 7-year simulations to measure long-term risks and economic value. Extended simulations help identify long-term mismatches where a bank may be liability sensitive in some years but asset sensitive in others. Banks use static simulations, assuming no balance sheet growth, or dynamic simulations, incorporating growth and other changes. While dynamic models are useful for planning, they rely heavily on assumptions that may lose accuracy over time, potentially hiding risks. Thus, banks run static simulations alongside dynamic ones for precision (FDIC, 2024).

Economic value of equity (EVE) is another method for assessing interest rate risk exposure. Economic value methods evaluate how a bank's economic value changes when interest rates shift. EVE is the difference between the present value of asset and liability cash flows. An EVE model forecasts capital value under normal conditions and compares it to a stress test scenario to assess long-term risks. The economic value approach covers a broader range than the earnings approach by considering a longer time horizon and all expected cash flows while better capturing embedded options. Unlike gap models and earnings simulations, which focus on short-term projections, economic valuation models assess all projected changes in the balance sheet and earnings. Despite methodological differences, earnings simulations and EVE models typically provide a consistent perspective on interest rate risk trends (FDIC, 2024).

2.5 Interest Rate Risk Management Strategies

Banks manage interest rate risk through Asset-Liability Management (ALM), which balances risks from balance sheet mismatches like interest rate, liquidity, credit, and capital adequacy risks. It involves long-term planning to control these risks while mitigating losses/maximizing returns. Initially based on simple gap models in the 1970s, ALM evolved into advanced duration gap models, driven by capital market expansion, advances in risk analysis, and increased financial education, with successful implementation requiring strong risk management, data monitoring, and oversight by the Asset Liability Committee (ALCO) (Zawalinska, 1999). Banks have two primary methods for managing interest rate risk (Caballero et al, 2023):

- Balance sheet restructuring,
- Interest rate derivatives.

Banks adjust their balance sheets to manage interest rate risk, though this process takes time and does not provide immediate protection. Rising rates can lead to losses since banks

typically hold long-term assets like fixed-rate mortgages but fund them with short-term liabilities like deposits. To mitigate this, banks can reduce long-term mortgages, increase adjustable-rate loans, or seek long-term funding, though competition and market conditions can limit these efforts. Additionally, features like embedded options can complicate managing and measuring interest rate risk. Typically, balance sheet restructuring strategies include cash flow and duration matching. Cash flow matching aligns asset and liability cash flows to minimize rate change impact, while duration matching balances the duration of assets and liabilities to reduce fluctuations in their value. However, duration matching does not fully address cash flow risks and leaves banks exposed to yield curve risk and basis risk (FDIC, 2024).

Hedging strategies often involve using derivatives to protect banks from sudden changes in Federal Reserve policy. Common derivatives include swaps, futures, forwards, options, caps, swaptions, and collars, with swaps and forwards being the most widely used for hedging interest rate risk. For instance, interest rate swaps allow banks exchange fixed payments for floating ones to offset fixed-rate asset losses in rising-rate environments. Conversely, they can swap floating-rate liabilities for fixed to stabilize funding costs (FDIC, 2024). Forward Rate Agreements (FRAs) allow banks to lock in borrowing rates. If rates rise, the bank can borrow at the lower agreed rate and save on funding costs, but if rates decrease or remain the same, it misses out on lower borrowing costs while still benefiting from predictable funding expenses (Purnanandam, 2005).

Interest rate options provide flexibility based on market conditions. If a bank expects to borrow soon and is worried about rising interest rates, it can hedge this risk by purchasing a call option, which locks in a maximum interest rate, allowing it to avoid higher costs and maintain flexibility (Corporate Finance Institute, n.d.). On the other hand, futures contracts allow banks to secure the price of an underlying asset, such as Treasury bills or government bonds, for a future date. This enables banks to protect their portfolios from rising interest rates by committing to sell their bonds at a locked-in price, offsetting potential losses and maintaining balance sheet stability even in unfavourable market conditions (Kuprianov, 1986). Effective hedging requires understanding its impact on earnings and capital. Fair value adjustments can introduce volatility, so banks must use derivatives strictly for risk mitigation, not speculation. Misuse can heighten exposure to unnecessary risks and destabilize the financial system (FDIC, 2024).

2.6 Challenges in Implementing Interest Rate Risk Hedging Mechanisms

This section addresses the challenges that banks face in implementing interest rate risk hedging practices. Let us start with derivatives and their complexity. Derivatives are complex financial instruments that lack transparency and require deep understanding. Banks must ensure they have the necessary expertise to evaluate and use these instruments appropriately. The lack of transparency in the derivatives market can increase risks. The valuation and pricing of derivatives are subjective and influenced by multiple factors,

making it difficult to assess their true value. Risk management often struggles to fully understand, monitor, and execute contract terms. For example, if a bank uses a swap to exchange cash flows based on different interest rates, currencies, or indexes, it may face problems in assessing and managing the swap's value, duration, and risk exposure. If not appropriately structured, valued, or accounted for, it could result in unexpected financial losses (Religare Broking, 2024).

Another challenge in using derivatives for risk mitigation is counterparty risk. When a bank enters into a contract, there is the risk of default by the other party. Over-the-counter derivatives, negotiated privately, require reliance on the counterparty's financial stability, creditworthiness, and reputation. If the counterparty fails to meet obligations, the bank could face losses or delays in payments. This risk is particularly concerning during financial crises. While central clearinghouses can help, counterparty risk remains a challenge in derivatives hedging (Religare Broking, 2024).

Hedging is not free. Additional costs and reduced potential profits are common issues. Implementing hedging strategies involves transaction fees, brokerage commissions, margin requirements, and bid-ask spreads. These costs may reduce potential profits or exceed hedge benefits if not managed properly. While hedging limits losses, it also limits potential profits. Achieving the right balance is difficult, especially in volatile market conditions. Furthermore, over-hedging is a common mistake that can lead to unnecessary costs or missed profit opportunities due to miscalculations or excessive caution, making the strategy less effective (Sharma, 2024).

Lastly, market volatility and regulatory risks also impact derivative hedging. Supply and demand factors, such as price changes of the underlying assets or shifts in market sentiment, influence derivative prices. Due to their volatility, derivatives are riskier than other investments, especially those linked to assets like bonds or stocks. Investors may suffer unanticipated losses if market conditions change unexpectedly (Tamplin, 2024). Additionally, derivatives markets are subject to frequent regulatory changes. Regulations are updated to improve transparency and reduce systemic risks, affecting margin requirements, trading strategies, and reporting obligations. For market player, adjusting to new regulations can be costly and time-consuming (Religare Broking, 2024).

Given the above, derivative hedging methods present challenges requiring a thorough understanding of counterparty risk, market volatility, complexity, costs, and regulations. However, despite these challenges, banks should engage in hedging to minimize risk exposure and ensure stability. Managing risks like interest rate risk helps banks protect balance sheets, improve resilience to financial shocks, and maintain customer confidence. As mentioned, expertise and in-depth knowledge of banking risks and derivative markets are key (FDIC, 2024).

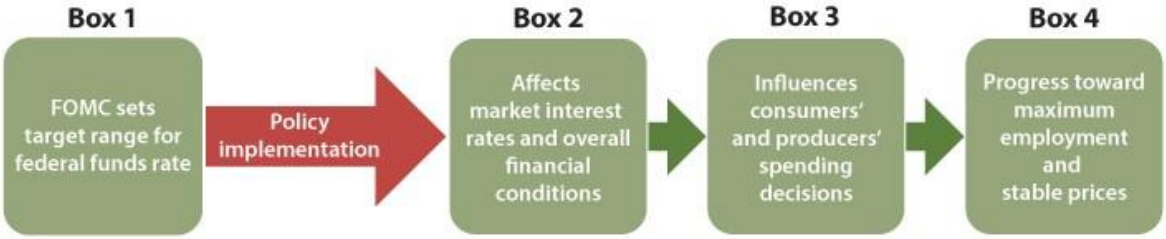
3 FED'S MONETARY CYCLES AND IMPLICATIONS FOR INTEREST RATES

3.1 The Federal Reserve's Monetary Policy Toolkit and Decision Making

The Federal Reserve, or the Fed, is the central bank of the United States, differing from other countries by rejecting a single-bank concept. Instead, it operates as a "system" comprising three main components: 12 decentralized Reserve Banks, a central Board of Governors, and the Federal Open Market Committee (FOMC). Together, these entities stabilize the U.S. financial system and economy. A unique feature of the Fed is its dual mandate to achieve price stability and maximum employment, treating both objectives equally. Additionally, the Fed performs five key functions: conducting monetary policy, supervising financial institutions, maintaining stability, fostering payment system efficiency, and promoting consumer protection (Federal Reserve, n.d.).

The Fed implements monetary policy by influencing interest rates and financial conditions. The FOMC exclusively makes policy decisions, setting the target range for the federal funds rate. Changes in target range adjust other interest rates, affecting business and household spending. Lowering the target range eases monetary policy, decreasing short-term interest rates, while raising the range tightens the policy, increasing rates. Present changes, along with expectations of future adjustments, impact long-term rates. For example, if borrowers and lenders expect future rate cuts, short-term rates may fall, and long-term rates may be lower than otherwise expected. Generally, federal funds rate changes immediately affect short-term rates, while long-term rates reflect expectations of future short-term rates over time (Federal Reserve Board, 2021). The following Figure 1 illustrates the transmission of monetary policy.

Figure 1: Transmission of Monetary Policy



Source: Ihrig & Wolla, 2022

To ensure that the federal funds rate stays within the set target range, Fed uses a variety of tools to implement the policy. The four key tools within Fed's implementation toolbox are (Ihrig & Wolla, 2022):

- Interest on reserve balances rate,
- Discount rate,
- Overnight reverse repurchase agreements facility,

- Open market operations.

Interest on reserve balances (IORB) is the interest the Federal Reserve pays on banks' reserve funds, serving as its main tool for influencing the federal funds rate. As of July 29, 2021, required and excess reserve rates merged into a single IORB rate. Along with the discount rate and overnight reverse repurchase agreement rate (ON RRP), IORB is an "administered rate" set by the Fed, not the market (as the federal funds rate is). Since depositing funds at the Fed is risk-free, banks will not lend below the IORB rate. If the IORB rate is higher than the federal funds rate, banks borrow at the lower rate and deposit at the Fed for profit, pushing the federal funds rate toward IORB. By controlling the IORB rate, the Fed influences overnight money markets, short-term rates, and broader financial markets. This makes the IORB rate an effective monetary policy tool (Ihrig & Wolla, 2022).

Not all financial institutions in the federal funds market earn IORB, which can lower the federal funds rate. To counter this, the ON RRP facility allows banks, money market funds, government-sponsored enterprises, and others to deposit funds overnight, receiving securities (like U.S. Treasuries) as collateral and earn interest at the ON RRP rate. Financial institutions use the ON RRP rate as a reservation rate, the same as banks treat the IORB rate, ensuring they do not invest in lower-rate markets. This facility is a supplementary tool that helps set a floor for the federal funds rate (Ihrig & Wolla, 2022).

The discount rate is the Fed's interest rate on loans through the discount window, used to provide liquidity. These loans have slightly higher rates than market averages. The discount window helps ease upward pressure on the federal funds rate (Federal Reserve Board, 2021). Since banks avoid borrowing at higher rates than the Fed's, the discount rate acts as a ceiling for the federal funds rate, set above IORB and ON RRP rates. The Fed adjusts all three rates simultaneously and by the same amount to maintain a constant spread (Ihrig & Wolla, 2022).

Before 2008, the Fed relied on open market operations (OMOs) to manage the federal funds rate by buying and selling government securities. Today, OMOs ensure ample reserves, making the Fed's use of administered rates feasible (Ihrig & Wolla, 2022). OMOs also provide policy support during crises. During the 2007-09 financial crisis, when the federal funds rate neared zero, the Fed conducted large-scale asset purchases to lower long-term yields. Similarly, during COVID-19 in 2020, it bought Treasury and mortgage-backed securities to maintain stability and support credit flow to households and businesses (Federal Reserve Board, 2021).

The FOMC considers three factors in setting monetary policy: anticipated factors, demand shocks, and supply shocks. Anticipated factors, like tax cuts, can influence markets before policy takes effect. Additionally, forward-looking financial markets may adjust interest rates in response to expected fiscal changes. Demand shocks, such as changes in credit standards or consumer confidence, can disrupt the economy. The FOMC adapts policy

accordingly, but detecting shocks takes time, and more importantly, monetary policy changes usually take time to impact the economy. During COVID-19, the FOMC lowered interest rates to near zero and the Fed launched quantitative easing program to inject liquidity, introduced emergency lending facilities to support credit markets, and provided forward guidance on low rates to help set market expectations for a slow recovery. Supply shocks, like rising oil prices, raise prices and lower output. The FOMC may tighten or loosen policy depending on inflation and output goals. Positive supply shocks, like technological advancements, can drive down the prices and boost output growth (Federal Reserve Board, 2021).

The FOMC holds eight annual meetings, where Federal Reserve Bank presidents and Board of Governors members assess economic and financial conditions. Based on data, surveys, and reports, they decide on monetary policy. Only voting members—the Board of Governors, the New York Fed president, and four rotating Reserve Bank presidents—make final policy decisions. The FOMC then issues a public statement outlining its decision and economic expectations (Federal Reserve Board, 2021).

3.2 Historical Monetary Policy Cycles in the U.S. and Implications for Interest Rates

To achieve its mandate of stable prices and maximum employment, the Fed adjusts interest rates during business cycles – periods of expansion and recession. A tightening cycle begins with an initial increase in the federal funds rate, followed by a series of subsequent hikes. Over the past 70 years, the U.S. economy has experienced sixteen monetary tightening episodes, often resulting in recession. Notably, when rates were raised by more than 5% (in 1969, 1973, 1979, and 1981), a recession soon followed (Frier, 2023).

In this section, I will explain the Federal Reserve's recent tightening cycles. I decided to focus only on the last five tightening cycles within the past 50 years, with the most recent cycle taking place in 2022/23, mainly for 2 reasons. First, the literature that examines all tightening episodes is very limited. Second, in Chapter 4.1, I will analyze the banking sector's performance during each tightening cycle. To ensure alignment between chapters and due to the lack of performance data for cycles before 1994, I decided to focus on cycles from 1994 onward. The first four cycles will be examined in this section, while the latest cycle will be covered in detail in the next chapter.

February 4, 1994 – February 1, 1995: It turned out that the FOMC meeting in February 1994 was historic. Not because the Committee decided to begin raising rates but rather because it formally announced in a public statement that it would. This was the very first time that the FOMC announced the outcome of the meeting to the public, marking a shift toward greater transparency in monetary policy. Following this event, the federal funds rate increased from 3% to 6% in a year. It appears that the Committee's decision for monetary tightening served as a response to an unanticipated acceleration of economic growth. At

the September 1993 meeting, participants projected a 2.5% GDP growth in 1994, far less than the 4.1% growth that occurred. Inflation, on the other hand, even decreased from 3.1% to 2.6% between 1992 and 1994. However, the FOMC predicted that inflation would stay above 3% in 1994 and 1995, so it took a more radical approach of moving cautiously before inflation even appeared (Amaral, 2013). The 1994/95 episode did not cause the yield curve to invert and was not followed by a recession (Kliesen, 2022a).

June 30, 1999 – May 16, 2000: To lower the risk of inflation, the Committee raised the federal funds rate from 4.75% to 5% at its meeting in late June 1999. At the time, it was anticipated that inflation would spike dramatically in the second quarter of 1999, which is exactly what happened, and that the economy would grow faster in the third quarter of the same year. This cycle proved to be relatively short, with only a 175 basis points increase in the policy rate (Amaral, 2013). Unlike the 1994/95 episode, this tightening cycle resulted in an inverted yield curve and led to recession (Kliesen, 2022a).

June 30, 2004 – June 29, 2006: The Committee paid close attention to the risk that economic growth could accelerate unpredictably in the first half of 2004 and put inflationary pressures on the rise. When the prediction for Consumer Price Index in the second and third quarters rose significantly, the FOMC took the opportunity to tighten monetary policy and prevent the economy from overheating. Since the federal funds rate was at a 45-year low of 1%, tightening seemed appropriate even though FOMC believed inflationary pressures were only temporary. This two-year cycle was the longest tightening period, with a 425-basis point increase in the federal funds rate bringing it up to 5.25% (Amaral, 2013). Similar to the episode of 1999/2000, the 2004/06 episode was marked by inverted yield curve, recession and an increase in interest rates by the FOMC well after the curve inverted (Kliesen, 2022a).

December 16, 2015 – December 19, 2018: In comparison with other three episodes, the last (fourth) episode had several noticeable differences. During the first three episodes, the FOMC was generally tightening as the economy was strengthening and the price pressures were rising. On the other hand, in the 2015/18 episode the FOMC started tightening as the economy was slowing down and inflation was still well below the 2% inflation target. Furthermore, since short and long-term inflation expectations were declining, there was a one-year pause between the federal funds rate's first and second increase. While the FOMC kept tightening the policy even after the yield curve inverted during the 2004/06 cycle, in 2015/18 episode the FOMC stopped tightening roughly 8 months before the yield curve inversion. The initial target range was set from 0 to 0.25% at the beginning of the period and increased to 2.25% to 2.50% at the end of the period (Kliesen, 2022a).

An overview of the above-mentioned tightening episodes is presented in Table 1. The last column indicates a post-tightening peak in business activity that was followed by a recession. In the three cases where a recession followed, the average length of time between

the last tightening action and the business cycle peak was about 14 months. "N/A" indicates that a recession did not follow the tightening episode.

Table 1: Tightening Cycles from 1994 to 2018

First Tightening Action	Initial FFTR Target (%)	Final Tightening Action	Final FFTR Target (%)	Total Tightening (percentage points)	Yield Curve Inversion?	Business Expansion Peak
Feb. 4, 1994	3.00	Feb. 1, 1995	6.00	3.00	No	N/A
June 30, 1999	4.75	May 16, 2000	6.50	1.75	Yes	March 2001
June 30, 2004	1.00	June 29, 2006	5.25	4.25	Yes	December 2007
Dec. 16, 2015	0.00-0.25	Dec. 19, 2018	2.25-2.50	2.25	Yes	February 2020

Source: Kliesen (2022b)

Every U.S. monetary tightening cycle has caused economic and financial shifts. Starting with the impact of tightening on short- and long-term interest rates, during each episode, both short- and long-term Treasury rates rose, though the extent varied. The three-month T-bill rate generally tracked the federal funds rate, except in 1999/2000 when it traded below it, and in 2015/18 when it traded above it for months. On average, the 10-year Treasury rate rose 95 basis points, much less than the 281-basis-point federal funds rate increase. The circumstances in the Treasury market during the 2004/06 cycle were particularly interesting. The FOMC raised the federal funds rate from 1% to 5.25%, but long-term Treasury yields stayed between 4% and 5%. Alan Greenspan called this incident "the Conundrum." Eventually, long-term rates rose sharply, climbing 100 basis points from mid-January to early July 2006 (Kliesen, 2022a).

There are a few other notable differences across episodes. First, the idea that tighter monetary policy slows GDP growth held true only during the 1994–2006 episodes. In these cycles, GDP growth rose slightly before liftoff, stayed stable for a year, and then slowed by about 1 percentage point in the second year. Second, the 2015/18 episode was unique, with the second rate hike delayed by a year after liftoff. Third, during the 2015/18 cycle, inflation expectations behaved differently. After liftoff, short-term inflation expectations rose in the first three episodes, while long-term expectations declined (Kliesen, 2022a).

3.3 The 2022/2023 Monetary Policy Tightening Cycle and Implications for Interest Rates

Although past cycles provide good context of U.S. monetary tightening, the 2022 tightening cycle was nothing short of extraordinary. The outbreak of Covid-19 in spring of 2020 changed the world as we know it. More than 7 million people died and countless more became ill. People were forced to stay at home during the early stages of the pandemic,

which led to the disruption of supply chains and closure of numerous companies. The unemployment skyrocketed, the GDP collapsed, and the stock market crashed. In the U.S., only between February 2020 and April 2020, the unemployment rate jumped from 3.5% to 14.7%. Furthermore, the second quarter of 2020 was marked by the largest quarterly drop of GDP in history, where real GDP of the U.S. fell for 28% compared to the first quarter of 2020 (Rodini, 2024).

During two emergency meetings in March 2020, the FOMC made significant rate cuts, bringing the federal funds rate back to the effective lower bound of 0-0.25%. Over the next year and a half, with vaccine progress and strong policy support, employment and economic activity improved, while inflation started to increase. Initially, FOMC members expected no tightening until late 2023 or later because they did not expect the economy to recover so quickly. However, inflation surged in early 2021. Much of this inflation increase was attributed to temporary factors like Economic Impact Payment checks to households and supply-chain bottlenecks, so the FOMC called the inflation "transitory". However, by early 2022, with inflation over 7%, the Committee dropped the word "transitory" from the statement and raised the federal funds rate on March 17, 2022. This marked the beginning of the most aggressive tightening in decades, with the rate increasing by 525 basis points between March 17, 2022, and July 26, 2023. This helped to decrease the extreme inflation that peaked in June 2022 at 9.1% (Ihrig & Waller, 2024). Table 2 shows the Fed's rate hikes in the 2022/23 tightening cycle.

Table 2: Fed's Rate Hikes in 2022/23 Tightening Cycle

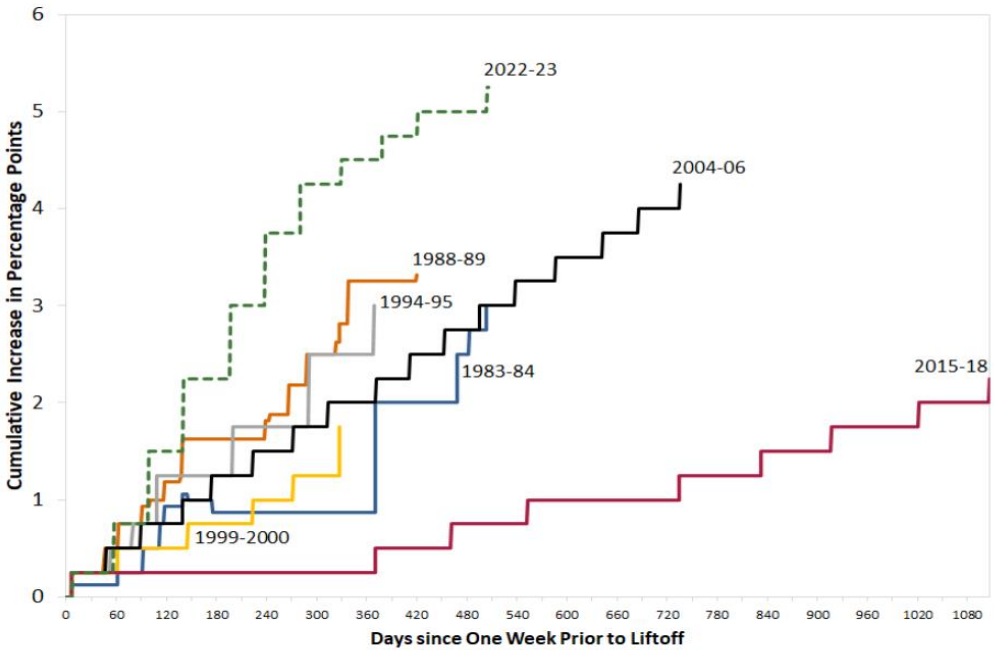
FOMC Meeting Date	Rate Change (bps)	Federal Funds Rate
July 26, 2023	+25	5.25% to 5.50%
May 3, 2023	+25	5.00% to 5.25%
March 22, 2023	+25	4.75% to 5.00%
Feb 1, 2023	+25	4.50% to 4.75%
Dec 14, 2022	+50	4.25% to 4.50%
Nov 2, 2022	+75	3.75% to 4.00%
Sept 21, 2022	+75	3.00% to 3.25%
July 27, 2022	+75	2.25% to 2.50%
June 16, 2022	+75	1.50% to 1.75%
May 5, 2022	+50	0.75% to 1.00%
March 17, 2022	+25	0.25% to 0.50%

Source: Tepper (2024)

Table 2 reveals how the FOMC slowed the pace of policy tightening in 2023 compared to late 2022. This slowdown was caused by several factors, such as cumulative effects of previous rate hikes, the delayed impact of monetary policy on inflation and economic activity, and instability in the banking sector in March 2023 (Ihrig & Waller, 2024). Nevertheless, the 2022/23 cycle was one of the most aggressive in history, marked by the fastest policy tightening in over 40 years. Figure 2 below illustrates the magnitude of the federal funds rate increases for each of the five tightening episodes, measured as the

cumulative increase from beginning to end. In the latest tightening cycle, the federal funds rate was raised by 525 basis points in only 16 months, making it the episode with the highest magnitude of tightening. The closest episode in terms of magnitude was 2004/06, at 425 basis points, while the smallest cumulative increase was during 2015/18 episode, when the FOMC increased the target range by 225 basis points over a three-year period (Kliesen, 2023).

