OFR BRIEF SERIES
OFFICE OF FINANCIAL RESEARCH

23-04 | December 27, 2023

Some U.S. Banks May Remain Vulnerable to Losses in Their Securities Portfolios: Introducing Two New Forward-looking Metrics to Assess Future Risk

by Peyton Young and Tom Doolittle[1]

The three large 2023 bank failures highlight the potential vulnerability of banks—and regional banks in particular—to fair-value losses in their securities portfolios. These failures also highlight the role of uninsured deposits in catalyzing bank runs upon a lack-of-confidence event. Many of the conditions that precipitated the 2023 banking crisis persist. Fair-value losses in bank securities portfolios are still large, deposits continue to decline, bank equities are underperforming, and the higher interest rates that catalyzed the banking crisis in the first place have not abated and may even increase further.

This brief introduces two new forward-looking metrics: the critical equity rate and the *critical leverage rate*, which could enable regulators to assess the future risk of fair-value losses in bank securities portfolios by solving for the 10-year Treasury rate such that fair-value securities portfolio losses either exceed bank shareholders' equity or force a bank's Tier 1 leverage ratio below statutory minimums. We have identified several banks with over $10 billion of assets with vulnerable securities portfolios and high unsecured deposits.

The 2023 bank failures stressed the banking system and required significant official-sector intervention to mitigate systemic risk that could have spread to similarly situated banks and destabilized the broader U.S. economy. The critical equity and leverage rates are two new tools that could enable regulators to identify banks at risk and enhance their supervision today before their condition worsens in the future, potentially necessitating official action.

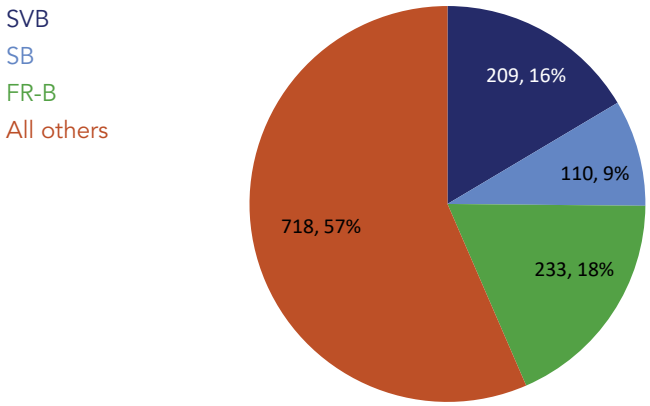
The 2023 Bank Failures Were Enormous and Destabilizing

The three large 2023 bank failures stressed the banking system and led to significant intervention to mitigate systemic risk that could have spread to similarly situated banks and destabilized the broader U.S. economy.[2] The collapse of Silicon Valley Bank (SVB) on March 10, 2023, Signature Bank (SB) on March 12, 2023, and First Republic Bank (FR-B) on May 1, 2023, represented 43% of the total assets of all failed banks since 2001 (see **Figure 1**). The concern over broader contagion generally led to sizable declines in bank stocks, as reflected in the KBW bank indexes (see **Figure 2**). Note that despite stabilizing in the weeks after FR-B entered receivership, the KBW bank indexes at the time of this writing are approximately 20% below their level at the beginning of the year and about 40% below the broader market (as measured by the S&P 500 Index).

The Origins of the 2023 Bank Failures: Loss of Confidence, Catalyzed by Fair-Value Losses and Uninsured Deposits

The three large 2023 bank failures[3] highlight the vulnerability of these institutions to fair-value losses in their held-to-maturity and available-for-sale securities portfolios (securities portfolios). The losses were created by the rise in interest rates. After two years, during which the federal funds rate target range was 0%–0.25%, and the discount rate was 0.25%,[4] the Federal Open Market Committee (FOMC) began raising interest rates on March 16, 2022.[5] This initiated a nearly unprecedented series of rate hikes[6] through July 26, 2023, raising the federal funds rate target range to 5.25%–5.50% and the discount rate to 5.50%.[7] These rate hikes created significant fair-value losses in banks' securities portfolios.[8] At the same time, bank customers began to redeploy cash held in deposits[9] into higher-yielding liquid investments such as money market funds. These two trends made banks with large unrealized losses in their securities portfolios and a significant amount of unsecured deposits (as a percentage of total deposits) vulnerable to loss-of-confidence events.[10]

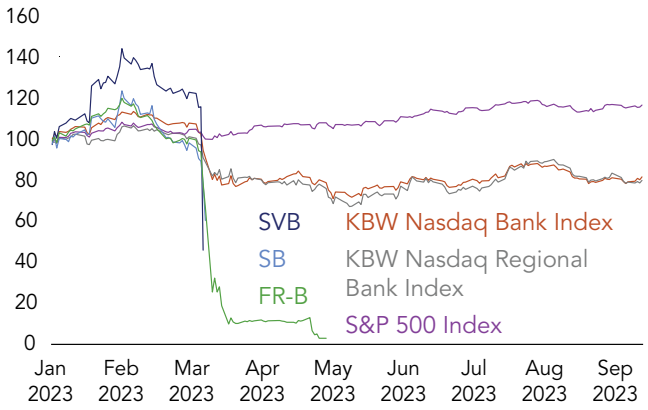
Figure 1. Total Assets of Failed Banks Since 2001 ($ billion)



Note: Total of 565 failed banks.

