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Pricing Tail Risks: Bank Equity Returns During the 2023 Bank Stress *

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Abstract

Did bank equity prices reflect growing sector imbalances before the 2023 failure of Silicon Valley Bank? We find that banks with higher reliance on uninsured deposits, or with higher marked-to-market leverage, had lower equity returns prior to SVB's collapse. Although markets priced uninsured deposits and high leverage individually, their interaction was not reflected in market prices prior to SVB's failure. Post-SVB, banks with less ability to meet outflows without severely depleting capital, and banks with too little useable liquidity relative to runnable funding, experienced larger stock price declines, beyond what other fundamentals and business model risks explain. In addition, we highlight evidence of feedback between equity prices and balance sheet management: banks with lower returns in 2023:Q1 were more likely to rely heavily on reciprocal deposits by 2023:Q2.

Keywords: Financial Institutions, Bank Capital, Interest Rate Risk, Liquidity

JEL Classification Numbers: G20, G21, G28

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1.0 Introduction

In an after-hours press release on Wednesday, March 8, 2023, Silvergate Capital announced it would be winding down Silvergate Bank (Silvergate 2023). The $11 billion crypto-centric bank succumbed to deposit outflows following a loss of confidence in the digital asset sector after the bankruptcy of FTX in late 2022. That same evening, the tech-focused Silicon Valley Bank (SVB) announced an equity raise of about $2 billion to cover losses it had realized to meet the higher cash demand of its depositors. SVB's acute need for equity shocked market participants and by Thursday close, its stock price dropped more than 60 percent as depositors ran. By Friday, the once $200 billion bank had failed. On Sunday, Signature Bank folded –the firm had $100 billion assets and significant exposure to the crypto sector. These events awakened broader banking sector concerns. The KBW Nasdaq Regional Banking Index (KRX) finished about 20 percent down over the week, while broader indices such as the S&P 500 were little changed.

There are several narratives detailing the causes of the spring 2023 banking stress. We focus on two. The first emphasizes macroeconomic and banking sector factors. Several researchers note that a significant share of banks became increasingly prone to a run equilibrium given the combination of the 2022 inflationary shock and sustained rise in long-term yields, which came at a time when interest risk, leverage, and reliance on uninsured deposits had increased significantly across the banking system (e.g., Cipriani, Eisenbach, and Kovner, (2024), Flannery and Sorecsu (2023), Jiang, Matvos, Piskorski, and Seru(2023), Drechsler, Savov, Schnabl, and Wang (2023), Kimble and Seay (2024)). The second narrative adds a dimension of business model risk – stress was most severe at a few outlier banks exposed to industries, namely crypto and venture capital, that had experienced a relative downturn (e.g., Kelly and Rose (2025), Metrick (2024)).

In this paper, we construct novel risk measures to capture bank business model and banking sector risks. We use these measures to examine bank equity returns before, during, and after the failure of Silicon Valley Bank. In addition, we analyze changes in bank balance sheet management following the abrupt loss of confidence in March 2023.

Our work sheds light on three questions.

1. Which factors explain bank stock price movements before the failure of SVB?
    a. Banks with high reliance on uninsured deposits, or with low capital after accounting for fair value losses, had lower returns prior the SVB's failure. However, we find no evidence that the interaction of broader banking sector vulnerabilities, such as the

interaction of higher reliance on uninsured deposits and low market-adjusted capital, as measured by common equity tier 1 ratios less fair value losses on loans and securities, were reflected in bank stock prices before SVB's failure.

2. Which factors explain bank stock price movements after the failure of SVB?
    a. Banks with exposure to declining venture capital activity or cryptocurrency market volatility had lower returns immediately following SVB's failure, but those factors become insignificant after the announcement of the Bank Term Funding Program (BTFP). Post-SVB and post-BTFP, banks less able to meet deposit outflows without severely depleting their capital positions underperformed, beyond what other fundamentals such as growth and profitability explain. This suggests market participants may have mispriced tail risks that ultimately contributed to a run equilibrium, despite the data being publicly available. Banks with more borrowing capacity and higher cash positions outperformed after SVB's failure. These findings suggest the shock propagated across the banking system, and banks that severely mismanaged the interaction of their leverage, interest-rate risk, and runnable funding became increasingly vulnerable to shocks, regardless of business model focus.
3. Did firms with worse cumulative excess returns during the first quarter implement different balance sheet management practices in subsequent quarters?
    a. We find that banks with worse stock price returns in the first quarter were more likely to have high growth of reciprocal deposits and large reductions in uninsured deposits during 2023:Q2.[1] Reciprocal deposits split large deposits across a network of other banks in increments of $250,000 or less, effectively providing insurance for large balances and reducing large depositor's incentives to run.[2] This action may have helped preserve their deposit franchise and soothe the market participant concerns as noted by Ken, Kundu, and Purnandum (2024).

Our findings have several policy implications. First, the majority of banks that survived the 2023 financial stresses did so by borrowing rather than selling assets outright (Cipriani, Eisenbach, and Kovner (2024), Glancy, Ionescu, Klee, Kotidis, Siemer, and Zlate (2024)).[3] By borrowing, these firms successfully met the cash demand of their depositors and avoided realizing large interest-rate driven

[1] Reciprocal deposits are offered to individual depositors with funds above $250,000. We do not isolate potential supply and demand effects for reciprocal and uninsured deposits. For a detailed discussion of reciprocal deposits see Prescott and Rosenberger (2024).
[2] Reciprocal deposits are limited to the minimum of 20 percent of liabilities or $5 billion for well-capitalized banks.
[3] We acknowledge this may pose significant costs in the form of stigma, reputational risk, and moral hazard.

losses. Thus, banks with otherwise viable business models could benefit by establishing discount window operational readiness in normal times. Second, more capital helps stave off run equilibriums for banks that operate with higher asset duration. Despite large holdings of liquid securities, SVB's interest rate risk rendered it insolvent. Third, limited diversification by industry, or outsized exposure to highly cyclical industries, can destroy deposit franchise value.[4] Deposit outflow assumptions in banks' liquidity management planning should be consistent with their level of diversification by industry. Lastly, vulnerable banks turned to reciprocal deposits after SVB failed. The large growth of reciprocal deposits during the emergence of stress suggests the uninsured deposit limit of $250,000 may require revisiting.[5]

The remainder of this paper is organized as follows. Section 2 reviews literature on the 2023 bank stress and places this paper's contributions in that context. Section 3 summarizes the data sources we use to construct vulnerability measures and other bank balance sheet controls. Section 4 describes the methods we use to test the relationship between bank balance sheet management and equity prices before and after the failure of SVB. Results are shown in Section 5 and policy implications are discussed in Section 6.