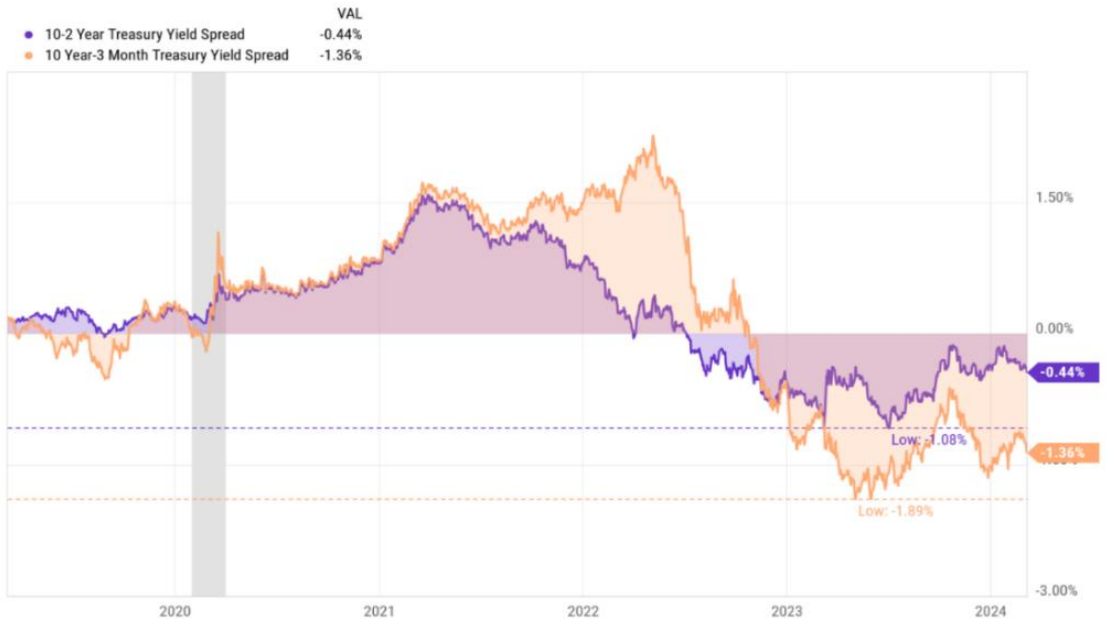
Figure 2: The Magnitude of Federal Funds Rate Increases during FOMC Tightening Episodes



Source: Kliesen (2023)

Just like three of the previous episodes, also the 2022/23 tightening cycle led to an inverted yield curve. Yield spreads usually provide a clear picture of the inverted yield curve. The 10 Year - 2 Year Treasury yield spread and the 10 Year – 3 Month Treasury yield spread are two of the most frequently followed spreads. The 10 Year – 2 Year spread inverted in July 2022 and remained negative until September 2024. The 10 Year - 3 Month Treasury yield spread inverted in October 2022 and remained negative until December 2024 (YCharts, 2024). The changes in both spreads are presented in the following Figure 3.

Figure 3: 10 Year – 2 Year and 10 Year – 3 Month Treasury Spread from 2019 to 2024



Source: YCharts (2024)

It is well known that the inverted yield curve is often a predictor of U.S. recessions. According to a definition provided by the National Bureau of Economic Research, there have been six significant U.S. recessions since 1976. All six recessions came after an inverted 10 Year - 3 Month spread and an inverted 10 Year – 2 Year Treasury spread, which lasted more than two months. Furthermore, recessions typically occurred within two years of a negative 10 Year – 2 Year spread. What is highly unusual is how long this particular inversion has lasted (YCharts, 2024). Despite the FOMC's most recent tightening measures and a 2-year long inverted yield curve, the U.S. economy has been growing at a rate faster than its potential, with real GDP reaching an annual average growth rate of 2.5% in 2023. Moreover, the unemployment rate remained low at 3.6% in 2023, and inflation dropped to 4.1% from 8% in 2022. Thus, according to the data available so far, it appears that the U.S. economy might avoid a recession this time (Kliesen, 2023).

4 EXPOSURE OF THE U.S. BANKING SECTOR TO INTEREST RATE RISK

4.1 Financial Performance of the U.S. Banking Sector During Monetary Tightening Cycles

When evaluating banks' performance during monetary tightening cycles, it is essential to consider their profitability beyond changes in asset and equity values. The Fed views NIMs as a key measure of bank profitability, so focusing on how NIMs fluctuate during these episodes is crucial. Observing NIM changes as policy rates rise helps understand banks' role in transmitting monetary policy. There are three primary channels through which the federal funds rate can affect bank NIMs. First, in the short run, NIMs fluctuate in response

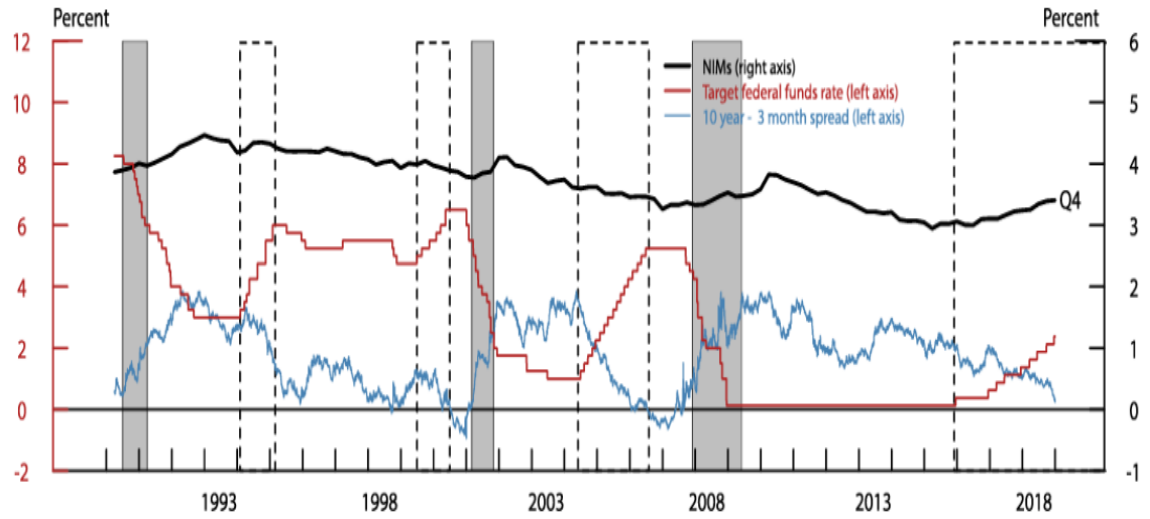
to interest rate levels, with higher rates leading to higher NIMs. Loans and other bank assets are usually floating-rate contracts that are benchmarked to reference rates that usually reprice with policy. On the other hand, payouts on bank liabilities, like deposits, are mostly at the bank's discretion and usually follow policy rates more slowly. As a result, bank NIMs typically increase when interest rates rise and decrease with rate cuts. Maintaining bank profitability in a low-rate environment was, in fact, a key concern for policymakers when rates reached the zero lower bound at the start of the pandemic (Laliberte & Sengupta, 2024).

Second, in the long run, bank NIMs depend on the slope of the yield curve. Longer-term, higher-yielding assets are typically financed by shorter-term, lower-yielding liabilities. Since NIMs are the difference between interest income on bank assets and interest expense on bank liabilities, their level can depend on the term premium, or the extra compensation investors anticipate for longer-term versus shorter-term lending. All else equal, bank NIMS tend to rise when the yield curve steepens (higher term premium). Conversely, when the yield curve flattens or inverts (lower term premium) bank NIMs tend to fall (Laliberte & Sengupta, 2024).

Third, policy rate changes can affect NIMs by altering the composition of banks' assets and liabilities. During rate hikes, if banks take too long to raise deposit rates, depositors may move their money to higher-yielding alternatives like money market funds. This can lead to deposit outflows, forcing banks to rely on more expensive funding sources, increasing costs, and reducing NIMs. Some argue that deposit outflows during rising rates are a primary channel through which monetary policy affects the economy. Banks can also adjust their assets, shifting from riskier loans to fixed-income securities with higher yields to benefit from rising rates. Ultimately, these changes in the balance sheet composition affect bank profitability. Together, these three channels suggest that the relationship between monetary policy changes and bank NIMs is not always clear and may vary by bank (Laliberte & Sengupta, 2024).

Over the years, NIMs have remained relatively stable during tightening episodes, ranging from 3% to 4.5%, but have decreased over the past few decades. Figure 4 illustrates federal funds rate movements, U.S. commercial bank NIMs, and the 10 Year – 3 Month Treasury yield spread over the past 30 years, with grey areas marking recessions and dashed boxes showing tightening periods (Berry et al., 2019).

Figure 4: NIM's, Federal Funds Rate and 10 Year - 3 Month Treasury Yield Spread



Source: Berry et al. (2019)

Berry et al. (2019) studied changes in aggregate banks' NIMs during the tightening cycles of 1994/95, 1999/2000, 2004/06, and 2015/18. In the first three episodes, NIMs declined slightly by 13, 13, and 24 basis points, respectively. However, during the 2015/18 cycle, NIMs rose by 39 basis points. The authors further decomposed NIM to better explain why NIMs increased only during the 2015/18 cycle. They analyzed how both interest expenses relative to interest-bearing assets (IE/IBA) and interest income relative to interest-bearing assets (II/IBA) responded to changes in the federal funds rate.

Table 3 presents the cumulative change in the federal funds rate for each tightening episode (Column 1) and the corresponding cumulative change in NIMs (Column 2). To illustrate how NIMs responded to each basis point increase in the federal funds rate, Column 3 divides the cumulative NIM change by the cumulative rate increase. During the 2015/18 tightening, NIMs rose by approximately 0.2 basis points for every basis point increase in the federal funds rate. This contrasts with the previous three episodes, where NIMs slightly decreased with each 1 basis point increase of federal funds rate. Although the federal funds rate increased by a total of 225 basis points during 2015/18, NIM changes were calculated based on a 200-basis point rise since the final 25 basis point hike was announced after the December 2018 FOMC meeting, and the data ended in Q4 2018. Columns 4 and 5 show how II/IBA and IE/IBA components change with each 1 basis point increase in the federal funds rate. It is essential to note that changes in NIMs are the sum of changes in II/IBA and IE/IBA. The data shows that during 2015/18, interest expenses grew more slowly relative to the federal funds rate compared to prior cycles, while interest income increased more rapidly in response to the rate hikes (Berry et al., 2019).

Table 3: NIMs Decomposition Relative to the Federal Funds Rate

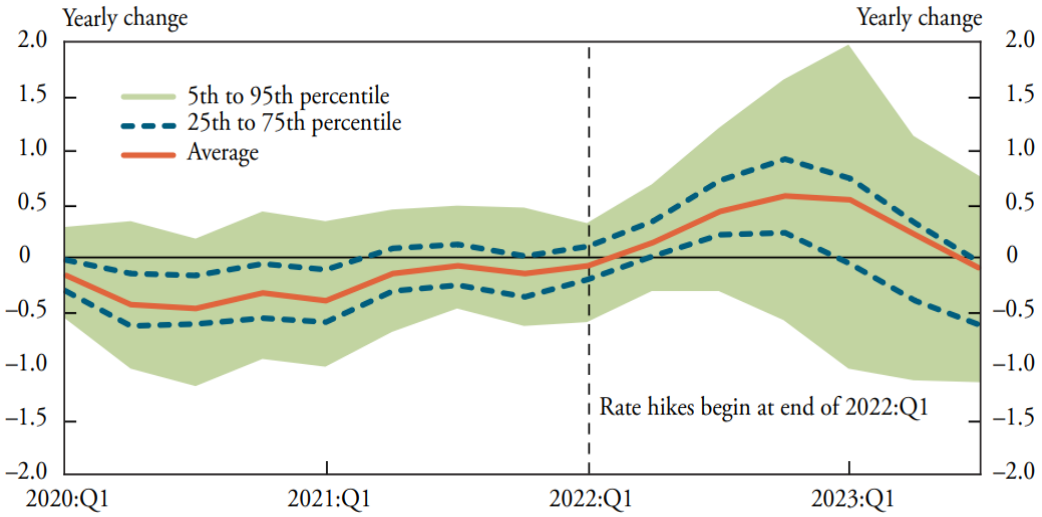
Monetary Policy Tightening Episode	Cumulative Change in FFR in bps (1)	Cumulative Change in NIMs in bps (2)	Cumulative Change in NIMs over Cumulative Change in FFR (3)	Cumulative Change in II/IBA over Cumulative Change in FFR (4)	Cumulative Change in - IE/IBA over Cumulative Change in FFR (5)
2015-18	200	39	0.2	0.49	-0.3
2004-06	425	-24	-0.06	0.39	-0.45
1999-2000	175	-13	-0.07	0.35	-0.41
1994-95	300	-13	-0.04	0.34	-0.39

Source: Berry et al. (2019)

To explain the different behaviour of banks' NIMs during the 2015/18 monetary tightening, changes in the U.S. banking environment must be considered. Two key factors were the abundance of deposits and compressed NIMs during the zero lower bound period. Since the 2008 Great Recession, the banking landscape shifted, influencing banks' lending and deposit rate-setting behaviours. With federal funds rates at zero, NIMs were squeezed as deposit rates hit zero while loan rates continued to decline. When the FOMC raised rates in December 2015, banks were slower to increase deposit rates than in prior cycles, aiming to regain lost profitability. The system also held substantial liquidity from the Fed's asset purchases, leaving banks with higher reserves and deposit funding. As a result, banks felt less pressure to compete for deposits during the 2015/18 cycle. Even if deposit rates rose at the same pace as earlier cycles, the effect on NIMs would still be smaller due to the higher share of deposit funding and faster rate adjustments of other funding sources. Lastly, the greater share of liquid assets, tied to shorter-term rates, allowed interest income to grow more quickly with federal funds rate increases (Berry et al., 2019).

Continuing with the banks' performance during the 2022/23 tightening cycle, while most banks became more profitable, a smaller group faced consistent declines in their NIMs. Figure 5 provides a clear illustration of these trends. Average NIMs initially rose as the Fed started raising rates in March 2022, reflecting an increase in floating - loan rates and limited pass-through of rate hikes to deposit rates. However, by late 2022, the rate of NIM growth slowed significantly as successive rate hikes began to take a broader toll. The main feature of this tightening cycle was the growing variation in how banks' NIMs responded. Figure 5 also shows a widening dispersion in NIM outcomes across banks, with the interquartile range (blue dashed lines) and the 5th–95th percentile range (green shaded area) expanding as the cycle progressed. This indicates that some banks experienced strong gains, while others saw much smaller improvements or even declines in their NIMs (Laliberte & Sengupta, 2024).

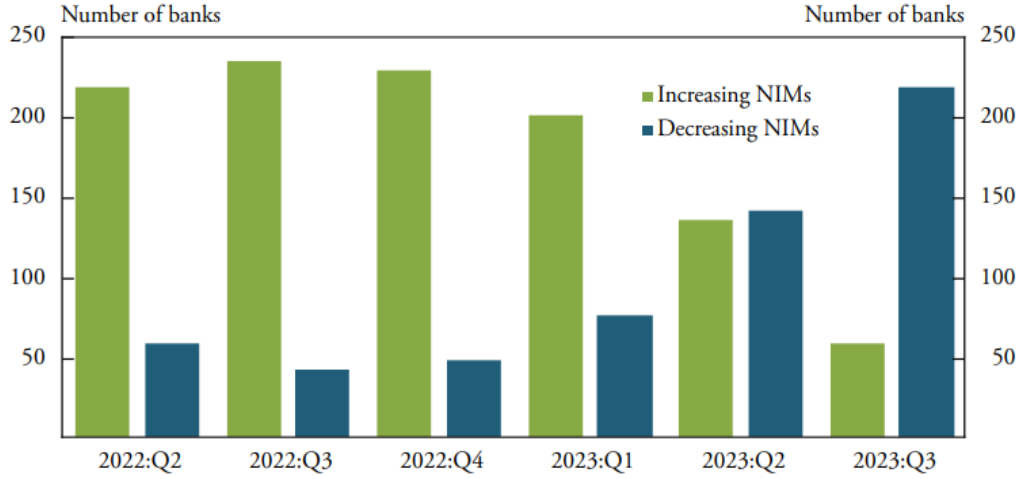
Figure 5: Distribution of Annual Changes in NIMs for Each Quarter Beginning in 2020



Source: Laliberte & Sengupta (2024)

Although most banks continued to report higher NIMs during the first year of rate hikes, the number of banks with declining NIMs increased steadily throughout the cycle. Figure 6 highlights this trend: while over 200 banks reported NIM increases by the end of 2022 (green bars), the number of banks with declining NIMs (blue bars) rose sharply, from 46 in Q3 2022 to 224 by Q3 2023. These declines were not limited to a particular type of bank, as they occurred across institutions of all sizes. Moreover, 52 banks have experienced declining NIMs in at least four out of six quarters. Unsurprisingly, these banks had lower average NIMs than others. This group included banks from various size categories: 26% were community banking organizations (CBOs), 19% were regional banking organizations (RBOs), and 19% were large banking organizations (LBOs). Thus, the size alone does not fully explain why some banks consistently experienced NIM declines (Laliberte & Sengupta, 2024).

Figure 6: Number of Banks with Declining NIMs Has Increased



Source: Laliberte & Sengupta (2024)

To better understand why certain banks experienced shrinking NIMs during the 2022/23 monetary tightening cycle, Laliberte & Sengupta (2024) analysed two groups: margin-decreasing banks, which showed declining NIMs in at least four of six quarters and had any NIM increases smaller than half a standard deviation of the long-term NIM distribution, and margin-increasing banks, which exhibited rising NIMs in at least four of six quarters and had any NIM decreases smaller than half a standard deviation of the long-term NIM distribution. Table 4 outlines the key characteristics of these two groups. Out of 275 banks analysed, 34 were identified as margin-decreasing banks, while 104 were classified as margin-increasing banks. The average NIMs for margin-increasing banks were also notably higher at 3.61% compared to 2.59% for margin-decreasing banks. Both groups included banks of all sizes, but on average, margin-decreasing banks were significantly smaller, with assets of approximately $96 billion compared to $168 billion for margin-increasing banks. This size difference suggests that larger banks were better positioned to benefit from rising rates during the 2022/23 tightening cycle.

Table 4: Margin-Increasing and Margin-Decreasing Banks by Size

Sample	Number of banks				Total assets (billions)	NIMs		
	Total	LBOs	RBOs	CBOs	Mean	Mean	Max	Min
Full Sample	275	31	99	145	$87.58	3.32	10.46	-1.39
Margin-increasing banks	104	19	42	43	$168.08	3.61	10.46	0.51
Margin-decreasing banks	34	3	11	20	$95.78	2.59	4.67	-1.39

Source: Laliberte & Sengupta, 2024

Interestingly, despite their higher NIMs, margin-increasing banks had return on assets (ROA) levels comparable to those of margin-decreasing banks. This is because margin-increasing banks generated more net interest income, while margin-decreasing banks relied more heavily on net noninterest income as a source of profitability. However, the recent widening of ROA between the two groups can largely be explained by the growing divergence in their NIMs during the 2022/23 tightening cycle. As margin-increasing banks maintained higher NIMs, their profitability improved more consistently, creating a clear gap in overall performance compared to margin-decreasing banks. This underscores how differences in interest margins directly impacted the financial outcomes of these two groups during the latest rate hike cycle (Laliberte & Sengupta, 2024).

A comparison of the asset and liability compositions of margin-increasing and margin-decreasing banks before the 2022/23 rate hikes revealed significant structural differences tied to their business models. Margin-decreasing banks held a smaller proportion of their

assets in loans and securities but a larger share in trading assets and repurchase agreements. This reflects their greater focus on capital market activities, which also contributed to higher net noninterest income, a crucial component of their overall profitability. In contrast, margin-increasing banks, with their emphasis on loans and securities, followed a more traditional banking model. On the liability side, the reliance on funding sources differed greatly between the two groups. Margin-increasing banks predominantly relied on deposit funding, with both interest and noninterest-bearing deposits making up about 70% of their funding. This reliance on deposits provided a cost advantage, as deposit funding is typically less expensive, especially during periods of rising interest rates. In contrast, deposit funding accounted for only about 32% of the funding for margin-decreasing banks, which instead relied more on non-deposit sources such as repurchase agreements, other borrowed money, and other liabilities (Laliberte & Sengupta, 2024).

One of the most notable differences between the two groups was the role of noninterest-bearing deposits. For margin-increasing banks, noninterest-bearing deposits represented about 21% of their total liabilities in Q4 2021, whereas for margin-decreasing banks, this figure was just 2.5%. Although the gap narrowed slightly as deposits flowed out during the tightening cycle, it remained a critical factor in explaining differences in NIM performance. Banks that managed to retain a significant share of noninterest-bearing deposits benefited from lower funding costs and reduced dependence on more expensive non-deposit funding sources. This advantage was a major driver of the stronger NIMs seen in margin-increasing banks during the 2022/23 tightening cycle (Laliberte & Sengupta, 2024).

The impact of interest rate hikes on banks' NIMs can be further broken down into two components: changes in yields (prices) and changes in shares (volumes). As rates rise, yields on both deposit and non-deposit funding increase, which can lower NIMs by raising funding costs. Additionally, higher rates may cause deposit outflows as customers seek better returns elsewhere. This, in turn, forces banks to depend more on non-deposit funding, increasing its share in their funding mix. Because yields on non-deposit funding tend to rise faster and higher than those on deposit funding, this shift from deposits to non-deposit funding further raises overall funding costs. The combined effects of rising yields and changing funding shares create downward pressure on NIMs, with the magnitude of the impact depending on the bank's reliance on non-deposit funding. By decomposing these contributions, it becomes clear that both the pricing of funding sources and the volume shifts in funding play important roles in shaping NIM performance (Laliberte & Sengupta, 2024).

Since the start of the 2022/23 tightening cycle, the Fed raised the target policy rate by more than 500 basis points, with most of the changes in NIMs being driven by changes in yields rather than shifts in asset or liability volume. On the asset side, both margin-increasing and margin-decreasing banks benefitted from rising loan yields, which contributed comparably to their NIMs. However, the contribution from rising securities yields was lower for margin-decreasing banks, while the contribution from yields on other assets was higher for

these banks, reflecting differences in their asset composition. Furthermore, margin-increasing banks, unlike margin-decreasing banks, also saw a modest positive contribution to their NIMs from an increase in the share of loans on their balance sheets. This ability to expand loan volumes during the tightening cycle provided an additional boost to their profitability, further differentiating their performance from the other group. Overall, while yield changes were the primary driver of NIM dynamics, differences in asset composition and shifts in shares contributed to the divergence between the two groups (Laliberte & Sengupta, 2024).

On the liability side, most of the changes in NIMs during the 2022/23 tightening cycle were driven by changes in yields on both deposits and non-deposits. However, both margin-increasing and margin-decreasing banks experienced a small but negative contribution to their NIMs from increases in non-deposit funding shares. For margin-decreasing banks, changes in non-deposit funding shares accounted for around 6% of the total negative contribution, whereas for margin-increasing banks, this figure was about 25%. The latter suggests that margin-increasing banks became more reliant on non-deposit funding during the rate hike cycle. In contrast, margin-decreasing banks already had higher non-deposit funding shares before the cycle began, reflecting their business models. As a result, the shift from deposits to non-deposit funding had a smaller impact on their NIMs compared to margin-increasing banks (Laliberte & Sengupta, 2024).