Sources: FDIC, OFR

Figure 2. Bank Stock Prices and Stock Indices (index)



Note: 12/31/2022 = 100.

Sources: Bloomberg, OFR

Figure 3 illustrates the financial position of SVB, SB, and FR-B at the end of the quarter before their failure. For example, at the end of 2022, SVB accumulated $17.7 billion of fair-value losses in its securities portfolio—an amount greater than its shareholders' equity. In addition, all three banks had a large proportion of uninsured deposits to total deposits relative to the Q1 2023 bank sector average of 34%.

On March 8, 2023, SVB announced significant losses in its securities portfolio, prompting a ratings

Figure 3. Selected Financials for 2023 Failed Banks ($ billions)

		Balance Sheet			Securities Portfolio				Deposits		
Bank	Date	Assets	Liabilities	SE	FV	AC	FV-AC	FV/AC (percent)	Uninsured	Total	Percent
SVB	12/2022	209.0	193.6	15.5	102.1	119.8	-17.7	85	151.6	175.5	86
SB	12/2022	110.4	102.4	8.0	25.4	28.6	-3.2	89	79.5	89.0	89
FR-B	3/2023	232.9	215.0	18.0	30.2	34.7	-4.4	87	50.8	105.6	48

Note: SE = shareholders' equity. FV = fair value, AC = amortized cost. First Republic Bank held $177.1 billion of total deposits and $119.5 billion of uninsured deposits (67% ratio).

Sources: FFIEC, OFR

downgrade and a negative ratings outlook. These developments led to a loss of confidence in the bank, as reflected by the sharp decline in its stock market price (see **Figure 3**). These developments also catalyzed an unprecedented bank run, which culminated in $100 billion in deposit withdrawals scheduled or expected on March 10, 2023.[11] On the same day, SB experienced a stock price decline and suffered a run, with depositors withdrawing 20% of deposit balances.[12] FR-B also experienced notable deposit outflows starting on March 10, and its equity price declined significantly.[13]

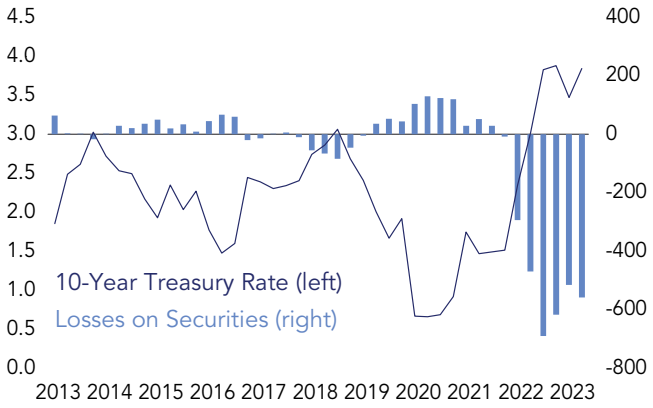
Banking Conditions Remain Fragile and Uncertain

Some banks remain pressured by conditions similar to those that precipitated the bank failures earlier in the year, including large fair-value losses in securities portfolios (see **Figure 4**) and a declining base of deposits (see **Figure 5**). Since 10-year Treasury rates increased in 2022,

banks have posted significant fair-value losses in their securities portfolios. As of Q2 2023, banks' fair-value losses on securities totaled $558 billion, a 10% discount on their amortized cost. In addition, rising short-term rates have catalyzed continued deposit outflows from banks. Since Q2 2022, approximately $1.3 trillion of deposits—or 7% of total deposits—have been withdrawn by customers, primarily due to more attractive yields on other investments such as money market funds.

The markets and observers have taken note of these difficult conditions. On August 7, 2023, Moody's Investor Services downgraded 10 banks and placed

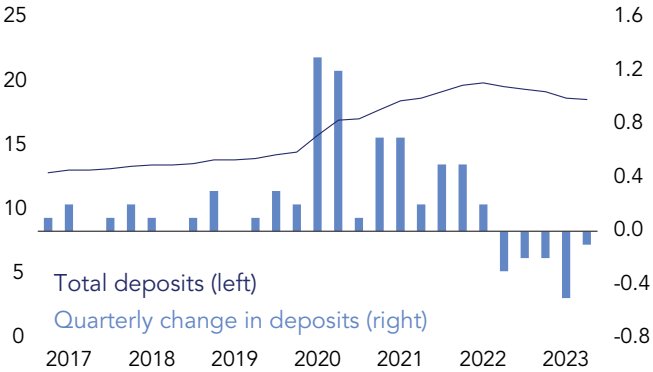
Figure 4. 10-Year Treasury Rate (percent)/Losses Securities ($ billions)



Note: Held-to-Maturity and available for sale securities.

Sources: Bloomberg, FDIC, OFR

Figure 5. Total Deposits and Quarterly Change in Deposits ($ trillions)



Note: All FDIC-insured financial institutions.

