Journal of Economic Perspectives—Volume 38, Number 1—Winter 2024—Pages 133–152

The Failure of Silicon Valley Bank and the Panic of 2023

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On Thursday, March 9, 2023, depositors withdrew almost 25 percent of the total deposits at Silicon Valley Bank (SVB). On the morning of Friday, March 10, early evidence suggested that virtually all of the remaining deposits would be withdrawn. Regulators were forced to close the bank in the middle of the day, unable to even "get to the weekend" as had been done for every other bank failure since the Great Depression. Silicon Valley Bank, with $209 billion of assets, the sixteenth-largest bank in the United States, became the second-largest bank failure in nominal terms in US history, ranking in size only behind the failure of Washington Mutual Bank during the Great Recession of 2007–2009.

Since the founding of the Federal Deposit Insurance Corporation (FDIC) in 1934, no US bank depositor has lost any insured funds. As a result, US bank runs have been rare, because depositors see no need to rush to the exits, even if a bank failure is imminent. However, US deposit insurance has a limit on the amount insured of $250,000 per account. Silicon Valley Bank was highly unusual in that about 94 percent of its deposits are large enough to be *uninsured*. This makes SVB a throwback, almost as though it was from the bank-panic frenzies of the late nineteenth century, before the modern safety net for banks was in place. It also makes the failure of SVB an illustrative model for the economics of banking—how things work can often become most clear when they break.

After the failure of Silicon Valley Bank, commentary focused on several possible causes: poor risk management by the bank; changes in bank regulation

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For supplementary materials such as appendices, datasets, and author disclosure statements, see the article page at https://doi.org/10.1257/jep.38.1.133.

in 2019 that had recently relaxed the rules for banks like SVB; weak oversight by supervisors for the rules that remained; a customer base highly concentrated in one industry (technology, particularly startups) and region (Silicon Valley, of course); and the interaction of modern social media with the tech-savvy customer base of SVB in accelerating the run. From this long list, one might conclude that SVB was a special case, an outlier that reveals little about bank stress in general. This would not, however, be correct, because the underlying problem was systemic, and when SVB was shut down, the Panic of 2023 had begun.

On Sunday, March 12, the Federal Deposit Insurance Corporation took control of another failed institution, Signature Bank, which then became the third-largest bank failure in the history of the United States. This failure convinced authorities that the US banking system faced the possibility of widespread runs. In response, the FDIC and the Federal Reserve each invoked emergency provisions available under the law. The "systemic-risk exception" included in a 1991 law allows the FDIC to act immediately without taking time to seek out a least-cost method of resolving a bank failure: in this case, the FDIC announced that even uninsured depositors would be fully covered at both Silicon Valley Bank and Signature. In turn, the Federal Reserve invoked its power to take action during "unusual and exigent circumstances" that was included in a 1935 revision of the Federal Reserve Act and created a novel emergency-lending program with generous terms. Together, these policy actions succeeded in slowing the deposit outflows, which delayed but did not prevent the eventual failure of First Republic Bank in May. At $213 billion in assets, First Republic was even larger than SVB, thus leapfrogging to become the "new" second-largest bank failure ever in the United States. Panic in the US banking sector also spread to Europe, providing the final nail in the coffin for the long-troubled Credit Suisse, which in April 2023 became the single largest bank failure in the world, ever.

Each of these failures had their own idiosyncratic reasons. But the US examples all shared two things: a very high percentage of uninsured deposits and significant "unrealized" losses on assets. That combination is a dangerous mix, and variations on it lie at the core of most financial panics. In most modern examples, such as the global financial crisis of 2008–2009, this dangerous mix is shrouded in layers of complexity, making it much harder to uncover its dynamics. But the special case of Silicon Valley Bank turns out to be a remarkably clean example, and thus can teach us a lot about the general case.

To elicit these lessons, we focus on underlying economics of the Silicon Valley Bank failure, leaving most of the discussion of government regulation until after the basic story is told. In the next section, we examine the balance sheet of SVB at the end of 2019 and thus before the pandemic, focusing on the largest categories of assets and liabilities. Like most banks, SVB's profits are driven mostly by "net interest margin"—the difference in interest earned and paid for via its assets and liabilities—and this business model has come under pressure since the onset of the pandemic. In the following section, we illustrate this pressure using diagrams showing the components of net interest margin and show how those components changed during the pandemic. With this background of SVB's balance sheet and

business model, we can then make sense of what happened at SVB and the ensuing Panic of 2023. In the penultimate section of the paper, we turn to the role of government bank regulation and oversight in the lead up to the crisis. The final section concludes with a discussion of the policy challenge in preventing future panics of this type.

Silicon Valley Bank before COVID-19

The top panel of Figure 1 shows the balance sheet for Silicon Valley Bank on December 31, 2019. At this time, the bank had a total of $70 billion of assets. The single largest item on the balance sheet was $63 billion of deposits, which comprised the vast majority of the bank's funding. SVB was unusual in that almost all of these deposits—about 94 percent—were not covered by federal deposit insurance.

In the United States, individual bank accounts are insured by the Federal Deposit Insurance Corporation up to a limit of $250,000. Balances below $250,000 are "insured," while all balances above $250,000 are "uninsured." This limit is high enough that the vast majority of all *accounts* are fully insured, but on a *dollar* basis, about 42 percent of the total deposits in the United States were above this limit, and thus uninsured (FDIC 2023c, p. 10). The specific choice of $250,000 as the legal threshold is an attempt to balance the benefits (financial stability) and costs (excess risk-taking by banks) of insurance. The Panic of 2023 has reopened the debate on this threshold—a topic we discuss in the conclusion of the paper.