In summary, differences in business models largely explain the variations in banks' NIMs during the latest tightening cycle. Margin-decreasing banks, which are more active in capital markets, faced higher non-deposit funding costs, as these yields are more sensitive to policy rate changes than deposit funding. While rising rates also increased non-deposit funding shares, this effect was more significant for margin-increasing banks. Ultimately, the decision to use more non-deposit funding was likely influenced by the high costs of maintaining a deposit franchise in the low-rate environment prior to the recent interest rate hikes (Laliberte & Sengupta, 2024).

4.2 Main Drivers of Interest Rate Exposure in the U.S. Banking Sector

This chapter addresses my first research questions, which is, why are the U.S. banks so vulnerable to interest rate risk and what are the main drivers of this exposure. I will start with the first half of the research question: Why are the U.S. banks so vulnerable to interest rate risk? Especially now, in the aftermath of the 2022/23 monetary tightening cycle, the analysts and officials are more certain than ever that European banks can better withstand interest rate risk than their U.S. peers. While European banks remain relatively safe, interest rate risk continues to pose a serious threat to small, mid-sized and regional U.S. banks (Illgner, 2023).

According to the research report conducted by the rating agency Moody's, poor regulation and light supervision led to smaller U.S. banks being increasingly exposed to interest rate

risk, while tight regulation and active supervision in Europe not only help but also require banks to implement measures to mitigate this risk. Moody's analysis emphasizes how regulation plays a major role in interest rate risk management, and how the very different regulatory landscapes in the U.S. and Europe result in very different approaches to managing interest rate risk. In Europe, for instance, supervisors have the authority to demand corrective actions or raise capital requirements. Additionally, European banks must pass the supervisory outlier test (SOT), which compares a bank's exposure to interest rate risk to that of its peers. The results of the tests are reported to supervisors on a quarterly basis, so supervisors can quickly see if new risks emerge. In practice, this means most banks tend to have a low appetite for interest rate risk (Illgner, 2023).

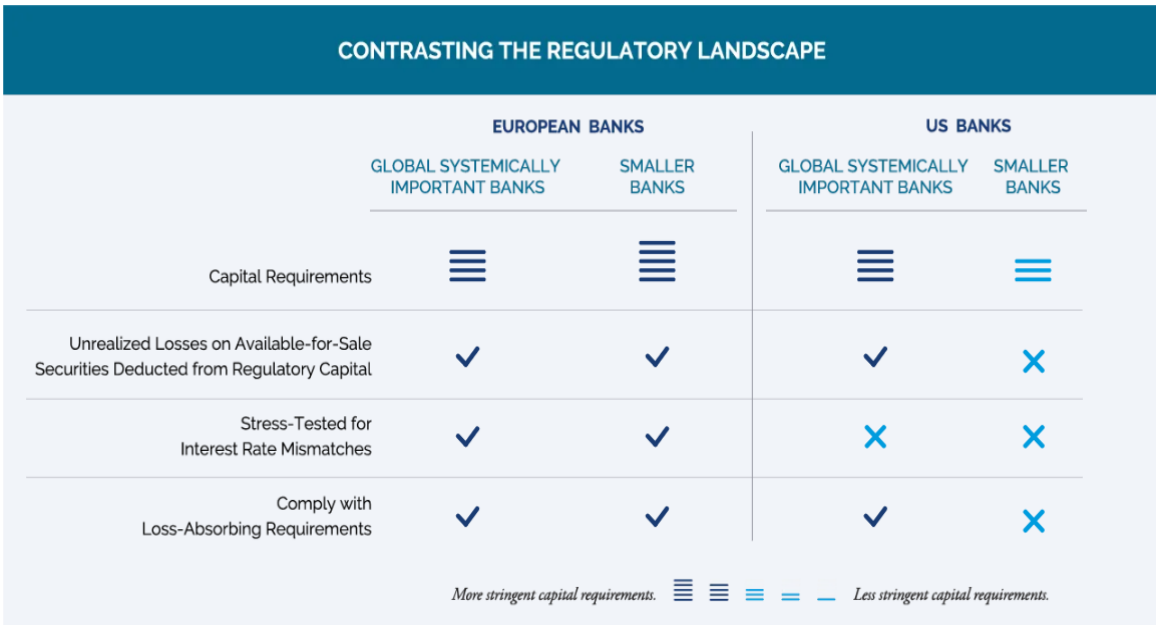
Under U.S. regulation, however, supervisors are required to determine whether an institution's interest rate risk policy is being followed by the bank's interest rate risk management. Risk is not evaluated by supervisors in comparison to other banks. This directly contradicts the recommendations made by the Basel Committee on Banking Supervision. In fact, identifying banks with excessive interest rate risk exposure in relation to their peers is one of the fundamental Basel principles. However, highlighting the differences in supervision between the U.S. and the EU is not new. The International Monetary Fund (IMF) made several recommendations already back in 2020 to strengthen the U.S. supervision and regulation of interest rate risk. According to the IMF, the U.S. authorities are not using enough quantitative analysis (stress tests) to assess and manage interest rate risk. This is significant because U.S. mortgages are typically very long-term which makes them very sensitive (Illgner, 2023).

Another reason why U.S. banks are more vulnerable to interest rate risk than their European peers is due to less strict capital requirements and lower capitalization, particularly for smaller banks. While systemically important banks in the U.S. and Europe have similar capital ratios, smaller U.S. banks tend to have significantly lower ratios than small banks elsewhere. A 2023 interest rate risk report examined around 900 U.S. banks and discovered that, under a shock scenario, the median EVE risk for Tier 1 capital at small and mid-sized supervised banks (those with assets of $115 billion or less) was 20%. The regulatory limit for EU banks is 15%. The EVE risk of the worst-performing U.S. banks reached a staggering 68%. Implementing stricter capital requirements could help mitigate interest rate risk, leading to a more resilient banking system overall. Although it may take years for banks to raise their capital levels, the advantages are clear: increased capital allows banks to focus less on identifying and managing small, individual risks and reduces the likelihood of facing sudden financial challenges, thereby strengthening the entire system (Illgner, 2023).

In the European banking system, unrealized losses on available-for-Sale (AFS) securities are deducted from regulatory capital for both large and small banks. This ensures that the banks’ capital accurately reflects market fluctuations, providing a transparent view of their financial health and resilience. By contrast, in the U.S., only large, systemically important

banks make this deduction, while smaller banks are exempt. This difference means smaller U.S. banks may appear financially stronger than they truly are during periods of rising interest rates, as their regulatory capital does not account for potential losses on AFS securities. Additionally, both large and small European banks are stress-tested for interest rate mismatches and must comply with loss-absorbing requirements, unlike in the U.S., where these measurements are not consistently applied, especially among smaller banks (Loomis Sayles Credit Research, 2023). The key differences in the regulatory landscape for U.S. and European banks are summarized in Figure 7.

Figure 7: Regulatory Landscape Differences between the U.S. and Europe

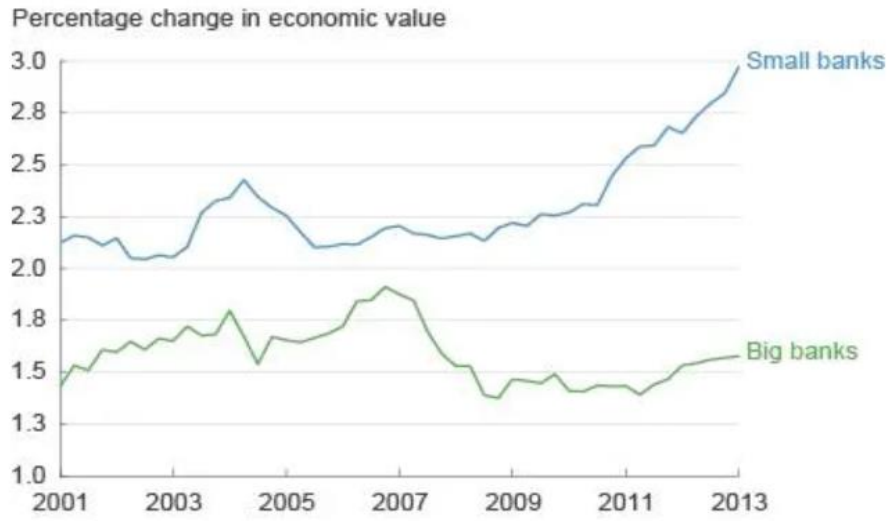


Note: While U.S. banks perform internal stress tests for interest rate risk (e.g., NII and EVE simulations), the table refers to regulatory-mandated stress testing for interest rate mismatches. Unlike in Europe, U.S. regulators do not formally require standardized stress tests with uniform assumptions.

Source: Loomis Sayles Credit Research (2023)

Bednar and Elamin (2014) studied changes in interest rate risk in U.S. banks to see whether the risk is increasing or decreasing over years. In their analysis they used an EVE model to measure the effect of an interest rate change on bank equity. The authors discovered that the average interest rate risk in the U.S. banking system has risen sharply since the end of the financial crisis of 2008. However, this increase was not the same across all banks. As seen from Figure 8, small banks experienced a significantly higher spike in interest rate risk compared to large banks. Although the average interest rate risk increased in the 50 largest commercial banks since 2009, the 2014 level remained significantly lower than the peak before the financial crisis. This suggests that small banks, not large ones, are responsible for the return to the pre-crisis risk levels. The graph shows the percentage change in economic value following a 2% increase in interest rates.

Figure 8: Interest Rate Risk in U.S. Banks



Source: Bednar & Elamin (2014)

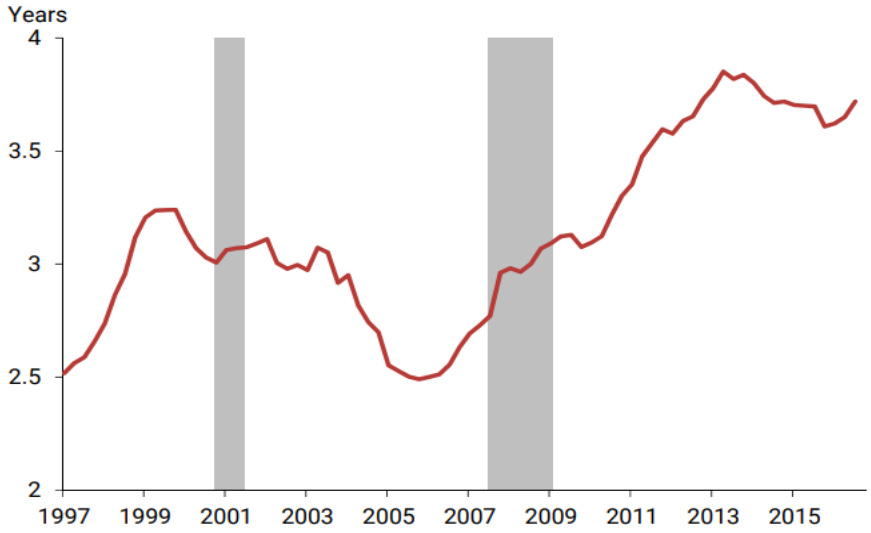
Further decomposing interest rate risk into asset and liability contributions and found that the rise in interest rate risk among the 50 largest banks is primarily driven by interest-sensitive liabilities. The contribution of assets remained steady. Nevertheless, within the asset category, two main asset types showed contrasting behavior: loans contributed less to interest rate risk, while securities contributed more, offsetting the decline from loans. On the other hand, small banks experienced a steep increase in interest rate risk after 2009. What is particularly concerning is that the small banks' exposure is driven by both assets and liabilities. However, it appears that the risk associated with assets is greater than the one of liabilities. Moreover, long-term loans and securities both contributed significantly to the overall increase in asset risk at small banks (Bednar & Elamin, 2014).

Now, focusing on the second part of my first research question, that is: What are the main drivers of interest rate risk exposure in the U.S. banking sector? According to the Federal Reserve, the interest rate risk exposure of the banks is driven by several sources. These sources refer to the various mechanisms or structural elements within a bank's balance sheet, operations, and financial instruments that can generate exposure to interest rate risk.

Funding sources can introduce risks like repricing, basis, yield curve, or option risks. Banks must closely assess the connection between funding sources and asset structures since the reliance on short-term or volatile funding sources to finance long-term fixed-rate assets can lead to serious maturity and repricing mismatches (FDIC, 2024). For instance, U.S. banks' exposure to interest rate risk increased during the 2020-2021 pandemic period, largely due to the rising proportion of long-term securities in their assets (Abdymomunov et al., 2023). While derivative instruments are often used as hedging tools, they as well can introduce complex interest rate risk exposures, including repricing, basis, yield curve, option, or price risk, depending on the specific instrument and its structure (FDIC, 2024). As Figure 9 illustrates, the maturity gap between assets and liabilities of U.S. banks has grown since

the 2008 financial crisis. The larger the maturity gap, the more exposed banks are to interest rate risk.

Figure 9: Maturity Gap of U.S. Banks



Source: Paul (2018)

Mortgage banking operations are exposed to price risk because their value is sensitive to changes in interest rates. This risk affects the loan pipeline (loans in progress), the held-for-sale portfolio, and the mortgage servicing rights portfolio. For example, if interest rates rise while loans are still in the pipeline or awaiting sale, their market value may decrease, as investors demand higher yields. Similarly, the value of mortgage servicing rights can decline if borrowers refinance or prepay loans when rates drop, reducing the income generated from servicing fees. Beyond affecting current asset values, interest rate changes also influence future business volumes—such as fewer borrowers seeking loans when rates are high—and related fee income, which can reduce overall profitability for banks engaged in mortgage banking (FDIC, 2024).

Fee Income Businesses: Non-interest revenue-generating activities, such as mortgage banking, trust services, credit card servicing, and non-deposit product sales, are sensitive to interest rate movements. Changes in rates can influence the volumes of these activities and the associated fee income. On the other hand, strategies like product pricing can introduce basis risk or yield curve risk (FDIC, 2024).

Embedded options in assets, liabilities, and off-balance sheet derivatives can create interest rate risk. These options give the holder the right, but not the obligation, to alter the cash flow of an instrument by buying, selling, paying down, withdrawing, or otherwise modifying its terms. The holder of the option can be the bank, the issuer, or a counterparty. Many financial instruments contain such options, including (FDIC, 2024):

- Non-maturity deposits: Depositors can withdraw funds at any time, causing uncertainty in funding.
- Callable bonds: The issuer has the option to redeem part or all the bond before maturity, depending on specific call dates.
- Structured notes: These can have embedded options like step-up features, interest rate caps, floors, and cash flow triggers.
- Wholesale borrowings: Lenders may have a call option (requiring banks to repay borrowings), or borrowing banks may have a put option (allowing them to prepay borrowings).
- Mortgage loans: Borrowers may have the option to partially or fully prepay the loan.
- Mortgage-backed securities (MBS): Borrowers' options to prepay individual mortgage loans included in an MBS loan pool can shorten the life of a tranche of loans within a security.

5 THE U.S. BANKING CRISIS IN 2023

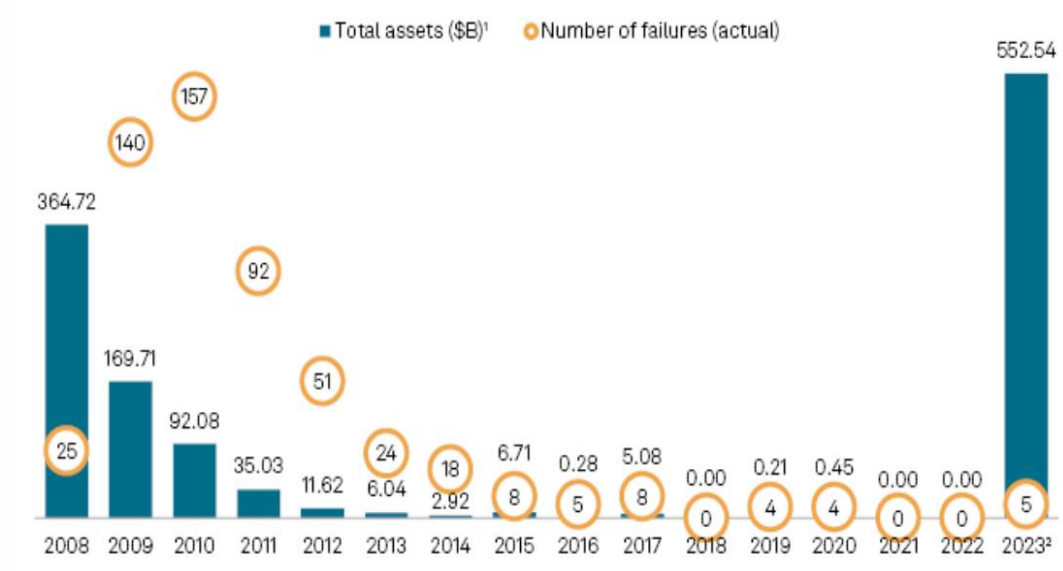
5.1 Overview of the U.S. Banking Crisis Events in 2023

Between March and May 2023, the U.S. financial system suffered from the most severe banking stress since the global financial crisis. The failure of a few large banks showed how many financial institutions were not prepared for a rising interest rate environment after a long period of low rates. As already mentioned, between March 2022 and July 2023, the Fed raised the federal funds rate by 525 basis points, marking the fastest tightening cycle since the 1980s. The fast and intense tightening of monetary policy exposed hidden vulnerabilities within the U.S. banking system, requiring forceful actions by the U.S. authorities to avoid a systemic risk event. The portfolios of government bonds and other long-term securities held by banks experienced great losses due to rising interest rates. By May 2023, it was estimated that U.S. banks faced around $2 trillion in unrealized losses on securities. These substantial losses created fears of potential bank collapses and triggered deposit withdrawals which led to funding and liquidity problems for some banks. Ultimately, this turmoil contributed to the collapses of six banks: Silvergate Bank, Silicon Valley Bank, Signature Bank, First Republic Bank, Heartland Tri-State Bank, and Citizens Bank (Ozili, 2024).

The reason why the banking crisis of 2023 in the U.S. is of such great importance is because it represents a record year for failed banks assets. First Republic Bank, Silicon Valley Bank and Signature Bank mark the second, third and fourth largest bank failures ever, respectively. The total assets of Silicon Valley Bank, Signature Bank, First Republic Bank, Heartland Tri-State Bank and Citizens Bank amounted to $552.54 billion, compared to $364.72 billion in 2008, the second-largest year by failed bank assets. On a side note, Silvergate Bank is officially not considered as a failed bank of 2023 since it self-liquidated and closed without the intervention of Federal Deposit Insurance Corporation (FDIC).

Figure 10 shows the U.S. bank failures since 2008 by the number of banks failed and the sum of their total assets (Graf & Gull, 2023).

Figure 10: U.S. Bank Failures by Years



Source: Graf & Gull (2023)

Silvergate Bank:

Although Silvergate Bank was a relatively small bank, with around $15 billion in assets and $9 billion in deposits, it was one of the main two banks in the U.S. for crypto companies. At the end of 2022, around 90% of its deposits were crypto-related. FTX, a major currency exchange firm, was one of Silvergate's biggest depositors, representing nearly $1 billion, or roughly 11% of the bank's total deposits. In November 2022, FTX declared bankruptcy. However, before filing bankruptcy, FTX withdrew all its funds from the bank, which triggered a bank run. Moreover, despite the bank's cryptocurrency relation, its portfolio was quite conservative. According to Silvergate's report, the bank invested up to 80% of its deposits in mortgage-backed securities and long-term U.S. bonds, with the great majority of held-to-maturity bonds (HTM) of maturity over 10 years. With an interest rate hike, the mark-to-market price of these securities fell sharply. To keep up with deposit withdrawals, Silvergate had to sell these securities and suffered a nearly one-billion-dollar loss. The bank experienced an $8 billion decline in total deposits from digital asset customers within two months. In early 2023, Silvergate faced further financial difficulties, being forced to sell more assets at a loss and even borrowed $3.6 billion from the Federal Home Loan Bank of San Francisco to maintain its liquidity. Despite the efforts, on 1st of March Silvergate declared that it was no longer considered a well-capitalized bank. The bank announced voluntary liquidation on March 8, 2023 (Benoit, 2023).

Silicon Valley Bank:

SVB was the second bank to fail on March 10, 2023. With about $210 billion in assets and $175 billion in deposits, SVB was the 16th largest bank in the U.S. It primarily served U.S.

tech startups and venture capitalists. SVB was a victim of a classical bank run that was driven by the Fed's interest rate hikes and SVB's poor investment strategies during the 2020-2021 tech boom. During that period, SVB invested heavily in mortgage-backed securities and long-term Treasury bonds. Importantly, over 95% of its deposits were demand deposits and 90% of the deposits were uninsured, exceeding the FDIC limit of $250,000. As interest rates rose, the market value of SVB's HTM and AFS portfolio fell sharply. Simultaneously, a few depositors started to withdraw funds, some seeking higher returns while others faced financial difficulties. By the end of 2022, SVB had $15 billion in HTM unrealized losses and $2.5 billion in AFS losses. Unable to meet withdrawal demands, the bank was forced to sell $21 billion in bonds and realized a loss of $1.8 billion. After announcing a $2.25 billion capital raise, the bank collapsed just 48 hours later, with $42 billion withdrawn in one day and pending withdrawal requests totaling $100 billion. The liquidity crisis led to SVB's failure, FDIC was appointed receiver and reached an agreement with First Citizens BancShares, Inc. to acquire SVB (Ozili, 2024).

Signature Bank:

Signature Bank failed on March 12, 2023, just two days after SVB's collapse, and was acquired by New York Community Bancorp. With $110 billion in assets, Signature was the 19th largest U.S. bank. Apart from the abnormally high share of uninsured deposits, 90% of total deposits amounting to $79.5 billion, Signature Bank was also highly exposed to the crypto sector, with around 20% of deposits being crypto. In November 2022, Signature faced reputational damage following the FTX bankruptcy, its crypto exchange client, which contributed to increased negative publicity even though the bank did not hold cryptocurrencies. Ultimately, the bank was a victim of the panic surrounding SVB and Silvergate Bank. It experienced a traditional bank run, with depositors withdrawing over $10 billion almost immediately after SVB collapsed. To prevent a chain reaction of withdrawals at other banks and protect the stability of the U.S. banking system, the FDIC quickly closed Signature Bank. FDIC took an extraordinary step and created bridge banks and ensured all depositors were protected, regardless of the usual $250,000 insurance limit. The failures of SVB and Signature Bank raised questions about the extents of deposit insurance and the definition of "too-big-to-fail" since their collapses nearly destabilized the entire U.S. banking system (Ozili, 2024).

First Republic Bank:

FRB soon followed the steps of SVB and Signature Bank and failed on May 1, 2023. As the 14th largest U.S. bank with $229 billion in assets, FRB's failure marked the second largest bank collapse in U.S. history. The bank, which focused on serving high-net-worth clients, started to face challenges after the Fed began raising interest rates. The collapse of SVB and Signature Bank worsened FRB's circumstances, pushing depositors to move their uninsured funds to larger banks while Standard and Poor's downgraded FRB's credit rating. In an effort to stabilize FRB, a consortium of 11 major banks injected $30 billion in deposits. However, in its first quarterly earnings report in 2023, FRB reported very poor earnings that were accompanied by enormous deposit outflows. Despite the infusion, FRB's

deposits had dropped from $173.5 billion to $102.7 billion between March 9 and April 21. As FRB began selling long-term assets at a loss to raise cash, its stock price crashed, falling from $122.50 on March 1 to just $1.80 by April 28. This decline triggered further deposit withdrawals. FRB tried to find a merger partner to avoid being seized by the federal government but was unable to reach a deal on time, so FDIC took FRB under receivership and sold it to JPMorgan Chase Bank on 1st of May 2023 (Ozili, 2024).