Sources: FDIC, OFR

another six on review for potential downgrades. In particular, they cited concerns that in the current high-rate environment, banks with sizable unrealized losses that are not reflected in their regulatory capital ratios are vulnerable to a loss of confidence.[14] On August 22, 2023, S&P Global Ratings downgraded five regional banks, citing deterioration in funding and profitability, high unrealized losses on their assets, or meaningful exposure to commercial real estate .[15] Although bank stock prices have subsequently stabilized, they remain below their pre-crisis levels (see **Figure 3**) and have underperformed the broader market, reflecting ongoing concern about the current market and financial conditions.

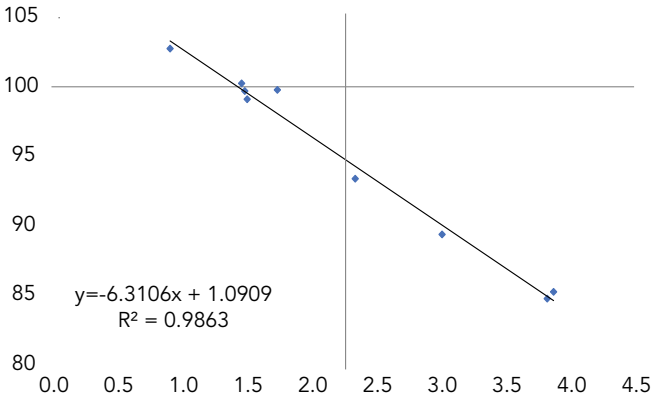
Finally, it is uncertain whether the FOMC will ease monetary tightening soon—suggesting sustained, if not higher, future interest rates. In a speech on August 22, 2023, the Chair of the Federal Reserve Board of Governors took a hawkish tone, noting that while inflation has stabilized in recent months, it is not yet at an acceptable level. He stated that Federal Reserve officials are prepared to be persistent in their efforts to bring inflation down to the 2% target level.[16] We are some distance from that target, as the most recent inflation report pegged the consumer price index up 3.7% annually.[17]

Identifying Vulnerable Banks: Introducing the Critical Equity Rate

The 2023 bank failures provide a foretaste of what could happen next. Concern over the safety of uninsured bank deposits may lead to substantial customer withdrawals that shrink a bank's capital base, necessitating deleveraging to meet cash outflows and regulatory capital requirements. The sale of assets, as in the case of SVB, or the potential for the future sale of assets, as in the cases of SB and FR-B, require these banks to realize or potentially realize fair-value losses on their securities portfolios. This could further exacerbate the loss of confidence in a bank, leading to eventual receivership.

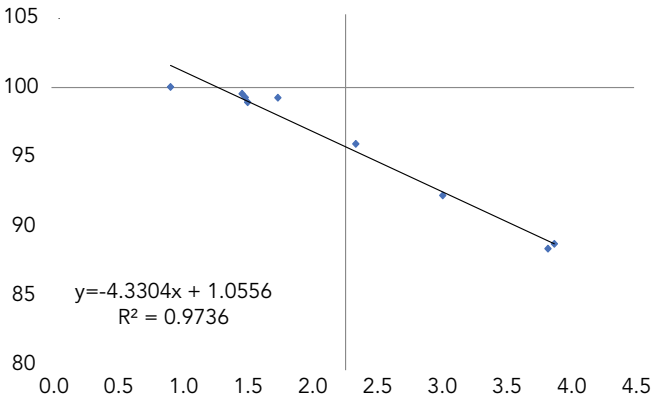
In this brief, we describe two forward-looking metrics that can identify banks that are vulnerable to future fair-value losses before those losses are crystallized. The correlation between rising interest rates and the fair-value securities portfolio losses of the recently failed banks holds the key to developing these forward-looking metrics.

Figure 6. SVB: 10-Year Treasury Constant Maturity (X) FV/AC of HTM and AFS Securities (Y) Q4 2020-Q4 2022



Sources: Bloomberg, FFIEC, OFR

Figure 7. Total Deposits and Quarterly Change in Deposits ($ trillions)



Note: All FDIC-insured financial institutions.

Sources: FDIC, OFR

Revisiting the 2023 bank failures, we find that there is a strong correlation between the rise in rates beginning in 2022 and the decline in the fair value of the securities portfolios held by banks, as these portfolios consist of interest rate–sensitive investments.[18] **Figures 6** and **7** plot the 10-year Treasury rate on the *x*-axis and the ratio of the fair value to amortized cost (or book value) of SVB and SB for nine periods from Q4

Figure 8. 2Q 2023 Critical Equity Rate Tiers for Selected Banks ($ billions)

Critical Equity Rate Tier (percent)	# of Banks	Balance Sheet			Securities Portfolio				Regression Slope	% of Uninsured Deposits
		Assets	Liabilities	SE	FV	AC	FV-AC	FV/AC (percent)		
N/A	2	138.1	133.9	4.2	63.2	70.2	-7.2	90	-4.66	10
4-5	4	147.7	139.1	8.5	62.7	68.3	-5.6	92	-4.78	47
5-6	7	241.3	224.2	17.1	73.8	82.5	-8.7	89	-6.17	42
6-7	8	3,266.5	2,972.7	293.9	856.8	993.8	-137.0	86	-5.73	32
7-8	11	765.7	696.4	69.3	197.6	220.7	-23.1	90	-5.46	35
8+	109	14,682.6	13,213.8	1,468.8	2,818.1	3,081.8	-263.8	91	-4.53	40
Total	141	19,242.0	17,380.1	1,861.9	4,072.1	4,517.3	-445.3	90	-4.76	38

Note: SE = shareholders' equity. FV = fair value, AC = amortized cost. The fair-value loss in the securities portfolios of the two banks in the N/A tier already exceeds their balance sheet equity.