[4] In SVB's case, technology companies and venture capital firm's demand for cash gradually eroded the bank's deposit franchise value. Once it became clear that the bank was unable to meet operational cash outflows without severely depleting its capital, depositors ran. SVB's failure demonstrates risks associated with a highly concentrated deposit base.

[5] Reciprocal deposits may have stabilized deposit franchise values; however, the underlying risk characteristics of large depositors likely remain unchanged.

2.0 Literature review and contribution

Several studies have explored the underpinnings of the 2023 U.S. bank failures. Below, we summarize our contribution, then provide an overview of relevant literature strands and highlight our additions to each.

Our contribution to this literature is threefold. First, we introduce novel measures to evaluate the distinct sector vulnerabilities arising from: 1) the interaction of too little *useable* liquid assets relative to runnable funding, 2) too little capital relative to interest rate risk, and 3) too little borrowing capacity relative to funding structure. While much of the literature has emphasized the possibility of a run equilibrium caused by high asset duration, solvency concerns, and substantial reliance on uninsured deposits, less analysis has been conducted on the imbalance of banks' *useable* liquidity and runnable funding, and banks' borrowing capacity relative to runnable funding. Second, using these novel measures, we examine the cross section of excess bank equity returns relative to the NASDAQ Regional Bank Index (KRX) before, during, and after the failure of SVB. Lastly, we document new evidence of feedback between bank stock price performance in the immediate aftermath of SVB's failure and balance sheet management choices among fragile banks during 2023:Q2. Notably, we find higher reciprocal deposit growth among more vulnerable banks, which may have reduced large depositors' incentives to run and preserved deposit franchise during the SVB episode.

Our work is closely related to growing theoretical and empirical literature on the interplay of the large inflation shock of 2022, higher asset duration in the banking system, and higher reliance on runnable funding. Flannery and Sorescu (2023) develop a measure of solvency and find that roughly half of U.S. banks would have capital ratios below their requirements if unrealized, interest-rate driven asset losses were fully reflected in regulatory capital requirements. Jiang, Matvos, Piskorski, and Seru (2024) develop a framework that shows both sides of bank balance sheets became increasingly fragile as higher yields reduced the value of bank assets and banks relied more heavily on uninsured deposits, leaving them more prone to a run equilibrium. Curti and Gerlach (2024) propose a similar measure and use it to predict bank runs. Dreschler, Savov, and Schnabl (2023) show that a run equilibrium is more likely when rates are high or when uninsured deposit reliance is high, both of which contribute to fragile deposit franchise. Hirtle and Plosser (2025) introduce a novel measure of economic capital that aims to offer a more integrated approach to evaluating banks' stability in light of changes in fair value of both sides of the balance sheet.

Like these papers, we propose a measure of solvency that includes interest rate risk. We adjust banks' risk-based capital ratios for fair value losses on all loans and securities and call this measure the

market-adjusted CET1 (MACET1) ratio. This solvency measure highlights a subset of banks became more fragile as they added asset duration throughout the pandemic, which made them increasingly vulnerable to the sudden rise of inflation and long-term yields in 2022. In an expansion of the literature, we develop two additional measures to encompass distinct vulnerabilities that banks face as yields and inflation increase. The first measure is lower friction liquidity (LFL). LFL is the ratio of cash and useable available-for-sale securities to uninsured deposits and other runnable funding. This measure is meant to capture firms with an imbalance of cash, and the fair value of assets that can quickly be converted to cash, relative to runnable funding. Importantly, the measure includes only AFS securities that could be liquidated at fair value without breaching common equity tier 1 requirements, consistent with the limited useability of high duration, highly liquid assets. We add a second measure which reflects viable banks' unique advantage to borrow against the discount window and other external funding sources. Our measure, which is called *borrowing capacity,* is the ratio of the fair value loans and securities, less pledged loans and securities, to uninsured deposits and other liabilities maturing within one year. This measure provides an upper bound on banks' ability to borrow, rather than liquidate assets outright.

We also contribute to empirical papers that have documented investors' response to various balance sheet-based measures of risk. This research generally finds that investors were not fully attentive to the broader sector risks associated with high interest rates before SVB's collapse. Choi, Goldsmith-Pinkham, and Yorulmazer (2023) argue that the market partially anticipated risks from uninsured deposits but did not fully price in the risks related to higher interest rates and higher unrealized losses. Fischl-Lanzoni, Hiti, Kaplan, and Sarkar (2024) highlight how investor perceptions of risk related to uninsured deposits and unrealized losses shifted as information related to financial stress emerged. Granja (2024) notes that notes that HTM reclassifications in 2021 and 2022 were highest among risky banks with larger uninsured deposit shares. Correia, Luck, and Verner (2024) find that the fundamentals of banks start deteriorating several months before a failure, but these signs are often overlooked or ignored by investors. Policy focused papers, such as Metrick (2024), provide a detailed account of the vulnerabilities specific to SVB's business model, highlighting how the bank's sectoral focus contributed to its collapse during the 2023 banking turmoil. Relatedly, Kelly and Rose (2025) argue that the 2023 bank stress was driven in part by vulnerabilities related to specific bank business models, primarily those focused on venture capital and crypto-asset firms.