FDIC insurance is backed by a standing fund financed by insurance premiums charged to banks, with a credit line from the US Treasury and the full faith and credit of the United States standing as additional lines of defense. For insured depositors, the typical bank failure is seamless. Uninsured deposits do not have this explicit protection. Nevertheless, in most bank failures the FDIC has been able to transfer the entire deposit base to another bank, allowing the uninsured depositors to be made whole. Indeed, the *total* losses by uninsured depositors in the last 30 years has been less than $300 million (FDIC 2023c, p. 22). With this history, it would be reasonable for uninsured bank depositors to feel relatively safe, even if that safety has not been legally guaranteed. This implicit safety supports the significant level of uninsured deposits in the US banking system. Most of these uninsured deposits are concentrated in the largest banks. Even among this group, however, Silicon Valley Bank stood out for having the highest percentage of uninsured deposits among all banks with assets of $50 billion or more.

On the asset side of the Silicon Valley Bank balance sheet in 2019, the largest line item was "loans" at $33 billion, followed by "securities" at $28 billion. Most of the loans were in the form of credit lines to SVB customers, instead of more traditional term loans for specific projects; the startup firms served by SVB often have lumpy inflows and outflows and rely on credit lines to smooth those lumps. Very few of the loans were residential or commercial mortgages. The securities holdings were almost exclusively government or agency-backed bonds. With securities holdings at

Figure 1
SVB Balance Sheet, 2019 and 2022

Dec. 31, 2019 ($billions)

Assets		Liabilities + equity	
Cash	6	Deposits	63
Securities	28	Other debt	2
Loans	33		
Other	3	Total liabilities	65
		Equity	5
Total	70	Total	70

Dec. 31, 2022 ($billions)

Assets		Liabilities + equity	
Cash	13	Deposits	175
Securities	117	Other debt	19
Mark-to-market	*99*		
Loans	74		
Other	5	Total liabilities	194
		Equity	15
		Mark-to-market	*–3*
Total	209	Total	209
Mark-to-market	*191*	*Mark-to-market*	*191*

Source: SVB (2019, 2022).
Note: Mark-to-market equity represents author's calculations of adjusted (mark-to-market) assets less book liabilities.

40 percent of all assets, SVB was above the national average of 25 percent, but was not an extreme outlier. Banks hold securities for two main reasons: (1) as a higher-yielding (compared to cash) way to store funds that they plan to later loan out; and (2) as a source of liquidity, because safe government securities can easily be sold for cash to meet deposit withdrawals. Plain "cash" was only at $6 billion.

Bank assets face two main risks: "credit risk" and "interest-rate risk." Credit risk is that a borrower will not make timely payments of interest or principal; this risk is what usually gets banks into trouble, but was not a problem for Silicon Valley Bank. Their loan portfolio was concentrated in the ecosystem of startup technology firms, the venture capital firms that fund them, and the employees of both. Although this portfolio was not well-diversified, SVB never faced serious concerns about the quality of its loans. Furthermore, SVB's securities portfolio was almost exclusively

comprised of government or agency-backed bonds, and thus had effectively zero credit risk.

The main problem at Silicon Valley Bank turned out to be interest-rate risk: in general, when interest rates change, the value of most assets and liabilities change as well, and this risk must be managed. Even risk-free securities like US government bonds are subject to interest-rate risk. For example, imagine that all interest rates are exactly zero, and you own a government security that will pay off in one year for exactly $1, without making any other payments along the way. In this zero-rate world, the market value of this government security today should also be $1. Next, imagine that all interest rates increase to be 1 percent. Now, if you wanted to sell that government security, any buyer will want to earn a return of 1 percent. For a bond that will ultimately pay $1 in one year, the price today would need to be (approximately) 99 cents. Even though the payment of $1 in one year is known for certain, the price of the security must still fall today to make the return (99 cents today turning into $1 in one year) competitive with newly issued securities that offer a 1 percent return.

Interest-rate risk tends to grow with the maturity of a security. Consider a bond that has a single payment of $1 in five years, with no other payments before that. In a zero-interest-rate world, the price of this bond today would still be $1. But now, if interest rates increase to 1 percent, an investor today would only be willing to pay about 95 cents for that bond, because the investor would require a return of 1 percent per year (95 cents today turning into $1 in five years) over the full five-year holding period. For the five-year bond, a 1 percentage point increase in interest rates leads to approximately a 5 percent decrease in the price. For the one-year bond example considered above, the decrease was only 1 percent.

With more complex bonds, the arithmetic gets messier, but the underlying intuition stays the same: when interest rates go up, the value of long-term assets is hurt more than short-term assets. If a bank wants to protect itself against interest-rate risk, it can try to match the maturity structure of its assets and liabilities, so that any change in interest rates would have an offsetting effect on both sides of the balance sheet. If this offset is perfect, then we would say that the bank has "perfectly hedged" its interest-rate risk.

Perfect hedges are difficult to achieve in banking. For most banks, the vast majority of their liabilities are customer deposits, most of which can be withdrawn upon demand. The legal maturity of such deposits is effectively zero. It is not feasible for traditional banks to get their assets down to zero maturity, so banks use a variety of other techniques to manage their interest-rate risk. The failure of Silicon Valley Bank to hedge its interest-rate risk properly was the proximate cause of its failure, but the story is more complicated than simple negligence. We return to this topic in the next section of the paper.