Sources: FFIEC, OFR

2020 to Q4 2022.[19] These figures show that as long-term interest rates rose, the fair value of the banks' securities portfolios declined. Of particular interest is that the R-squared of these two figures is close to 1, and linearity holds with a high degree of confidence. The slope of the linear regression provides an estimate of the average duration of securities in the portfolios: in the case of SVB, 6.3 years, and the case of SB, 4.3 years. These duration estimates closely match the securities portfolio durations reported by the two banks in their 10-Ks in the quarter before their failures: SVB reported a Q4 2022 duration of 5.7 years,[20] and SB reported a Q4 2022 duration of 4.2 years.[21]

We can use the regression equation to model the future decline of the fair value of a bank's securities portfolio as interest rates rise. As we noted earlier in **Figure 3**, in the quarter before its failure, SVB reported a $17.7 billion fair-value loss in its securities portfolio, which exceeded its shareholders' equity of $15.5 billion. Consequently, we view the point at which fair-value losses in a bank's securities portfolio exceed the bank's shareholders' equity as the critical level at which the bank is at risk of failure. Using the regression equation of SB, we can solve for the 10-year Treasury rate such that the fair-value losses of SB's securities portfolio exceed its shareholders' equity. For SB, this 10-year Treasury rate is 7.75%[22] — this is the *critical equity rate* for this bank. We note that this is a highly conservative estimate of the interest rate at which shareholders' equity would be wiped out since we are not including possible losses in the bank's loan book, which are difficult to estimate accurately. By contrast, the fair-value losses of banks' securities portfolios are publicly reported and highly visible to investors, depositors, and regulators.[23]

Calculating the Critical Equity Rate for Operating Banks

Using publicly available bank call reports,[24] we have employed this methodology to calculate the critical equity rate for 141 banks with total assets exceeding $10 billion over 11 periods of consecutive call reports from Q4 2020 to Q2 2023.[25] We then grouped the banks into six tiers based on their critical equity rate (see **Figure 8**). As of 2Q 2023, in aggregate, these banks hold $19.2 trillion of assets, $1.9 billion of shareholders' equity, $445 billion of fair-value losses in their securities portfolios, and a ratio of uninsured deposits to total deposits of 38%.

The analysis indicates that in addition to the two banks whose fair-value loss in their securities portfolio already exceeds their balance sheet equity,[26] four banks have $148 billion of assets and a critical equity rate ranging from 4% to 5%. That is, the fair value of their securities portfolio will exceed their shareholders'

Figure 9. 2Q 2023 Critical Equity Rate Tiers for Selected Banks with Interest Rate Derivative Contracts ($ billions)

Critical Equity Rate Tier (percent)	# of Banks	Balance Sheet			Securities Portfolio				Interest Rate Derivative Contracts Mkd-to-Mkt		
		Assets	Liabilities	SE	FV	AC	FV-AC	FV/AC (percent)	Total	% of FV Securities	% of Assets
N/A	2	138.1	133.9	4.2	63.2	70.2	-7.2	90	5.1	8	4
4-5	4	147.7	139.1	8.5	62.7	68.3	-5.6	92	0.5	1	0
5-6	7	241.3	224.2	17.1	73.8	82.5	-8.7	89	58.4	79	24
6-7	8	3,266.5	2,972.7	293.9	856.8	993.8	-137.0	86	214.4	25	7
7-8	11	765.7	696.4	69.3	197.6	220.7	-23.1	90	213.6	108	28
8+	109	14,682.6	13,213.8	1,468.8	2,818.1	3,081.8	-263.8	91	3,091.3	110	21
Total	141	19,242.0	17,380.1	1,861.9	4,072.1	4,517.3	-445.3	90	3,583.2	88	19

Note: SE = shareholders' equity. FV = fair value, AC = amortized cost. The fair-value loss in the securities portfolios of the two banks in the N/A tier already exceeds their balance sheet equity.

Sources: FFIEC, OFR

equity if the 10-year Treasury rate reaches this level. (As of October 10, 2023, the 10-year Treasury rate was 4.65%.) There are seven banks with $241 billion of assets and a critical equity rate ranging from 5% to 6%, eight banks with $3.3 trillion of assets and a critical equity rate ranging from 6% to 7%, and so on. As shown in the table, most of the banks analyzed have a significant proportion of uninsured deposits. In particular, we note that eight of the banks analyzed with $607 billion in assets and a critical equity rate of 7.50% or less have a ratio of uninsured deposits to total deposits exceeding 50%. This is higher than FR-B's uninsured deposit ratio of 48% in the quarter prior to its failure.

