SVB Failures: Liquidity Stress Test and Interest Rate Risk Analysis

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The collapse of Silicon Valley Bank (SVB) can mainly be boiled down to two reasons: Liquidity Risk and Interest Rate Risk. Why did the SVB bank run happen? That is because the depositors had lost confidence in the bank and were worried that they would not be able to get all their deposits back. Where did this concern come from? Why didn't the public trust SVB any more? Data helped us unveil the truth of the failure in SVB.

Bank Liquidity Stress Test

According to the excellent article written by Professor Stephen Cecchetti, the SVB collapse can be sensed before the crisis happened if regulators did some simple stress tests on the bank's leverage ratio. I very much agree with this conclusion and decided to conduct further analysis based on the stress test models to see if we as investors can filter out those banks that need to be vigilant.

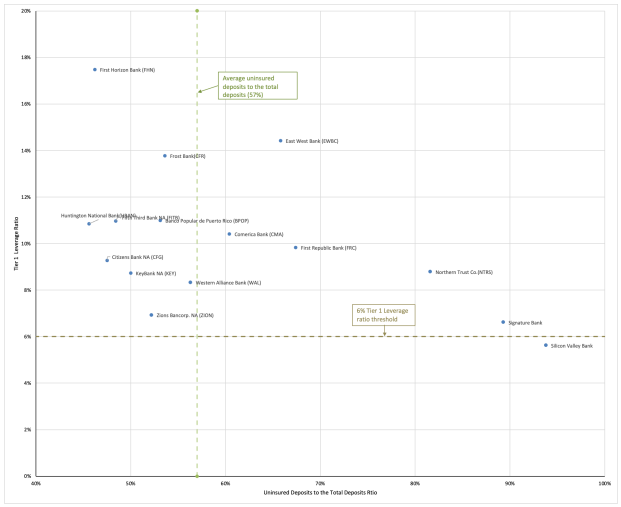
Similarly, we also used NYU Stern V-Lab's SRISK, the expected capital shortfall for financial firms in a systemic crisis, to run the simple stress test on publicly-traded medium-sized U.S. banks at the end of 2022. The approximate market decline was 40% within the 6 months during the financial crisis of 2007-2009 and that during the Covid period was 10%.

As the article says, we can sense whether a bank has sufficient capital based on the stressed leverage ratio. Apart from this indicator, the proportion of uninsured deposits to the total deposits should also be noticed as the larger this ratio, the higher probability that the bank run will happen. The FDIC defines uninsured deposits as any amount over the $250,000 limit. That is, if the depositor's account exceeds $250,000, the FDIC will only protect that amount, and the excess will not be compensated.

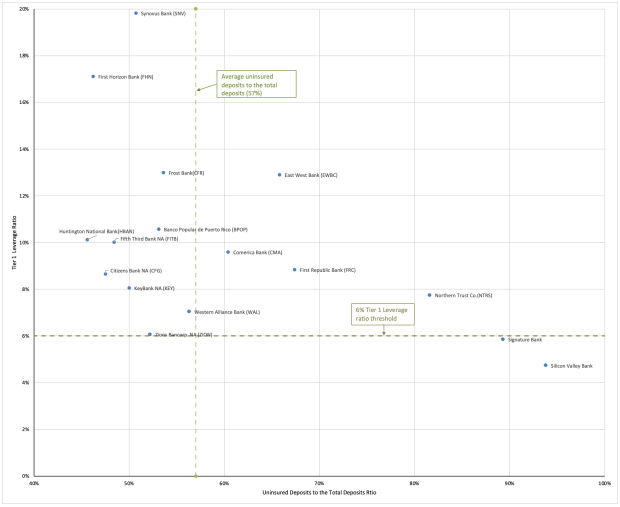
In order to judge whether banks have sufficient capital to repay debts, undertake losses, and resist risks in the dismal outlook, we add the impact of the huge market downturn on the bank's leverage ratio. The stressed leverage ratio is calculated by the bank's Tier 1 capital minus SRISK to its 2022 book value of total assets, which is different from the one defined in this article.

