

Analyzing the Role of Duration Mismatch in the Collapse of Silicon Valley Bank

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Abstract: This paper focuses on the role of duration mismatch in the context of the Silicon Valley Bank (SVB) failure. The failure was one of the major banking failures that took place in the U.S. SVB used short-term liabilities to finance long-term assets—a significant duration risk for the bank, especially with rising interest rates. We look at the measures of capital, bank leverage, and solvency ratios. We also analyze the decisions made by the executives that worsened the situation. So far, we have analyzed the bank's poor risk management, particularly during periods without a chief risk officer at critical junctures. Subsequent revisions will consider other factors, including the more extensive legal framework and how SVB's external economic environment may have contributed to its collapse. The paper thus provides insights regarding the stewardship and leadership lessons around managing the risk associated with the duration gap.

Keywords: Silicon Valley Bank, Duration Mismatch, Collapse, Economy

1. Introduction

Silicon Valley Bank (SVB), the sixteenth-largest U.S. bank before its collapse, suddenly failed in March 2022. This was the largest bank failure in the U.S. since the financial crisis of 2008. SVB played a significant role in financing Silicon Valley's entrepreneurial firms, particularly in technology, bioscience, and healthcare. During the COVID-19 pandemic, SVB thrived along with the technology boom and was rated by Forbes as one of the most promising banks [1]. It invested its large deposits in long-term bonds; however, the price decreases in the bond markets, causing SVB significant unrealized losses, which led to a loss of confidence in SVB's solvency, resulting in a bank run.

Following SVB's collapse, regional banks in the U.S. were significantly impacted, and the U.S. financial market experienced severe turmoil. Around the same time, Signature Bank and Silver Gate Bank also announced their downfalls, further unsettling the financial market.

Current research analyzing the causes of SVB's collapse mainly focuses on poor management of solvency and interest rate risks or the lack of supervisory standards for emerging risks. However, we

aim to examine a more fundamental cause—duration mismatch—which occurs when financial institutions hold instruments of varying durations on their asset and liability sides. In the banking sector, institutions often exploit duration mismatch by borrowing cheaply and investing in higher-yield assets to boost profits. However, this practice makes them vulnerable when interest rates rise.

The first section of our paper analyzes the duration mismatch in SVB's failure. We address questions such as: What specific path did the duration mismatch follow to cause SVB's failure? What financial data can be used as evidence? And what are the connections between these data? The second section examines financial ratios, from the capital adequacy ratio and the leverage ratio to economic value equity and the solvency ratio. Then, the paper explores the executive's incentives, starting with the compensation and personal interests of the chief executive officer, the responsibilities of the chief risk officer, and how human greed played a role in SVB's bankruptcy.

2. Duration mismatch analysis

2.1. Definition of duration mismatch

The duration gap is an important metric for accounts under risk management. It determines how much interest rate movements will affect a bank's equity by measuring the difference between the duration of its assets and that of its liabilities. The primary reason SVB collapsed in March 2023 was the duration mismatch.

SVB had most of its assets in long-term fixed-rate investment, which included the U.S. Treasury bonds and mortgage-backed securities. At the end of 2022, SVB held approximately \$117 billion in long-term securities, which made up 55% of its total assets of \$212 billion [2]. Among these long-term securities, \$82.7 billion were residential mortgage-backed securities with an average maturity duration of 5.7 years [3]. On the liabilities side, SVB relied mostly on short-term deposits, practically having considerably shorter durations, disrupting the setup of an unhealthy duration gap. As a major part of SVB's liabilities were short-term, the duration gap was estimated to be 3 to 4 years by Golding and Lucas [4]. Since March 2022, the Federal Reserve has implemented aggressive interest rate hikes, marking the largest increase in nearly 5 years [5]. The value of long-term bonds in SVB's investment portfolio started to decrease in 2022 as interest rates rose. Nonetheless, this reduction directly hurt the bank's net asset base because the value of its deposit obligations stayed stable. The bank was forced to sell off some of these investments at a loss and declare it, which is when these losses were made public in March 2023. It is crucial to look at the external interest rate risk as well as the portfolio mix in order to properly assess the duration mismatch.

2.2. Identification of duration mismatch risks

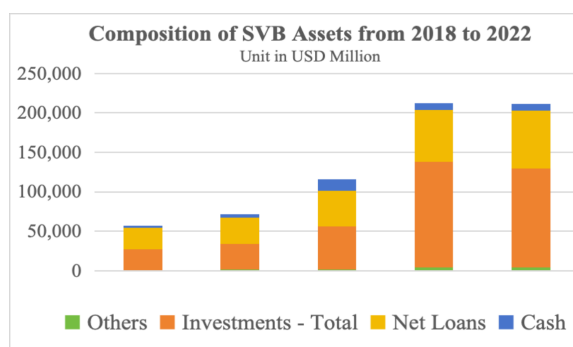


Figure 1. The composition of SVB assets from 2018 to 2022 [2]

Based on Figure 1, SVB's deposits have more than tripled from more than \$60 billion to nearly \$190 billion in 2020 and 2021. But SVB used nearly two-thirds of the \$130 billion in new deposits in the past two years have been used for investment.

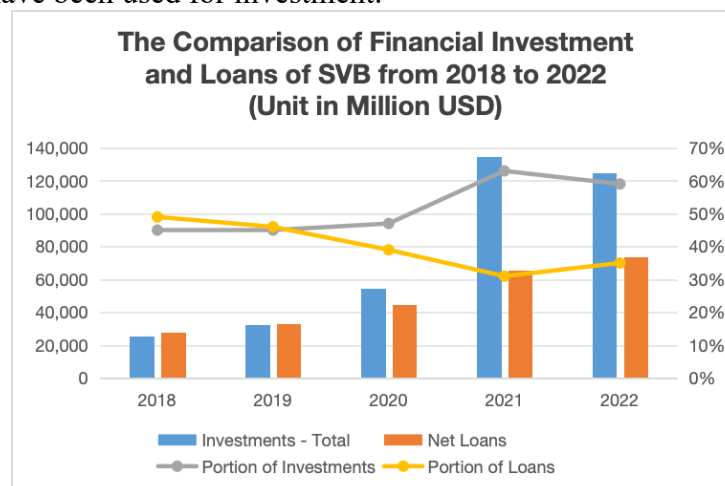


Figure 2. The comparison of financial investment and loans of SVB from 2018 to 2022 [2]

Figure 2 suggests that the total amount of financial investment has increased year by year from a low level in 2018, reaching approximately \$140 billion in 2022 and accounting for more than 70% of total assets [2]. Since interest rates were cut in 2020, SVB purchased large amounts of long-term bonds in pursuit of interest income. As can be seen from the balance sheet, SVB's long-term investments have grown from \$50 billion in 2020 to \$120 billion in 2022, indicating the longer maturity of assets. The total amount of net loans declined after 2018, and its proportion in 2022 will be significantly lower than the proportion of financial investment during the same year. This may lead to Borrowing-Short and Lending-Long, causing duration mismatch.