Of course, banks can deploy risk management strategies such as interest rate hedging, to bound or change the duration of their securities portfolios, and critical-equity-rate analysis may not capture such strategies. Fortunately, publicly available call reports do capture and report interest rate derivative contract information, and we can use those data to augment our analysis (see **Figure 9**). We have used the 2Q 2023 marked-to-market value of total interest rate derivative contracts reported by the banks. This measure includes all of a bank's interest rate contracts; therefore, it may overstate the extent to which banks hedge their securities portfolios. Of the 141 banks analyzed, 48 banks with $924 billion in assets hedge 20% or less of the fair value of their securities portfolios; this includes 15 of 32 banks with a critical equity rate of 8% or less. When comparing interest hedging to total assets, we find that 100 banks with $1.9 trillion of assets have 20% or less of their assets hedged. Fourteen banks with $510 billion of assets report no interest rate derivative contracts at all. This is in general agreement with Jiang et al. (2023b)[27], who find that most banks protect only a small fraction of their assets against potential interest rate risk, and quite a few do not carry any protections.

The fact that many banks do not hedge or only partially hedge their securities portfolios is not surprising. Effective interest rate hedges are expensive and reduce the yield of securities held in portfolio, thus making banks reticent to use them. For example, in the quarter before it failed, SVB reported $550 million of interest rate derivatives, compared with a fair value of securities of $102 billion (0.5%) and total assets of $209 billion (0.3%). SB reported $11 billion of interest rate derivatives, compared with a fair value of securities of $25 billion (41%) and total assets of $110 billion (10%). FR-B reported no interest rate derivative contracts at all.

Figure 10. 2Q 2023 Critical Leverage Rate Tiers for Selected Banks ($ billions)

Critical Equity Rate Tier (percent)	# of Banks	Balance Sheet			Securities Portfolio				Regression Slope	% of Uninsured Deposits
		Assets	Liabilities	SE	FV	AC	FV-AC	FV/AC (percent)		
N/A	10	3,397.2	3,100.0	297.2	972.4	1,113.8	-141.4	87	-4.84	34
4-5	16	1,249.8	1,127.6	122.2	309.4	356.8	-47.4	87	-5.84	38
5-6	23	3,733.5	3,384.1	349.5	847.1	951.7	-104.5	89	-5.29	42
6-7	18	1,634.7	1,476.6	158.2	333.9	368.7	-34.7	91	-5.42	39
7-8	12	2,518.5	2,268.2	250.4	585.8	630.2	-44.4	93	-4.79	44
8+	62	6,708.2	6,023.7	684.5	1,023.5	1,096.1	-72.6	93	-4.08	37
Total	141	19,242.0	17,380.1	1,861.9	4,072.1	4,517.3	-445.3	90	-4.76	38

Note: SE = shareholders' equity. FV = fair value, AC = amortized cost. The fair-value loss in the securities portfolios of the two banks in the N/A tier already exceeds their balance sheet equity.

Sources: FFIEC, OFR

The Critical Equity Rate is a Conservative but Realistic Metric

Although the critical equity rate is an effective tool for measuring the level of interest rate risk in a bank's securities portfolio relative to its shareholders' equity, it is, as noted earlier, a conservative metric. In particular, it does not capture the fair-value losses or the interest rate risk present in a bank's consumer, real estate, and commercial and industrial loan and lease portfolio—which, on average, compose the majority of a bank's assets. As of 2Q 2023, on average, net loans and leases made up 52% of bank assets, while securities represented only 23%.[28] It seems likely that if there are fair-value losses in a bank's securities portfolio due to higher interest rates, there are also fair-value losses in its loan and lease portfolio. Thus, the critical equity rate does not capture or measure fair-value losses in a bank's loan and lease book, making it a conservative metric.

Even if banks reported the fair value of their loan and lease portfolios as they do for securities in their call reports, it may not be appropriate to include that value in a metric that measures the likelihood of bank failure. Most loans are not easily priced or readily marketable, except for certain real estate and consumer loans through securitization. This is in contrast to securities, which enjoy robust markets and transparent pricing. As a result, loans cannot be easily or quickly sold to repay depositors in the case of a bank run. Furthermore, since the fair values of loans are not reported, fair-value losses in a loan-and-lease book are opaque to investors and depositors when compared to securities losses. Such fair-value losses are, therefore, less likely to enter into investors' and depositors' sentiments regarding a bank's stability.

Refining the Critical Equity Rate into the Critical Leverage Rate

A low critical equity rate is a signal that a bank's securities portfolio is vulnerable to interest rate risk, but this signal may not be sufficient to warrant enhanced scrutiny. For example, there are two banks in **Figure 8** with fair-value securities portfolio losses that exceed their shareholders' equity. As far as we know from public information, these banks have not suffered deposit runs.

However, there are benchmarks that *require* public and regulatory attention; they are a bank's minimum capital requirements. By statute, all banks must adhere to up to six minimum capital requirements with defined calculations.[29] One such requirement is a bank's *leverage ratio*, which is the ratio of its Tier 1 capital to its average consolidated assets minus certain exclusions. We can refine the critical equity rate into the *critical leverage*

rate by solving for the 10-year Treasury rate at which a bank's fair-value security losses reduce its Tier 1 capital to such an extent that its leverage ratio falls below the statutory minimum of 4%.[30] In this case, the bank's regulator is required to take supervisory action, up to and including receivership.