We improve on the use of isolated balance sheet metrics of bank vulnerabilities by introducing the measures discussed above, which to the best of our knowledge are untested in the current literature on bank stock price reactions during 2023. We use these metrics in an event study to demonstrate that markets underappreciated the interaction of sector risks before the failure of SVB. Second, we reconcile

various accounts of the 2023 banking stress, and examine whether market discipline was driven by fundamentals, business model risk such as exposure to crypto and venture capital, or a combination of the two. In contrast to prevailing results in the literature, we find that high leverage and high reliance on runnable funding were priced individually prior to SVB's collapse. However, their interaction – which ultimately contributed to a run equilibrium at a subset of banks – was overlooked. Similarly, we present results that suggest the interaction too little *useable* liquidity relative to runnable funding – which we call lower friction liquidity – drew the attention of market participants only after SVB's failure. We further add to the literature on bank stock price performance during the 2023 banks stress by analyzing returns of banks with specific business model risks – exposure to declining venture capital revenues or to cryptocurrency markets. To the best of our knowledge, these risks have not been previously explored in the literature.

Finally, several papers have explored the bank-runs and deposit flows during the spring 2023 bank stress. Caglio, Dlugosz, and Rezende (2023) emphasize the role of perceived safety in driving deposit flows, where safety is determined by fundamentals, regulatory oversight, and too big to fail status. Cipriani et al. (2023) show that runs were driven by large depositors and were tied to weak balance-sheet characteristics. Glancy et al. (2024) highlight that BTFP was vital in stabilizing banks with large securities losses. Huberdeau-Reid, D.A. and Pennacchi (2025) show that riskier banks were more likely to utilize reciprocal deposits. We add to this literature by documenting characteristics of underperforming publicly traded banks and provide evidence of feedback between bank stock price returns and bank balance sheet management strategies of fragile banks. Banks that faced the lowest returns during 2023:Q1 were more likely to see large growth in reciprocal deposits the following quarter.

3.0 Data and vulnerability measures

Our paper studies bank balance sheet management and bank stock price reactions surrounding the failure of SVB.

3.1 Data

We limit our analysis to publicly-traded banks for three reasons. First, most banks that could pose financial stability risks are publicly traded. Second, banks that are publicly traded banks were more likely to face runs than privately held banks with similar risk characteristics (Cipriani et al. (2024)). And finally, information on loan fair values is disclosed by publicly-traded banks, but is not available for other firms.

Most of the bank balance sheet and income characteristics we use in this paper are sourced from merger-adjusted FR Y-9C and Call Reports.[6] An exception is loan fair values, which we source from S&P Global Market Intelligence (via 10-Qs). Combined with securities fair values from Call Reports, this allows us to calculate a measure of capital (leverage) that accounts for interest rate risk, in addition to a battery of other control variables.

Daily stock prices for 2022 through May 2023 are collected from S&P Capital IQ Pro. We use daily stock prices to calculate individual bank's cumulative excess returns relative to the Nasdaq Regional Bank Index (KRX). Earnings transcripts for 2022 are from S&P Global's Transcript feed.[7] The transcript feed allows us to analyze conversations between investors and bank management teams and glean references to cryptocurrency and digital assets which we employ as a control variable.

We exclude banks that wound down their operations and or failed: Silvergate, SVB, Signature Bank, and First Republic.[8] We also drop the eight U.S. Globally Systemic Banks (GSIB) banks, and banks that acquired failed banks, such as First Citizens Bank (acquired SVB on March 27th), New York Community Bank, and Columbia Banking System.[9] This results in a consolidated dataset of 297 publicly-traded banks.

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[6] We use bank holding company level balance sheet and income statement data from FR Y-9C where available. BHCs with at least $3 billion in consolidated assets are required to file FR Y-9C. All commercial banks are required to file Call Reports, regardless of size. For the remainder of publicly traded banks, we roll up commercial bank Call Report filers to their high holders to construct controls and variables of interest. Certain variables, such as the maturity distribution of loans, are only available in Call Reports and those variables are merged with FR Y-9C BHCs using an entity mapping.

[7] We construct an RSSDID to ticker mapping using S&P Global Capital IQ Pro, which allows us to merge the stock price data with bank balance sheet information.

[8] Silvergate voluntarily wound down its operations following a period of stress in the digital asset space. This differs from SVB and Signature, which failed rapidly and were placed into receivership by the FDIC.

[9] GSIBs and other large banks have access to other sources of liquidity, such as their trading book, which enhances their liquidity positions beyond what is explored in this note.

3.2 Vulnerability measures and other control variables

The literature on 2023 bank runs has identified outsized reliance on uninsured deposits and sizeable fair value losses on held-to-maturity securities as key factors related to run risk. Broader literature on bank failures points to fundamentals such as credit risk, profitability, and growth (Correia Luck, and Verner (2024)). In this section, we introduce novel banking sector and business model risk measures that are robust to controls suggested by the literature and discuss other control variables.

3.2.1 Lower friction liquidity – the interaction of runnable funding, interest rate risk, and leverage

Uninsured deposits increased substantially as the federal response to the pandemic made its way into the banking system during 2020. Through 2021, growth of runnable funding – defined as uninsured deposits and short-term wholesale funding maturing within one year – was mostly matched with higher cash positions and larger holdings of available-for-sale securities. As the pandemic waned and the Fed tightened monetary policy, the quantity of reserves in the banking system shrank but uninsured deposits remained sticky. This imbalance of runnable funding relative to useable, liquid assets peaked during the second half of 2022 and left a subset of banks less equipped to meet deposit outflows without either increasing reliance on repo market depth, turning to other funding sources such as Federal Home Loan Banks (FHLBs), or using the discount window (DW). To reflect these risks, we construct a measure called lower friction liquidity (LFL).