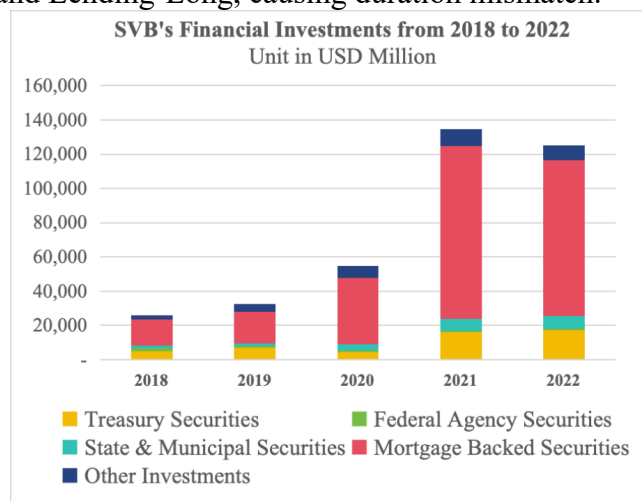


Figure 3. The composition of SVB's financial investments from 2018 to 2022 [2]

As we can see in Figure 3, SVB invested in long-term fixed income such as Treasury Securities, Federal Agency Securities, and State & Municipal Securities. At the same time, SVB invested a large amount in Mortgage-Backed Securities, which has negative convexity. Therefore, the risk of the investment portfolio continues to rise with the Fed's interest rate hike policy. When risks became greater and losses were severe, the senior manager did not conduct corresponding hedging and

ultimately lost \$15 billion in 2022. However, the profit in the past thirty years was about \$10 billion. In 2022, due to mistakes in investment decisions, all profits were lost.

2.3. Impact of interest rate volatility

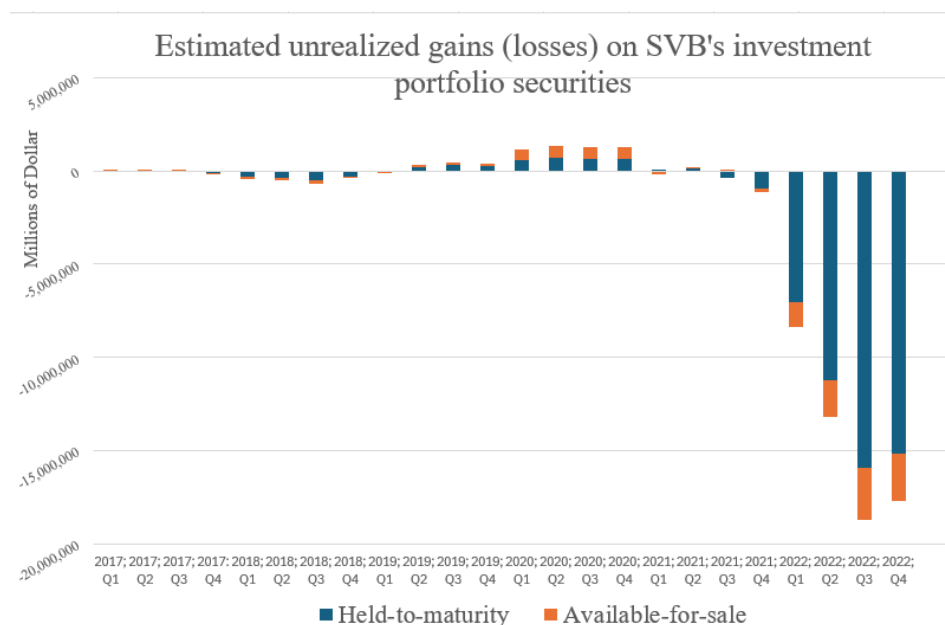


Figure 4. Estimated unrealized gains (Losses) on SVB's investment portfolio securities from 2017 Q1 to 2022 Q4 (FR Y-9C/FRED, 2023)

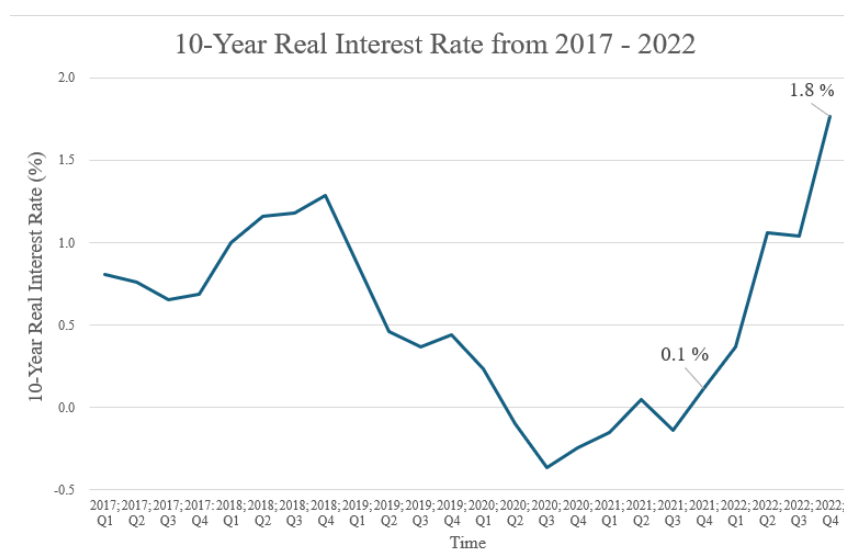


Figure 5. 10-year real interest rate from 2017 Q1 to 2022 Q4 (Federal Reserve Economics Department, 2023)