Using publicly available bank call reports, we calculated the critical leverage rate for 141 banks with total assets exceeding $10 billion over 11 periods of consecutive call reports from Q4 2020 to Q2 2023. We then grouped the banks into six tiers, based upon their critical equity rate (see **Figure 10**). As of 2Q 2023, in aggregate, these banks hold $19.2 trillion of assets, hold $1.9 billion of shareholders' equity, have $445 billion of fair-value losses in their securities portfolios, and have a ratio of uninsured deposits to total deposits of 38%.

The analysis indicates that there are currently 10 banks (with $3.4 trillion in assets) whose fair-value losses in their securities portfolios, if recognized, would reduce their leverage ratios below the regulatory minimum of 4%. In addition, there are 16 banks with $1.2 trillion of assets and a critical leverage rate ranging from 4% to 5%. That is, the recognition of the fair-value loss of their securities portfolios would reduce their leverage ratios below the statutory minimum should the 10-year Treasury rate reach 5%. (As of October 10, 2023, the 10-year Treasury rate was 4.65%.) There are 23 banks with $3.7 trillion of assets and a critical leverage rate ranging from 5% to 6%, 18 banks with $1.6 trillion of assets and a critical equity rate ranging from 6% to 7%, and so on. As shown in the table, most of the banks analyzed have a significant proportion of uninsured deposits. In particular, we note that 11 of the banks analyzed with a critical leverage rate of 7.50% or less and total assets of $971 billion have a ratio of uninsured deposits to total deposits exceeding 50%.

Recent Academic Research and Future Analysis

We have reviewed current academic research on bank fair-value.[31] In summary, the research confirms our findings that 1) fair value losses in bank assets due to increased interest rates pose a risk to their solvency, (2) uninsured deposits are the catalyst for bank runs in the case of a loss-of-confidence event, and (3) interest rate hedging at current levels is not enough to insulate most banks from fair value losses. This brief expands upon recent research in several ways. In particular, we show that regressing the ratio of fair value-to-amortized cost of bank securities against the 10-year Treasury rate provides a useful measure of the duration of a bank's securities holdings. Using this regression, we created two forward-looking metrics—the critical equity rate and the critical leverage rate—that investors, depositors, and regulators can use to project the level of bank fair-value losses on securities that would result from a further rise in long-term interest rates. In addition, the critical leverage rate projects the 10-year Treasury rate at which bank regulators must take supervisory action against a bank should fair value losses be realized.

Conclusion

Banks remain pressured by conditions similar to those that precipitated the failures of SVB, SB, and FR-B—including large fair-value losses in securities portfolios, a declining base of deposits, and elevated and potentially increasing interest rates. These difficult current conditions are reflected in underperforming bank equity prices, as well as selected downgrades and future outlook warnings by nationally recognized statistical rating organizations (NRSROs). We believe that the current unsettled conditions, combined with higher interest rates, could set conditions for future bank failures.

The two metrics introduced by this brief, the *critical equity rate* and the *critical leverage rate,* allow regulators and industry observers to identify banks that are vulnerable to fair-value losses in their securities portfolios should interest rates increase in the future. We suggest that these metrics, combined with measures of uninsured deposit levels, could serve as useful tools for assessing the likelihood of financial instability at individual banks. As forward-looking measures, the critical equity rate and critical leverage rate allow regulators to identify vulnerable banks today and target them for additional supervisory analysis before fair-value losses create a bank panic scenario. For example, had the critical equity rate and critical leverage rate been applied to SVB in the second half of 2022, our analysis would have signaled significant risk of failure up to nine months before its collapse.

Endnotes

1 Peyton Young, Research Principal, Office of Financial Research (Hobart.Young@ofr.treasury.gov); and Tom Doolittle, Financial Analyst, Office of Financial Research (Thomas.Doolittle@ofr.treasury.gov).

2 On Sunday, March 12, 2023, the boards of the FDIC and the Federal Reserve voted unanimously to recommend that the FDIC could use the emergency Systemic Risk Exception (SRE) under the Federal Deposit Insurance Act (FDI Act) to mitigate emerging systemic risk. The Secretary of the Treasury made the same determination, in consultation with the President of the United States. The SRE allowed the FDIC to consider resolution options that did not minimize the cost to the FDIC's deposit insurance fund (DIF) but were designed to help mitigate contagion that could spread systemic risk to similarly situated banks and adversely affect certain regional economies. In this case, the SRE allowed the FDIC to protect all depositors (insured and uninsured) through the transfer of all deposits to two separate bridge depository institutions chartered to continue the operations of SVB and SB. Concurrently, the Federal Reserve established a Bank Term Funding Program (BTFP) designed to provide banks with loans against the par value of high-quality securities; the loans had maturities of up to one year. The facility was specifically created as an additional source of liquidity, eliminating an institution's need to quickly sell high-quality securities in times of stress. With the approval of the Secretary of the Treasury, the U.S. Department of the Treasury has committed to making available up to $25 billion from the Exchange Stabilization Fund as a backstop for the BTFP. It is not anticipated that it will be necessary to draw on these backstop funds.