A scatter plot was used to screen the questionable banks grounded on two dimensions: stressed leverage ratio and the proportion of uninsured deposits. Here, the horizontal axis is the share of uninsured deposits to the total deposits and the vertical is the stressed Tier 1 leverage ratio. The Federal Reserve Board and FDIC published requirements for Regulatory Capital Rule in 2019 and announced that the minimum of Tier 1 Leverage Ratio should be 5%. In addition, if a bank has shown itself to be undercapitalized in the past, it must demonstrate a Tier 1 leverage ratio of at least 6% to be considered adequately capitalized. To be more conservative in risk management, we defined the stressed Tier 1 leverage ratio threshold as 6%. If the leverage ratio is under 6%, it indicates that the bank is undercapitalized and investors should be cautious.

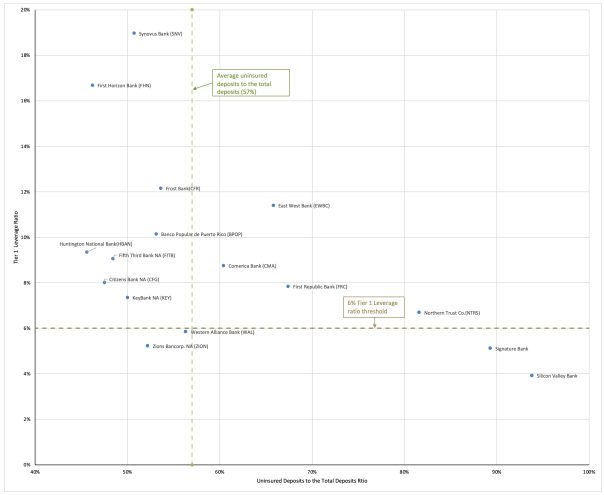
Here we listed several scenarios on how the projected system capital shortfall would impact banks' Tier 1 leverage ratio in Dec. 2022. The decline in the S&P 500 index was incremented by 10%, ranging from 10% to 50%. Sources come from NYU Stern V-Lab, S&P Global Inc., BankRegData.



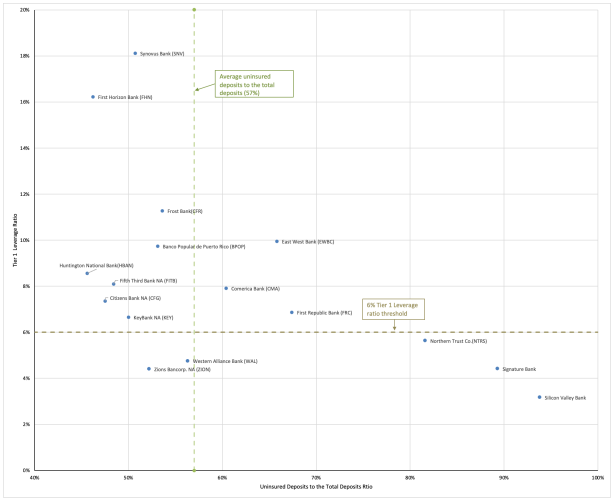
(Scenario 1: 10% market decline)



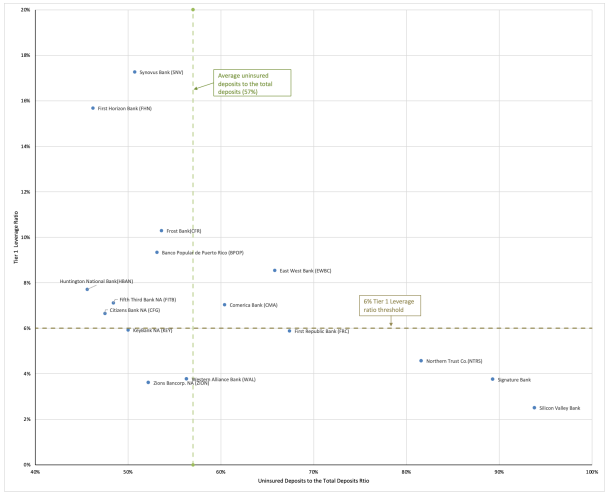
(Scenario 2: 20% market decline)



(Scenario 3: 30% market decline)



(Scenario 4: 40% market decline)



(Scenario 4: 50% market decline)

Scenario 1: When the decrease in S&P 500 index was about 10% within six months, ***Silicon Valley Bank*** was undercapitalized as it was under the leverage ratio threshold of 6% and their deposits were almost uninsured. Although Signature Bank's stressed leverage ratio was 6.6%, above the requirements, its risks cannot be ignored as it had higher uninsured deposits and a lower leverage ratio compared to peers.