Heartland Tri-State Bank:
On July 28, 2023, Heartland Tri-State Bank in Kansas became the fifth U.S. bank to fail that year, with approximately $139 million in assets. Unlike other failed banks, Heartland collapsed because of alleged fraudulent activities by its CEO, Shan Hanes. The Federal Reserve Bank of Kansas City identified the bank as a victim of a large-scale scam known as “pig butchering”. In this scheme, the scammer (the "butcher") convinces the victim (the "pig") to invest increasing amounts in seemingly legitimate virtual currency, only to steal the funds. Between late May and early July, the CEO initiated ten wire transfers totaling $47.1 million from Heartland's accounts to a cryptocurrency wallet registered in his name. Under his influence, bank employees bypassed internal controls to process and execute these transfers. To keep up with the transfers, Heartland borrowed $21 million from a Federal Home Loan Bank in June and July, which was unusual for the bank. The wire transfers severely reduced Heartland's liquidity, and once the fraudulent activities were exposed, depositor confidence was lost, leading to the bank's insolvency. Heartland Tri-State Bank was later acquired by Dream First Bank of Kansas (Federal Reserve Board, 2024).

Citizens Bank:
Citizens Bank was closed by the Iowa Division of Banking on November 3, 2023, making it the smallest bank failure of the year with just $65.6 million in assets. The main cause of its collapse were significant loan losses related to the trucking industry. Lax lending practices and poor management of large commercial trucking relationships were key issues. Initially, the bank focused on agricultural loans, but starting in 2014, it began issuing commercial loans to trucking companies. By June 30, 2023, trucking loans made up 43% of its portfolio. This, combined with inadequate credit underwriting and ineffective credit risk management, increased regulatory concerns. During the 2020 to 2022 period of pandemic, many trucking borrowers faced financial difficulties due to supply chain disruptions and rising operational costs of fuel, insurance and repairs. Citizens Bank made matters worse by providing additional funds through overdrafts, often exceeding State’s lending limits, without proper financial assessments. The bank’s non-performing loans ratio reached 9.55%, leading to serious losses and a liquidity crisis that ended in the bank’s collapse. FDIC was appointed receiver and Iowa Trust and Savings Bank bought the bank (FDIC OIG, 2024).

In this section of my thesis, I will address my second research question regarding the root causes and systemic factors behind the U.S. banking crisis of 2023. According to the Fed,

the main contributors to the banking crisis were bad investment strategies and inadequate interest rate risk management practices. In contrast, many banks and economists argue that the crisis was primarily triggered by the Fed's aggressive interest rate hikes. The Government Accountability Office, however, argues that the crisis is the fault of the Fed but because of its ignorance and insufficient regulative and supervisory measures. The Office reported that the Fed failed to take early corrective actions, like regular stress testing, enhanced supervision and improved risk management practices, as advised already in 2011. Additionally, it is important to consider also other significant factors that led to rising interest rates in the first place, such as the Covid-19 pandemic and the Russia-Ukraine war (Ozili, 2024).

To properly analyze the 2023 U.S. banking crisis, it is necessary to start with the impacts of the COVID-19 pandemic and the Russia-Ukraine war. These two events contributed to the crisis in unique ways. The pandemic led to a low-interest-rate environment and remarkable fiscal stimulus in 2020 and 2021 to restore aggregate demand, stimulate economic growth, and pull the economy out of recession. However, the combination of low rates and massive government spending fueled rising inflation, which eventually required higher interest rates. Additionally, the Russia-Ukraine war, which began in March 2022, disrupted global supply chains, causing energy crisis and food shortages that further increased inflation. Even before the war, advanced economies like the U.S. and UK were already facing inflation rates above 5%. The war only pushed inflation to new highs, with the U.S. inflation rate peaking at 9.1% in June 2022, the highest in 40 years. In response, the Fed began raising interest rates in March 2022. Although the Fed warned prior to the crisis that its monetary tightening would bring economic distress through reduced lending, it did not foresee that these measures would lead to a banking crisis (Ozili, 2024).

It should be pointed out that the U.S. banking crisis of 2023 was systemic. Not because banks were so interconnected but rather because they adopted similar strategies and later faced similar difficulties. One could argue that the roots of this banking crisis go back to 2009. In the aftermath of the 2008 global financial crisis, the Fed held interest rates near zero for a very long time, from 2009 to 2022. Between 2009 and 2016, the federal funds rate was close to zero, during the tightening cycle of 2015/18 it was less than 2.5%, and then it returned to zero once again between 2020 and 2022. Historically, there has never been a longer period when interest rates were so low. The lowest federal funds rate recorded before 2009 was 0.63% in May 1958 and it stayed there less than a month (Dinh, 2023).

After the extended low-rate period of 2009 to 2022, both the public and the banks were misled into believing that any interest rate increases in 2022 and afterwards would be gradual and temporary, like during the 2015/18 period. Thus, the fast and aggressive tightening of 525 basis points came as a shock. The Fed's inaction in 2021 was a key factor that led to these sharp and frequent interest rate increases. That year, FOMC maintained low interest rates, although the Taylor rule suggested that the federal funds rate should rise. In the second half of 2021, the rule again required higher short-term interest rates, but the

Fed remained committed to low interest rates. The Fed was certain that both the increase in inflation and inflation expectations were "transitory" and would soon return to the 2% target level (Dinh, 2023).

The Fed's four rounds of quantitative easing in 2009, 2010, 2012, and 2020 substantially expanded the balance sheets of both the Fed and the banking sector. While quantitative easing can stimulate economic growth, it can lead to inflation, or even hyperinflation, if the overflowing funding in financial markets is not eventually retrieved. Usually, commercial banks do not make heavy investments in long-term bonds. Yet, the Fed's series of quantitative easing lowered bond interest rates, making short-term rates unattractive. In contrast, long-term treasury bonds offered higher yields, which encouraged banks to change their portfolio positions (Hsiao, 2023). The Fed's total assets increased from $0.9 trillion in 2008 to $8.9 trillion in March 2022, while banking sector assets more than doubled, from $10.9 trillion to $22.7 trillion during the same period. Because of this, demand for deposits grew quickly in an environment of low interest rates. The total amount of demand deposits in the U.S. banking system increased from $1.7 trillion to $5.1 trillion between January 2020 and January 2023. This growth trend was seen also in the balance sheets of SVB and FRB (Dinh, 2023).

In March 2020, the Fed eliminated mandatory reserve requirements for banks, a decision that made sense during the pandemic when banks urgently needed to lend to households and businesses. However, this move not only increased the volatility of reserves but also made it harder for the Fed to control the money supply. With no reserve requirements and a growing demand deposit base in a low-interest rate environment, banks naturally sought higher returns by investing in long-term securities. This created a classic maturity gap, as demand deposits became the largest share of bank liabilities, while long-term loans and securities made up most of the assets. As discussed in the previous chapter, this repricing mismatch between short-term liabilities and long-term assets is a key driver of financial instability in the U.S. banking sector. Furthermore, the immense inflow of demand deposits can also encourage excessive risk-taking, increasing the likelihood of bank runs under these circumstances (Dinh, 2023).

In the aftermath of the crisis, it is essential to understand the implications of these developments for the banking industry. First, to repay the deposit insurance fund for the losses from SVB, Signature Bank and FRB, FDIC insurance premiums for the banks are likely to increase. The Secretary of the Treasury declared that these expenses will not be covered by U.S. taxpayers. Second, bank regulators will have to require improved stress testing for a much larger group of banks, not only for systematically important banks. The upgraded stress tests should focus on both assets and liabilities, particularly including deposit behavior and forecasting against changes in interest rates. Bank regulators should devote more attention to examination of banks' securities portfolios to determine if they align with the deposit characteristics (Peck et al., 2023). Third, to help banks absorb fair-value losses from rising interest rates, capital and equity requirements should be stricter.

For instance, if SVB was subject to a 20% equity requirement, its shareholders would have been responsible for the losses instead of the FDIC. Fourth, supervision under Basel Pillar II needs to be strengthened, particularly regarding unprofessional maturity transformation practices - the degree of SVB's maturity transformation was highly unprofessional. Fifth, risk categorization should end. It is important to identify correlations between liquidity risk, credit risk and interest rate risk, that arise from the same macroeconomic events, such as shifts in interest rates (Admati et al., 2023).

Perhaps the most crucial change needed in the banking sector is the adoption of mark-to-market or fair-value accounting for all assets. This means abandoning the idea that changes in the fair value of HTM assets are irrelevant. The interest rate hikes of 2022/23 led to significant declines in asset values, yet these losses often went unreported because many banks, including SVB, categorize most securities as HTM. Current accounting rules do not acknowledge the valuation losses from rising interest rates on these assets, hiding the fact that a bank might be insolvent. In SVB's case, risk-weighted capital ratios and accounting valuations masked the underlying solvency issues, leading to a lack of oversight from regulators. Risk-based regulations for HTM assets only address credit risk but ignore the potential fair value losses. The market value declines of SVB's assets were a significant factor in determining its existence and supervisors should have recognized and addressed this issue proactively (Admati et al., 2023).

This solvency problem is not exclusive to SVB and FRB. The failures of these two banks only warned the markets of the systemic problem. The Fed's response to the crisis, which was expanding bank lending programs, temporarily mitigates the impact of deposit withdrawals but does little to address the solvency issues the banks are facing. Specifically, in May 2023 the Fed was charging at least 5% through its discount window, and on March 12, it launched a new Bank Term Funding Program that offered loans up to one year at an interest rate of 4.83% (now already at 5.4%). Both programs value bank collateral at par, which is frequently significantly higher than the fair market value. Furthermore, a lot of banks borrowed money through the Federal Home Loan Bank system, which typically has stricter terms. Thus, if a bank borrows from the Fed to pay off its depositors instead of selling its securities, the cost of borrowing can exceed the returns on those securities. Earning less than 2% on government bonds bought in 2021 while borrowing funds at 5% is a road to failure. The same goes for increasing deposit rates to keep depositors if asset yields remain low (Admati et al., 2023).

Insuring deposits while ignoring insolvency issues can lead to devastating outcomes. Providing liquidity support without restoring solvency can push certain banks to gamble for resurrection (i.e., excessive risk-taking by failing banks). Enlarging deposit insurance without eliminating the so-called zombies (insolvent banks that continue to exist due to government assistance) is equally problematic. If bailouts of uninsured depositors continue, the extra taxes placed on the banking sector to compensate for losses to the insurance fund could threaten the stability of the remaining banks. For banks whose equity capital does not

satisfy standards after fair-value accounting is applied, limiting executive compensation and shareholder payouts, like dividends and stock repurchases, is one way to decrease solvency issues. This would stop shareholders and managers from paying themselves excessively while their banks put depositors and the deposit insurance system at risk of severe losses. Also, the banking sector is in great need of restructuring, with some banks merging and others leaving. It is crucial that solvent banks survive and that small and medium-sized banks are involved in mergers rather than banks that are already too large (Admati et al., 2023).

5.2 Exposure of the U.S. Banking Sector to Interest Rate Risk in 2023

In this chapter, I will examine more closely the banks' exposure to interest rate risk during the 2022/23 period. The 2022/23 tightening cycle led to bank runs and some of the largest bank failures in the history that shook the stability of the entire U.S. banking sector. Specifically, the crisis showed just how significantly exposed banks' assets were to interest rates. The market value of HTM and AFS securities dropped dramatically when interest rates rose sharply, leading to large unrealized losses on banks' balance sheets. Longer-term assets recorded astonishing declines in value from Q1 2022 to Q1 2023. For example, the market values of residential mortgage-backed securities and commercial mortgage-backed securities fell by more than 10%. The monetary tightening had a particularly negative impact on long-term Treasury bonds, with 10–20 year and 20+ year Treasury bonds losing roughly 25% and 30% of their market value, respectively. Assets such as loan portfolios held to maturity and securities, like residential mortgage-backed securities, commercial mortgage-backed securities, U.S. Treasuries, and other asset-backed securities, represent more than two-thirds of banks' total assets (72% of $24 trillion dollars). More specifically, real estate loans account for 42% of the assets of the average U.S. bank, whereas the other mentioned securities make up 24% (Jiang et al., 2023).

In aggregate, the unrealized losses of the U.S. banking sector reached a staggering $2.2 trillion, which roughly equals to 96% of the total pre-tightening bank capital. However, there were differences in unrealized losses among different groups of banks. The aggregate losses of small banks, the ones with assets less than $1.384 billion, amounted to $144 billion, with a median bank loss being $22.3 million. Large banks, with assets over $1.4 billion, had aggregate losses of $1.3 trillion, with a median loss of $308 million. Global Systemically Important Banks (GSIB) made an aggregate loss of $0.73 trillion, with a median loss reaching $837 million. Breaking down these dollar losses to see where they are coming from, further differences between groups are noticed. For GSIB, the largest part of the losses were residential mortgages (20.5%), then residential mortgage-backed securities (17.4%), followed by Treasury and other securities (8.1%) and other loans (1%). For large banks, the highest percentage of total losses came from other loans (33.8%), then residential mortgage-backed securities (22.6%), followed by residential mortgages (20.4%) and Treasury and other securities (10.4%). For small banks, other loans also represented the biggest sources of losses (32.7%), followed by residential mortgages (19.8%), Treasury

and other securities (17%) and residential mortgages-backed securities (11.4%) (Jiang et al., 2023).

The median asset value of a small bank decreased by 9.1% between Q1 2022 and Q1 2023. In that same period, the median value of assets of a large bank dropped by 10%, while for GSIB the decrease was the smallest at 4.6%. Furthermore, assets of the entire U.S. banking sector decreased by 9.2% on average, while the bottom 5th percentile had a decline of 20%. Compared to SVB, around 500 banks (10%) suffered larger unrealized losses. Similarly, 10% of banks had lower capital before and after the tightening period, accounting for mark-to-market losses. In fact, there was a minimal difference in capitalization among banks. The 10th percentile worst capitalized bank had 8% capital, while the 10th percentile best capitalized bank had a 14% equity-to-assets (E/A) ratio. Thus, SVB's capitalization being at the 10th percentile of all U.S. banks does not make it an outlier (Jiang et al., 2023).

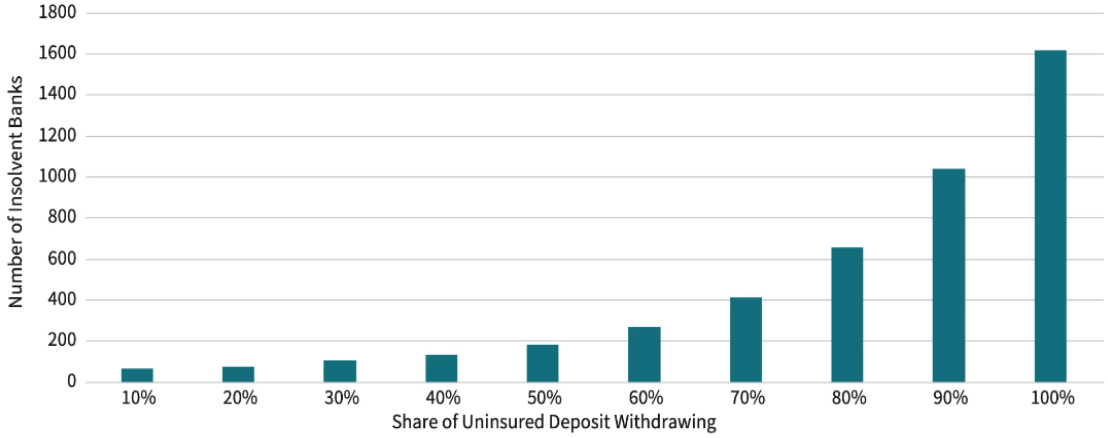
Looking at the funding structure of the U.S. banking sector, an average bank funds 10% of its assets with equity, 63% with insured deposits, and 27% with uninsured debt, which is made up of 23% uninsured deposits and 4% other debt funding. However, U.S. banks vary significantly in the share of funding from uninsured sources. For example, a bank in the 5th percentile uses 6% of uninsured debt. For this bank, 94% of funding (equity and deposits) is not run-prone to withdrawals by the uninsured depositors. On the contrary, the 95th percentile bank uses 52% of uninsured debt. For this bank, even if only half of uninsured depositors panic, this leads to a withdrawal of one quarter of total marked to market value of the bank. In the case of SVB, uninsured deposits funded 78% of its assets. Put differently, only 1% of banks had higher uninsured leverage than SVB. The latter suggests that uninsured deposits were a key factor in SVB's failure (Jiang et al., 2023).

While unrealized losses do not directly affect a bank's profits and stability, they do undermine investor confidence. So, only when the losses need to be realized, like during unexpected withdrawals, the bank faces liquidity problems. Rising interest rates can trigger self-fulfilling solvency bank runs. Before the Fed raised interest rates, U.S. banks were solvent, whether all uninsured depositors decided to run or only half of them. Put differently, if deposit withdrawals do not lead to fire sales at depressed prices, even if all uninsured deposits were withdrawn the remaining assets would be enough to cover insured deposits. Still, after the monetary tightening of 2022/23 banks became far more vulnerable to uninsured deposit runs. In a scenario, where all uninsured depositors withdraw their funds from U.S. banks after the tightening, 1,619 U.S. banks do not have sufficient value of assets left to repay all insured deposits. Even though the median bank in this case is small, with assets of just $0.3 billion, these banks together have $4.9 trillion in assets and $2.6 trillion in insured deposits assets. Their failure would result in a $300 billion shortfall for the deposit insurance fund. In the second scenario, where only half of uninsured depositors withdraw funds after the tightening, 186 banks, with approximately $300 billion in assets and $250 billion in insured deposits, do not have sufficient value of assets left to

repay all insured deposits. Their failure would result in a $10 billion loss for the insurance deposit fund (Jiang et al., 2023).

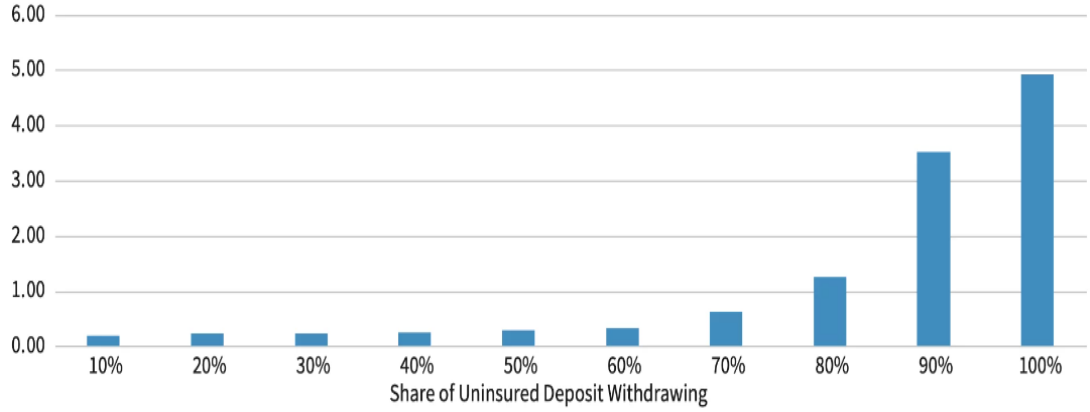
Figures 11 and 12 show the number of insolvent banks and their aggregate assets for a given uninsured deposit withdrawal scenario. If the bank's mark-to-market asset value is insufficient to repay all insured deposits after paying a certain share of the uninsured depositors, the bank is considered insolvent. There are ten scenarios where 10% to 100% of uninsured deposits are withdrawn at each bank. Figure 11 shows that 66 banks with approximately $210 billion in assets would become insolvent even if merely 10% of uninsured depositors chose to take their money out. If 30% of uninsured depositors left, which is similar to the percentage of withdrawals right before the SVB's shutdown, 106 banks would fail with assets of $250 billion (Jiang et al., 2023).

Figure 11: Number of Insolvent Banks for Different Case Scenarios



Source: Jiang et al. (2023)

Figure 12: Aggregate Assets (in $ Trillions) of Insolvent Banks for Different Case Scenarios



Source: Jiang et al. (2023)

It is important to mention that the possibility that banks may have hedged their interest rate exposure was not considered in the analysis above. Assuming that most of the banks had interest risk hedges, it becomes crucial to determine who was the counterparty that provided

these hedges. If other banks provided the hedges, the overall losses would remain unchanged and would only be reallocated across banks. Since all U.S. banks had relatively low capitalization before the 2022/23 tightening episode, with an average E/A ratio of about 10%, the overall impact remained largely the same. Alternatively, if it was non-bank institutions that provided the interest rate hedges to the U.S. banking system, such institutions would probably be in a distress by now, as was the case of AIG's systemic risk exposure in 2007 (Jiang et al., 2023).

Studying more closely the extent to which U.S. banks hedged their asset exposure in response to the 2022/23 tightening, Jiang et al. (2023) discovered that hedging was quite limited. Larger banks, who hedged a small share of their assets, were the main user of interest rate swaps. In fact, only 6% of all assets in the U.S. banking system are hedged with interest rate swaps. Therefore, the great majority of a $2.2 trillion decline in assets value was not offset by the small use of interest rate derivatives. Furthermore, during the monetary tightening, banks with the most fragile funding even sold or reduced their hedges. For example, SVB hedged 12% of its securities at the end of 2021, but by the end of 2022, they hedged only 0.4%. Although this decision further exposed banks to rate increases, it enabled them to record accounting profits.

There is one possible explanation for the lack of hedging that is more accounting related. Like for many other U.S. banks, SVB's interest rate risk in 2022/23 came mostly from its portfolio of HTM bonds. The value fluctuations of a HTM bonds do not impact the income statement, balance sheet, or regulatory capital of a bank. The book value of the assets does not change in response to changes in the market price of the bond, so a bank does not experience an increase or decrease in income. However, the value fluctuations of interest-rate swap have an impact on bank's balance sheet and income statement. When a swap's market value increases (or decreases), the assets' book value increases (or decreases) as well, and a bank records a gain (or loss). Interest-rate derivatives are mark-to-market assets by nature, meaning that changes in their value are reflected in income. Certainly, the rates were more likely to rise than fall, but even with a 0.25% decline the hedge would cause significant losses (Levine, 2023).

Thus, hedging HTM bonds would create a so-called accounting mismatch that reduces a bank's economic risk but makes reported regulatory capital and financial results significantly more volatile. Hedge accounting allows a bank to take an asset and the derivative to hedge that asset, offset them against one other, and neutralize the accounting effect of changes in their values. For instance, a bank can hedge its AFS bonds with this method. As a result, its income statement and capital will appear less volatile. The big issue, however, is that this approach is not allowed for HTM assets. The accounting rules align with how banks have traditionally viewed their role, which is holding long-term assets until they mature (Levine, 2023).

5.3 Assessing Interest Rate Risk of Individual U.S. Banks in the 2023 Banking Crisis

In this chapter of my thesis, I will answer to another one of my research questions, that is how exposed were the U.S. banks that failed in 2023 to interest rate risk. I will focus my analysis exclusively on SVB, FRB, and Signature Bank, as the failures of Heartland Tri-State Bank and Citizens Bank were driven by entirely different factors and circumstances, as already explained in the previous chapter. My analysis will be conducted in light of the research paper Tightening and U.S. Bank Fragility in 2023: Mark-to-Market Losses and Uninsured Depositor Runs by Jiang et al. (2023). I will focus on analyzing NII and EVE, the two primary measures used to assess a bank's exposure to interest rate risk. Furthermore, I will also have a look at unrealized losses, level of capital, and deposit structures of the three banks, to get a full understanding of the reasons behind each bank's failure. I will be using data from banks annual call reports (10-K), which are available on the official websites of the banks, the U.S. Securities and Exchange Commission (SEC), FDIC and a website Annual Reports.