On a bank's balance sheet, the difference between assets and liabilities is mechanically equal to "equity," which in Silicon Valley Bank in 2019 stood at $5 billion, yielding an equity-to-assets ratio of about 7 percent. For the purposes of this paper, we will consider equity to be a synonym for "capital"—that is, the

cushion that protects depositors and other debtholders from variations in the value of the assets. To the extent that assets are completely riskless in all respects, any positive level of capital would be sufficient to provide safety for all depositors, insured and uninsured. But once any uncertainty arises about the value of assets, a rational depositor (or insurer) would require more capital to feel safe.

One useful way to conceptualize the necessary capital cushion for a bank is to think of it as an input in the production of money. To satisfy the value of bank deposits (like checking accounts) as a transactions medium, it must be possible to use these deposits in exchange *at par value* with "no questions asked" (Holmstrom 2015). If an agent has to worry that the money they are receiving is not actually worth the number written on the check, then it will lose its usefulness as money. Having a sufficient capital buffer is the most important step a bank can take to ensure this monetary use. Conversely, if equity levels fall too low, then it would be reasonable for counterparties to be concerned about the quality of the liabilities, and the bank's checks and deposits would lose their no-questions-asked property.

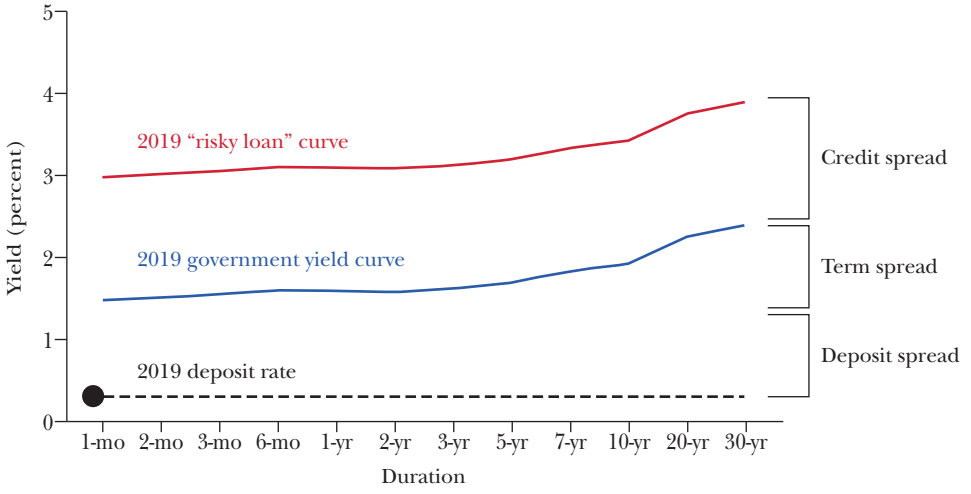
The link between the potential solvency of a bank (through its equity levels) and the liquidity of the bank (through the risk of bank runs) is driven by the connection of both to the no-questions-asked property of deposits. When bank money loses its no-questions-asked property, the rational response for (uninsured) depositors is to take their money out of the bank and put it someplace safer. Bank balance sheets contain many components that are costly to evaluate. No depositor earning a small (or zero) interest rate on their deposits should do a deep analysis of their bank to determine whether or not it was still safe—withdrawing deposits is much easier.

Silicon Valley Bank and the Business Model of Banking

At its core, banking is a simple business. Almost all of a bank's assets and liabilities are essentially just digital equivalents of pieces of paper: mortgages, commercial loans, checking accounts, cash reserves, and so on. The profitability of a bank is driven by earning higher interest on the assets than is paid on the liabilities, with this difference known as the "net interest margin." Indeed, one can think of a bank of producing a consumer good ("deposit services") that is itself just a liability, using the rest of its balance sheet as the factory floor for this production.[1]

[1] US banks earn about two-thirds of their revenue from net interest. The remaining noninterest revenue comes from fees and service charges on deposit accounts and credit cards, investment banking, asset management, and other activities. See Haubrich and Young (2019) for an analysis of these components over time. The Silicon Valley Bank business model focused mainly on net interest: "Net interest income accounts for the major portion of our earnings. It is comprised primarily of income generated from interest rate spread differences between the interest rates received on interest-earning assets, such as loans extended to clients and securities held in our fixed income securities portfolio, and the interest rates paid by us on interest-bearing liabilities, such as deposits and borrowings" (Silicon Valley Bank Financial Group 2023, p. 7).

Figure 2
Silicon Valley Bank and the Business Model of Banking



Source: US Department of the Treasury (2023); SVB (2020a); author's calculations.
Notes: The 2019 deposit rate is a year-end estimate based on SVB presentations. The 2019 government yield curve represents the government's cost of borrowing at different maturities. The 2019 "risky loan" curve represents a 150–basis point premium on the government yield curve as an estimate of a premium on risky lending.

Figure 2 illustrates the three main sources of net interest margin for Silicon Valley Bank as of December 31, 2019. The y-axis shows interest rates (= "yield") measured as an annualized percentage; the x-axis shows time. Starting in the middle of the figure, the solid blue line shows the term structure of government debt: the market interest rates paid by the government to borrow at various maturities, ranging from one month to 30 years. (As is standard in these kinds of figures, the x-axis is not drawn to scale, instead showing many observations for short-term maturities before getting sparser at the long end.) The graph of these government interest rates, represented by the blue line, is called the "yield curve." The curve begins at approximately 1.5 percent for Treasury bills with one month remaining on their term, rising to about 2 percent for 10-year bonds and 2.5 percent for 30-year bonds. The "term spread" shown on the right side of the figure represents the difference between the yields on the shortest- and longest-horizon government debt. This term spread is positive, which is the usual condition. To the extent that SVB—like most banks—will be borrowing at the short end of the curve and lending at the long end of the curve, a bank will capture some component of this term spread as part of its net interest margin.