LFL is the ratio of cash and useable available-for-sale securities to uninsured deposits and short-term wholesale funding maturing within one year, where useable AFS securities are defined as the maximum amount of AFS a firm could liquidate at fair value without breaching its total CET1 ratio requirement (see Kimble and Seay (2024)).[10]

During the quarter preceding SVB's failure (2022:Q4), most firms could sell their entire AFS portfolio without breaching their total CET1 requirements. For the subset that could not, LFL calculations assume that banks sell each dollar of securities at a loss rate equivalent to the average fair value decline of their AFS portfolio and continue to sell until their post-stress CET1 ratio equals their total CET1 requirement.[11]

[10] Estimates are based on the impact of higher yields on asset values and do not reflect additional losses due to fire sales.

[11] We use individual capital requirements for stress tested banks. For all other banks subject to risk-based capital requirements, we assume a minimum of 7 percent. There is evidence that banks manage their balance sheets to avoid dipping into their capital requirements, as falling below requirements can lead to reductions in capital distributions or potential downgrades, both of which pose large costs to the firm. See Berrospide, Gupta, and Seay (2024).

Selling AFS securities impacts both the numerator and denominator of bank capital ratios (through fair value losses on the numerator and reductions in RWA on the denominator). To include the impact of securities sales within LFL ratios, hypothetical post-stress CET1 ratios after selling AFS at fair value should be greater than or equal to each bank's total CET1 requirement:

$$\frac{Post-stress\ CET1_i}{Post-stress\ RWA_i} \geq TotalCET1RatioRequirement_i \quad (1)$$

Expanding post-stress CET1 ratios to incorporate Sellable AFS:

$$\frac{CET1_i - AFSLossRate_i \times SellableAFS_i}{RWA_i - \frac{SecuritiesRWA_i}{SecuritiesOutstanding_i} \times SellableAFS_i} \geq TotalCET1RatioRequirement_i \quad (2)$$

Solving for maximum SellableAFS:

$$SellableAFS_i \leq \frac{CET1\ _i - TotalCET1RatioRequirement_i \times RWA_i}{TotalCET1RatioRequirement_i \times \frac{SecuritiesRWA_i}{SecuritiesOutstanding_i} - AFSLossRate_i} \quad (3)$$

With Sellable AFS, we compute LFL ratios as:

$$LFL_i = \frac{Cash\ (including\ reserves)_i + \boldsymbol{SellableAFS_i}}{UninsuredDeposits_i + Short-termWholesaleFunding_i} \quad (4)$$

LFL captures imbalances between useable liquid assets to runnable funding, with lower LFL ratios indicating more severe imbalances. Firms with LFL ratios less than 1 have less ability to meet runnable funding outflows without raising equity, increasing reliance on repo market, or turning to other funding sources.[12] In addition, firms bound by capital constraint have less ability to shrink to meet outflows in the event of severe funding stress and lack of access to other funding sources.

The left panel of figure 1 shows that banks' ability to meet runnable funding outflows – as measured by LFL ratios – rose gradually during 2018 to 2019. During the early stages of the pandemic, LFL ratios were bolstered by significant holdings of AFS securities and reserves. LFL ratios declined materially during 2022, as uninsured deposits remained fairly sticky while cash and reserve positions declined as the Fed tightened, and securities portfolios shifted toward held-to-maturity. This imbalance is demonstrated by the leftward shift in the distribution of firms' LFL ratios, as shown in the right panel of figure 1.

[12]This measure flags banks with similar balance sheet risks similar to SVB. The firm had large HQLA holdings, but its failure to manage interest rate risk led to a severe imbalance of useable liquid assets and runnable funding. It's LFL ratio was around 0.22, implying it could cover less than a quarter of its runnable funding with its most useable assets. In addition, its interest rate risk rendered the firm insolvent, which limited access to other funding sources. The firm was operationally unprepared to borrow at the discount window.

3.2.2 Market-adjusted common equity tier 1 – a measure of solvency

Standard measures of regulatory capital do not fully reflect interest rate risk. This is demonstrated by the recent pandemic experience. Through-out the pandemic, a subset of banks invested heavily in longer-maturity securities. At the time, yields on these assets were low, but offered a premium relative to short-term investments. Higher asset duration left some banks' capital positions increasingly vulnerable to higher long-term yields. That vulnerability manifested in 2022 when inflation unexpectedly rose and substantially increased long-term yields.

To illustrate the impact of unrealized losses on banks' regulatory capital, we construct Market-adjusted common equity tier 1 (MACET1) ratios. MACET1 ratios illustrate that bank capital would be significantly depleted in an extreme scenario where fair value losses are realized (left panel, figure 2). Higher asset duration, coupled with rising long-term yields, significantly reduced MACET1 ratios relative to 2021 year-end levels as demonstrated by the right panel of figure 2.

We note that the varying methods used across the literature yield substantial differences in fair value asset losses, deposit franchise value, and consequently, bank capital. For example, Flannery et al. (2023) estimate total asset fair value declines of roughly $1 trillion among Call Report filers as of 2022:Q4, compared to about $2 trillion by Jiang et al. (2024) for that same period.[13] [14] This paper focuses on publicly-traded banks, and sources loan and securities fair values from banks' quarterly regulatory filings to construct MACET1, rather than rely on various estimation techniques used in the literature.[15]

3.2.3 Borrowing capacity – a measure of liquidity

Viable banks have the unique advantage of borrowing from the Fed and other liquidity providers. Indeed, most banks that came under stress during 2023 shored up cash by borrowing from the FHLBs and the Discount Window at the onset of SVB's failure to survive potential runs, rather than selling assets

[13] For example, Flannery et al. (2023) construct securities fair value losses by taking the difference of amortized cost and fair values as reported in Call Reports. They estimate loan fair values using the maturity distribution of loans from Call Reports and interest rate information. Jiang et al. (2024) do not use Call Report data for reported securities losses. Instead, they estimate all securities and loan fair values by mapping declines in prices of Treasury and MBS ETFs at targeted maturities to balances in in the maturity distribution of loans and securities from Call Reports, which results in significantly larger estimates of asset fair value losses.