5.3.1 Silicon Valley Bank

Since interest rate risk is the primary market risk for SVB, the bank is regularly using simulation models to analyze the sensitivity of NII to changes in interest rates. In these simulations, the bank's balance sheet size and composition, as well as the market interest rates, are kept constant over a one-year period. Short-term interest rates, such as the federal funds rate, SOFR rate, 1-month and 3-month LIBOR, and the national prime rate, are the main rates that impact NII. Variations in these short-term rates affect the interest earned on SVB's variable rate loans and balances held as cash and cash equivalents. In scenarios where interest rates increase, the interest income from variable rate assets, primarily variable rate loans, is expected to positively affect the base 12-month NII projections. On the contrary, a decrease in rates is anticipated to have the opposite effect. The following Table 5 shows SVB's estimates of its NII sensitivity exposure to a sudden and persistent shift in market interest rates. NII sensitivity is measured as a percentage change in the projected 12-month NII under +/-100 and +/-200 basis point interest rate shock scenarios compared to a base scenario, where balances and interest rates remain unchanged throughout the year (SVB Financial Group, 2022).

Table 5: SVB's 12-month NII Sensitivity to Market Interest Rates

Stress test scenario	2020 Estimated change in NII	2021 Estimated change in NII	2022 Estimated change in NII
+ 200 bps	29.1%	22.9%	3.5%
+ 100 bps	15.1%	10.9%	1.8%
- 100 bps	-2.6%	-6.4%	-1.8%
- 200 bps	-2.8%	-8.6%	-5.8%

Source: Own work based on Bank Call Reports data (2020-2022)

From Table 5 we can see that SVB's NII sensitivity to interest rate changes has diminished over the years. NII was the most sensitive to interest rate increases in 2020, with a 29.1% increase for +200 bps and 15.1% for +100 bps. In 2021 sensitivity decreased compared to 2020 but was still significant, with 22.9% for +200 bps. The main reason for this decline in sensitivity was changes made in balance sheet composition – more fixed-rate HTM securities and less variable-rate loans on the asset side. In 2022 sensitivity continued to decrease particularly to interest rate increases, with a 3.5% increase for +200 bps and 1.8% for +100 bps, showing a significant reduction in the impact of rate changes on NII. On the other hand, NII was less sensitive to interest rate decreases in 2020 (-2.6% for -100 bps) compared to 2021 (-6.4% for -100 bps). In 2022, NII sensitivity to rate decreases reduced, returning towards the levels of 2020.

The high sensitivity of NII to rising interest rates seen in years 2020 and 2021 reveals one very important characteristic about SVB: the bank was more asset-sensitive to interest rates in the short-term from NII perspective. This means that the bank's assets are repriced more quickly or higher than its liabilities. In 2021, SVB had a high share of non-interest-bearing deposits (67%), which significantly shielded the bank from rising funding costs. Additionally, deposit rates tend to increase more slowly than yields on other investments. Furthermore, 31% of the bank's assets were in variable-rate loans, which generated higher interest income during rate hikes.

A relatively modest increase of 3.5% in NII in 2022 suggests that the bank's asset-liability structure at the end of 2022 did not heavily benefit from higher interest rates. The reduction in NII sensitivity to interest rate changes was driven by the following changes: Firstly, the bank shifted its funding mix towards short-term borrowings and interest-bearing deposits, increasing its interest expenses. Secondly, SVB increased Deposit Beta assumption in its model. This means that the bank expects to raise deposit rates more in response to rising market rates, thus lowering profit margin on interest-earning assets. Thirdly, termination of pay-fixed swaps portfolio reduced SVB's interest rate sensitivity since the bank lost the benefit of receiving variable-rate payments, which increase when interest rates rise. Lastly, the bank extended its fixed income portfolio (increased the average maturity of bonds), making it less possible to benefit from higher rates. This further reduced the sensitivity of NII to rising interest rates (SVB Financial Group, 2022). SVB's simulation model turned out to be reasonably accurate in estimating the relationship between interest rate increases and NII growth. On December 31, 2021, the model predicted for 2022 a 22.9% increase in NII if interest rate increased for 200 bps. When the interest rate rose for 425 bps in 2022, SVB's NII increased by 41%, meaning the model effectively captures the bank's NII sensitivity to interest rates.

SVB was also conducting stress tests to evaluate how fluctuations in market interest rates affect EVE. EVE is calculated as the difference between the market value of assets and the market value of liabilities. The data in Table 6 reveals a significant increase in SVB's EVE exposure to interest rate changes from 2020 to 2021. On December 31, 2021, compared to

December 31, 2020, cash balances decreased by $3.1 billion, while fixed income investments in AFS portfolio dropped by $3.7 billion. Conversely, the HTM portfolio increased by $81.6 billion, and loan balances grew by $21.1 billion. The funding for these assets primarily came from a $87.2 billion rise in total deposits. The rapid growth in deposits outpaced loan growth, leading to a substantial portion of excess deposits being allocated to investment portfolio. Much of this portfolio consisted of fixed-rate mortgage-backed securities and collateralized mortgage obligations, which tend to lose market value when rates rise, unlike variable-rate loans or cash. Thus, under a scenario of rising interest rates, the market value of investments is more affected than the market value of deposits, resulting in a negative change in EVE. For example, for a 200-basis point increase in rates, the estimated change in EVE at the end of 2021 was -27.7%. This does not only emphasize SVB's high exposure to interest rate fluctuations, but it even makes the bank liability-sensitive in the long-run.

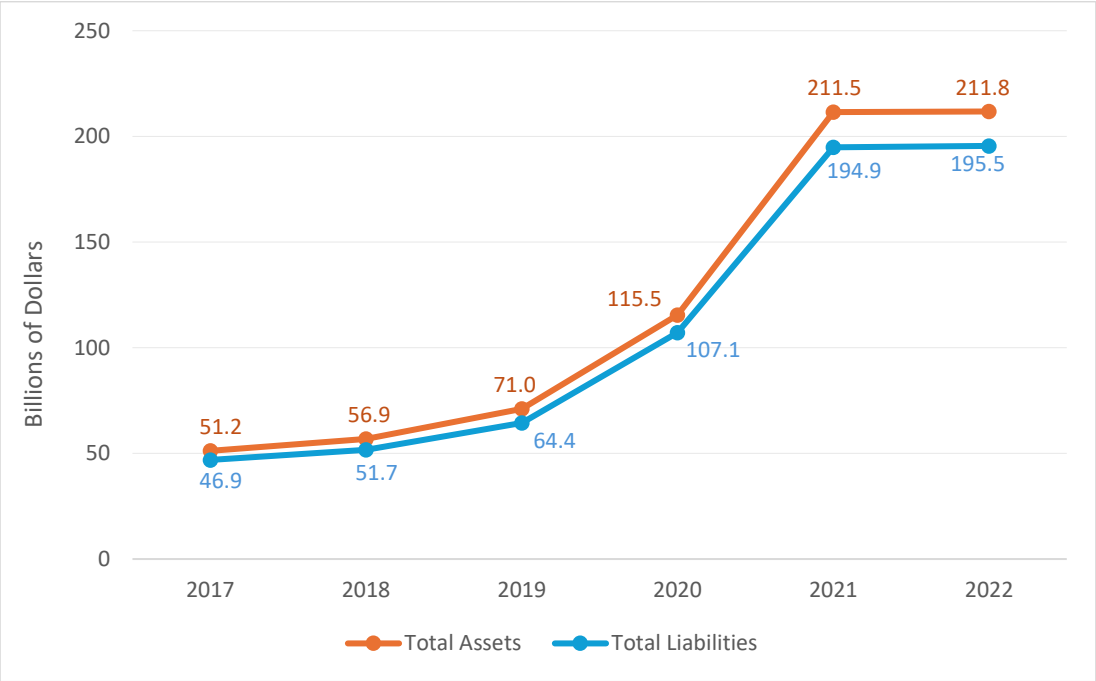
Table 6: SVB's EVE Sensitivity to Market Interest Rates

Stress test scenario	**2020 Estimated change in EVE**	**2021 Estimated change in EVE**
+ 200 bps	-15.4%	-27.7%
+ 100 bps	-5.9%	-13.9%
- 100 bps	3.2%	6.0%
- 200 bps	2.8%	3.1%

Source: Own work based on Bank Call Reports data (2021)

SVB specialized in supporting the innovation economy, with a customer base reflecting its strategic focus. For nearly four decades, the bank primarily served clients in the technology, life sciences, and venture capital sectors. In fact, SVB provided banking services to almost half of all venture-backed tech and life sciences companies in the U.S. Its funding structure was largely based on private equity and venture capital firms, whose deposits tend to be irregular and involve large cash flows, making SVB especially sensitive to its clients' business cycles. Between 2017 and 2022, SVB's total assets saw a remarkable increase, doubling twice over five years. The bank's assets grew from just over $51 billion at the end of 2017 to more than $100 billion by 2020 and surpassed $200 billion in 2021. In its 2021 annual report, SVB claimed its expansion was supported by a thriving tech market, highlighting a $36 billion rise in average client funds, driven by increased venture capital activities. However, the Office of the Comptroller of the Currency had already warned at that time that rapid or uncontrolled growth could signal weaknesses in risk management. Such growth could also increase a bank's exposure to risk, challenge the capacity of its management, and overextend its resources, potentially leading to sudden bank failure if economic conditions in the sector changed (Federal Reserve Board 2023). Figure 13 presents rapid and uncontrolled growth in SVB's balance sheet.

Figure 13: SVB's Total Assets and Liabilities, 2017 - 2022



Source: Own work based on Bank Call Reports data (2018-2022)

After seeing the fast growth in SVB's assets and liabilities, it is important to examine where the deposits were allocated and which investments the bank made. Between 2018 and 2021, net loans grew from $28 billion to $65.9 billion, a 135% increase. This growth, while significant, was outpaced by the expansion of the bank's securities investments, indicating a shift in the allocation of assets toward long-term, fixed-rate securities. During a period of low interest rates, SVB invested a significant portion of its clients' deposits into long-term securities, particularly U.S. Treasury bonds and agency-issued mortgage-backed securities. SVB's total securities investments climbed from $23 billion in 2018 to $125 billion in 2021, representing a 439% increase. The AFS securities rose from $8 billion to $27 billion, while HTM securities jumped from $15 billion to $98 billion, an increase of over 500%. This investment strategy in long-term securities created a concentration risk, exposing SVB to significant losses in the value of assets in case of rising interest rates (Federal Reserve Board, 2023).

Long-term fixed-rate bonds with low yields are most affected by price fluctuations when interest rates increase. By the end of 2022, nearly 40% of SVB's AFS bond portfolio consisted of fixed-rate, low-yield bonds with maturities exceeding five years, and over 25% had maturities over ten years. Specifically, 27.8% of the bank's AFS portfolio was invested in fixed-rate bonds with low yield of 1.51% and maturity longer than 10 years. Likewise, nearly 95% of the HTM bond portfolio was composed of fixed-rate, long-term bonds (with maturities over 10 years) with a low yield of 1.63% (Aridas, 2023).

Another important observation is the sharp increase in SVB's reliance on borrowings, particularly short-term borrowings, by the end of 2022. These borrowings surged from just

$121 million in 2021 to $13.6 billion in 2022, highlighting the bank's growing need for external liquidity to manage funding pressures. This reliance on short-term borrowings suggests that SVB faced significant challenges in meeting liquidity demands, especially as rising interest rates eroded the value of its long-term securities and deposit outflows accelerated. Additionally, the increase in long-term debt from $844 million in 2020 to $5.4 billion in 2022 further indicates that the bank was taking on more financial leverage, potentially amplifying its vulnerability to higher funding costs during a period of monetary tightening. This dynamic emphasizes how SVB's balance sheet became increasingly strained under the pressure of a rapidly changing interest rate environment. The detailed structure of SVB's consolidated balance sheet is presented in Table 7.

Table 7: SVB's Consolidated Balance Sheet for 2020, 2021 and 2022

Assets (Dollars in millions)	**2020**	**2021**	**2022**
Cash and cash equivalents	17,675	14,586	13,803
AFS securities	30,913	27,221	26,069
HTM securities	16,592	98,195	91,321
Net loans	44,734	65,854	73,614
Other Assets	5,597	5,622	6,986
Total assets	115,511	211,478	211,793
Liabilities (Dollars in millions)			
Deposits	101,982	189,203	173,109
• Insured deposits	4,982	7,103	7,709
• Uninsured deposits	97,000	182,100	165,400
Short-term borrowings	21	121	13,565
Long-term debt	844	2,570	5,370
Other Liabilities	4,231	2,975	3,454
Total liabilities	107,078	194,869	195,498
Total equity	8,433	16,609	16,295
Total liabilities and Total equity	115,511	211,478	211,793

Source: Own work based on Bank Call Reports data (2021, 2022)

When interest rates rose in 2022, SVB faced substantial unrealized losses on its AFS and HTM investment portfolios. On December 31, 2021, the HTM portfolio represented about 46% of the bank’s total assets, while AFS made up 13%. The remaining 41% of assets consisted of loans (31%), cash (7%), and other assets (3%). When rates increased from 0.25% in March 2022 to 4.5% by December 2022, unrealized losses on these securities skyrocketed, while funds from venture capital activity declined. Because of higher interest rates, the value of $26 billion in AFS securities dropped by $2.5 billion below their book value. Similarly, SVB held over $91 billion in high-quality HTM bonds, but by the end of 2022, their value had declined to $76 billion.

Unrealized losses on AFS securities jumped from $0.3 billion in 2021 to $2.5 billion by the end of 2022, while losses on HTM securities soared from $1.3 billion to staggering $15.2 billion during the same period. U.S. Treasuries and residential mortgage-backed securities

(RMBS) were key contributors to the AFS portfolio losses, while RMBS dominated the HTM portfolio. Unrealized losses on U.S. Treasuries rose from $70 million in 2021 to around $1.1 billion in 2022. Furthermore, RMBS losses, which were the largest contributor to unrealized losses on AFS portfolio, climbed from $219 million in 2021 to $1.2 billion in 2022. RMBS consistently accounted for the majority of HTM losses, contributing $1 billion or 76.8% in 2021 and $11.2 billion or 74.1% in 2022. Additionally, municipal bonds and notes recorded a notable rise in their share of HTM unrealized losses, increasing from 2% to 8.4% or in dollar terms from 27 million to 1.3 billion. The latter suggests an increased exposure of these instruments to interest rate hikes. A summary of SVB's unrealized losses on its AFS and HTM investment portfolios is shown in Table 8.

Table 8: SVB's Unrealized Losses on AFS and HTM Portfolios

(Dollars in millions)	2021	2021	2022	2022
AFS Unrealized Losses	**313**	**100%**	**2,533**	**100%**
US Treasuries	70	22.4%	1,071	42.3%
US agency debenture	4	1.3%	19	0.8%
Foreign Government debt securities	0	0%	121	4.8%
Residential MBS	219	70.0%	1,182	46.7%
Commercial MBS	20	6.4%	140	5.5%
HTM Unrealized Losses	**1,343**	**100%**	**15,160**	**100%**
US agency debentures	2	0.1%	52	0.3%
Residential MBS	1,032	76.8%	11,236	74.1%
Commercial MBS	277	20.6%	2,494	16.5%
Municipal bonds and notes	27	2.0%	1,269	8.4%
Corporate bonds	5	0.4%	109	0.7%

Source: Own work based on Bank Call Reports data (2021, 2022)

SVB was not an outlier when it came to marked-to-market losses. In fact, around 11% of banks (more than 500) had larger unrealized losses than SVB. This indicates that, while SVB's investment portfolio was highly exposed to interest rate risk, its failure was not solely due to this factor (Jiang et al., 2023). That is why I decided to further explore other elements. By looking at SVB's capital ratio, the key measure used by regulators to evaluate bank stability, it soon becomes clear that capital was not a contributing factor in the bank's failure. As of December 31, 2022, SVB had both CET1 and Tier 1 risk-based capital ratios of 15.26%, well above the regulatory requirements of 7% and 8.5%, respectively. Additionally, its total risk-based capital ratio was 16.05%, exceeding the required 10.5%. According to Jiang et al. (2023), 10% of banks had lower capital levels than SVB both before and after monetary tightening, even when considering mark-to-market losses.

The last part left to analyze on SVB's balance sheet is its liabilities, particularly its deposit structure. Similar to the Savings and Loan (S&L) institutions of the late 1980s, which held long-term loans and fixed-income securities on the asset side and short-term deposits and borrowings on the liability side, leaving them vulnerable to losses when interest rates rose,

SVB faced a similar challenge (Aridas, 2023). As was shown in Figure 13, SVB's liabilities rapidly grew from $47 billion in 2017 to $195 billion by 2021. By the end of 2021, deposits made up 97% of total liabilities, but the share slightly decreased to 89% by the end of 2022. However, as visible from the bank's consolidated balance sheet (Table 7), the real issue was with uninsured deposits, which are highly volatile during periods of uncertainty and pose a serious flight risk to the banks. At the end of 2022, SVB had a particularly high concentration of uninsured deposits, amounting to approximately $165 billion or 95.5% of its total deposits. Detailed deposit structure of SVB is shown in Table 9.

Table 9: SVB's Deposit Structure in 2021 and 2022

(Dollars in millions)	**2021**	**2021**	**2022**	**2022**
Noninterest-bearing demand	125,851	67%	80,753	47%
Interest-bearing checking and savings account	5,106	3%	32,916	19%
Money market	54,842	29%	52,032	30%
Money market deposits in foreign offices	696	0%	51	0%
Sweep deposits in foreign offices	969	1%	664	0%
Time	1,739	1%	6,693	4%
Total deposits	189,203	100%	173,109	100%

Source: Own work based on Bank Call Reports data (2021, 2022)

Table 9 reveals several important shifts in SVB's deposit structure as interest rates rose. First, noninterest-bearing demand deposits declined significantly from $125.9 billion in 2021 to $80.8 billion in 2022. This means that many customers moved their funds out of noninterest-bearing accounts, some in search of higher returns, while others (particularly start-up clients) withdrew their cash reserves in response to the challenging economic environment. Nevertheless, these accounts still presented 47% of total deposits. Second, interest-bearing checking and savings accounts recorded a sharp increase, jumping from $5.1 billion in 2021 to $32.9 billion in 2022. This growth implies that SVB responded to the rising rate environment by offering competitive interest-bearing accounts to retain depositors who were seeking returns on their cash. Money market deposits remained relatively insignificant, amounting to $52 billion in 2022. One of the more important changes happened in time deposits, which grew from $1.7 billion in 2021 to $6.7 billion in 2022. Time deposits are more long-term and present a stable source of funding with lower withdrawal risk.

Uninsured leverage, the ratio of uninsured debt to assets, is where SVB stood out the most. The bank funded 78% of its assets with uninsured deposits. Only 1% of U.S. banks had higher uninsured leverage than SVB (Jiang et al., 2023). Moreover, SVB's ratio of loans and HTM securities to total deposits stood at 94.4%, meaning that over 94% of the bank's deposits was tied up in loans and long-term investments, seriously limiting SVB's liquidity (Krantz, 2023).

While SVB successfully started to increase its long-term deposits, the high concentration of short-term, uninsured deposits exposed the bank to significant liquidity risk in case of sudden and large withdrawals. The long-term bond holdings would have been far less problematic if SVB had a greater proportion of long-term liabilities to match its long-term assets. This would have created a better match between the maturity of its assets and liabilities, reducing the risk of liquidity shortfalls and balance-sheet losses due to rising interest rates (Federal Reserve Board, 2023).

5.3.2 Signature Bank

Signature Bank's ALCO is responsible for managing the bank's interest rate risk by structuring the balance sheet in a way that maximizes NII, while keeping exposure to changes in market interest rates within an acceptable range. To assess and manage this risk effectively, the bank uses simulation models to evaluate how different interest rate shock scenarios could impact NII. The bank conducted stress testing only for upward interest rate scenarios, as rates were at historically low levels (0 - 0.25%) at the time. Given the environment, an increase in rates was considered the most likely and relevant scenario for assessing potential risk exposure. Table 10 shows the projected sensitivity of a 12-month NII to potential interest rate changes, measured as a percentage change compared to a base scenario, in which balances and interest rates remain unchanged throughout the year (Signature Bank, 2021).

Table 10: Signature Bank's 12-month NII Sensitivity to Market Interest Rates

Stress test scenario	**2020 Estimated change in NII**	**2021 Estimated change in NII**	**2022 Estimated change in NII**
+400 bps	28.8%	49.6%	-0.1%
+300 bps	22.2%	37.6%	-0.4%
+200 bps	15.5%	25.6%	-0.6%
+100 bps	7.5%	12.3%	-0.8%

Source: Own work based on Bank Call Reports data (2020-2022)

From the provided stress testing data, it can be observed that Signature Bank's NII sensitivity to interest rate changes followed a dynamic pattern over the years. In 2020, the bank showed strong sensitivity to interest rate increases, with a 15.5% rise in NII for a +200-bps scenario and 28.8% for a +400-bps scenario. In 2021, the NII exposure to rate increases almost doubled, with NII increasing by 25.6% for a +200-bps scenario and 49.6% for a 400-bps increase. This sharp rise in sensitivity was mostly driven by Signature Bank's assets growth of $44.6 billion. Nearly $17 billion of this increase came from loan portfolio, with a significant portion of these loans being variable-rate. Such increase in variable-rate loans amplified the bank's exposure to interest rate changes, leading to a more noticeable effect on NII. Moreover, the share of noninterest-bearing deposits increased from 26% to 42%. However, in 2022, the trend reversed. The bank's NII showed a slight decline in

response to rising rates across all scenarios, from a 0.8% decrease for a 100 bps increase to a minimal 0.1% decline for a 400-bps increase. In reality, at the end of 2022, with interest rates rising by 425 bps, Signature Bank's NII increased by 34.77%. Although the stress test projections estimated a 49.6% increase in NII for a +400-bps scenario, the actual increase was a bit lower. This discrepancy indicates that the stress test model might not have fully captured all the factors affecting NII.

Like SVB, also Signature Bank was highly asset-sensitive during 2020 and 2021. However, not only did Signature Bank's asset sensitivity decrease in 2022, but it even shifted to being slightly liability sensitive. This change means that, instead of benefiting from rising interest rates, the bank's NII is more influenced by fluctuations in its interest-bearing liabilities. This drastic shift in interest rate sensitivity was driven by various factors. Firstly, both assets and liabilities decreased in 2022 compared to 2021, assets fell from $118.5 billion to $110 billion, and liabilities dropped from $110.6 billion to $102.4 billion. This reduction in the total balance sheet size likely altered the dynamics of interest rate sensitivity. Secondly, although total assets decreased, the proportion of fixed-rate assets rose from 46% to 57%. Lastly, while deposits declined from $106.1 billion to $88.6 billion, the composition of these deposits changed significantly. The share of interest-bearing deposits increased from 58% to 64%. Additionally, the bank started paying higher deposit rates in order to keep its depositors.

Apart from stress testing NII sensitivity to interest rates, Signature Bank also regularly performed stress tests to assess the impact of market interest rate fluctuations on EVE. As shown in Table 11, the bank's EVE sensitivity fluctuated significantly between 2020 and 2022. In particular, the change in EVE was constantly positive across all stress test scenarios in all three years, meaning the bank always remained asset sensitive. The increase in EVE exposure to interest rates from 2020 to 2021 can mostly be attributed to a rapid assets growth. As said before, loans increased for $17 billion, with around 50% of these loans having variable interest rates. Additionally, cash and due from banks, which can earn interest that adjusts with prevailing short-term rates, also increased by approximately $17 billion. Furthermore, the share of noninterest-bearing deposits climbed from 27% to 42% of total deposits. This larger share of low-cost funding means that any increase in interest rates would increase the value of the bank's variable-rate assets while keeping the cost of liabilities relatively stable, therefore contributing positively to EVE.

One of the main causes for the sudden drop in EVE sensitivity from 49.6% in 2021 to 11% 2022 (under +400 bps scenario) was shrinking of the balance sheet. The reduction in assets and liabilities lowered the overall impact of interest rate changes on EVE. On top of that, a shift towards more fixed-rate assets, from 46% of total assets to 57%, further reduced the value of EVE. Lastly, a rise in share of interest-bearing deposits from 58% to 64% increased funding costs. When these short-term deposits are repriced, they increase in market value and lower EVE.