If all the bank did was to borrow short-term at the government rate and then lend long-term back to the government, the net interest margin would be exactly equal to the term spread. But banks can improve upon the seemingly risk-free

borrowing rates of the government. At the bottom left of the figure, the solid circle at 0.4 percent represents the average interest rate paid by Silicon Valley Bank on deposits at the end of 2019. Because these deposits can be demanded at any time, their *legal* term-to-maturity is close to zero, and thus the solid circle lies right next to the y-axis. The vertical difference between this solid circle and the leftmost point on the blue government yield curve is the "deposit spread" earned by SVB. Effectively, SVB's customers are willing to accept an even lower return than they would get in government T-bills because of the transaction services and other perquisites provided by their demand deposits at the bank. Unlike Treasury bills, bank deposits can be used to facilitate transactions; many components of the legal ability to provide these services are unique to banks.

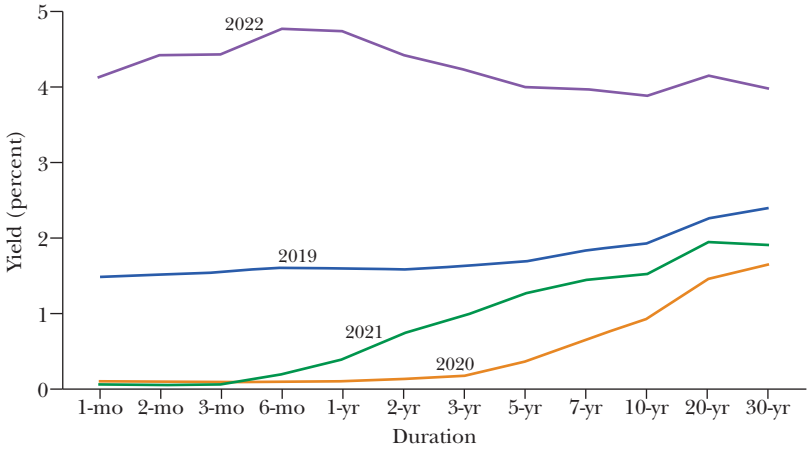
Figure 2 also includes a dotted line extended from the solid circle. This dotted line represents the expectation that deposits are "sticky" in the sense that depositors do not switch banks in the short run. In the limit, if we make an extreme (counterfactual) assumption that most depositors make a lifetime commitment to their bank at current dotted-line rates, then any further increase in the blue line would effectively be a windfall for the bank.

Of course, in normal times we do not expect banks to invest all of their deposits in government securities. As seen in the Silicon Valley Bank balance sheet in Figure 1, approximately half of the assets at SVB were in securities at the end of 2019, with the other half in more traditional loans to businesses and individuals. Unlike government securities, these traditional loans are risky and would be expected to earn a premium over the government yield curve. This "risky-loan" curve is shown in red, with the difference between the red and blue curves shown on the right as the "credit spread." The risky-loan curve represents an estimate of expected yields on the loans, drawn just for expositional purposes: no public data is available to show the rates on the SVB loan book, so we just use a fixed premium here of 1.5 percent. Note that if a bank turns out to have chosen its loans poorly, the *realized* return on risky loans could easily lie beneath the government yield curve.

Taken together, the net interest margin in any given period would be the sum of these three components: the term spread, the deposit spread, and the credit spread. In ordinary times, when a bank is able to pay deposit rates below the government borrowing rate (positive deposit spread), when the government yield curve slopes up (positive term spread), and when risky loans are being paid back (positive realized credit spread), banks will have healthy net interest margins. For 2019, Silicon Valley Bank realized a net interest margin above 3 percent.

But the monetary policy response to COVID-19 led to major changes. Figure 3 traces the evolution of the government yield curve for the next three years. The blue line gives the starting point at the end of 2019, with the same curve as shown in the same color on Figure 2. Even though this curve was already low by historical standards, the response of the Federal Reserve to the pandemic drove rates even lower. The orange line shows the government yield curve at the end of 2020. Short-term rates were effectively zero, and Silicon Valley Bank—like all banks—was no longer earning a positive deposit spread.

Figure 3
Treasury Yield Curves, 2019–2022

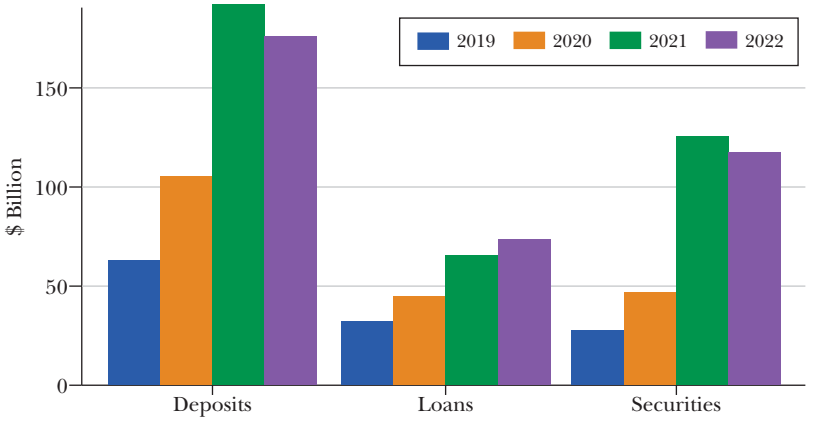


Source: US Department of the Treasury (2023).
Note: Lines represent the government's cost of borrowing at different maturities, measured at year-end.