Scenario 2: When the systemic risk increased by 10%, ***Silicon Valley Bank and Signature Bank*** both lacked the capital to protect against risks.

Scenario 3: When the market decreased by 30%, ***Silicon Valley Bank and Signature Bank*** were short of capital and had over 85% uninsured deposits. Also, ***Western Alliance Bank and Zions Bancorp*** were in danger as their stressed Tier 1 leverage ratio was below the threshold.

Scenario 4: When the market dropped 40% as the financial crisis of 2007-2009 happened again, ***Silicon Valley Bank, Signature Bank, and Northern Trust Co.*** had insufficient capital as required and had higher probability of bank run risks. ***Western Alliance Bank and Zions Bancorp*** were at high risk of failure

Scenario 5: When the economic outlook was worse than the 2008 financial crisis, falling by 50%. Apart from ***Silicon Valley Bank, Signature Bank, Northern Trust Co., Western Alliance Bank, and Zions Bancorp***, were two more banks likely to collapse, that is, ***First Republic Bank and KeyBank NA***. Their Tier 1 leverage ratio was just below 6% and investors should be cautious about that in case things got worse.

The failure of Silicon Valley Bank and Signature Bank can be sensed from the simple chart and scenario tests. As the average market decline during the Covid was around 10%, Silicon Valley Bank obviously lacked the capital to satisfy the depositors' needs and absorbed the potential losses. Its management team was aware of the dangers of insufficient capital and announced to raise new capital by offering $1.25 billion common stock and $500 million of depositary shares. Since most of SVB's depositors are startups and venture capital firms in the tech community, these closed groups, spooked by the news that the bank is underfunded, rush to withdraw their deposits. Therefore, SVB shut down on March 10, 2023. Fueled by the panic in the bank run and crypto uncertainty, Signature Bank became the second to fail two days later.

It's clear that as the systemic risk gets higher and higher, the number of banks that are probable to collapse is increasing as well. These banks' Tier 1 leverage ratio is below the conservative threshold of 6% and the average percentage of uninsured deposits to the total deposits accounts for around 70%, indicating that once the bank run happens, about 70% of depositors cannot get their money back and cannot be compensated from FDIC, which will be a huge disaster to individuals, companies, and the financial market. If investors are more risk averse, they can set a band on these indicators, like 5% buffer band, to highlight those banks needed to be cautious.

Interest Rate Risk Analysis

Why would SVB lack capital and need to raise new funds? The answer was in its three financial statements. The expansion of SVB was dramatic since the Covid. Standing at the end of 2022 and comparing figures with 2019 level, its total assets had increased by 198%, net loan climbed up by 124%, cash and cash equivalents grew by 104%, and securities and investments raised by 313%, in which AFS added by 119% and HTM increased by 560%. It's clear that SVB focused on investing more in securities and investments, especially HTM, to maximize its profits instead of attracting more loans to earn the interest rate differentials. This shift is also understandable as the companies have less need to borrow from banks due to the market downturn.

From the 2022 balance sheet, we can see that cash and cash equivalents accounted for 6.5% of total assets, while securities and investments made up 57% of total, of which 1.3% were available-for-sale (AFS) mark-to-market and 43.1% were held-to-maturity (HTM). The unrealized gain or loss in AFS will be listed in Accumulated Other Comprehensive Income (AOCI) in the equity section of the balance sheet while HTM is assumed to be held until the end of maturity and is recorded at notional value. The unrealized part will reflect on the balance sheet but won't impact the income statement. Only if it converts to realized gain or loss, it will show in the income statement.