Table 11: Signature Bank's EVE Sensitivity to Market Interest Rates

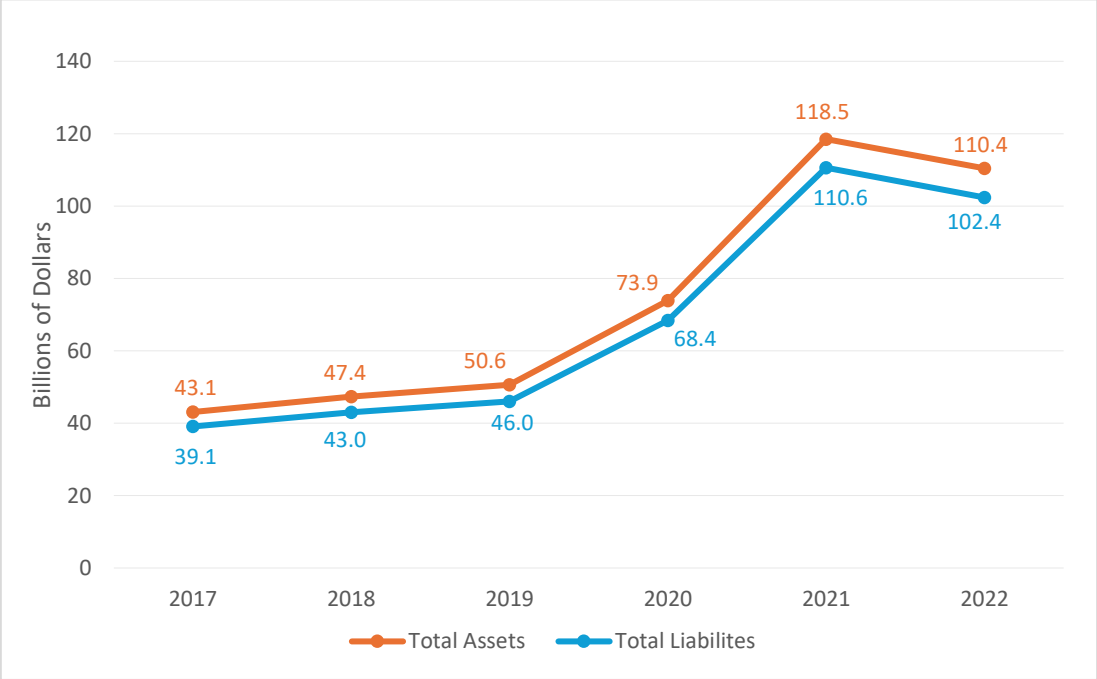
Stress test scenario	2020 Estimated change in EVE	2021 Estimated change in EVE	2022 Estimated change in EVE
+400 bps	40.3%	49.6%	11%
+300 bps	33.9%	40.2%	8.5%
+200 bps	25.7%	29.8%	6.2%
+100 bps	14.7%	16.9%	3.3%

Source: Own work based on Bank Call Reports data (2020-2022)

Signature Bank's primary focus was on commercial real estate and industrial lending, funded mainly through uninsured deposits from mid-sized companies. As part of its growth strategy, the bank expanded into the digital asset banking sector, launching its blockchain-based payment platform Signet, in 2019. The platform allowed commercial clients to make real-time payments to one another, which fueled a remarkable growth for the bank. Between June 2020 and June 2021, deposits from clients involved in digital assets skyrocketed by over 800%, reaching about $15 billion. The bank's liabilities climbed from $46 billion to $111 billion during 2020 and 2021, mainly due to incredible deposit growth that was driven by COVID-19 stimulus funding and expansion among a customer base involved in the digital asset-related industry. At the end of 2021, $29 billion of deposits was related to digital-asset industry. Total assets increased by approximately $68 billion during that period, mostly driven by growth in loans related to private equity firms (FDIC OIG, 2023).

By December 31, 2022, Signature Bank's total assets had dropped down to $110.4 billion from $118.5 billion at the end of 2021. The decline occurred mostly due to a deposit run by digital asset-related customers. At a time, the market faced major disruptions, including the collapse of two cryptocurrencies in May 2022 and the bankruptcy of digital asset exchange company, FTX, and its hedge fund, Alameda Research, in November 2022. Despite not holding cryptocurrencies, because of its association with digital asset clients like FTX, Signature Bank faced increased negative publicity. The outflows of deposits during 2022 continued as the concerns spread through social and mainstream media. At the end of the year, the bank held just $10.3 billion in highly liquid assets, representing approximately 9% of its total assets (FDIC OIG, 2023). The growth of the bank's total assets and liabilities is shown in Figure 14.

Figure 14: Signature Bank's Total Assets and Liabilities, 2017 - 2022



Source: Own work based on Bank Call Reports data (2018-2022)

Looking at Signature Bank's consolidated balance sheets (Table 12), there are several signs of risk, particularly concerning liquidity. The bank's cash and cash equivalents dropped significantly from $29.6 billion in 2021 to just $5.96 billion in 2022. This sharp decline in liquidity made it difficult for the bank to meet short-term obligations and handle sudden withdrawals, especially in a rising interest rate environment. Another major concern was the bank's heavy reliance on uninsured deposits. These deposits made up 88-90% of total deposits in 2021 and 2022. The high concentration of uninsured deposits increases the likelihood of a "run" on the bank, putting additional stress on liquidity and financial stability.

The significant increase in short-term borrowings, from $174 million in 2021 to $3.28 billion in 2022, is another red flag. This surge in short-term debt indicates that Signature Bank had to rely on more expensive and potentially volatile funding sources to address liquidity challenges. The reliance on short-term borrowing to cover liquidity gaps signals stress, as it suggests the bank was unable to maintain sufficiently stable funding from deposits or other long-term sources.

Table 12: Signature Bank's Consolidated Balance Sheet for 2020, 2021 and 2022

Assets (Dollars in millions)	**2020**	**2021**	**2022**
Cash and cash equivalents	12,348	29,621	5,955
AFS securities	8,890	17,153	18,594
HTM securities	2,283	4,998	7,780
Net loans	48,325	64,863	73,803
Other Assets	2,042	1,810	4,232
Total assets	73,888	118,445	110,364
Liabilities (Dollars in millions)			
Deposits	63,315	106,133	88,590
• Insured deposits	7,598	8,491	9,125
• Uninsured deposits	55,717	97,642	79,465
Short-term borrowings	321	174	3,276
Long-term debt	1,962	984	852
Other Liabilities	2,822	3,314	9,633
Total liabilities	68,420	110,605	10,2351
Total equity	5,468	7,840	8,013
Total liabilities and Total equity	73,888	118,445	110,364

Source: Own work based on Bank Call Reports data (2021, 2022)

Between the end of 2019 and the end of 2021, the bank's deposits increased by nearly $66 billion, while its total assets grew by $68 billion. In this period, Signature Bank allocated a significant portion of its deposits, around $26 billion, into loans, mostly mortgage and commercial loans. Additionally, a large share of the deposits was held as cash and cash equivalents, which increased by $29 billion over the two years. This means that only a small portion of deposits was invested in AFS and HTM securities. In fact, AFS securities grew by just $10 billion, while HTM securities saw a modest increase of only $2.7 billion. As a result, nearly 38% of the total assets were highly liquid at the end of 2021.

Given this investment strategy, it is unsurprising that Signature Bank's unrealized losses in 2022 were significantly smaller than those of SVB. By December 31, 2021, the bank held $17 billion in AFS securities, which accounted for approximately 14.5% of total assets, and just $5 billion in HTM securities, representing around 4% of total assets. The remaining 81.5% of assets were split between loans (55%), cash (25%), and other assets (1.5%). When interest rates increased by 425 basis points in 2022, Signature Bank's unrealized losses on AFS securities totalled $2.5 billion, while losses on the HTM portfolio were only $765 million, which is nearly 20 times smaller compared to SVB's $15 billion.

Interestingly, unrealized losses on AFS securities climbed from $0.3 billion in 2021 to $2.5 billion by the end of 2022, which is exactly the same as for SVB. Unrealized losses on HTM securities grew from $73 million to $765 million over the same period. Of the $10 billion increase in AFS securities between 2019 and 2021, $4 billion came from RMBS,

and another $4 billion from collateralized mortgage obligations (CMOs). As these two asset classes made up the largest portion of AFS securities, they were also the primary contributors to the $2.5 billion unrealized loss in 2022, accounting for $1.4 billion and $847 million in losses, respectively. In the HTM portfolio, U.S. agency debentures, RMBS, and CMOs made up the largest portion of total HTM investments. Accordingly, the $765 million unrealized loss in the HTM portfolio was distributed across these three categories, contributing $233 million, $166 million, and $370 million, respectively. A summary of Signature Bank's unrealized losses on its AFS and HTM portfolios is presented in Table 13.

Table 13: Signature Bank's Unrealized Losses on AFS and HTM Portfolios

(Dollars in millions)	2021	2021	2022	2022
AFS Unrealized Losses	**293**	**100%**	**2,482**	**100%**
US Treasuries	0	0%	5	0.2%
Residential MBS	58	19.8%	847	34.1%
Collateralized mortgage obligations	203	69.3%	1,409	56.8%
Commercial MBS	2	0.7%	10	0.4%
Municipal bonds	1	0.3%	38	1.5%
Other debt securities	29	9.9%	173	7.0%
HTM Unrealized Losses	**73**	**100%**	**765**	**100%**
US agency debentures	21	28.8%	223	29.2%
Residential MBS	13	17.8%	166	21.7%
Collateralized mortgage obligations	39	53.4%	370	48.4%
Other debt securities	0	0%	6	0.78%

Source: Own work based on Bank Call Reports data (2021, 2022)

Signature Bank's EVE exposure to interest rate risk was significantly smaller compared to SVB's, indicating that the primary cause of its collapse was another one. Like SVB, Signature Bank's capital levels were not a concern. In fact, its capital ratios improved in 2022 compared to 2021. On December 31, 2022, the bank's CET1 risk-based capital ratio stood at 10.41%, well above the 6.5% minimum requirement. Its Tier 1 risk-based capital ratio was 11.20%, and its total risk-based capital ratio was 12.32%, both exceeding the required limits of 8% and 10%, respectively.

Because Signature Bank ultimately collapsed due to a deposit run, just like SVB, it is essential to examine its deposit structure in greater detail. By the end of 2021, deposits accounted for 96% of the bank's total liabilities, slightly decreasing to 87% by the end of 2022. However, like SVB, Signature Bank faced the critical problem of an excessive concentration of uninsured deposits. At the end of 2022, uninsured deposits amounted to $79.5 billion, representing 90% of the bank's total deposits. Much like SVB, Signature Bank had a significant uninsured leverage ratio. At the end of 2022, 72% of its assets were funded by uninsured deposits (Jiang et al., 2023). Furthermore, the bank had 93% of its

deposits invested in loans and HTM securities, which substantially restricted its liquidity (Krantz, 2023).

Table 14 highlights a significant drop in total deposits at Signature Bank, from $106.1 billion in 2021 to $88.6 billion in 2022. As previously mentioned, due to disruptions in the cryptocurrency market, the bank was hit by a partial deposit run. Additionally, there was a clear shift from non-interest-bearing to interest-bearing deposits. Non-interest-bearing deposits, a key source of low-cost funding, decreased by $12.5 billion. While the dollar amount of interest-bearing deposits remained relatively stable, their share of total deposits increased from 16% to 19%. Furthermore, there was a visible increase in time and brokered deposits. Time deposits, though still a small portion of the deposit base, rose from $1.5 billion (1%) in 2021 to $2.6 billion (3%) in 2022, indicating a need to secure longer-term, but higher-cost, funding. Brokered deposits grew from $1.2 billion (1%) in 2021 to $3.8 billion (4%) in 2022, showing a growing reliance on external brokered deposits, which can be more volatile and expensive, further increasing the bank's liquidity risk.

Table 14: Signature Bank's Deposit Structure in 2021 and 2022

(Dollars in millions)	**2021**	**2021**	**2022**	**2022**
Non-interest-bearing demand	44,065	42%	31,501	36%
NOW and interest-bearing demand	17,148	16%	16,872	19%
Money market	42,143	40%	33,769	38%
Time deposits	1,532	1%	2,644	3%
Brokered deposits	1,245	1%	3,804	4%
Total deposits	106,133	100%	88,590	100%

Source: Own work based on Bank Call Reports data (2021, 2022)

Due to its fragile deposit structure with high share of uninsured deposits, Signature Bank was a victim of a bank run triggered by the panic surrounding the failures of other large banks. Silvergate Bank, which focused on cryptocurrency businesses, announced its self-liquidation on March 8, 2023, followed by the closure of SVB just two days later. This led to panic in the banking market, with investors speculating that Signature Bank might be the next to collapse due to similarities with the failed banks. Like SVB, Signature Bank had significant concentrations in uninsured deposits. Additionally, negative publicity about the bank’s connections to the crypto sector further increased concerns. On March 10, 2023, customers withdrew $18.6 billion, or 20% of the bank’s total deposits. Over the weekend, the expected outgoing wire transfers grew to $8 billion. Moreover, the bank struggled to obtain additional liquidity quickly to cover all deposit withdrawals because it lacked contingency funding mechanisms. It did not have enough pre-approved collateral to pledge to the Federal Reserve, so it could not meet the Fed's requirements for Discount Window borrowing (FDIC OIG, 2023).

5.3.3 First Republic Bank

While parts of balance sheet and other financial data for FRB were available for previous years, official 10-K filings, typically found on FDIC or SEC platforms, were not accessible. These call reports generally include banks' NII and EVE simulations, which are crucial for my interest rate risk analysis. Consequently, for FRB's interest rate sensitivity, I am unable to conduct the same 2020-2022 analysis as I did for SVB and Signature Bank, since the only complete data available is for 2022. Nevertheless, I will review FRB's 2022 NII and EVE simulations to see what insights they offer. At first glance, FRB was highly sensitive to interest rate fluctuations. With a 12.47% decline in NII in a +400-basis point scenario, it is obvious the bank was heavily dependent on low interest rates to maintain income, meaning it is liability-sensitive from NII perspective. Throughout 2022, as interest rates rose and the yield curve inverted, depositors at First Republic began shifting from noninterest-bearing accounts to higher-cost, interest-bearing options like Certificates of Deposit (CDs). This shift led to a much higher cost of funds for the bank. For instance, between June 2022 and January 2023, CDs increased from 5% to 14% of total deposits, while the bank's average rate paid on total deposits rose from 9 basis points to 163 basis points. By the end of 2022, only 35% of total deposits were non-interest-bearing (FDIC, 2023).

Table 15: FRB's NII and EVE Sensitivity to Market Interest Rates

Stress test scenario	**2022** **Estimated change in NII**	**2022** **Estimated changed in EVE**
+ 400 bps	-12.5%	-224.0%
+ 300 bps	-9.1%	-172.0%
+ 200 bps	-6.0%	-117.0%
+ 100 bps	-3.1%	-59.0%

Source: Own work based on FDIC (2023)

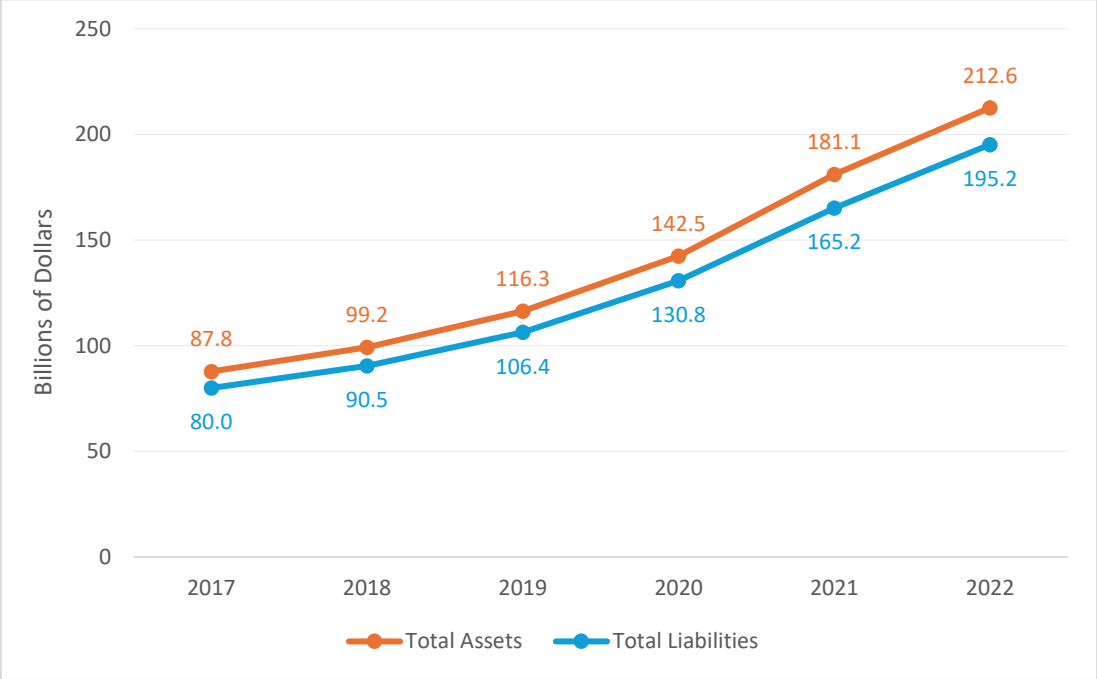
In 2022, First Republic began identifying breaches in its risk tolerance and risk appetite related to its EVE projections. As shown in Table 15, by the end of 2022, the bank's EVE position was highly liability-sensitive, with projections revealing a substantial decline in the market value of its equity. Interest rate hikes would further worsen this decline, pushing First Republic into negative equity. For instance, a 200-basis point increase in interest rates would reduce the bank's economic value of equity by 117%, resulting in negative equity. According to internal documents, this high liability sensitivity in 2022, compared to the previous year, was primarily driven by sharp declines in asset prices and shorter duration of liabilities. The duration of assets continued to extend as FRB changed its loan originations from shorter-term fixed and variable rate hybrid loans to 30-year fixed-rate loans. On the other hand, liability duration shortened as market conditions changed and the funding mix shifted toward higher-yielding, shorter-duration deposits and financial products. Furthermore, the bank was lowering its mortgage rates to preserve market share, despite the Federal Reserve's aggressive interest rate hikes. The steep declines of 117% and 224% in EVE underline a considerable mismatch between FRB's assets and liabilities over the long term. According to the FDIC (2023), the declining EVE models were

common among banks during the rising rate environment of 2022, the magnitude of First Republic's EVE deterioration was far more severe than that of other large institutions.

First Republic was a large but not particularly complex bank with a business model that performed well in an environment of low interest rates. It specialized in serving high-net-worth individuals, offering a wide range of services such as residential real estate lending, business banking, wealth management, private banking, trust, and brokerage services. The bank attracted deposits and loans by offering a more personalized service and competitive interest rates compared to other larger bank and non-bank institutions. FRB's primary loan products were single-family rental (SFR) loans and other real estate-secured loans. Home equity lines of credit and SFR loans remained stable though the years, constantly accounting for about 60% of all loans. Normally, about 50% of FRB's loans would adjust to current interest rates. According to FDIC, around 30% of the bank's floating-rate loans would reset each year, and new loans, making up about 20% of the total loan portfolio, would be issued at current rates. However, starting in 2016, borrowers began favouring longer-term loans over 5/1 adjustable-rate mortgages. By December 2021, 75% of new SFR loans were 30-year fixed-rate or 10/1 hybrid loans. Additionally, many existing customers also refinanced their loans to secure lower rates and longer terms. This change in the loan structure eventually became a major source of interest rate exposure for the bank (FDIC, 2023).

In the years leading up to its failure, First Republic grew significantly faster than its peer banks. From 2018 to 2022, its total assets increased by an average of 21% per year, largely due to an increase in loan portfolio. While this growth was not as rapid as the one of SVB or Signature Bank, which grew by 45% and 31% annually, First Republic still expanded at about twice the rate of its peers. For comparison, banks in First Republic's peer group grew their assets by just 11% per year. FRB's asset growth ranked in the 78th percentile, and its loan growth was in the 81st percentile. In 2022 alone, its assets grew by 17%, while peer banks saw just a 3% increase. The bank funded its growth by attracting low-cost deposits (FDIC, 2023). Figure 15 shows the growth of First Republic's assets and liabilities from 2017 to 2022.

Figure 15: FRB's Total Assets and Liabilities, 2017 - 2022



Source: Own work based on Bank Call Reports data (2018 - 2022)

Between 2019 and 2022, First Republic's deposits grew by $86 billion, while its assets increased by $96 billion. The most notable growth was in the loan portfolio, which expanded by $76 billion, making loans 78% of the bank's total assets by the end of 2022. In contrast, AFS and HTM securities saw smaller increases of $2 billion and $11 billion, respectively, with HTM securities accounting for 13% and AFS securities just 2% of total assets. A large portion of the loan portfolio was concentrated in SFR loans, which made up 59% of total loans. These loans included nonconforming jumbo mortgages with an initial interest-only repayment period of about ten years, followed by amortization until maturity. By the end of 2021 and 2022, loans with an initial interest-only repayment period represented 59% and 61% of the bank's SFR loans, respectively.

This growth in loans and HTM securities exposed First Republic to considerable risks during the interest rates hike. The concentration of low-yield HTM securities, which increased from $16.6 billion in 2020 to $28.3 billion in 2022, presented valuation and liquidity challenges. Meanwhile, the rapid loan expansion, that peaked at $166.1 billion in 2022, particularly in interest-sensitive sectors like SFR loans, heightened credit risk and suggested a potential shift toward riskier lending practices to drive growth.

Liquidity risk is another notable issue. While deposits increased to $176.4 billion by 2022, a large portion (68%) consisted of uninsured deposits. Cash and cash equivalents fluctuated, peaking at $12.9 billion in 2021 but dropping to $4.28 billion in 2022. This sharp decline in liquidity reduced the bank's ability to handle unexpected withdrawal demands and financial shocks. Adding to this challenge, short-term borrowings surged to

$6.7 billion in 2022, reflecting growing reliance on expensive, short-term funding to cover liquidity gaps, a clear sign of financial strain.

Although equity grew steadily, from $11.8 billion in 2020 to $17.4 billion in 2022, it did not keep pace with the growth in total assets, which reached $212.6 billion by 2022. This imbalance suggests a weakening capital position relative to the bank's size and risk exposure, limiting its ability to absorb losses from unrealized securities devaluations or defaults in the loan portfolio. The detailed composition of FRB's consolidated balance sheet is presented in Table 16.

Table 16: FRB's Consolidated Balance Sheet for 2020, 2021 and 2022

Assets (Dollars in millions)	**2020**	**2021**	**2022**
Cash and cash equivalents	5,095	12,947	4,283
AFS securities	1,906	3,381	3,347
HTM securities	16,603	22,292	28,348
Net loans	111,931	134,262	166,084
Other Assets	6,967	8,205	10,577
Total assets	142,502	181,087	212,639
Liabilities (Dollars in millions)			
Deposits	114,929	156,321	176,437
• Insured deposits	34,629	39,621	56,937
• Uninsured deposits	80,300	116,700	119,500
Short-term borrowings	0	0	6,700
Long-term debt	13,529	5,477	8,579
Other Liabilities	2,293	3,391	3,477
Total liabilities	130,751	165,189	195,193
Total equity	11,751	15,898	17,446
Total liabilities and Total equity	142,502	181,087	212,639

Source: Own work based on Bank Call Reports data (2021, 2022)

When interest rates rose sharply in 2022, First Republic's investment portfolio experienced major unrealized losses. The losses on AFS securities were relatively small since these made up a small portion of the bank's total assets, rising from $52 million in 2021 to $471 million in 2022. Most losses in AFS portfolio came from Agency RMBS, representing 98.1% and 90.2% in 2021 and 2022, respectively. Exposure to Agency Commercial MBS increased as the unrealized losses rose from $1 million to $45 million. The HTM portfolio suffered much bigger losses, jumping from $53 million in 2021 to $4.8 billion by the end of 2022. The increase in HTM unrealized losses was driven mainly by two asset groups. Losses on Securities of U.S. States and political subdivisions, which grew from $22 million to $3.4 billion, and losses on Agency Commercial MBS, that rose from $12 million to $668 million. However, the largest unrealized losses were recorded on the bank's loan portfolio. Already standing at $5 billion in 2021, those losses climbed to $22.2 billion by the end of 2022. The increase was caused by the bank's large concentration of long-term fixed-rate

loans, which made up 76% of the portfolio in 2020 and increased to 88% by 2022. Table 17 shows a more detailed decomposition of all FRB's unrealized losses.