From the analysis of both Figure 4 and Figure 5, it is clear that the increase in interest rates has a direct impact on increasing duration mismatches. Figure 4 shows the estimated unrealized gains and

losses¹ on SVB's held-to-maturity (HTM) and available-for-sale (AFS) investment portfolio securities in the time scale provided (2017 Q1 to 2024 Q4). The reduction in unrealized gains, mainly in HTM securities from the last quarter of 2022, is a clear indication of the markdown of long-term investment due to the increase in interest rates. Unrealized losses are estimated as the difference between fair value and the amortized cost for HTM and AFS securities. At the end of the year 2022, the estimated losses that were unrealized on the HTM securities were around \$15 billion, pointing out a highly declining value of SVB's long-term investments. Figure 5 complements this analysis by showing the sharp rise in real interest rates, particularly during 2022. From approximately 0.1% recorded in the first quarter of 2022 to 1.8% in the fourth quarter, the real interest rate for the 10-year bond exhibited a more restrictive monetary landscape. The increment in interest rates reduced the market price of SVB's fixed-income assets and escalated the unrealized losses. The incident shows how necessary it is to manage the duration gap that measures the difference between the time needed to recover the value of assets and the time needed to eliminate the obligations to pay creditors. But SVB managed to obscure these losses by not recording the changes in the value of its bond assets on its balance sheet, using a method known as held-to-maturity accounting, which allows institutions to avoid marking certain assets to market and eventually end up with bankruptcy, a more detailed analysis is introduced in Section 4. In the appendix section, we will analyze a successful comparison of how GSEs deal with duration mismatch and interest risk.

2.4. Risk mitigation strategies SVB could have taken

The tragedy of SVB falling could be prevented in three perspectives, strategies are introduced.

2.4.1. Diversification and flexibility in adjusting the percentage of bonds in the three classifications

Under IFRS 9², the following measurement levels should be used to assess debt instrument investments: (1) amortized cost, (2) FVOCI³ (with subsequent reclassification to profit or loss) (3) FVTPL⁴, regardless of the legal form, based on the entity's business strategy for the management of assets and the cash flows inherent in the instrument [6].

Amortized cost is calculated using the effective interest rate method. This method recognizes interest income based on the effective interest rate of the financial asset over its expected life. To illustrate, if a company has a loan with a fixed interest rate, it would be categorized as an amortized cost asset if it fulfills the aforementioned criteria. Under the FVOCI classification, gains and losses are recognized in other comprehensive income (OCI) until the financial asset is sold or impaired. For example, if a company holds a bond with a fixed interest rate and intends to hold it until its maturity but also has the option to sell it, it would be classified as an FVOCI asset. Under the FVTPL classification, any gains or losses are recognized in the profit and loss account, with no option for recognition in OCI. Financial assets that are held for trade or that don't fit into the FVOCI or amortized cost classification categories fall into this category [7].

Based on the above illustration of asset categorization, we can see that in terms of liquidity, $FVTPL > FVOCI > AC$, and the opposite is true for return stability and capital consumption.

¹ The estimated unrealized losses on securities here calculated as: (held-to-maturity fair value less held-to-maturity amortized cost) + (available-for-sale fair value less available-for-sale amortized cost)

² IFRS 9 is an accounting standard that provides guidance on the ways to quantify and categorize financial obligations, assets, and certain contracts for the purchase or sale of non-financial goods. It also covers impairment and hedge accounting.

³ FVOCI is fair value through other comprehensive income.

⁴ FVTPL is fair value through profit or loss.

Table 1. The AFS securities and HTM securities in SVB from 2019 to 2022 (unit in million USD)
[8,9]

	2019	2020	2021	2022
Average AFS securities (\$ Million)	9,597	18,652	24,996	28,795
Average HTM securities (\$ Million)	14,672	13,113	58,030	95,394

However, we can look at Table 1 and see that SVB has a relatively large investment in HTM-type bonds (according to IAS39, the classification of financial assets contains HTM category, and financial assets classified as HTM or LAR are measured at amortized cost) suggests that most of the bonds SVB invests in are less liquid and more prone to maturity mismatches.

Although SVB has low credit risk and low valuation volatility in investing in long-term bonds, the asset class is illiquid. Therefore, when making investment decisions, it is important to ensure stability of returns as well as a certain level of liquidity.

When determining the proportion of the three classifications of financial assets, it is necessary to consider various factors such as capital adequacy ratio, risk appetite and liquidity indicators. For example, in the case of poor liquidity, the proportion of FVTPL assets can be adjusted upward to hedge the corresponding maturity mismatch risk; in the pursuit of yield and stability, the proportion of AC assets can be adjusted upward.

2.4.2. Focus on liability structure

SVB Bank as a whole adopts a “short-term borrowing and long-term lending” model. According to SVB’s balance sheet, short-term borrowings on the liability side account for a relatively low percentage, while long-term debts on the asset side account for a relatively high percentage. When short-term interest rates rise, the cost of short-term borrowings on the liability side increases, while the return on long-term loans cannot cover the cost of borrowing, which leads to interest rate risk; at the same time, short-term borrowings on the liability side need to be repaid in a short period of time, and long-term assets cannot be realized in a timely manner, which in turn leads to liquidity risk. long-term assets cannot be realized in time, which in turn will lead to liquidity risk.

Therefore, in terms of asset allocation, we still need to consider the maturity structure of the liability side, the cost of liabilities, and other factors to rationalize the arrangement of investment types.

2.4.3. Risk hedging through interest rate swaps

SVB does not have any hedging operations for the interest rate risk exposure exposed to long-term bonds, and Interest rate swaps are one of the tools to effectively hedge interest rate risk.

An interest rate swap is a contractual agreement between two parties that exchanges one series of interest payments for another over a specified period of time. Derivative contracts, which are traded over the counter, are known as swaps. The most traded and liquid interest rate swaps include the exchange of fixed-rate payments for floating-rate payments based on the supported Overnight Financing Rate (SOFR), a broad indicator of the cost of borrowing money overnight backed by US Treasury assets. The term “plain vanilla” swaps alludes to them. While there are many different forms of interest rate swaps available, such as switching one floating rate for another, plain vanilla swaps constitute the majority of the market [10].