3 In addition to the failures of SVB, SB, and F-RB, Silvergate Bank announced on March 8 that it would self-liquidate.

4 Board of Governors of the Federal Reserve System. "Federal Reserve Actions to Support the Flow of Credit to Households and Businesses." Press Release, March 15, 2020: FRB, https://www.federalreserve.gov/newsevents/pressreleases/monetary20200315b.htm.

5 Board of Governors of the Federal Reserve System. "Federal Reserve Issues FOMC Statement." Press Release, March 16, 2022: FRB, https://www.federalreserve.gov/newsevents/pressreleases/monetary20220316a.htm.

6 The Economist. 2022. "Rates are rising at unprecedented speed. When will they bite?" The Economist (October 13, 2022). https://www.economist.com/finance-and-economics/2022/10/13/rates-are-rising-at-unprecedented-speed-when-will-they-bite.

7 Board of Governors of the Federal Reserve System. "Federal Reserve Issues FOMC Statement." Press Release, July 26, 2023: FRB, https://www.federalreserve.gov/newsevents/pressreleases/monetary20230726a.htm.

8 Federal Deposit Insurance Corporation. *Held-to-Maturity Securities/Available-for-Sale Securities, 2008–2023. 2023. FDIC.* https://www.fdic.gov/analysis/quarterly-banking-profile/qbp/2023jun/chart7.xlsx.

9 Federal Deposit Insurance Corporation. *Quarterly Change in Deposits, 2008–2023*. 2023. FDIC. https://www.fdic.gov/analysis/quarterly-banking-profile/qbp/2023jun/chart5.xlsx.

10 Federal Deposit Insurance Corporation. "FDIC-Insured Institutions Reported Net Income of $70.8 Billion in Second Quarter 2023." Press Release, September 7, 2023: FDIC, https://www.fdic.gov/news/press-releases/2023/pr23072.html.

11 There were $42 billion in deposit withdrawals on March 9. See State of California Department of Financial Protection and Innovation. *Silicon Valley Bank: Order Taking Possession of Property and Business. Departmental Order, San Francisco, CA (March 10, 2023).* https://dfpi.ca.gov/wp-content/uploads/sites/337/2023/03/DFPI-Orders-Silicon-Valley-Bank-03102023.pdf?emrc=bedc09. There were also $100 billion in scheduled or expected deposit withdrawals for March 10. See Board of Governors of the Federal Reserve System. "Review of the Federal Reserve's Supervision and Regulation of Silicon Valley Bank." Washington, D.C.: Federal Reserve Board of Governors, April 28, 2023. https://www.federalreserve.gov/publications/files/svb-review-20230428.pdf.

12 Federal Deposit Insurance Corporation. "FDIC's Supervision of Signature Bank." Press Release, April 28, 2023: FDIC. https://www.fdic.gov/news/press-releases/2023/pr23033a.pdf.

13 First Republic Bank's equity prices declined more following the publication of its first-quarter earnings on April 24, and the California Department of Financial Protection and Innovation took possession of First Republic Bank before markets opened on Monday, May 1, appointing the FDIC as receiver. See State of California Department of Financial Protection and Innovation. "California Financial Regulator Takes Possession of First Republic Bank." Press Release, May 1, 2023: DFPI, https://dfpi.ca.gov/2023/05/01/california-financial-regulator-takes-possession-of-first-republic-bank/

14 The FDIC entered into a purchase-and-assumption agreement with JPMorgan Chase Bank to assume all of the deposits and most of the assets of the failed bank, with the bank and the FDIC entering into a loss-sharing agreement. See Federal Deposit Insurance Corporation, "JPMorgan Chase Bank, National Association, Columbus, Ohio Assumes All the Deposits of First Republic Bank, San Francisco, California." Press Release, May 1: FDIC, https://www.fdic.gov/news/press-releases/2023/pr23034.html.

15 Reuters. 2023. "Shares of US banks drop after S&P downgrades some of its ratings." Reuters (August 22, 2023). https://www.reuters.com/business/finance/sp-downgrades-multiple-us-banks-citing-tough-operating-conditions-2023-08-22/.

16 Powell, Jerome H. "Inflation: Progress and the Path Ahead." Speech, Federal Reserve Bank of Kansas City, "Structural Shifts in the Global Economy" symposium, Jackson Hole, WY, August 25, 2023. https://www.federalreserve.gov/newsevents/speech/powell20230825a.htm.

17 Smialek, Jeanna. 2023. "Inflation Sped Up as Gas Prices Rose." The New York Times (September 13, 2023). https://www.nytimes.com/2023/09/13/business/august-inflation-report.html.

18 Detail composition of securities portfolio.

19 FR-B is not shown because nine periods of data are unavailable.

20 Q4 2022 10K: The estimated weighted-average duration of our fixed-income investment securities portfolio was 5.7 years on December 31, 2022, and 4.0 years on December 31, 2021. The weighted-average duration of our total fixed-income securities portfolio, including the impact of our fair-value swaps, was 5.6 years on December 31, 2022, and 3.7 years on December 31, 2021. The weighted-average duration of our AFS securities portfolio was 3.6 years on December 31, 2022, and 3.5 years on December 31, 2021. The weighted-average duration of our AFS securities portfolio, including the impact of our fair-value swaps, was 3.6 years on December 31, 2022, and 2.4 years on December 31, 2021. The weighted-average duration of our HTM securities portfolio was 6.2 years on December 31, 2022, and 4.1 years on December 31, 2021.