[14] Gupta (2025) shows there is considerable uncertainty in deposit franchise value estimates. For example, for all commercial banks he estimates a range of $0.6-$1.9 trillion during 2022:Q4. The estimates are highly sensitive to assumptions that are difficult to quantify, such as the average amount of time deposits stay in the bank (maturity), appropriate discount rates, market-adjusted capitalization of the bank, and deposit betas through time. Our work assumes a system-wide run, in which the franchise value of uninsured deposits is zero.

[15] Our sample includes 297 publicly-traded banks which account for about 70 percent of total banking system assets excluding GSIBs. We note that banks may have incentives to under-report fair value losses, but have access to granular loan characteristics that are not available in Call Reports. We leave this for future exploration.

outright.[16] To understand banks' ability to borrowing, we construct a measure of borrowing capacity to runnable funding. Our measure of borrowing capacity is the ratio of cash plus the fair value of loans and securities less pledged loans pledged securities to uninsured deposits and other liabilities maturing within one year.[17] Loan fair values are sourced from S&P Capital IQ Pro. All other variables are sourced from FR Y-9C and Call Reports.

Figure 3 shows banks' ability to meet sudden outflows by utilizing repo, or pledging assets to the Federal Home Loan Banks, the Discount Window, or other contingent liquidity sources gradually declined through-out the pandemic. The reduction in borrowing capacity is demonstrated by the leftward shift in the distribution of capacity ratios on the right panel of figure 3.

By comparing LFL and borrowing capacity, we analyze whether market participants' attention was focused on bank capacity to tap funding markets to shore up liquidity (borrowing capacity), impairment associated with the acute need to liquidate assets to meet outflows (LFL), or some combination of the two.[18]

3.2.4 Cryptocurrency references from earnings transcripts

Standard regulatory filings do not contain data on banks' cryptocurrency exposures. To develop a proxy, we use bank's 2022 quarterly earnings call transcripts and construct the fraction of total paragraphs that reference cryptocurrency, and terms related to digital assets, as a share of total paragraphs for each bank.

3.2.5 Other control variables

We include other factors identified by the 2023 bank run literature (Choi, Goldsmith-Pinkham, and Yorulmazer (2024), Correia, Luck, and Verner (2024)). We include changes in the fair value of securities as a share of assets, uninsured deposits as a share of assets, return on assets, net interest margin, common equity tier 1 ratios, and bank size controls. We add an additional control for venture capital revenues as a fraction of assets from FR Y-9C and Call Reports.

[16] During 2023, banks also borrowed using the BTFP program. The program allowed banks to borrow against collateral at par, rather than fair value. Our measure is conservative in that collateral is based on fair value rather than par.

[17] Call reports include fields for pledged loans and securities but granularity is limited. For example, the fields may include assets that are registered at the discount window but not used to secure a loan. Thus, the measure may exclude assets that are quickly convertible to cash at the discount window. On the other hand, additional collateral haircuts are not applied to asset fair values. For estimates of collateral haircuts see Gorton and Ross (2024).

[18] The measure does not include a proxy for operational readiness to borrow, such as differences in the costs associated with collateral pledging process, which proved critical during SVB's failure.

4.0 Methods

We focus first on correlations of individual banks' cumulative returns in excess of the Nasdaq Regional Bank Index (KRX) before, during, and after SVB's collapse with our vulnerability measures and other balance sheet controls. We conclude with a baseline specification for predicting high reliance on reciprocal deposits in the quarter that followed the collapse.

4.1 Cumulative excess returns

The failure of SVB propagated across the banking system, but had little impact on broader indices of market performance. Thus, our cumulative excess return model focuses on industry-adjusted returns, rather than market-adjusted returns, to identify risk characteristics that underly heterogeneity in the cross-section of bank returns.

We construct cumulative excess returns following Choi, Goldsmith-Pinkham, and Yorulmazer (2024). We start with daily returns. Daily returns r_{it} are calculated for each bank *i* in period *t*. Cumulative returns are examined during three periods: the week before SVB's failure (March 3, 2023 – March 8, 2023), the two-day period of SVB's failure (March 9, 2023 – March 10th), and post-BTFP (March 13th – May 31st).

Bank *i's* cumulative returns are calculated as:

$$R_i^{period\ end} = \prod_{t \geq period\ start}(1 + r_{i,t}) - 1 \quad (5)$$

We calculate excess returns as the difference between each bank's cumulative returns and the returns of the Nasdaq Regional Bank Index (KRX) for each period. Similarly, we analyze prior year excess returns (from January 1, 2022 through December 31, 2022) to understand the timing and magnitude of when balance sheet characteristics were priced (e.g., was higher asset duration and runnable funding, or its interaction, a driver of 2022 returns).

We conduct cross sectional regressions with robust standard errors using ex-ante balance sheet characteristics. We define banks with low LFL ratios as those in the bottom quartile as of 2022:Q4.[19] We classify banks as having low borrowing capacity if their borrowing capacity ratios are in the bottom quartile. We create a dummy variable for banks with MACET1 ratios less than 7.0 percent to represent

[19] The lower quartile corresponds to an LFL ratio of 0.33 during 2022:Q4. First Republic and SVB had LFL ratios of 0.06 and 0.22, respectively, during 2022:Q4. 2022:Q4 reflects the most current, comprehensive balance sheet information available to market participants at the time of SVB's failure. FR Y-9C and Call Report forms are generally available 45 days after each quarter-end. Earnings calls were hosted about 4 to 6 weeks after SVB's failure for most publicly-traded banks.

firms that may need to raise equity should stress re-emerge.[20] The resulting sample consists of 297 publicly traded domestic banks. Tables 1 and 2 summarize the distribution of our key variables across banks. Independent variables are standardized to a mean 0 a variance 1, excluding dummy variables.