Had the yield curve stayed at these historical lows, Silicon Valley Bank would have been fine. Although the deposit spreads available at the end of 2019 had disappeared, the term spread still existed and the legacy loans from before the COVID era were continuing to perform, preserving credit spreads from that time. But the Fed began fighting the COVID-era inflation in earnest in early 2022, and by the end of the year the government yield curve (in purple) was strikingly different from its blue, orange, and green predecessors; both the level and the slope of the curve had changed. On December 31, 2022, the yield curve for government securities was relatively flat at about 4 percent for all maturities, eliminating the term-spread component.

Figure 4 illustrates the main changes to Silicon Valley Bank's end-of-year balance sheet from 2019 to 2022, using the same color scheme as for interest rates in Figure 3. Taken together, these two figures show how the rapid growth at SVB coincided with changes in the interest-rate environment during the COVID era. In 2020, the powerful easing of rates was also combined with aggressive expansionary fiscal policy. The combined effect of these twin policies was felt particularly strongly in the tech sector of the Silicon Valley region. Younger firms were awash in cash, and a lot of that cash made its way to SVB, where deposits more than tripled from the end of 2019 to the end of 2021. Even in the best of times, it would have been difficult to find enough good lending opportunities to soak up these deposits. SVB did lend out some of these deposits, but the majority went into the purchase of securities. The same dynamics applied in 2021: the loan book grew, but not as fast as the securities portfolio.

Figure 4
SVB: Loans, Deposits, and Securities, 2019–2022



Source: SVB (2019, 2020b, 2021, 2022).
Note: This figure illustrates the main changes to Silicon Valley Bank's end-of-year balance sheet from 2019 to 2022, using the same color scheme as for interest rates in Figure 3.

The bank's growth in 2020 and 2021 took place in a low-interest-rate environment. When the Federal Reserve aggressively raised its target interest rate in 2022, the balance sheet at Silicon Valley Bank stopped growing. Towards the end of the year, tighter credit conditions and the need for operating funds led some of SVB's customers both to withdraw deposits and to tap their credit lines. To hold on to customers, SVB did begin to raise the interest rates paid on deposits, slightly, but even at the end of 2022, about half of all its deposits paid no interest.

For Silicon Valley Bank, the greatest damage of the interest-rate changes came from the effect on the balance sheet, as the increase in long-term interest rates reduced the value of all of the long-maturity assets. The bottom panel of Figure 1, showing the balance sheet on December 31, 2022, allows us to assess the damage. At this time, the book value (or original cost) of assets and liabilities was $209 billion and $194 billion respectively, leaving $15 billion left over as an equity cushion. From this book-value accounting perspective, SVB was solvent and had an equity-to-assets ratio of approximately 7 percent, the same ratio as it had at the end of 2019.

But things look different once we "mark-to-market" the assets—that is, when we look not at the value of the assets at the time they were purchased, but at what they are worth at current market prices. For securities held by Silicon Valley Bank, most of which were purchased when interest rates were much lower in 2020 and 2021, the rise in long-term rates caused a reduction in mark-to-market value of about $17 billion, with this newly mark-to-market value shown in red as $103 billion. Note that these mark-to-market values are not based on realized or expected credit losses; rather, all of the reduction in value comes only from the fact that the value of a bond that pays a certain fixed interest rate will fall when market interest rates rise.

There is no mystery about this mechanical relationship, and it was well understood by management, bank supervisors, and market analysts. Indeed, most of these losses had already been incurred by the end of the third quarter of 2022, and the information about these losses was available in public filings by the bank well before the end of 2022. By this measure, Silicon Valley Bank was already insolvent by December 31, 2022, as shown in the bottom panel of Figure 1, with negative $3 billion in equity. From these facts, one might wonder what regulators, investors, and uninsured depositors could possibly have been thinking to allow SVB to continue operating for so long after this apparent "insolvency" was clear.

The answer here is that Silicon Valley Bank relied on the stability of their customer relationships—the "stickiness" of deposits—as their main method to hedge interest-rate risk. At first glance, this belief may seem counterintuitive, and perhaps even a little magical. Most deposits are in-demand accounts and can be withdrawn at any time. In principle, if interest rates rise, one would expect that either deposit rates would rise or customers would leave and go to another bank. But reality is different. Loyalty, transactions costs, and simple inertia keep many consumers at their banks even when interest rates change—indeed, this stickiness is the reason for the dotted line in Figure 2.

Silicon Valley Bank is not unusual in relying on the stability of its deposits. In an influential paper, Dreschler, Savov, and Schnabl (2021) demonstrate that profits from the deposit spread have been a remarkably good hedge for interest-rate risk for US banks. Their analysis shows that deposit rates are quite inelastic to market interest rates, so that an increase in market rates leads to an increase in deposit *spreads*. Banks build their business plans around this relationship, using marketing, branch networks, and personal service to maximize the stability of their deposit base. We can think of the net present value of this deposit spread like an additional asset for banks, the "franchise value of deposits," but one that is never included in any formal balance sheets. When interest rates rise, the deposit spread increases and this franchise value goes up, but not even "mark-to-market" accounting will capture this change.

The rise in interest rates in 2022 caused significant losses for the entire banking system (Jiang et al. 2023; Flannery and Sorescu 2023). Hundreds of banks were likely close to insolvency if we were to accurately mark-to-market *only the securities and loans* of their balance sheets. If we try to account for the increased value of the deposit franchise, the insolvency often disappears. If deposits lose their stickiness, however, then the value of the deposit franchise will fall, and fear of insolvency can cause actual insolvency. For Silicon Valley Bank, that is exactly what happened next.