The principle of how a swap works could be explained as follows: when two firms have opposite interest rate risk exposures, a swap can be arranged. In a standard swap, the companies agree to swap a portion of their interest payments, sometimes through the use of an intermediary. Because one

company pays a fixed rate and the other pays a fluctuating rate based on their needs, each company is able to better control the interest rate risks associated with their separate businesses.

In essence, a company with floating-rate obligations assumes a portion of the interest payments made by a company with fixed-rate liabilities and vice versa. In exchange for a floating-rate payment of 50 basis points above the 3-month Treasury bill (T-bill) rate on the same principle, a company with liabilities whose interest rates fluctuate in line with the 3-month T-bill rate could agree to pay another company a fixed rate of 12 percent on an agreed-upon dollar amount (principal). In practice, one business changes the basis for interest payments on its liabilities from fixed to floating rates, while the other business changes the basis from fixed to floating rates [11]. The use of swap rates to SVB in a previous manner illustrates the effectiveness of swap rates in mitigating interest rate risk.

3. Financial ratio analysis

Financial ratios are crucial for assessing a company's financial health and critical solvency indicators for banks. This part focuses on SVB and examines how specific financial ratios reveal essential aspects of the bank's financial stability.

3.1. Capital Adequacy Ratio (CAR)

The most straightforward solvency measure is the Capital Adequacy Ratio (CAR). It tells us how well a bank can satisfy its obligations by comparing its capital and the risk-weighted assets on its books. Regulators tend to pay a lot of attention to a bank's CAR, and if the ratio is too low, it heightens the public's anxiety that the bank might fail.

The CAR Formula is:

$$\text{The Capital Adequacy Ratio (CAR)} = \frac{\text{Tier 1 Capital}^5 + \text{Tier 2 Capital}^6}{\text{Risk Weighted Assets}} \quad (1)$$

Risk-weighted assets indicate the minimum amount of capital a bank or other institution must hold to insure itself against insolvency.

The minimal CAR can show if certain banks have sufficient capital to withstand a fair level of damage should they go insolvent and lose depositor money as a result. As a result, CAR plays a vital role in safeguarding depositors and advancing the stability and effectiveness of financial institutions around the globe [12].

CAR significantly correlates positively with the Tier 1 risk-based Capital Ratio, which is 15.4% higher than the industry benchmark of 8.5% [13]. This indicates that SVB has a much stronger capital cushion than the general banking average. A higher tier-1 capital ratio means that SVB was better at absorbing potential losses. From this perspective, it can well reflect its financial strength.

3.2. Leverage ratio

A leverage ratio is any economic ratio that measures the amount of debt the bank entity has accrued as a ratio with respect to any other accounts in the balance sheet, income statement, or cash flow statements. These ratios indicate how the bank's assets and business operations are financed (using debt or equity). Below is an example of two common leverage ratios for banks:

1. Deposit/equity ratio
2. Deposit/capital ratio

⁵ Tier-1 capital consists of equity capital, ordinary share capital, intangible assets and audited revenue reserves. They are easily available to absorb the losses.

⁶ Tier-2 capital comprises unaudited retained earnings, unaudited reserves, and general loss reserves. It's used once the Tier-1 capital is all lost.

Banks are among the most leveraged institutions in the United States. Generally, banks that experience rapid growth or face operational or financial difficulties must maintain higher leverage ratios.

From 2019 to 2022, its leverage ratios increased from 7.30% to 7.96 % over the same time period, compared to the industry's average of 8.98 %, suggesting the bank leverages less in equity capital [14]. However, despite having a low equity capital ratio, its total risk-based capital is substantially higher than the average for the industry as (1) it holds a higher percentage of U S government securities, which tend to involve lower credit risk than investments in loans and leases, and a smaller proportion of loans/leases; (2) the bank has had its assets with low credit risks. Moreover, the bank's capital ratios exceed the required ratios set by the U.S. government under Basel III.9. This resulted in the bank being classified as "well capitalized" for multiple years by the U.S. banking regulators.

3.3. Economic value equity (EVE)

The economic value of equity (EVE) is a long-term economic measure/indicator of net cash flow. Through long-term monitoring, the EVE indicator seeks to assist bankers in managing their assets and obligations more effectively. It aids in figuring out the net present value of a bank or other financial organization. It is also employed in the evaluation of risk exposure, particularly interest rate risk. The present value of all asset cash flows is taken into account while calculating EVE, and the present value of all liabilities cash flows is subtracted.

The formula for the EVE is as follows:

$$\Delta \text{Economic Value} = \Delta \text{Present Value of Assets}^7 - \Delta \text{Present Value of Liabilities}^8 \quad (2)$$

EVE measures the rate-sensitivity, or duration, of a bank's capital; it quantifies the amount that would be lost due to a particular change in interest rates. Specific Economic Value of Equity figures for Silicon Valley banks are not usually disclosed directly in public earnings reports. However, we can still look at it from the interest rate perspective. At the time of SVB's collapse, a +200 basis-point rate shock was accompanied by over \$5.4 billion expected reduction in EVE, a still relatively small portion of the bank's Tier 1 capital [15]. This exposure stems from their long-term, low-yield loans, such as mortgage-backed securities (MBS), where the bank's value was significantly affected in a rising rate environment. SVB's durations of assets and funding were considerably out of line, forcing the bank into high levels of unrealized losses realized when the bank had to sell these positions in times of a liquidity crunch.

3.4. Solvency ratio

The solvency ratio is a comprehensive measure of solvency because it measures a company's actual cash flow. It assesses a company's viability by adding back depreciation and other non-cash expenses. It measures cash flow capacity against all liabilities, not just short-term debt.