5.0 Results

Figure 4 plots the simple average of cumulative stock price returns for low LFL banks (LFL ratio < 0.33) and all other firms (LFL ratios > 0.33). The chart suggests markets priced the interaction of vulnerabilities captured by low LFL ratios after the failure of SVB. Furthermore, the similar cumulative returns across both bank groups before the failure of SVB suggest evidence of parallel trends. We use cross-sectional analysis to explore this more formally.

5.1 What factors explain cumulative excess returns leading up to SVB's failure?

Table 3 shows individual banks' cumulative excess returns relative to the KRX index from March 3rd through March 8th regressed on several vulnerability measures. Our main variable of interest that separates the treatment and control in our specifications is a dummy variable which takes the value of 1 if a firm has a LFL ratio below 0.33 (within the bottom quartile of the distribution). We include dummy variable set equal to 1 for firms with MACET1 ratios less than their total CET1 requirement. This control is designed to capture firms that may need to raise equity to cover interest rate risk stemming from securities and loans (FV losses) in the event of a severe bank run. We add a separate control for runnable funding using a dummy variable equal to 1 for firms with above-average reliance on uninsured deposits.[21] Finally, we add a control to reflect total borrowing capacity relative to total runnable funding.

The results in Table 3, Column 1 highlight that banks with lower market adjusted capital or higher reliance on runnable funding individually had lower excess returns before SVB's failure. Importantly, variables that reflect the interaction of funding and leverage risks, such as low LFL ratios or banks with both low capital and above average reliance on uninsured deposits, are not associated with worse stock price performance in the week preceding SVB's failure. These correlations suggest market participants may have discounted the possibility of a bank run emerging. We add controls for VC and cryptocurrency exposures, bank size and other fundaments, and prior year returns in Columns 2 and 3 in Table 3.[22] The results show that firms with higher 2022 returns and profitability continued to outperform in early 2023.

[20] MACET1 ratios are not regulatory capital measures. However, we apply prompt corrective action thresholds to understand bank capitalization in extreme scenarios where interest rate risk is realized.
[21] Using the median produces similar results.
[22] Exposure to VC activity and cryptocurrency were associated with lower excess returns in 2022.

However, firms with above average reliance on uninsured deposits or low MACET1 ratios individually, had lower returns in early 2023, above what can be explained by 2022 performance.

5.2 What factors explain cumulative excess returns during and after SVB's failure?

In this section, we explore banks' cumulative excess returns for three distinct periods and start with the final specification discussed in 5.1. The first period is from March 3rd through March 8th (Table 4, Column 1) and captures performance in the week leading up to SVB's failure. The second includes returns from March 8th until March 10th (Table 4, Column 2), a period after SVB's failure but before the announcement of broader banking system support in the form of the BTFP or the FDIC's guarantee of all uninsured deposits at SVB. The final period reflects performance after the BTFP announcement, and includes March 10th – May 31st (Table 4, Column 3).

Banks with limited ability to cover outflows using cash and AFS securities (LFL ratios in the bottom quartile) suffered harsher stock price declines after SVB's failure (Table 4, Column 2). In addition, banks with both low capital and high reliance on uninsured deposits underperformed. Business model risks, such as less robust VC revenue growth and ties to cryptocurrency markets were also associated with larger stock price declines before the BTFP announcement.

The last column of Table 4 suggests focus shifted to banks with low LFL ratios, low borrowing capacity, or low MACET1 ratios. VC and cryptocurrency exposures lose their significance in this post-BTFP period. This suggests market participant focus shifted from niche bank business models to broader sector vulnerabilities owing to solvency, and imbalance of liquid assets relative to runnable funding.

5.3 Is there evidence of feedback from equity prices to balance sheet management? If so, how did banks facing worse returns adjust their balance sheets?

Several researchers have noted that banks boosted their borrowings to shore up cash after SVB-related stress emerged. Much less work has been done on the role of reciprocal deposits as a balance sheet management tool. Reciprocal deposits split large deposits across a network of other banks in increments of $250,000 or less, effectively providing insurance for large balances and reducing large depositor's incentives to run. Thus, we test whether banks with worse returns and less resilient balance sheets were more likely to turn to reciprocal deposits.

First, we create a dummy variable flagging banks in the top quartile of reciprocal deposit growth during 2023:Q2. We use a logit model to test whether banks with high reciprocal deposit growth had worse excess returns during 2023:Q1 and had weaker balance sheets by our vulnerability measures. Column 1 of Table 5 suggests that bank stock performance during the first quarter was correlated with

high reciprocal deposit growth. There is no loading on prior year returns. In Columns 2 and 3 we add controls for LFL ratios and borrowing capacity, both of which remain significant while controlling for other fundamentals. The results suggest that banks facing outsized stock price declines during 2023:Q1 and banks with less ability to ward off sudden deposit outflows were more likely to take actions to stabilize their deposit base by offering reciprocal deposits.

6.0 Policy implications

Our findings have several policy implications. First, banks with otherwise viable business models could benefit by establishing discount window operational readiness procedures in normal times. Indeed, banks that survived the 2023 financial stresses did so by borrowing rather than selling assets outright (Cipriani et al. (2024), Glancy et al. (2024)). This highlights the importance of borrowing capacity in addition to the focus on adequate holdings of liquid assets. Examples of readiness efforts include signing up to use the window, pre-pledging collateral, and conducting periodic transactions during normal times. The goal of readiness efforts is to establish the window as an ordinary source of contingent liquidity rather than a tool shrouded in stigma which historically has limited its use during times of stress.

Second, more capital could help stave off run equilibriums for banks that operate with higher asset duration. As an example, SVB had substantial holdings of liquid assets, but its high asset duration rendered it insolvent as inflation rose precipitously in 2022 and long-term yields climbed. Most interest rate risk on bank assets is not captured under the current risk-based capital framework. For example, the CET1 ratio numerator excludes all held-to-maturity fair value losses and loan fair value losses.[23] Recognition of fair value losses in regulatory capital can potentially increase the volatility of regulatory capital but also create different incentives for banks by altering their appetite for duration. During the recent rate tightening cycle, Fuster at al. (2024) show banks that reflect unrealized AFS securities losses in regulatory capital were more willing to shed duration by selling underwater bonds. Drechsler et al. (2023) focus on the liability side of the balance sheet, suggesting the required amount of capital should vary positively with a banks uninsured deposit share, and negatively with their deposit beta.