Table 17: FRB's Unrealized Losses on AFS, HTM and Loan Portfolios

(Dollars in millions)	2021	2021	2022	2022
AFS Unrealized Losses	**52**	**100%**	**471**	**100%**
Agency Residential MBS	51	98.1%	425	90.2%
Other Residential MBS	0	0%	1	0.2%
Agency Commercial MBS	1	1.9%	45	9.6%
Securities of U.S. States and political subdivision	0	0%	0	0%
HTM Unrealized Losses	**53**	**100%**	**4,839**	**100%**
U.S. Government-sponsored agency securities	3	5.7%	27	0.6%
Agency Residential MBS	15	28.3%	250	5.2%
Other Residential MBS	0	0%	1	0%
Agency Commercial MBS	12	22.6%	668	13.8%
Securities of U.S. States and political subdivision	22	41.5%	3,437	71.0%
Corporate debt securities	1	1.9%	456	9.4%
Loans Unrealized Losses	**5,000**		**22,200**	

Source: Own work based on Bank Call Reports data (2021, 2022)

Like many other banks, FRB was subject to regulatory capital requirements supervised by the FDIC. Like SVB and Signature Bank, FRB's capital levels were not worrying. As of December 31, 2022, the bank's Basel III capital ratios not only surpassed the minimum regulatory requirements but also exceeded the thresholds for well-capitalized institutions. Its CET1 capital ratio stood at 9.2%, Tier 1 risk-based capital was 11.6%, and Total risk-based capital was 12.6%.

Like SVB and Signature Bank, FRB's business model was heavily reliant on uninsured deposits. From the end of 2019 to the end of 2021, FRB's uninsured deposits nearly doubled, rising from $59 billion to $116.7 billion, because clients held larger liquidity positions compared to the pre-pandemic period. FRB's focus on relationship-based banking and high-quality service continued to attract high-net-worth clients and their businesses, leading to substantial deposit balances. For comparison, while FRB's uninsured deposits as a percentage of total assets ranged from 51% to 64% between 2018 and 2022, the median percentage for peer banks during the same period ranged from 31% to 41% (FDIC, 2023). Another important detail to highlight is that 99.5% of First Republic's total deposits had a duration of one year or less, while only 18.9% of its loans and securities had a duration of one year or less. Therefore, FRB was operating with a very large maturity gap.

In general, one of the biggest strengths of First Republic was its ability to attract deposits, providing the bank with a stable and low-cost source of funding. The bank focused on

increasing core deposits by deepening relationships with existing clients and attracting new ones, both consumer and business. Most clients held deposits at the bank, and a large portion of these were non-interest-bearing checking accounts. This approach kept the bank's funding costs low, enabling it to offer loans at competitive, lower rates (FDIC, 2023). By the end of 2021, deposits made up 95% of FRB's total liabilities, while this proportion slightly decreased to 90% by the end of 2022. By March 2022, FRB reported that 73% of its total liabilities were non-rate sensitive. However, by September 2022, in response to interest rate hikes, customers started shifting their funds from non-interest-bearing accounts to Time/CD accounts, which led to higher interest expenses and reduced NIM. For a detailed breakdown of First Republic's deposit structure, see Table 18.

Table 18: FRB's Deposit Structure in 2021 and 2022

(Dollars in millions)	**2021**	**2021**	**2022**	**2022**
Noninterest-bearing checking	70,840	45%	62,579	36%
Interest-bearing checking	41,248	26%	41,178	23%
Money market checking	20,303	13%	25,805	15%
Money market savings and passbooks	16,573	11%	21,663	12%
CDs	7,357	5%	25,212	14%
Total deposits	156,321	100%	176,437	100%

Source: Own work based on Bank Call Reports data (2021, 2022)

Between December 31, 2021, and December 31, 2022, First Republic witnessed a notable shift in its deposit structure. Total deposits grew to $20.1 billion or 12.9%. While the share of noninterest-bearing checking accounts decreased from 45% to 36%, the proportion of CDs grew from 5% to 14%. This sharp increase in CDs from $7.4 billion to $25.2 billion drove up the bank's expenses to the extent that the interest paid on domestic deposits jumped from $95 million in 2021 to $654 million in 2022. Money market checking and savings accounts also grew, showing a move towards higher-yielding deposit products. This transition away from low-cost, noninterest-bearing deposits to short-term yet high-yield CDs is what severely damaged the bank's NII and EVE. According to Jiang et al. (2023), compared to SVB and Signature Bank, First Republic had a relatively lower uninsured deposit leverage ratio, though it was still higher than its peer group. By the end of 2022, 56% of the bank's assets were funded by uninsured deposits. However, according to Krantz (2023), the bank had an exceptionally high ratio of loans and HTM securities to total deposits, reaching 110.6%. A high ratio of loans and HTM securities to deposits does not only suggest aggressive asset growth, but also that the bank may face great liquidity challenges if it needs to access cash quickly.

First Republic was ultimately a victim of contagion effect caused by a loss of confidence following the failures of Silvergate Bank, SVB, and Signature Bank in March 2023. These events caused widespread concern about large regional banks, especially those similar to SVB, like First Republic. Both banks were based in the San Francisco Bay Area, served similar clients (private equity and venture capital firms), had high unrealized losses, and

relied heavily on uninsured deposits. Although FRB survived the first wave of a bank run, it ended up in a weaker financial position due to the higher cost of funding. Limited on-balance sheet liquidity, short-term nature of funding, and no further borrowing capacity left First Republic unable to meet the continued deposit outflows (FDIC, 2023).

To summarize, SVB failed due to a combination of several key factors. First, it was highly exposed to interest rate risk, with the value of its assets falling by billions of dollars due to a large concentration in HTM and AFS securities. Second, its concentrated business model, serving tech companies, venture capital firms, and startups, left it vulnerable to risks within that sector. Third, rapid growth over the past five years brought new risks and management challenges for the bank. Lastly, the bank had an unusually high level of uninsured deposits, making it particularly vulnerable to a bank run during times of distress. One of the main reasons for Signature Bank's failure was panic triggered by the collapses of SVB and Silvergate Bank. Additionally, disruptions in the cryptocurrency market damaged the bank's reputation, as it was closely related to the digital-asset sector. The bank also had an unusually high concentration of uninsured deposits that, combined with insufficient contingency funding, led to severe liquidity problems. Like Signature Bank, FRB's collapse was driven by contagion effects following the failures of other major financial institutions. The bank's high exposure to interest rate risk caused a significant drop in the fair value of its assets, especially loans, which severely impacted its liquidity and capital. Moreover, the bank struggled with a major asset/liability mismatch between its short-term deposits and long-term investments. Finally, First Republic's strategy of attracting high-net-worth clients with competitive loan terms, while relying on low-cost deposits, led to a high concentration of uninsured deposits, making the bank more run-prone.

5.4 Discussion and Policy Recommendations Regarding 2023 U.S. Banking Crisis

In this last section of my thesis, I will address my fourth and final research question: How did the Federal Reserve's aggressive monetary tightening contribute to financial instability during the 2023 banking crisis? Monetary tightening is considered aggressive when a central bank raises interest rates sharply and frequently within a short period, often in response to high inflation or an overheated economy. The Federal Reserve adopted this approach by taking decisive actions to control rising inflation following the pandemic. Starting from historically low interest rates, the Fed implemented a series of aggressive rate hikes between March 2022 and July 2023, increasing the federal funds rate by a total of 525 basis points. Some of these hikes were as large as 75 basis points, marking the fastest tightening cycle in decades (Kliesen, 2023). In comparison, the European Central Bank also engaged in tightening but at a slightly slower pace, raising its key policy rate by 450 basis points between July 2022 and November 2023. While both central banks acted to fight inflation, the Fed's actions were notably more aggressive in both magnitude and speed (Jude & Levieuge, 2024).

The recent events in the U.S. sparked once again a debate about the potential trade-off between monetary policy and financial stability. This trade-off means that actions taken by a central bank to achieve its primary goal of controlling inflation/reaching price stability can sometimes create risks to the stability of the financial system, and vice versa. Two main factors that often trigger financial instability are rising interest rates and the weakening of bank balance sheets. Aggressive interest rate hikes to fight inflation destabilize financial institutions as they weaken their balance sheets due to a mismatch in maturity between their assets and liabilities. This mismatch reduces banks' liquidity and weakens their financial position, therefore, increasing the risk of bank failures (Mishkin, 1997).

The U.S. banking regulatory system is known to be highly fragmented, with multiple overlapping regulators and a dual state-federal regulatory system. At the federal level, financial regulators can be sorted in the following groups: Depository regulators are the Office of the Comptroller of the Currency (OCC), FDIC, Federal Reserve for banks and National Credit Union Administration (NCUA) for credit unions. SEC and Commodity Futures Trading Commission (CFTC) are securities market regulators. Under government-sponsored enterprise (GSE) regulators belong Federal Housing Finance Agency (FHFA) and Farm Credit Administration. Finally, Consumer Financial Protection Bureau (CFPB) is a consumer protection regulator. As if the complex and fragmented regulatory system is not challenging enough, regulators failing to do their job properly only makes matters worse, leading to serious consequences (Labonte, 2023).

Many economists and financial experts argue that the Federal Reserve played a central role in the financial instability seen in 2023, but not only because of its aggressive monetary tightening. The Fed's primary focus is on monetary policy, as it should be. However, as much as a combination of monetary policy and bank regulation under one institution can be beneficial, it can also create conflicts. The 2023 financial instability is an example of such a conflict. While Fed's monetary policy focused on controlling inflation through rate hikes, its responsibilities as a banking regulator got overshadowed. Consequently, the Fed did not adequately address the risks that banks were taking by accumulating interest rate-sensitive assets. When the Fed raised rates, the value of these assets plunged, contributing to the crisis. The Federal Reserve, as the primary bank regulator, had a particularly close relationship with SVB. SVB's CEO was a member of the board of the Federal Reserve Bank of San Francisco, which was responsible for regulating the bank. This conflict of interest led to poor decision-making, limited the Fed's ability to address problems at SVB, and gave the appearance of regulatory approval. As a result, the Fed's oversight and regulation proved to be inadequate and ineffective. Silvergate was another bank under the Federal Reserve's regulatory oversight, where supervision and regulation were similarly problematic (Klein, 2024).

According to FDIC (2023), many U.S. banks faced asset/liability mismatches because of the aggressive interest rate hikes. Thus, this imbalance was not limited only to the banks that failed. In fact, no bank anticipated such magnitude and speed of the rate hikes or the

inversion of the yield curve in 2023. As a result, banks were highly unprepared for such a shock, as their models did not consider such extreme scenarios. During the pandemic, banks experienced a fast growth in deposits due to fiscal and monetary policies. They invested these deposits in long-term fixed-rate assets and mortgage-backed securities. When the Fed began raising interest rates to control inflation, it had a significant impact on banks: the cost of short-term funding rose sharply, squeezing NIMs, while depreciation of assets led to potential solvency issues. Growing capital losses on bank balance sheets, unnoticed by investors and regulators, reduced banks' net worth and increased financial stability risks. Moreover, many regional banks became highly reliant on uninsured deposits.

Although the banking environment was challenging for all banks, SVB, FRB, and Signature Bank were in a class of their own. The key factors that set these three banks apart from their peers were the exceptionally rapid growth, highly concentrated customer bases, and reliance on uninsured deposits, coupled with significant mismanagement of concentration risks in both their assets and liabilities. These three banks catered to niche markets, such as venture capitalists and tech startups (SVB), cryptocurrency firms and digital-assets depositors (Signature Bank), and high-net-worth individuals (FRB). The uninsured deposits were alarmingly high for SVB (93.9%), Signature Bank (89.7%), and First Republic (67.7%), though they were not alone in this. State Street Bank had 91.2% of its deposits uninsured, and Bank of New York Mellon topped the chart with 96.5%. One might wonder why Bank of New York Mellon did not face a similar fate. But uninsured deposits are only half the story. The ratio of loans and HTM securities to total deposits was dangerously high for the three failed banks, with First Republic at staggering 110.6%, SVB at 94.4%, and Signature Bank at 93.3%. In contrast, Bank of New York Mellon had a much lower ratio of 31.2%. The combination of having both ratios so high was fatal for the three banks, making them highly vulnerable to sudden deposit withdrawals and liquidity shortfalls. Table 19 shows top 10 U.S. banks with the highest percentage of uninsured deposits and their loans and HTM securities to total deposits ratios (Krantz, 2023).

Table 19: Banks with the Highest Uninsured Deposit Balances at the end of 2022

Company	Symbol	Uninsured deposits / domestic deposits	Loans and HTM securities / total deposits
Bank of New York Mellon	(BK)	96.5%	31.2%
SVB Financial Group	(SIVB)	93.9%	94.4%
State Street	(STT)	91.2%	40.1%
Signature	(SBNY)	89.7%	93.3%
Northern Trust	(NTRS)	83.1%	54.5%
Citigroup	(C)	77.0%	64.6%
HSBC Holdings	(HSBA)	72.5%	47.4%
First Republic Bank	(FRC)	67.7%	110.6%
East West Bancorp	(EWBC)	65.9%	91.1%
Comerica	(CMA)	62.5%	72.8%

Source: Krantz (2023)

A study by Parkinson (2023) analysed 3,821 U.S. banks and revealed significant disparities in uninsured deposit levels based on asset size. Smaller banks, with assets under $1 billion, had a median uninsured deposit share of 24.6%, while mid-sized banks ($1 billion to $10 billion) held a slightly higher median of 30.1%. The exposure increased notably for larger banks, with median uninsured deposits reaching 41.9% for those with $10 billion to $100 billion in assets and 48.6% for banks exceeding $100 billion. Overall, the median across all banks stood at 25.7%, underscoring how large important banks, including SVB, First Republic, and Signature Bank, had a disproportionately high reliance on uninsured deposits, heightening their liquidity risk during financial turbulence.

Despite the glaring risks, the failed banks' risk management practices did not tackle these concentrations, as they implemented virtually no strategies to mitigate interest rate or liquidity risks. Absence of hedging activities was another crucial characteristic the three failed banks had in common (FDIC, 2023). Looking at the banks' call reports, SVB significantly reduced its hedging activities, cutting its pay-fixed, receive-variable interest rate swaps on AFS securities from $15.3 billion in 2021 to just $563 million in 2022. This move, caused by weak profitability, allowed the bank to lock in a $517 million gain but made it enter 2023 completely unhedged. Signature Bank also eliminated its hedges on AFS securities before March 2023. Initially, in 2018, it used interest rate swaps totalling $650 million to hedge fixed-rate commercial real estate loans. However, $200 million and $250 million of these swaps matured in 2020 and 2021, respectively, and the remaining $200 million matured by March 2022. As for First Republic, the bank did not engage in any hedging activities, exposing itself fully to interest rate risk. According to FDIC (2023), this no-hedging strategy was in line with the bank's overall philosophy of not engaging in overly complex strategies or transactions.

The characteristics mentioned above set SVB, FRB, and Signature Bank apart from their peers while also drawing similarities among them. Now, let us explore how these three banks differed from one another. As previously mentioned, the three banks had significantly different customer bases. Moreover, SVB and FRB had one major difference: the liquidity of SVB's portfolio was much higher than of FRB. Net loans made up a huge amount of FRB's assets (78% of total assets compared to 35% for SVB), especially mortgage loans (64% for FRB compared to 6% for SVB). On the other hand, securities represented the largest portion of SVB's assets, with mortgage securities accounting for 43% of the total. From this perspective, Signature Bank fell between SVB and FRB in terms of liquidity. Signature had a significant portion of its assets in loans (67% of total assets), similar to FRB, but a smaller share in mortgage loans. Its investment portfolio included a mix of variable-rate loans (43%), which provided some protection against rising interest rates, and its lower reliance on fixed-rate assets helped it manage rate sensitivity better than FRB. However, unlike SVB, Signature Bank had less exposure to securities (only 24% of assets), meaning its liquidity was more constrained than SVB's but slightly better than FRB's. This intermediate liquidity profile helped Signature avoid some of the extreme

vulnerabilities seen in SVB and FRB but still left it exposed to deposit instability (Dinh, 2023).

To prevent similar failures in the future, reforms of the Federal Reserve System are needed. Some countries separated the responsibilities of monetary policy and bank regulation, adopting a so-called "twin peaks" model, which has often been successful. This model divides the responsibilities, with one regulatory body focusing on monetary policy and another on financial regulation. By splitting these roles, conflicts of interest can be reduced, allowing each institution to focus on its core responsibilities without the risk of one undermining the other. Removing all bankers from the boards of Federal Reserve Banks can be considered as a relatively modest reform. A more significant change would be transferring a complete bank regulation from the Fed to one of the two other primary regulators, such as the OCC or FDIC. Such action could also give the Fed greater freedom and flexibility to conduct monetary policy. Nevertheless, regardless of the structure, effective regulation requires independence and sound judgment, both of which were lacking in the Fed's supervision of the banks that failed (Klein, 2024).

Since funding fragilities remain a key vulnerability in the U.S. banking sector (44.7% of all domestic deposits were uninsured in 2022), regulators must carefully examine the risks associated with heavy reliance on uninsured deposits, especially large, concentrated ones like those held by Signature Bank and SVB. Thus, a targeted regulatory approach is crucial to prevent negative impacts on businesses and households. Banks with a significant proportion of uninsured deposits should be required to provide detailed data on these deposits, enabling regulators to assess their stability. This data should include whether the deposits are retail or wholesale, whether wholesale deposits are operational or non-operational, and how concentrated non-operational wholesale deposits are. Banks could report these breakdowns in call reports, with the potential for public disclosure. For deposit types at high risk of a run (like non-operational wholesale deposits), regulators might consider limiting the bank's usage of such unstable funding (as a percentage of total deposits or perhaps total assets), as well as placing a cap on a bank's reliance on unstable deposits from a small number of depositors (Parkinson, 2023).

Furthermore, collaboration between banks, regulators, and the Federal Reserve is essential to ensure banks are ready to use the discount window when liquidity pressures exceed expectations. Additionally, efforts should be made to reduce the stigma around its use, so banks feel comfortable borrowing when needed, as the discount window is vital for maintaining banking stability (Parkinson, 2023).

To close, the latest Trump's presidency is expected to bring a significant shift in U.S. economic policy, with an emphasis on deregulation and trade protectionism. His financial deregulation could have a great impact on the banking sector as it seems to aim to ease mergers and acquisitions and reduce regulatory oversight, which could accelerate industry consolidation. Moreover, it might reduce or eliminate certain regulatory requirements for

U.S. banks, particularly targeting the Basel Endgame capital rules. Additionally, proposed changes to liquidity rules are expected to be sidelined. While this could benefit large banks by enabling more aggressive expansion, it might also increase risks and decrease accountability. The easing of regulations might improve profitability for banks in the short term, but long-term implications on stability and competition remain a concern (Pianese, 2024).

6 CONCLUSION

Bank's exposure of current and future capital and earnings to adverse movements in interest rates is known as interest rate risk. Interest rate risk can be an important source of bank's profitability, yet, if not managed effectively, it can negatively impact its profits, economic value and capital level. When measuring interest rate risk, risk management most often performs gap analysis, duration analysis, earnings simulation analysis and economic value of equity analysis. Once the level of exposure is determined, banks have two primary methods for managing that exposure: balance sheet restructuring and derivative hedging. While balance sheet adjustments help mitigate interest rate risk over time, they do not provide immediate protection. On the other hand, in hedging, banks can choose among many alternatives like swaps, futures, forwards and options, with swaps being the most popular ones. However, hedging mechanisms come with their own challenges. The most frequent problems that banks face when engaging in derivatives is lack of their understanding, as these instruments are very complex. Consequently, the banks can face counterparty risk, high unnecessary costs, market volatility and time-consuming regulatory changes.

When FOMC increases the federal funds rate target, we are talking about tightening of monetary policy. To ensure that the federal funds rate stays within the set target range, the Fed uses four key tools: interest on reserve balances rate, discount rate, overnight reverse repurchase agreement rate and open market operations. The three rates are so-called administered rates, meaning they are directly set by the Fed. On the contrary, the federal funds rate is set by the market. Within the last 50 years there have been seven tightening cycles, with the last one starting in 2022. In five of these seven cycles, the tightening led to an inversion of the yield curve. The 2022/23 tightening episode was one of the most aggressive ones in history, with the fastest policy tightening in the last few decades. The Fed raised the federal funds rate by 525 basis points in only 16 months.

Looking at the financial performance of the U.S. banking sector during monetary tightening cycles, banks’ NIMs decreased in 1994/95, 1999/2000 and 2004/06 episodes. Because the rise in short-term interest rates gradually increases banks' interest expenses, and the flattening of the yield curve lowers the income of interest-bearing assets linked to longer rates, NIMs tend to slightly decline or remain flat during periods of monetary policy tightening. However, during 2015/18 tightening episode NIMs rose. Changes in the banking environment after an extended period at the zero lower bound resulted in an

abundance of deposits and liquid assets, which played a crucial role in the rise of NIMs. During the 2022/23 monetary tightening cycle, average NIMs initially increased in early 2022, driven by higher floating-loan rates and limited pass-through to deposit rates, but growth slowed significantly by late 2022 due to the broader impact of successive rate hikes. Banks' NIM performance varied significantly due to differences in business models and funding structures. Margin-increasing banks, which relied more on deposit funding and retained a higher proportion of noninterest-bearing deposits, benefitted from lower funding costs and rising loan yields, leading to stronger NIMs and profitability. In contrast, margin-decreasing banks, more reliant on non-deposit funding and capital market activities, faced higher funding costs and less favourable yield contributions, highlighting the critical role of funding strategies in shaping financial outcomes during periods of monetary tightening.

After the 2022/23 banking crisis, vulnerability of the U.S. banks to interest rate risk became one of the main topics. In this context, my first research question focused on why U.S. banks are so vulnerable to interest rate risk and what the main drivers of this exposure are. I found that while European banks remained relatively safe during interest rate hikes, interest rate risk continues to pose a serious threat to small, mid-sized and regional U.S. banks. Mainly weak capital requirements, different regulatory treatment of unrealized losses, and poor supervision led to smaller U.S. banks being increasingly exposed to interest rate risk. Unlike European banks that are subject to various stress tests and must pass the supervisory outlier test, U.S. banks are not being stress tested, and supervisors are required to only determine whether an institution's interest rate risk policy is being followed by the bank's IRR management. Therefore, in the U.S. risk is not evaluated in comparison to other banks. In general, banks are exposed to five types of interest rate risk, namely repricing risk, yield curve risk, basis risk, option risk and price risk. The most significant and often discussed is repricing risk, which arises from repricing of assets and liabilities at different times or amounts. Indeed, the maturity gap of U.S. banks has grown greatly since the financial crisis of 2008, making banks increasingly more exposed to interest rate risk. The main drivers of named interest rate risk types are often funding sources, derivative instruments, mortgage banking operations, fee income businesses and embedded options.

My second research question addressed the root causes and systemic factors that led to the banking crisis in the U.S. in 2023. There are many different factors that contributed to the crisis. Covid-19 pandemic and Russia-Ukraine war certainly stimulated inflation, which required higher interest rates. Furthermore, the Fed's inaction in 2021 was a key factor that led to these sharp and frequent interest rate increases. While the Taylor rule suggested to raise federal funds rate, the Fed maintained low interest rates since it was convinced inflation was transitory. Nonetheless, I discovered that the roots of the latest banking crisis go back to 2009. Fed practically held interest rates near zero from 2009 to 2022 while executing four rounds of quantitative easing in 2009, 2010, 2012, and 2020, which substantially expanded the balance sheet of the banking sector. Because of this, demand deposits grew quickly in an environment of low interest rates while banks were encouraged

to change their portfolio positions, shifting toward long-term investments with higher yields. The latter created a big maturity gap for the banks.