The main formula for calculating the solvency ratio is as follows:

$$\text{Solvency Ratio} = \frac{(\text{Net Income} + \text{Depreciation})}{\text{All Liabilities (Short Term} + \text{Long Term Liabilities)}} \quad (3)$$

The solvency ratio of 12% for SVB refers to the capability of meeting long-term liabilities in the year 2022, which was lower than the modal industry value of 15% [16]. Specifically, it shows a lower

⁷ Present Value of Assets: The current worth of SVB's future asset cash flows, discounted at a specific rate (often reflecting the risk or opportunity cost of holding those assets).

⁸ Present Value of Liabilities: The current worth of an SVB's future obligations or debts, also discounted to reflect their value today.

solvency ratio, reflecting the bank's reduced capacity to absorb potential shocks within the financial sector. Due to the emergence of the banking crisis, SVB has weakened CAR and has a higher sensitivity to the change in EVE, making the bank's financial position vulnerable and constraining its ability to operate effectively in the banking sector.

4. Executive management failure

4.1. SVB's profitability and duration mismatch

4.1.1. Exploring the specifics of SVB's profitability

To further explore the specific factors behind SVB's high payroll that led to its bankruptcy, we first explored SVB's earnings further.

According to research, banks that demonstrate greater revenue diversification and enhanced operational efficiency tend to exhibit superior profitability, irrespective of the profitability metric employed, whether it be return on assets (ROA) or the rate of return on equity (ROE) ^[17]. ROE is one of the main benchmarks in assessing the financial health of a company. ROE shows how effective the bank is in generating profits from the capital invested by shareholders [18]. Therefore, this part of the study analyzes the profitability of SVB Bank using SVB's ROE data, as well as using the DuPont analysis formula:

$$ROE = ROA \times Financial\ Leverage^9 \quad (4)$$

ROA is utilized to aid in the analysis of the causes of trends in ROE.

According to DuPont analysis, the growth of ROE mainly depends on the change of ROA.

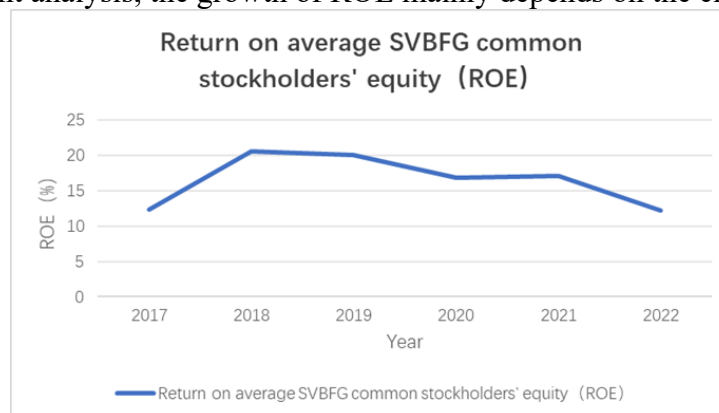


Figure 6. Current and historical return on equity (ROE) values for SVB financial group [2,8,9]

⁹ Financial Leverage: the use of borrowed funds (debt) to amplify the potential return on equity (ROE). It measures the proportion of a company's assets that are financed by debt, rather than equity, which increases the company's exposure to risk.

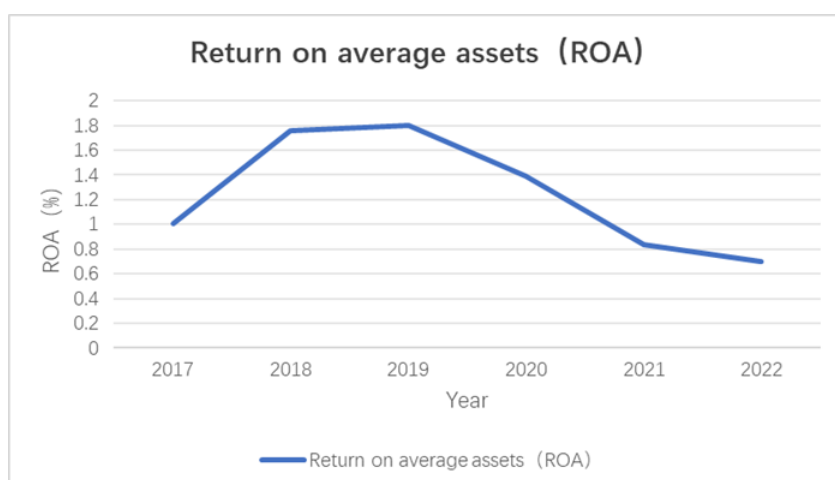


Figure 7. Current and historical return on assets (ROA) values for SVB financial group [2,8,9]

According to Figure 6 and Figure 7, the ROE of SVB at the end of 2017 was relatively low at 12.38%, but by the end of 2018, SVB's ROE had leaped to 20.57%, more than 20%, which is almost double or so, which is a very fast growth rate as the ROA has also reached 1.8%, which makes SVB Significantly profitable.

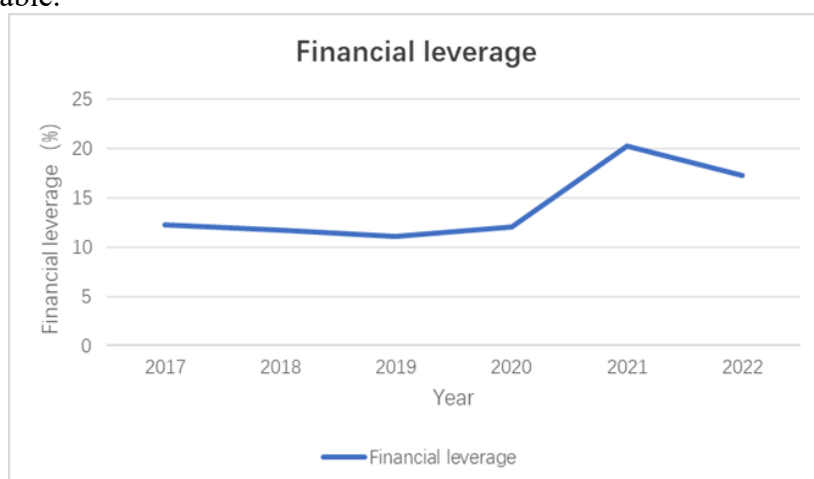


Figure 8. Current and historical debt to equity ratio values for SVB financial group [2,8,9]

However, bonuses are also increasing significantly, according to Figure 8. It shows that SVB's leverage has decreased by 1.2% from 2017 to 2019. After SVB's ROE reaches 17.1% at the end of 2021, SVB's ROE drops dramatically and reaches as low as 12.1% at the end of 2022, thus leading to the lack of profitability of the SVB bank and ultimately to insolvency.