Silicon Valley Bank and the Panic of 2023

Most of the mark-to-market losses shown in the bottom panel of Figure 1 had already manifested by the end of the third quarter of 2022. The existence of these losses was public. Everybody could see—without doing much work—that by

this measure Silicon Valley Bank was "insolvent" on paper. So why didn't anything happen until March 2023?

The crucial shock arrived on March 8, 2023, when Silicon Valley Bank announced that it had sold $24 billion of book value securities for a loss of $1.8 billion, along with a plan to raise $2.25 billion of new equity. This announcement contained new information. By selling the securities, SVB was now required to recognize these losses on its income statement and balance sheet—the losses were now "realized." Banks would prefer not to realize losses, and it was reasonable to conclude that the bank did not have better options. Outside onlookers could ask reasonable questions: Maybe the deposit outflow is more severe than we thought? Maybe SVB will need to recognize even more losses to the point that they are actually insolvent? When these kinds of questions become salient, that is all it takes for uninsured deposits to lose their no-questions-asked property.

Once the no-questions-asked property is lost, the cost-benefit calculation for uninsured depositors changes. While history suggests that uninsured depositors have a good chance of ultimately getting all of their money back, it also suggests the possibility of significant delays before this happens. Thus, uninsured depositors knew that if Silicon Valley Bank failed, the potential costs of delay could be material, easily surpassing the transactions costs of switching banks. Many depositors seemed to share this thinking on Thursday, March 9, 2023. The $42 billion withdrawn that day represented almost one-quarter of SVB deposits. Once the news of those withdrawals spread, even more depositors started asking questions. On Friday, March 10, the pace of withdrawals was so rapid that the authorities did not expect SVB to make it through the day.

The Federal Deposit Insurance Corporation took the bank into receivership in the morning—the first intraday receivership in its history. Its announcement on Friday, March 10, 2023, showed that uninsured depositors were right to be concerned: "All insured depositors will have full access to their insured deposits no later than Monday morning, March 13, 2023. The FDIC will pay uninsured depositors an advance dividend within the next week. Uninsured depositors will receive a receivership certificate for the remaining amount of their uninsured funds. As the FDIC sells the assets of Silicon Valley Bank, future dividend payments may be made to uninsured depositors" (FDIC 2023a).

On that Friday, uncertainty was all the Federal Deposit Insurance Corporation could promise for uninsured depositors. But the failure of Silicon Valley Bank, along with the murky outlook for uninsured depositors, led to a violation of the no-questions-asked property at many other banks. In particular, depositors ran from banks that had the same dangerous combination as SVB: a high percentage of uninsured deposits combined with significant unrealized losses on their assets. Two large banks were particularly hard-hit by deposit outflows that same Friday, March 10: Signature Bank, with $110 billion in assets, had about $10 billion in outflows, and First Republic Bank, with $213 billion in assets, had about $25 billion in outflows. Signature was particularly unprepared for this event. Many banks have collateral "pre-positioned" at the Federal Reserve, which involves filling out paperwork which designates certain bank assets and assures that the Fed would have a top priority

claim on those assets if the bank wants to use them as collateral for emergency discount-window borrowing. However, Signature Bank had no pre-positioned collateral, and thus would not have been able to access emergency borrowing from the Fed. This unpreparedness, combined with long-standing regulatory concerns about the management of the bank, convinced regulators to close the bank on Sunday, March 12, and create another FDIC receivership.

As the Federal Deposit Insurance Corporation sought to reassure the uninsured depositors, it faced a substantial obstacle. In any bank resolution, the FDIC is required by law to cover the insured depositors at the "least cost" to the deposit insurance fund. In many cases, another bank is often willing to take on all of the deposits of the failed bank in order to obtain those banking relationships for itself. However, the Silicon Valley Bank failure happened so fast that there was no time to arrange for such a purchase, nor any way to be certain that any such purchase would eventually occur. The FDIC would have had a hard time making a convincing case it was "least cost" to make noncontractual payments to uninsured depositors. The only way around the least-cost requirement is for the FDIC to invoke a "systemic risk exception," enacted in 1991 legislation. This exception cannot be invoked casually: doing so requires a positive vote from the boards of both the FDIC and Federal Reserve, as well as approval by the US Secretary of the Treasury. Invoking the exception also brings close scrutiny to the FDIC, especially since Silicon Valley Bank had not previously been classified as being systemically important.

However, the Federal Deposit Insurance Corporation invoked the systemic risk exception on Sunday, March 12, and promised to protect uninsured depositors, thus showing how much can happen in two days (FDIC 2023b):

> After receiving a recommendation from the boards of the FDIC and the Federal Reserve, and consulting with the President, Secretary Yellen approved actions enabling the FDIC to complete its resolution of Silicon Valley Bank, Santa Clara, California, in a manner that fully protects all depositors. Depositors will have access to all of their money starting Monday, March 13. No losses associated with the resolution of Silicon Valley Bank will be borne by the taxpayer. We are also announcing a similar systemic risk exception for Signature Bank, New York, New York, which was closed today by its state chartering authority. All depositors of this institution will be made whole. As with the resolution of Silicon Valley Bank, no losses will be borne by the taxpayer.

What changed from Friday, March 10, to Sunday, March 12? Given the information now publicly available, I speculate that on Friday, March 10, when Silicon Valley Bank was closed, the authorities had hoped that its failure was idiosyncratic and that the panic would not spread to other banks—or at least would not spread quickly. However, by Sunday, March 12, it was clear that the panic was contagious, and that the no-questions-asked property had been lost for unsecured deposits at banks with large unrealized losses.