The reason why the banking crisis of 2023 in the U.S. is of such great importance is because it represents a record year for failed banks assets. Because of the aggressive monetary tightening, the U.S. banks faced around $2.2 trillion in unrealized losses on their securities portfolios, with large banks having the highest aggregate losses. Rising interest rates can also lead to self-fulfilling bank runs driven by solvency concerns, which is precisely what caused the collapse of six banks: Silvergate Bank, Silicon Valley Bank, Signature Bank, First Republic Bank, Heartland Tri-State Bank, and Citizens Bank. Moreover, interest rate risk hedging in the banking sector was very limited, with only 6% of all assets being covered in rate swaps.

By conducting a thorough analysis of Silicon Valley Bank, Signature Bank and First Republic Bank I answered to my third and most central research question of my thesis, that is how exposed the three banks were to interest rate risk. The analysis revealed that SVB and FRB were highly exposed to interest rate risk, both from NII and EVE perspective. On the other hand, Signature Bank's exposure was lower compared to the other two banks, especially at the end of 2022. Moreover, in the last five years, all three banks experienced very rapid growth in their balance sheets, which brought its own challenges and risks. Furthermore, all three had incredibly high unrealized losses in their AFS and HTM investment portfolios, a very fragile deposit structure with overreliance on large uninsured deposits, and a very specific depositor group, related to tech- and crypto- industries. Finally, none of them engaged in hedging activities. The combination of the abovementioned factors was fatal for the three banks.

In the aftermath of the crisis, the potential trade-off between price stability and financial stability once again came into light. As my fourth and last research question I explored how exactly the Fed's aggressive monetary tightening contributed to the financial instability seen during the 2023 banking crisis. In my research I found out that the Fed's aggressive tightening was certainly one of the main causes for the financial instability in the U.S. in 2023. Not only it weakened banks' balance sheets, but it created increasing asset/liability mismatches and increased the risk of bank runs and capital losses. Furthermore, some argue that apart from its aggressive tightening, the Fed played a crucial role in the crisis through its poor regulation of the financial system and inadequate oversight of the banks. Indeed, European banks went through a similar tightening distress, yet no bank failed. Ultimately, the 2023 U.S. banking crisis highlighted deeper systemic vulnerabilities that extended beyond monetary policy alone. As for now, the future of U.S. banking will depend on the policies and actions of the Trump administration, and only time will reveal their impact.

REFERENCES

1. Abdymomunov, A., Gerlach, J., & Sakurai, J. (2023, January 1). *Interest Rate Risk in the U.S. Banking Sector*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4395529
2. Admati, A., Hellwig, M., & Portes, R. (2023, May 18). *When will they ever learn? The US banking crisis of 2023.* https://cepr.org/voxeu/columns/when-will-they-ever-learn-us-banking-crisis-2023
3. Ailani, G. (2024, February 29). *Duration Gap*. https://www.wallstreetmojo.com/duration-gap/
4. Amaral, P. S. (2013, July 9). Monetary Policy Tightening and Long-Term Interest Rates. *Economic Commentary, No. 2013-08*.
5. Aridas, C. (2023, March 22). *7 Possible Causes of SVB Failure and Predicting the Impact on Regulatory Reporting.* https://blogs.perficient.com/2023/03/22/7-possible-causes-of-svb-failure-and-predicting-the-impact-on-regulatory-reporting/#:~:text=1.,the%208.50%25%20regulatory%20required%20ratio.
6. Basel Committee on Banking Supervision. (2016, April). *Interest rate risk in the banking book.* https://www.bis.org/bcbs/publ/d368.pdf
7. Bednar, W., & Elamin, M. (2014, June 24). Rising Interest Rate Risk at US Banks. *Economic Commentary, No. 2014-12.*
8. Benoit, D. (2023, January 21). *Silvergate Raced to Cover $8.1 Billion in Withdrawals During Crypto Meltdown*. https://www.wsj.com/articles/silvergate-raced-to-cover-8-1-billion-in-withdrawals-during-crypto-meltdown-11672895207
9. Berry, J., Ionescu, F., Kurtzman, R., & Zarutskie, R. (2019, April 19). Changes in Monetary Policy and Banks' Net Interest Margins: A Comparison across Four Tightening Episodes. *FEDS notes, No. 2019-04-19-2.*
10. Caballero, J., Maurin, A., Wooldridge, P., & Xia, D. (2023, September 18). Interest rate risk management by EME banks. *BIS Quarterly Review, September 2023.* 49-60.
11. Corporate Finance Institute. (n.d.). *Interest Rate Call Option*. https://corporatefinanceinstitute.com/resources/derivatives/interest-rate-call-option/#:~:text=Institutions%20that%20lend%20capital%2C%20like,in%20times%20of%20economic%20uncertainty.
12. Dinh, H. T. (2023, June). The U.S. Banking Crisis of 2023 and Its Implications for Africa. *Policy Center for the New South, Policy Brief, June 2023, No. 23/23.*
13. Ennis, H. M., Fessenden, H., & Walter, J. R. (2016, May). Do Net Interest Margins and Interest Rates Move Together? *Economic Brief, No. 16-05.*
14. Enria, A. (2022, November 8). *Monitoring and managing interest rate risk along the normalization path.* https://www.bankingsupervision.europa.eu/press/speeches/date/2022/html/ssm.sp221108~ee0264b638.en.html

15. “Explainer: Six factors that influence interest rates in an economy”. (2019, April 26). https://www.moneycontrol.com/news/business/personal-finance/explainer-six-factors-that-influence-interest-rates-in-an-economy-3549621.html
16. FDIC OIG. (2023, October 23). Material Loss Review of Signature Bank of New York. *Evaluation Report, No. EVAL-24-02.*
17. FDIC OIG. (2024, March). Failed Bank Review, Citizens Bank, Sac City, Iowa. *AEC Memorandum No. 24-02.*
18. FDIC. (2023, September 8). *FDIC’s supervision of First Republic Bank.* https://www.fdic.gov/sites/default/files/2024-03/pr23073a.pdf
19. FDIC. (2024, October 28). *Risk Management Manual of Examination Policies.* https://www.fdic.gov/resources/supervision-and-examinations/examination-policies-manual/risk-management-manual-complete.pdf
20. Federal Reserve Bank of Kansas City. (2023, September 27). *Community Banking Bulletin Highlight: Decline in net interest income driven primarily by interest rates*. https://www.kansascityfed.org/banking/community-banking-bulletins/highlight-decline-in-net-interest-income-driven-primarily-by-interest-rates/
21. Federal Reserve Board. (1998, February). *Trading and Capital-Markets Activities Manual.* https://www.federalreserve.gov/boarddocs/supmanual/trading/3000p2.pdf
22. Federal Reserve Board. (2021). *The Fed Explained: What the Central Bank Does.* https://www.federalreserve.gov/aboutthefed/files/the-fed-explained.pdf
23. Federal Reserve Board. (2023, September 25). Material Loss Review of Silicon Valley Bank. *Evaluation Report, No. 2023-SR-B-013*.
24. Federal Reserve Board. (2024, February 7). Material Loss Review of Heartland Tri-State Bank. *Evaluation Report, No. 2024-SR-B-004.*
25. Federal Reserve. (n.d.). *Structure and Functions of the Federal Reserve System.* https://www.federalreserveeducation.org/about-the-fed/archive-structure-and-functions/#:~:text=Conducts%20the%20nation's%20monetary%20policy,in%20the%20U.S.%20and%20abroad.
26. Feldman, R.J., & Schmidt, J. (2000, July 1). *Interest rate risk: What is it, why banks would want it, and how to evaluate it.* https://www.minneapolisfed.org/article/2000/interest-rate-risk-what-is-it-why-banks-would-want-it-and-how-to-evaluate-it
27. First Republic Bank. (2018). *2018 Annual Report*. https://www.annualreports.com/HostedData/AnnualReportArchive/f/NYSE_FRC_2018.pdf
28. First Republic Bank. (2020). *2020 Annual Report*. https://www.annualreports.com/HostedData/AnnualReportArchive/f/NYSE_FRC_2020.pdf
29. First Republic Bank. (2021). *2021 Annual Report.* https://www.annualreports.com/HostedData/AnnualReportArchive/f/NYSE_FRC_2021.pdf

30. First Republic Bank. (2022). *Annual Report, Form 10-K.* https://www.annualreports.com/HostedData/AnnualReports/PDF/NYSE_FRC_2022.pdf
31. Frier, K. (2023, August). *A DISTINCTIVE FED TIGHTENING CYCLE.* https://atlasca.com/a-distinctive-fed-tightening-cycle/
32. Graf, A. & Gull, Z. (2023, November 8). *Annual failed bank total climbs to 6-year high with fall of Iowa community bank.* https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/annual-failed-bank-total-climbs-to-6-year-high-with-fall-of-iowa-community-bank-78276908
33. Hayes, A. (2023, September 27). *Yield Curve: What It Is and How to Use It.* https://www.investopedia.com/terms/y/yieldcurve.asp#:~:text=An%20inverted%20yield%20curve%20slopes,trend%20lower%20in%20the%20future.
34. Hsiao, W. (2023, March 17). *Who should be held responsible for the Silvergate Bank and SVB crises?* https://forkast.news/what-caused-silvergate-svb-bank-fail/
35. Ihrig, J. & Wolla, S. A. (2022, May 2). *How Does the Fed Use Its Monetary Policy Tools to Influence the Economy?* https://research.stlouisfed.org/publications/page1-econ/2022/05/02/how-does-the-fed-use-its-monetary-policy-tools-to-influence-the-economy
36. Ihrig, J., & Waller, C. (2024, February 14). *The Federal Reserve's responses to the post-Covid period of high inflation.* https://www.federalreserve.gov/econres/notes/feds-notes/the-federal-reserves-responses-to-the-post-covid-period-of-high-inflation-20240214.html#:~:text=At%20each%20meeting%20from%20March,September%2C%20and%20November%202022%20meetings.
37. Illgner, A. (2023, October 13). *Why European banks can better withstand interest rate risks than their US peers.* https://www.thebanker.com/content/0f6bb366-210e-5199-b275-6ad2babf806a#:~:text=According%20to%20the%20report%2C%20loose,take%20steps%20to%20manage%20it.
38. Jiang, E. X., Matvos, G., Piskorski, T. & Seru, A. (2023, March 13). Monetary Tightening and U.S. Bank Fragility in 2023: Mark-to-Market Losses and Uninsured Depositor Runs? *Working Paper No. 31048.*
39. Jude, C. & Levieuge, G. (2024, March). The pass-through of monetary policy tightening to financing conditions in the Euro area and the US. Is this time different? *Policy Note, Issue No 342.*
40. King, T. B. & Yu, J. (2018). How have banks responded to changes in the yield curve? *Chicago Fed Letter, No. 406*(1).
41. Klein, A. (2024). Federal Reserve: Conflicts between Monetary Policy and Bank Regulation in Tackling Inflation. *Journal of Financial Crises, 6*(2), 1-42.
42. Kliesen, K. L. (2022a, January 31). A Comparison of Fed "Tightening" Episodes since the 1980s. *Working Paper Series No. 2020-003B.*

43. Kliesen, K. L. (2022b, April 14). *A Look at Fed Tightening Episodes since the 1980s: Part I.* https://www.stlouisfed.org/on-the-economy/2022/apr/fed-tightening-episodes-since-1980s-part-one
44. Kliesen, K. L. (2023, August 15). *Gauging the Fed's Current Tightening Actions: A Historical Perspective.* https://www.stlouisfed.org/on-the-economy/2023/aug/gauging-fed-current-tightening-actions-historical-perspective
45. Krantz, M. (2023, March 15). *Report: 10 Banks Are Most Exposed To Uninsured Deposits.* https://www.investors.com/etfs-and-funds/sectors/banks-report-most-exposed-to-uninsured-deposits/#:~:text=%22Silicon%20Valley%20Bank%20and%20Signature,David%20Hayes%20in%20a%20report.
46. Kuprianov, A. (1986). Short-term interest rate futures. *Economic Review, 72*(5), 12-26.
47. Labonte, M. (2023, October 13). *Who Regulates Whom? An Overview of the U.S. Financial Regulatory Framework.* https://crsreports.congress.gov/product/pdf/R/R44918#:~:text=Overview%20of%20the,U.S.%20Financial%20Regulatory%20Framework,to%20various%20historical%20financial%20crises.
48. Laliberte, B., & Sengupta, R. (2024, March 8). Why Do Net Interest Margins Behave Differently across Banks as Interest Rates Rise? Evidence from the Recent Tightening Cycle. *Economic Review*, *109*(3).
49. Levine, M. (2023, May 9). *It's Never Too Late for Banks to Hedge*. https://archive.ph/GgVk2#selection-3559.0-3559.38
50. Loomis Sayles Credit Research. (2023, September 18). *Shifting Trends Favor European Banks vs. US Banks for the First Time in Years.* https://blog.loomissayles.com/shifting-trends-favor-european-banks-vs.-us-banks-for-the-first-time-in-years
51. Mishkin, F. S. (1997). *The causes and propagation of financial instability: Lessons for policymakers, (pp. 55-96).* https://www.kansascityfed.org/documents/3591/pdf-s97Mishk.pdf
52. Ozili, P. K. (2024, February 21). Causes and consequences of the 2023 banking crisis. *MPRA Paper No. 120153*.
53. Parkinson, P. (2023, October 5). *What to do About Uninsured Deposits?* https://bpi.com/what-to-do-about-uninsured-deposits/
54. Paul, P. (2018, February 26). Monetary Policy Cycles and Financial Stability. *FRBSF Economic Letter, No. 2018-06*.
55. Peck, R. R., Troop, A. M., & Young, P. F. (2023, April 14). *The Banking Crisis of 2023: Outlook for the U.S. Banking Sector, Possible Regulatory and Legislative Responses, Lessons for Bank Customers and Management*. https://www.pillsburylaw.com/en/news-and-insights/banking-crisis-outlook-regulatory-lessons.html

56. Pianese, B. (2024, November 20). *How Trump's deregulation drive could impact banks.* https://www.thebanker.com/content/05e97cf7-7d6a-580d-91cb-d27cd4d03092
57. Purnanandam, A. (2005, May). Interest Rate Risk Management at Commercial Banks: An Empirical Investigation. *FDIC CFR Working Paper, No. 2006-02.*
58. Religare Broking. (2024, April 1). *Financial Derivatives: Advantages & Disadvantages.* https://www.religareonline.com/blog/financial-derivatives-advantages-disadvantages/#disadvantages-of-financial-derivatives-trading
59. Reserve Bank of Australia. (n.d.). *Bonds and the Yield Curve*. https://www.rba.gov.au/education/resources/explainers/bonds-and-the-yield-curve.html
60. Rodini, L. (2024, April 12). *A timeline of the Fed's '22–'23 rate hikes & what caused them.* https://www.thestreet.com/fed/fed-rate-hikes-2022-2023-timeline-discussion
61. Sharma, J. (2024, September 10). *What is Hedging: Types, Advantages and Disadvantages.* https://www.shiksha.com/online-courses/articles/hedging-types-advantages-and-disadvantages/
62. Signature Bank. (2018). *Annual Report, Form 10-K.* https://www.annualreports.com/HostedData/AnnualReportArchive/s/NASDAQ_SBNY_2018.pdf
63. Signature Bank. (2019). *Annual Report, Form 10-K.* https://www.annualreports.com/HostedData/AnnualReportArchive/s/NASDAQ_SBNY_2019.pdf
64. Signature Bank. (2020). *Annual Report, Form 10-K.* https://www.annualreports.com/HostedData/AnnualReportArchive/s/NASDAQ_SBNY_2020.pdf
65. Signature Bank. (2021). *Annual Report, Form 10-K.* https://www.annualreports.com/HostedData/AnnualReports/PDF/NASDAQ_SBNY_2021.pdf
66. Signature Bank. (2022). *Annual Report, Form 10-K.* https://efr.fdic.gov/fcxweb/efr/fcxservlet/PublicEfrFileDownload?instFlngId=11266&instFlngAtchId=1&fileType=instFlng
67. SVB Financial Group. (2018). *Annual Report, Form 10-K.* https://d18rn0p25nwr6d.cloudfront.net/CIK-0000719739/5ecafd8b-bb6a-48ee-a129-87794311fe9c.pdf
68. SVB Financial Group. (2019). *Annual Report, Form 10-K.* https://d18rn0p25nwr6d.cloudfront.net/CIK-0000719739/7e378d3a-e964-4a21-9209-1db147371d01.pdf
69. SVB Financial Group. (2020). *Annual Report, Form 10-K.* https://www.sec.gov/Archives/edgar/data/719739/000071973921000023/sivb-20201231.htm
70. SVB Financial Group. (2021). *Annual Report, Form 10-K.* https://www.sec.gov/Archives/edgar/data/719739/000071973922000023/sivb-20211231.htm

71. SVB Financial Group. (2022). *Annual Report, Form 10-K.* https://www.sec.gov/Archives/edgar/data/719739/000071973923000021/sivb-20221231.htm
72. Tamplin, T. (2023, June 8). *Interest Rate*. https://www.financestrategists.com/banking/interest-rate/
73. Tamplin, T. (2024, March 2). *Derivatives*. https://www.financestrategists.com/wealth-management/alternative-investment/derivatives/
74. Tepper, T. (2025, January 29). *Federal Funds Rate History 1990 to 2025. https://www.forbes.com/advisor/investing/fed-funds-rate-history/*
75. Trefethen, J. (2020, February 14). *Measuring Interest Rate Risk*. https://www.hedgestar.com/single-post/2020/02/14/measuring-interest-rate-risk#:~:text=Three%20of%20the%20more%20widely,net%20interest%20income%20simulation%20models.
76. YCharts. (2024, March 13). *The Inverted Yield Curve: What It Means and How to Navigate It.* https://get.ycharts.com/resources/blog/inverted-yield-curve-what-it-means-and-how-to-navigate-it/
77. Zawalinska, K. (1999). Asset and Liability Management: The Institutional Approach to ALM by Commercial Banks in Poland: A Special Focus on Risk Management. *CASE Network Studies and Analyses, No. 185.*

APPENDIX

Appendix 1: Slovenian summary

Naslov: Obrestno tveganje ameriških bank v letu 2023 v luči zaostrene monetarne politike FED-a

Magistrska naloga raziskuje izpostavljenost ameriških bank obrestnemu tveganju in sistemske dejavnike, ki so prispevali k ameriški bančni krizi leta 2023. Tveganje obrestnih mer se nanaša na potencialni vpliv negativnih premikov obrestnih mer na kapital, dobiček in splošno finančno stabilnost banke. Čeprav je to tveganje lahko vir dobička, če je pravilno obvladovano, pa lahko nepravilno upravljanje bankam povzroči resne finančne težave. Za merjenje in obvladovanje tega tveganja banke uporabljajo orodja, kot so t.i. gap analiza, duration analiza, earnings simulation analiza in analiza ekonomske vrednosti kapitala. Glavni strategiji za obvladovanje tveganja obrestnih mer sta prestrukturiranje bilance stanja in uporaba izvedenih finančnih instrumentov (ang. hedging). Vendar pa kompleksnost teh orodij, še posebej izvedenih finančnih instrumentov, prinaša izzive, kot so t.i. counterparty risk, visoki nepotrebni stroški in regulativne ovire.

Zaostrovanje monetarne politike ameriške centralne banke Fed, ki zvišuje ključno obrestno mero, ima ključno vlogo pri oblikovanju obrestnega tveganja za banke. V zadnjih 50 letih je bilo v ZDA sedem ciklov zaostrovanja, pri čemer je bil zadnji, ki se je začel leta 2022, najbolj agresiven doslej. Zvišanje obrestnih mer načeloma vodi v zmanjšanje neto obrestnih marž bank zaradi povečanja kratkoročnih obrestnih stroškov in izravnave krivulje donosnosti. V ciklu 2022/23 pa je prišlo do začetnega zvišanja neto obrestnih marž zaradi višjih posojilnih obrestnih mer in počasnejšega prilagajanja depozitnih obrestnih mer. Banke z močnejšimi depozitnimi bazami in strukturami financiranja so imele višje marže, medtem ko so se tiste, ki so se zanašale na sredstva iz drugih virov financiranja, spopadale z višjimi stroški in nižjimi dobički.

Bančna kriza leta 2023 je pokazala izjemno ranljivost ameriških bank na obrestno tveganje. V nasprotju z evropskimi bankami, ki so podvržene strogim stresnim testom, ameriške banke, zlasti manjše regionalne, nimajo strogega regulativnega nadzora, zato so bolj izpostavljene tveganju. K tej ranljivosti največ prispevajo šibke kapitalske zahteve, slab nadzor in različna obravnava nerealiziranih izgub v primerjavi z Evropo. V nalogi je opredeljenih pet vrst obrestnega tveganja: tveganje prevrednotenja, tveganje krivulje donosa, bazično tveganje, opcijsko tveganje in cenovno tveganje, pri čemer je tveganje prevrednotenja najpomembnejše. Razlike v zapadlosti med sredstvi in obveznostmi, t.i. maturity gap, ki so se po finančni krizi leta 2008 še povečale, so povečale izpostavljenost ameriških bank tem tveganjem.

Temeljni vzroki za bančno krizo leta 2023 segajo v čas po finančni krizi leta 2008. Fed je več let ohranjal nizke obrestne mere in izvajal kvantitativno sproščanje, zaradi česar so banke svoje portfelje preusmerile v dolgoročne naložbe z višjimi donosi. To je povzročilo vse večjo vrzel v zapadlosti in vse večjo izpostavljenost obrestnemu tveganju. Leta 2023 so se ameriške banke zaradi naraščajočih obrestnih mer soočile z 2,2 trilijona dolarjev

nerealiziranih izgub, banke kot so SVB, Signature Bank in FRB pa so zaradi visoke izpostavljenosti obrestnemu tveganju in likvidnostih težav propadle.

V nalogi sem podrobneje analizirala stresne teste in premoženjske bilance SVB, Signature Bank in FRB in ugotovila, da sta bili zlasti SVB in FRB zelo izpostavljeni tveganju obrestnih mer tako z vidika neto obrestnih prihodkov kot ekonomske vrednosti kapitala. Po drugi strani pa je bila izpostavljenost Signature Bank nekoliko nižja, zlasti ob koncu leta 2022. V zadnjih petih letih so vse tri banke doživele zelo hitro rast svojih bilančnih postavk, kar je prineslo dodatna tveganja. Poleg tega so vse tri banke imele izjemno visoke nerealizirane izgube na svojih naložbah AFS in HTM, zelo krhko strukturo depozitov s prekomerno odvisnostjo od velikih nezavarovanih depozitov ter zelo specifično skupino deponentov, ki so bili povezani s tehnološkimi in kripto industrijami. Poleg tega ni nobena od teh bank uporabljala izvedenih finančnih instrumentov za zavarovanje pred tveganji, kar je še dodatno povečalo njihovo ranljivost.

Magistrsko nalogo sem zaključila z diskusijo o tem kako je agresivno zaostrovanje denarne politike s strani Fed-a prispevalo k finančni nestabilnosti med krizo leta 2023. Zaostrovanje je oslabilo bilance bank, povečalo neusklajenost med sredstvi in obveznostmi ter povečalo tveganje bega na banke in kapitalskih izgub. Čeprav je imela denarna politika ključno vlogo, je krizo okrepilo tudi pomanjkanje učinkovite regulacije in nadzora s strani Fed-a. V nasprotju z evropskimi bankami, ki so podobne zaostritve prestale brez propada, so ameriške banke razkrile globlje sistemske ranljivosti, ki segajo prek same monetarne politike. Slednje poudarja potrebo po robustnem upravljanju tveganj s strani bank in strožjem regulativnem nadzoru nad bankami. Bančna kriza 2023 v ZDA služi kot opomin na morebitne nevarnosti agresivnega monetarnega zaostrovanja, zlasti v kombinaciji s sistemskimi pomanjkljivostmi, ki so trenutno prisotne v bančnem sistemu. Prihodnost ameriškega bančništva bo odvisna od ukrepov in politik, ki jih bo sprejela nova administracija, in njihovih zmožnosti za odpravo teh ranljivosti in krepitev regulativnih okvirov za preprečevanje prihodnjih kriz.