Therefore, based on the above data analysis, it is summarized that the overall SVB salary is significantly decreasing after a substantial overall increase from 2017 to 2022, with a wide range of fluctuations.

4.1.2. Exploring the relationship between the trend of high ROE and maturity mismatch

Secondly, in order to explore the relationship between the trend of high ROE and maturity mismatch, we analyzed the data of short-term borrowings and long-term debt in SVB's financial statements from 2017 to 2022. The following is an extract of the data related to SVB's financial statements from 2017 to 2022.

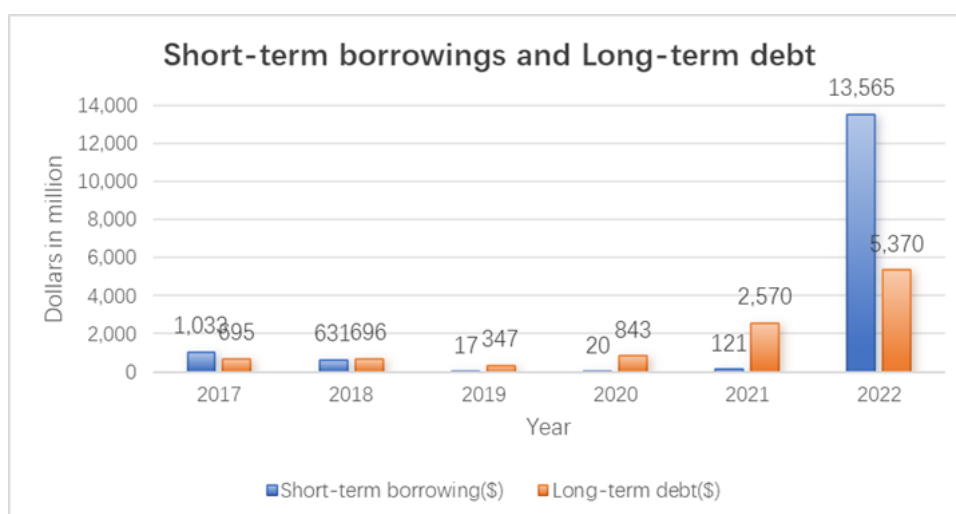


Figure 9. Short-term borrowings and long-term debt from the financial statement of SVB [2,8,9]

Based on Figure 9, SVB was mainly dominated by short-term assets in its asset allocation in 2017, and between 2018 and 2021, long-term loans exceeded short-term borrowings, and long-term loans increased year-on-year after 2019, with the gap between the number of short-term borrowings gradually increasing, and the overall investment in long-term loans dominated. In 2021 long-term loans are about 21 times higher than short-term borrowings, and long-term loans are over-represented. After 2022, the number of short-term borrowings surged to approximately 112 times the number of short-term borrowings in the previous year, and the number far exceeded the current long-term loans, resulting in a serious maturity mismatch.

According to the analysis of the above data, SVB Bank chose to allocate a significant amount of short-term borrowing to long-term loans in pursuit of higher yields after 2017 due to the relatively low U.S. federal interest rates and the longer maturity of long-term loans with higher yields. However, in reaction to historically high US inflation after the COVID-19 epidemic, the Federal Reserve commenced an incremental increase in its policy rate on 17 March 2022 [19]. The value of the large number of long-term bonds that SVB had previously allocated declined dramatically, and it was forced to augment its liquidity by pledging the bonds as collateral, creating a severe maturity mismatch that ultimately led to the bank's insolvency.

Therefore, based on the combined analysis of the above two parts, the main factor leading to SVB Bank's maturity mismatch is SVB's excessive pursuit of high yield and high ROE since 2017 and the pursuit of high salary for the purpose of maximizing personal interests, which has led to an inappropriate asset allocation and an inability to respond to the market changes in a timely manner, resulting in a serious maturity mismatch after 2022.

4.2. Chief risk officer responsibility

4.2.1. The role of Chief Risk Officer

Chief Risk Officers (CROs) are responsible for assessing and mitigating significant challenges associated with competition, regulations, and digital developments. The chief risk officer's primary duties include developing group risk management plans and strategies, suggesting policies and procedures, overseeing their implementation, creating organizations and standards for risk management evaluation, and planning and implementing the development of internal control and risk management systems. Relevant actions include setting up the risk director's evaluation and the risk management team, evaluating the company's macro risks and the group's external environment,

offering suggestions on risks that are present in the environment, strategy, and operations of the business, and routinely reporting to the board of directors.

Risk officers typically focus on identifying, anticipating, and managing the various risks a company may face, including regulatory, operational, competitive, or other business-related risks. At SVB, the Chief Risk Officer (CRO) reports directly to the "Risk Committee," a panel that oversees the company's risk management framework. The committee consists of key figures, including the chairs of the SVB Board of Directors and all board committees, as well as the CEO. The committee's role is not limited to overseeing risk management; They are tasked with making key decisions, such as hiring, performance reviews, and possibly firing the CRO. As of 2023, the committee consists of seven distinguished members who together guide the bank's risk strategy during critical periods [2].

4.2.2. Risk management in silicon valley bank

U.S. federal regulations require financial institutions that manage \$50 billion or more in assets to establish a chief risk officer. SVB managed more than \$200 billion in assets before its collapse. However, it went eight months without a Chief Risk Officer. Laura Izurieta resigned as SVB Financial Group Chief Risk Officer (CRO) in April 2022 and officially left in October of the same year, as detailed in SVB's proxy filing. It was not until January 2023 that the bank appointed Kim Olson to the position of CRO. This left SVB without any formal chief risk officer during this period, especially during a time when venture capital markets were experiencing significant volatility. The lack of a risk chief at such a critical time may be one reason why the bank is facing increasing difficulties [2]. During this period, the Fed raised interest rates 11 times in a row, with a cumulative rate of increase of 525 basis points. The Fed maintained its target range for the federal funds rate at 5.25% to 5.5%, the highest level since 1997. The absence of the chief risk officer directly led to the collapse of SVB.