21 Q4 2022 10K: On December 31, 2022, the baseline average duration of our investment securities portfolio increased to approximately 4.23 years, compared with 3.55 years on December 31, 2021, due to the higher interest rate environment in 2022.

22 Critical Equity Rate = $(((AC_{SP} - SE) / AC_{SP}) - \alpha) / \beta$

AC_{SP} = quarter-end amortized cost of securities portfolio

SE = quarter-end shareholders' equity

α and β from the linear regression of the quarter-end 10-year Treasury rate and the quarter-end ratio of the fair value-to-amortized cost of securities portfolio.

23 In a recent study, Jiang et al. (2023a) conduct an estimation of the market value of banks' assets in their entirety, including securities portfolios, commercial loans, leases, and residential mortgages. The authors estimate that in the recent interest rate run-up, banks' assets declined by at least 10% and in some cases by as much as 20%. That decline implies that a large number of banks could end up with no equity if all their assets were sold at current market valuations.

24 See Federal Financial Institutions Examination Council. Bulk Data Download. 2023. FFIEC. https://cdr.ffiec.gov/public/PWS/DownloadBulkData.aspx/.

25 Eleven banks with $10 billion or more of assets did not meet the requirement for 11 periods of consecutive call reports and were thus excluded from the analysis.

26 The fact that these banks, in aggregate, have a ratio of uninsured deposits to total deposits of 10% may be one reason why they have not yet failed.

27 Jiang, et al in Limited Hedging and Gambling for Resurrection by U.S. Banks During the 2022 Monetary Tightening? (April 2023), see https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4410201, focuses primarily on bank interest rate hedging. It assesses that only 6% of aggregate assets of banks are hedged by interest rate swaps and that the use of hedging and other interest rate derivatives was not large enough to offset a large proportion of the $2.2 trillion fair value loss in the value of banks assets, including both loans and securities.

28 Federal Deposit Insurance Corporation. "FDIC Quarterly." Volume 17, no. 3. Washington, D.C.: FDIC, 2023. https://www.fdic.gov/analysis/quarterly-banking-profile/qbp/2023jun/qbp.pdf/.

29 Cornell Law School. *12 CFR § 3.10—Minimum capital requirements*. 2023. Cornell Law School. https://www.law.cornell.edu/cfr/text/12/3.10.

30 Critical leverage Rate = $(((AC_{SP} - (CT1 - (.04 \times AC))) / AC_{SP}) - \alpha) / \beta$

AC_{SP} = quarter-end amortized cost of securities portfolio

C_{T1} = quarter-end Tier 1 capital

A_C = quarter-average consolidated assets

α and β from the linear regression of the quarter-end 10-year Treasury rate and the quarter-end ratio of the fair value-to-amortized cost of securities portfolio.

31 Three previous academic papers by Jiang, et al have examined bank fair value losses and the potential for future bank failures. Jiang, et al in Monetary Tightening and U.S. Bank Fragility in 2023: Mark-to-Market Losses and Uninsured Depositor Runs? (March 2023), see https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4387676, analyzes U.S. banks' asset exposure to the recent rise in the interest rates. Jiang proposes that the decline in the fair value of bank assets, including an estimate of the fair value of loan portfolios held to maturity as well as reported fair value of securities portfolios, are about 10% below their book value due to a rise in interest rates. It notes that most of these asset declines were not hedged by banks with use of interest rate derivatives. It hypothesizes that if half of uninsured depositors at banks withdraw their funds, almost 190 banks with assets of $300 billion are at a risk of impairment – the fair value of their remaining assets after these withdrawals will be insufficient to repay all insured deposits.

Jiang, et al in Limited Hedging and Gambling for Resurrection by U.S. Banks During the 2022 Monetary Tightening? (April 2023), see https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4410201, focuses primarily on bank interest rate hedging. It assesses that only 6% of aggregate assets of banks are hedged by interest rate swaps and that the use of hedging and other interest rate derivatives was not large enough to offset a large proportion of the $2.2 trillion fair value loss in the value of banks assets, including both loans and securities. It finds that bank with the highest proportion of uninsured deposits reduced their interest rate derivatives contracts during the recent interest rate increases, allowing them to report increased profitability, but exposed them to increased fair value losses if interest rates continued to rise.

Jiang et al in U.S. Bank Fragility to Credit Risk in 2023: Monetary Tightening and Commercial Real Estate Distress (April 2023), see https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4413799, focuses on the ability of banks to withstand commercial real estate (CRE) loan defaults in light of their $2.2 trillion of fair value losses. It finds that a 10% to 20% default rate on CRE loans would generate approximately $80 to $160 billion of bank credit losses. Should this occur, it finds that an additional 280 to 579 banks with aggregate assets of $700 billion to $1.2 trillion would incur fair value losses on their assets below the book value of all their non-equity liabilities.