In addition to regulation, supervisory and disclosure changes are another option. For instance, new requirements to compute interest rate risk metrics under the Basel Committee's standardized framework would help limit disparate metrics across banks.[24] Further, adequate disclosure of deposit

[23]Under current rules, most banks can opt out of unrealized losses on available-for-sale securities in their CET1 ratio calculations. Only the most systemic firms, Category 1 and Category 2 bank holding companies, are required to include unrealized losses.

[24]Banks compute two interest-rate risk metrics. The economic value of equity (EVE) is a long-term metric that measures the market value of banks assets minus the market value of liabilities. The second measures the short-term impact of rate movements on net interest income.

assumptions would facilitate reliable comparisons of interest rate risk across banks and help identify unsubstantiated deposit assumptions. As early as April 2022, a year before they failed, SVB extended the duration of its deposits in response to breaching their self-imposed EVE-at-risk limits. This change was inconsistent with their unique depositor base and the recent surge in deposits. The change gave the illusion of reduced interest rate risk, despite no material changes in the balance sheet or improved risk management practices. Hence adequate disclosures and standardized metrics could improve not only monitoring of interest rate risk by supervisors, but also by market participants and creditors.

Third, limited diversification by industry, or outsized exposure to highly cyclical industries, can destroy deposit franchise value. Deposit outflow assumptions in banks' liquidity management planning, and regulatory liquidity measures such as the LCR, could be modified to be consistent with their level of diversification by industry. Furthermore, to promote reliable and well-diversified deposit funding, regulators could introduce enhanced disclosures and limits on the reliance on certain deposit categories (e.g. Warren (2024)).

Lastly, some vulnerable banks turned to reciprocal deposits after SVB failed. The large growth of reciprocal deposits during the emergence of stress suggests the uninsured deposit limit of $250,000 may be worth revisiting.[25]

7.0 Conclusion

In this paper, we use bank stock price returns in the periods surrounding SVB's failure to understand the timing and extent to which business model risks and banking sector risks were realized. We find that firms with exposure to deterioration in the venture capital space, or to cryptocurrency volatility, faced harsher returns following SVB's failure. These concerns abated after the introduction of the BTFP. In addition, we find that the 2023 bank stress reflected imbalance of runnable funding relative to useable liquid assets and too little capital relative to the magnitude of their interest rate risk. The interaction of these risks were largely realized in bank equity returns after SVB's failure. These risks continued to remain in focus even after BTFP. Finally, we highlight feedback between banks facing large stock price declines and bank balance sheet management via the use of reciprocal deposits. We find banks with lower returns during 2023:Q1 were more likely to rely heavily on reciprocal deposits 2023:Q2.

[25]In addition to runs by uninsured depositors, the invocation of the systemic risk exception, and establishment of the BTFP. See FDIC (2023) for a comprehensive discussion of deposit insurance reform options.

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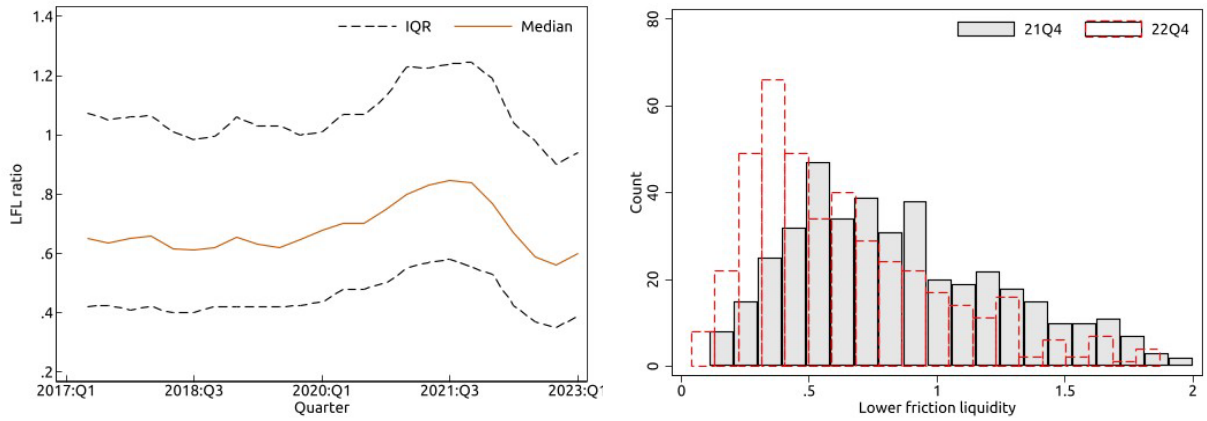
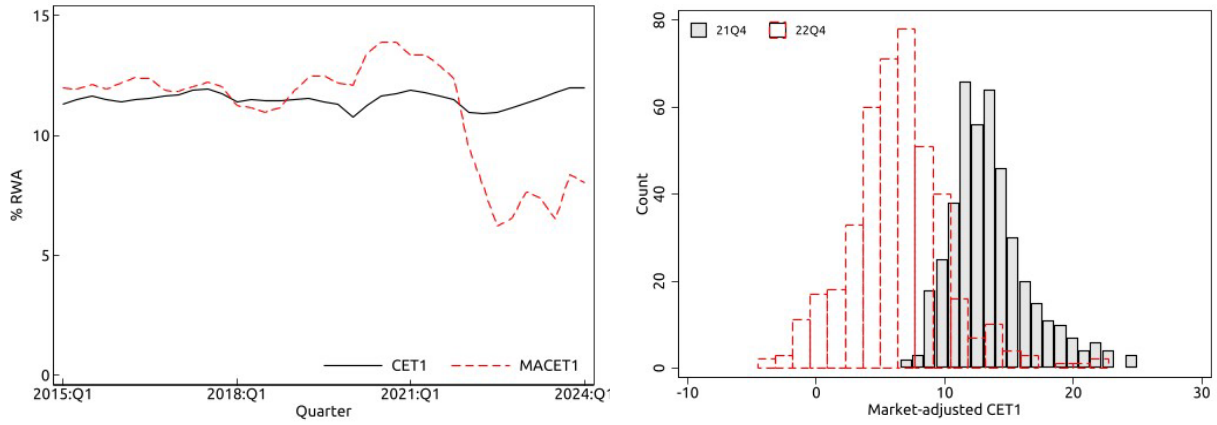
Figures