Liquidity tightened in 2022, SVB's main customers (technology start-ups) declined rapidly, and they needed to continue to withdraw funds from SVB. SVB's bank deposits fell from \$200 billion to \$175 billion in 2022. SVB suffers from over-concentration problems in both its client and investment sectors. Customer concentration is high, behavior patterns converge, and liability stability is poor. This high degree of concentration exposes Major deficiencies in bank risk management.

Under the pressure of low investment returns and the continuous loss of deposits, SVB issued a document on March 8, 2023, publicly stating that it would sell the AFS Sale Size worth \$21 billion so that they could realize a total loss of \$1.8 billion. And also announced the issuance of new shares and preferred shares to raise \$2.25 billion, causing panic in the market. On March 9, Silicon Valley entrepreneurs simultaneously withdrew deposits from SVB. In one day, 42 billion U.S. dollars were withdrawn from the Bank (about 1/4 of the bank's deposits), resulting in a bank run. This is a result of CRO's misjudgment of the market environment, which accelerated market panic and intensified bank runs.

4.3. Comparison with GSEs' management of duration gaps

The problems that SVB had due to the duration gap between its long-term assets and short-term liabilities are not new in the financial history. In the 1980s and 1990s, government-sponsored enterprises (GSEs), for example, Fanny Mae and Freddie Mac, were not exempted from such challenges. The GSEs mainly held long-term mortgage exposures with a balance sheet funded by short-term liabilities. As shown in Figure 10, the interest rates decreased dramatically from 6% to 1% during the early 2000s; GSEs also faced a duration of their mortgage assets shortened more rapidly than the duration of their debt because of the interest rate risk and combined with higher-than-expected mortgage prepayments.

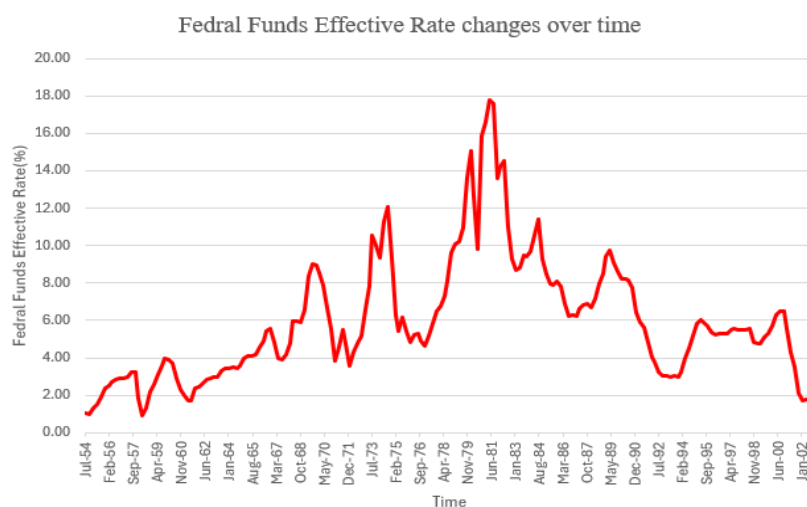


Figure 10. Federal funds effective rate changes over time [20]¹⁰

According to Figure 11, to mitigate these risks, the GSEs adopted voluntary reforms in 2000, which included the regular disclosure of duration gaps. This practice minimizes the company's exposure to interest rate risks and avoids the typical huge market risk that Fannie Mae faced when it had a 14-month gap duration as of 31st August 2002 [21]. To respond to this misalignment, Fannie Mae also strategically engaged in the following forms of rebalancing: acquiring long-term fixed-rate mortgage-backed securities and repaying long-term outstanding securities as they traded in option-based derivatives [20]. These strategies increased the duration times of its mortgage assets and managed its unfavorable duration deficit. At the end of 2022, Fannie Mae achieved a duration gap of -5 months, proofing the success of its strategies in managing risk against interest rate changes [22].

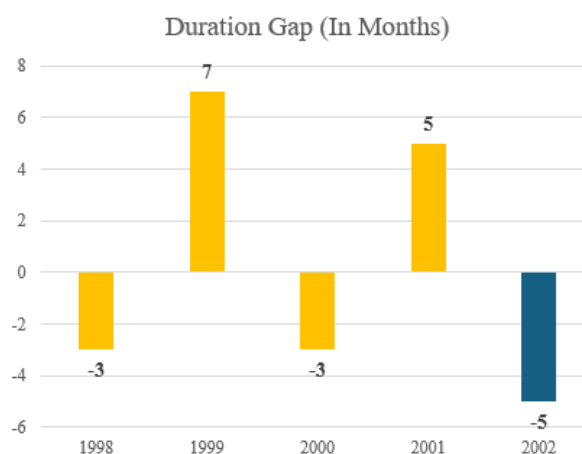


Figure 11. Fannie Mae duration gaps [22]¹¹

This foresighted management in duration mismatch is exemplified by evaluating and releasing on-time information always to the public as well as managing the duration gap in a bid to avoid high risk from interest rate changes.

¹⁰ The federal funds market consists of domestic unsecured borrowings in U.S. dollars by depository institutions from other depository institutions and certain other entities, primarily government-sponsored enterprises.