SVB FINANCIAL GROUP AND SUBSIDIARIES
CONSOLIDATED BALANCE SHEETS

(Dollars in millions, except par value and share data)	December 31, 2022	December 31, 2021
Assets		
Cash and cash equivalents	$ 13,803	$ 14,586
Available-for-sale securities, at fair value (cost of $28,602 and $27,370, respectively, including $530 and $61 pledged as collateral, respectively)	26,069	27,221
Held-to-maturity securities, at amortized cost and net of allowance for credit losses of $6 and $7 (fair value of $76,169 and $97,227, respectively)	91,321	98,195
Non-marketable and other equity securities	2,664	2,543
Total investment securities	120,054	127,959
Loans, amortized cost	74,250	66,276
Allowance for credit losses: loans	(636)	(422)
Net loans	73,614	65,854
Premises and equipment, net of accumulated depreciation and amortization	394	270
Goodwill	375	375
Other intangible assets, net	136	160
Lease right-of-use assets	335	313
Accrued interest receivable and other assets	3,082	1,791
Total assets	$ 211,793	$ 211,308

The depositors, most of them start-up technology companies, were constantly withdrawing the money in the bank to support their own operations and development. Banks found that if things went on like this, their liquid assets could not meet the needs of customers at all. In addition to the capital raise, SVB sold about $21 billion of AFS, which resulted in a loss of approximately $1.8 billion. The unrealized losses became realized and could be found in the company's AOCI.

Accumulated other comprehensive income (loss)	(1,911)	(9)

At the beginning, the depositors just withdrew cash normally, but after seeing a series of actions of the bank, they realized that something was wrong. So they started frantically asking the bank to get back all their deposits. The start of the bank run happened. What could SVB do at this moment? They had no choice but to keep selling their assets to meet their obligations.

As we said before, HTM is security that companies will hold until they mature, if the holder did so, they would earn the projected return otherwise they would undertake unexpected gain or loss due to the economic outlook. Since the Fed continued its year-long rate-hiking campaign and the fed fund rate soared between 4.75% and 5% in March 2023, the bond market was arguably wrecked and values of fixed income portfolio plunged far away. According to an insider in SVB, the bank had an unrealized losses of $15.1 billion in HTM, which means if the bank sold HTM for money, the $15.1 billion losses became real and showed in the income statement. However, the net income before noncontrolling interests and dividends was $1.5 billion in 2022. Obviously, these investment losses could not be absorbed and the bank had to announce bankruptcy.

	December 31, 2022									
	Total		One Year or Less		After One Year to Five Years		After Five Years to Ten Years		After Ten Years	
(Dollars in millions)	Net Carry Value	Weighted Average Yield	Net Carry Value	Weighted Average Yield	Net Carry Value	Weighted Average Yield	Net Carry Value	Weighted Average Yield	Net Carry Value	Weighted Average Yield
U.S. agency debentures	$ 486	1.91 %	$ 1	2.39 %	$ 118	2.50 %	$ 367	1.72 %	$ —	— %
Residential MBS:										
Agency-issued MBS	57,705	1.56	—	1.65	25	2.38	1,066	2.32	56,614	1.54
Agency-issued CMO - fixed rate	10,461	1.48	—	—	90	1.47	129	1.71	10,242	1.48
Agency-issued CMO - variable rate	79	0.74	—	—	—	—	—	—	79	0.74
Agency-issued CMBS	14,471	1.63	39	0.45	153	0.86	966	1.93	13,313	1.62
Municipal bonds and notes	7,416	2.82	29	2.26	235	2.48	1,362	2.74	5,790	2.85
Corporate bonds	703	1.86	—	—	115	1.72	588	1.88	—	—
Total	$ 91,321	1.66	$ 69	1.25	$ 736	1.90	$ 4,478	2.43	$ 86,038	1.63

Here, the interest rate risks played an important role when SVB decided to sell HTM and the risk can actually be quantified. Back to SVB's 2022 10K, the estimated weighted-average duration of fixed income investment securities portfolio was 5.7 years at December 31, 2022, of which the weighted-average duration of AFS securities portfolio was 3.6 years and that of HTM was 6.2 years. The average duration 5.7 years in fixed income portfolio means it takes the bank 5.7 years to be repaid by the future total cash flows from coupon payments and principal. The larger duration, the higher interest rate risks. Therefore, the bank can actually mitigate these risks by adjusting its fixed income portfolio to lower duration or buying some interest rate swaps and derivatives to transfer the interest rate risks.

Conclusion

The lesson from the SVB bank run emphasizes the importance of managing liquidity risk and interest rate risks. With healthy and controllable internal systems, no matter how dark the economy will be, the bank still has the ability to go through.What's more, regulators should scrutinize banks' financial situations more carefully and rigorously and conduct stress tests to verify their resilience to prevent such cases from happening again.