The Federal Reserve also made an important policy announcement on that same Sunday, March 12, by introducing the Bank Term Funding Program, which broke new ground in emergency lending. Historically, the Federal Reserve would use the market value of securities as their collateral value and only allow banks to borrow up to that market value minus a small cushion. For the Bank Term Funding Program, it raised this collateral value to par for government securities. Thus, five-year duration government bonds issued in 2021, which were then trading at about $0.85 on the dollar, would still count as a full $1 of collateral from the discount window. Had this program been in place on March 9, and had Silicon Valley Bank possessed the operational capability to pledge all of its securities to the Fed, it would have been able to survive a much larger run.

The Bank Term Funding Program represented a major break from past Fed practice and required an invocation of the "unusual and exigent circumstances" clause from Section 13(3) of the Federal Reserve Act. This emergency authority, granted by Congress in 1935, went unused for more than 70 years before getting its first workout during the global financial crisis of 2008–2009. Since then, the Fed has decided that the "unusual and exigent circumstances" applied twice more, first during COVID-19 and again in the Panic of 2023.

The combination of the Federal Deposit Insurance Corporation using the systemic risk exception to reassure the uninsured depositors that they would be protected and the Federal Reserve using the unusual and exigent circumstances rule to create the Bank Term Funding Program succeeded in slowing down the outflow of deposits at many banks, but not in stopping it. First Republic Bank, which had seemed on Friday, March 10, only hours away from failure, was able to limp on for seven more weeks before being closed on May 1. This delay provided the FDIC enough time to organize an orderly auction, and the "least-cost" winning bid—from J. P. Morgan—included full assumption of all the uninsured deposits. Thus, the FDIC did not need to use the systemic-risk exception for the resolution of First Republic.

The government actions in March 2023 did not solve the underlying solvency concerns in the banking system. Interest rates remained high, so that the mark-to-market losses arising from higher interest rates remained. What the policies did achieve, however, was to reinforce the no-questions-asked property at a large number of troubled banks, thus allowing the deposit franchise of those banks to retain value. The franchise value from deposits then adds to the solvency strength of the bank, which reinforces the no-questions-asked property again, which further reinforces solvency strength, which further reinforces the no-questions-asked property—and then it is turtles all the way down.

The Regulation and Supervision of Silicon Valley Bank

Bank oversight by the government consists of two main components: regulation and supervision. "Regulation" consists of the specific rules banks must follow; these rules are derived from federal and state law, and go through a detailed and

time-consuming administrative process for any changes. Overall, regulation moves slowly. "Supervision" is the day-to-day enforcement of these rules, with some limited discretion given to supervisors as circumscribed by the rules. In principle, supervision can be fast. In practice, it often is not.

Most bank regulation focuses on either capital or liquidity, but the connections between the two receive far less attention. For capital, banks face a variety of regulations, with standards harmonized internationally through the Basel Committee on Banking Supervision. While the specific rules are complex, they are all variations on a theme: set a minimum ratio where the numerator is some measure of capital and the denominator is some measure of "risk-adjusted" assets. In the simplest case, capital = equity and risk-adjusted assets = total assets, yielding a capital rule based on the equity-to-assets ratio. Indeed, preserving that simple equity-to-assets ratio has proved to be the binding constraint for many of the largest banks since the global financial crisis of 2008–2009. More complex versions of capital rules allow certain types of long-term debt into the numerator of the ratio and reduce the weight of relatively safe assets in the denominator. There are many good references that explain the details of these capital rules; for present purposes, the basic equity-to-assets ratio will suffice. At 7 percent, the ratio at Silicon Valley Bank at the end of 2019 was below the 9.66 percent average for insured banks in the United States, but still above the acceptable minimum of 4 percent.[2]

For liquidity, the classic form of regulation is "reserve requirements," where a bank is required to maintain some minimum cash-to-deposits ratio, with the cash held either in its vault or at the central bank. As with the capital ratio, modern forms of liquidity regulation start with this simple formula and then allow more complex calculations in the numerator and denominator of the ratio.[3] But the main idea remains the same: the bank should have enough liquidity to meet even an unusual level of deposit withdrawals. However, these requirements are not meant to satisfy a full run of all depositors—no bank will have sufficient reserves to do that.

To enforce these capital and liquidity rules, government agencies employ supervisors to perform regular examinations. For Silicon Valley Bank, three agencies shared supervisory oversight. The Department of Financial Protection and Innovation was the chartering agency on behalf of the State of California. Because SVB was a member of the Federal Reserve System, the state-level department shared the regular examination work with the Federal Reserve Bank of San Francisco. The Fed also had authority over the bank holding company, SVB Financial. In this case, 98 percent of the assets of SVB Financial were held in the bank subsidiary, "Silicon Valley Bank" itself, which is the focus of our attention in this paper (Silicon Valley

[2]The historical development of capital rules is described in Haubrich (2020). The changes to international standards imposed after the global financial crisis are described in McNamara, Wedow, and Metrick (2019). A detailed discussion of the current rules and acceptable minimums in the United States is Scott and Labonte (2023). Aggregate statistics for insured banks at the end of 2019 is in FDIC (2020).
[3]A summary of the current international standards for liquidity regulation is given in Bank for International Settlements (2013). The specific application of these standards for Silicon Valley Bank is analyzed in Feldberg (2023a).

Bank Financial Group 2023). Because the San Francisco Fed has a much larger staff than the California Department of Financial Protection and Innovation, and also much more experience in the examination of large banks, the Fed took the lead on most of the examinations. Finally, as the insurer, the Federal Deposit Insurance Corporation is the "backup federal regulator," and had access to all information from the supervisory process.