¹¹ Fannie Mae's duration gap is a measure of the difference between the duration of its assets and liabilities

5. Lessons for the banking sector: human error

5.1. Compensation structure

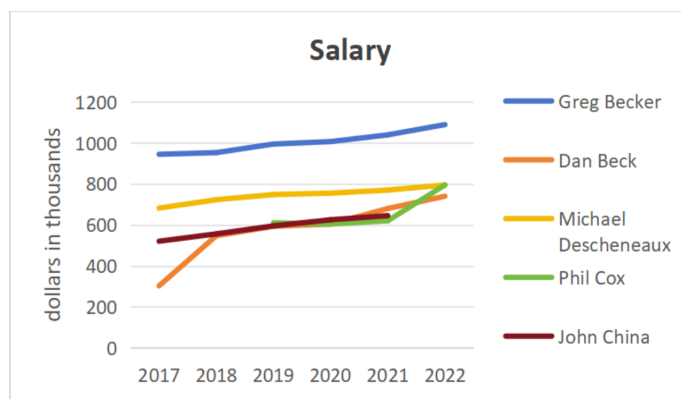


Figure 12. The salary of SVB NEOs from 2017 to 2022 [8]

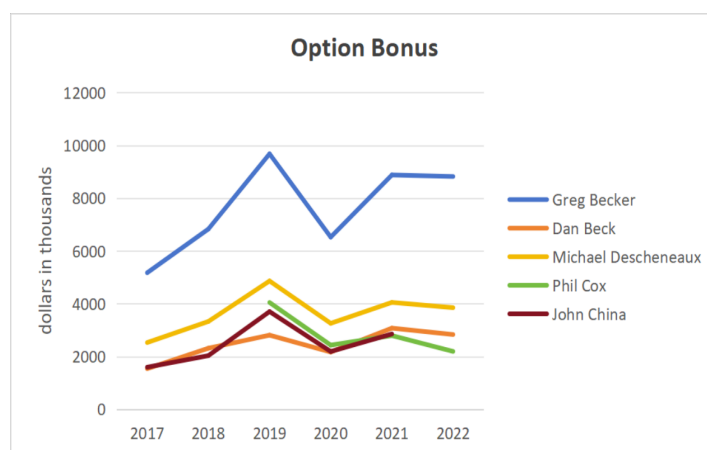


Figure 13. The option bonus of SVB NEOs from 2017 to 2022 ¹²[8]

Figure 12 and Figure 13 show that the salaries of SVB's NEOs have gradually increased over the past six years and the bonuses earned by all of them have generally been on an upward trend (except for the year 2020). Although SVB marked a strong reversal with share price in 2022 falling by 66% (from \$682 to \$224). The CEO's total compensation has remained relatively stable (at a high income). This suggests that the pay structure may not fully reflect the company's actual performance and market changes. This can cause them to ignore the risks to the company.

5.2. The impact of compensation structure on risk taking

SVB's corporate STIP score in 2022 was determined entirely by ROE—2/3 absolute and 1/3 compared to peers—with a component based on individual performance indicators that was not provided. Additionally, 50% of the PSU (Performance Share Unit) performance multiplier was calculated using relative ROE. The yearly incentive payouts to executives are directly linked to SVB's ROE performance, according to the Company's CD&A. Therefore, CEOs may choose to implement

¹² Greg Becker, as President and Chief Executive Officer, led the overall strategic direction of the bank. Dan Beck served as Chief Financial Officer, managing the bank's financial health and strategy. Michael Descheneaux, the President of SVB, was responsible for overseeing the bank's operations. John China, Head of Technology Banking, spearheaded the bank's focus on technology clients, while Michael Dreyer, as Chief Operations Officer, handled the bank's internal operations and infrastructure management.

aggressive investment strategies in order to boost ROE as a result of the performance-oriented incentive structure. Executives made a number of long-term investments to increase ROE in order to receive higher compensation. Executives could disregard the possibility of a temporal mismatch as a result.

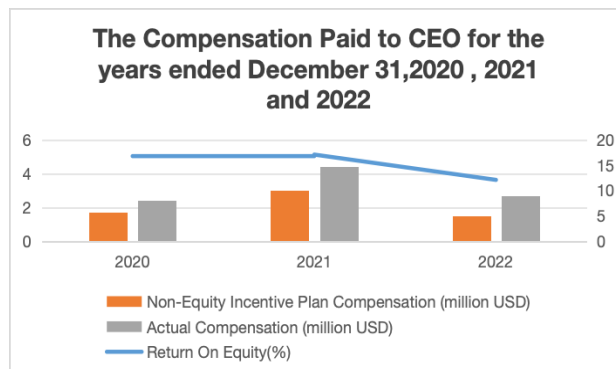


Figure 14. The figure sets the compensation paid to the CEO (Greg Becker) for the years ended December 31, 2022, 2021, and 2020 [8].

Figure 14 highlights the considerable volatility in the CEO's actual compensation over recent years, demonstrating how it closely mirrored fluctuations in SVB's stock performance. Specifically, the stock saw a 75% surge in 2021, followed by a steep 66% drop in 2022. This pattern underscores how the CEO's bonus structure was directly tied to the company's Return on Equity (ROE), which significantly influenced his annual earnings. Despite the substantial drop in stock value, the CEO's total compensation remained relatively steady, largely due to adjustments in the structure of his pay package.

In calculating the CEO's 2022 bonus, several factors were taken into consideration. While the corporate score was recorded at 92% in 2022, it had been a much higher 178% in 2021. This led to a reduction in the CEO's bonus payout, which fell to 68% of the target, compared to a much higher 190% of the target the previous year. A closer look at the numbers shows that despite this 24% reduction in his bonus for 2022, his overall compensation remained stable. This was due to two significant factors: first, an increase in the CEO's target compensation from \$8 million to \$11 million, and second, a reallocation of his pay mix, which increased his long-term incentives from 67% to 71%. This shift encouraged the CEO to prioritize long-term investments, such as the acquisition of long-term bonds, to boost the bank's earnings. Ultimately, this strategy was aimed at offsetting short-term market challenges [8][9].

6. Conclusion

The failure of Silicon Valley Bank demonstrates a high level of risks that accrue with duration mismatching risk in banking and the consequences of poor risk management together with high leverage. SVB used short-term liabilities to buy long-term fixed assets which exposed the bank to risks, including the recent Federal Reserve rate hikes in 2022. The absence of effective hedging and the absence of a Chief Risk Officer aggravated the weakness of the bank during this period. This case well demonstrates that, while pursuing the increased duration gap as a measure for shifting the risk, it is crucial to keep the balance and establish effective measures for managing the related risks and preventing the financial system from shocks. In the future, it is necessary for banks to reconsider the possibilities of the connections between asset and liability management and many other external factors that could violate the stability of management; also, consider providing the corresponding executive management teams with pertinent experiences for coping with complicated financial scenes.

The implications of this paper hold that while there may have been explanations for the banking crises, future occurrences should be avoided by rigorous regulatory control and sound risk management processes.

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