In the aftermath of the Panic of 2023, the performance of these regulations—and the supervisors that enforce them—came under close scrutiny, with several government agencies producing reports (DFPI 2023; Federal Reserve Board 2023; FDIC 2023d; Government Accountability Office 2023). The most comprehensive of these reports came from the Federal Reserve, the agency with the most supervisory resources dedicated to Silicon Valley Bank. The report concludes that SVB was in compliance with the specific capital and liquidity rules in place at the time of its failure, but faults itself for a set of recent reforms that kept SVB (and other similarly-sized banks) from having more stringent standards. They conclude, however, that there is no guarantee that these more stringent standards would have prevented SVB's collapse. The Fed report also criticizes its own lack of supervisory zeal, saying that supervisors were aware of weaknesses at SVB, but were not aggressive enough in using their discretion to insist on timely corrections. This conclusion is well supported by evidence, but the remedy is not obvious. "Supervisors should do their jobs better" is not an easy goal to achieve.

To illustrate the challenge faced by supervisors, it is helpful to examine the largest source of concern—interest-rate risk. Many of the official reports emphasized the mismanagement of interest-rate risk by Silicon Valley Bank and the failure of regulation and supervision to correct this mismanagement. The Fed report concludes that "we need to evaluate how we supervise and regulate a bank's management of interest rate risk. While interest rate risk is a core risk of banking that is not new to banks or supervisors, SVB did not appropriately manage its interest rate risk, and supervisors did not force the bank to fix these issues quickly enough" (Federal Reserve Board 2023, p. 3).

But on this point, the regulations themselves do not provide clear guidance to supervisors. In the computation of regulatory capital measures, most mark-to-market interest-rate losses are exempt from inclusion, allowing banks to ignore such losses in meeting required ratios. Even the regulatory "stress tests" performed on the largest banks, with binding implications for their dividend and capital policy, do *not* include a specific stress for interest-rate risk. I think it is asking too much of supervisors to enforce an ethos that is not already in the plain language of the rules.

In contrast, the European Union carefully monitors "interest-rate risk in the banking book" and uses a variety of mechanisms to discourage banks from taking on too much interest-rate risk. Their methods work: EU banks have lower interest-rate risk then do US banks. But these rules do not make the risk disappear—they just shift it to a different place. For example, one main mechanism in the EU financial system to move interest-rate risk away from banks is for more borrowers to pay

variable interest rates. In that case, if interest rates go up, bank balance sheets do not take a hit, but borrowers have to make higher payments. There, the risk of rising interest rates sits with borrowers.[4]

As long as actual investments take time to mature, the provision of liquidity will be a risky endeavor. That risk needs to sit somewhere, and no amount of supervisory vigilance can make this risk disappear. The European Union has chosen to shift this risk to borrowers, while the United States allows much more of that risk to sit on the balance sheets of banks. To the extent that the deposit franchise is a natural hedge for this interest-rate risk, there is a benefit in leaving this risk with banks. But there is also a potential cost, as we saw in March 2023.

Conclusion

The alchemy of banking is that solvency and liquidity reinforce each other. Bank deposits remain money-like because of the assurance of solvency. Money-like deposits tend to be sticky within a given financial institution, because it is costly for depositors to switch banks and replicate an earlier long-term relationship with a new institution. This stickiness gives banks a form of monopoly power, the rents earned from this power comprise a large portion of bank profits, and thus the capitalization of these rents comprises a large portion of the bank's market value. Therein lies the alchemy. As long as the deposit base is stable, the expectation of future profits from deposit spreads adds to the solvency strength that supports the very same deposit stickiness. An information event that calls into question a bank's solvency can quickly become self-reinforcing, as a large component of the solvency disappears when the questions are asked openly. This is the main story of Silicon Valley Bank.

If the stability of the deposit base plays such a central role, why not simply increase the maximum level of deposit insurance? For example, during the global financial crisis of 2008–2009, the Federal Deposit Insurance Commission introduced the Transaction Account Guarantee (TAG) program, which provided unlimited insurance for non-interest-bearing accounts. This program was temporary—expiring at the end of 2010—and has generally been considered to be successful at calming depositors during the worst times of that crisis.

There are several challenges for making a program like the Transaction Account Guarantee permanent. First, when the program was deployed in 2009–2010, interest rates were headed toward zero. Depositors gave up very little by sticking with non-interest-bearing accounts in that environment. In the higher-interest-rate environment that we have today—and which we should expect to recur at least occasionally—the incentives for depositors to leave banks for other vehicles would be significantly stronger. Second, if we went further than the Transaction Account Guarantee and allowed unlimited deposit insurance even for interest-bearing

[4]For a discussion of the US approach to interest-rate risk as compared with the rest of the world, see Feldberg (2023b). For an analysis of EU interest-rate risk, see Dries et al. (2022).

deposits, we should not be surprised to see clever bankers finding ways to sell all kinds of financial products that are ultimately backed by an infinite safety net. For an intermediate solution of raising the deposit limit above $250,000 but less than infinity, the same two problems exist, just in intermediate form.

The challenge of finding the "right" level of deposit insurance is a good example of the general problem of finding the right balance in financial regulation writ large. We should—of course!—try to do the best job we can in enforcing the regulations currently on the books. But in writing new regulations, we must recognize the tradeoffs. In general, bank regulation cannot change the total amount of risk in the economy, but it is highly effective at shifting that risk around. Banks, their customers, their substitutes ("shadow banks"), government, and taxpayers—what is our choice for who should hold what share and what kind of risk?

■ *I thank Greg Feldberg, Eric Hurst, Steven Kelly, Nina Pavcnik, Timothy Taylor, Rosalind Wiggins, and Heidi Williams for helpful comments and Vincient Arnold, Anmol Makhija, and Carey Mott for excellent research assistance.*

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