Figure 1: Lower friction liquidity



Note: LFL is the ratio of cash and useable AFS securities to uninsured deposits and other runnable funding. Both charts include panel of banks with at least $1 billion in assets. The left panel shows the interquartile range and median of LFL ratios through time. The right panel is trimmed to show banks with LFL ratios less than 2.
Source: FR Y-9C, Call Reports, S&P Global Capital IQ Pro, Author Calculations.

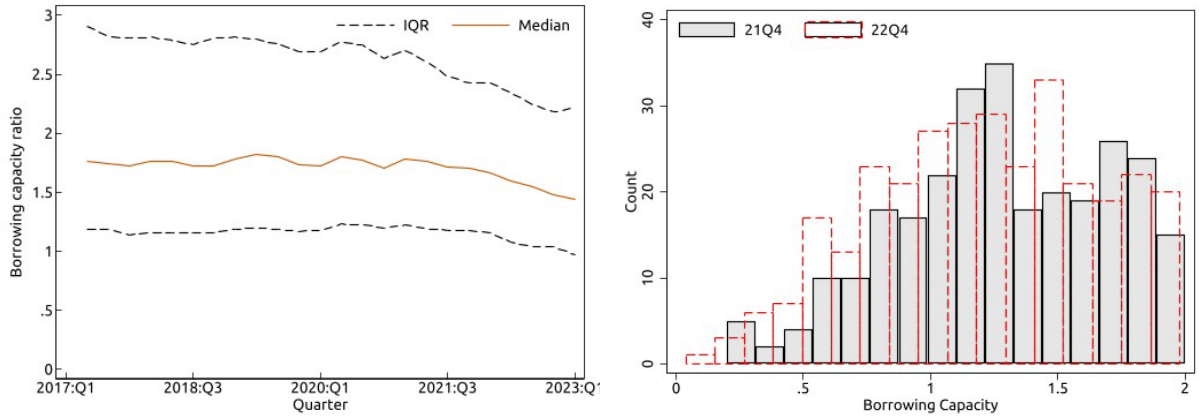
Figure 2: Market-adjusted capital (MACET1)



Note: MACET1 ratios are equal to CET1 ratios less fair value losses on all securities and loans. Securities fair value losses are sourced from FR Y-9C and Call Reports. Loan fair value losses are sourced from S&P Global Capital IQ Pro. Both charts include panel of banks with at least $1 billion in assets. The left panel shows the MACET1 ratios for publicly-traded banks through time. The right panel is trimmed to show banks with MACET1 ratios between -5 and 25 percent.

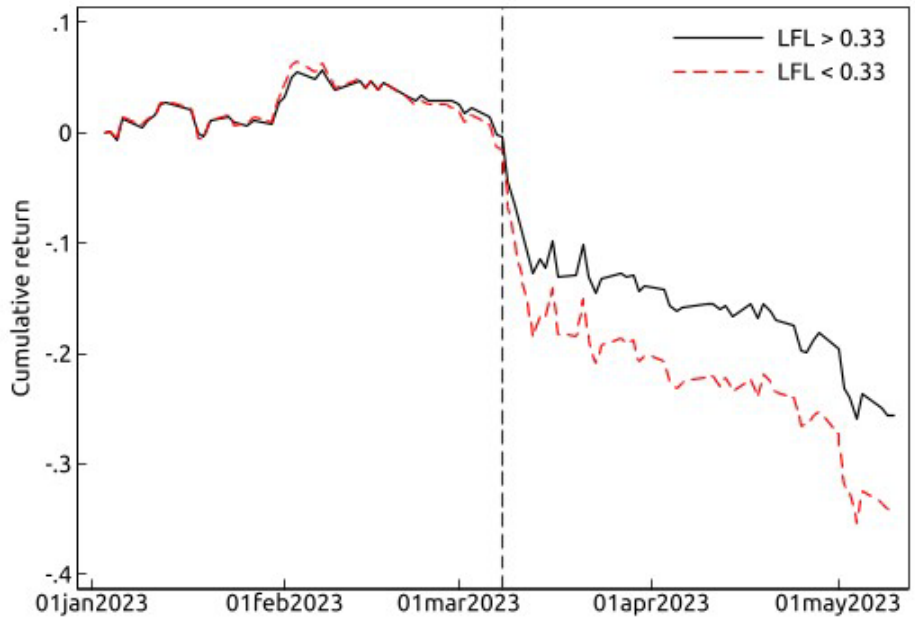
Source: FR Y-9C, Call Reports, S&P Global Capital IQ Pro, Author Calculations.

Figure 3: Borrowing Capacity



Note: Borrowing capacity is the sum of cash, loans, securities less pledged loans and securities to the sum of uninsured deposits and other runnable funding. Both charts include panel of banks with at least $1 billion in assets. The left panel shows the interquartile range and median of borrowing capacity ratios through time. The right panel is trimmed to show banks with borrowing capacity ratios less than 2.
Source: FR Y-9C, Call Reports, S&P Global Capital IQ Pro, Author Calculations.

Figure 4: Cumulative returns by LFL group



Note: LFL is the ratio of cash and useable AFS securities to uninsured deposits and other runnable funding. The chart shows the simple average of cumulative returns by LFL grouping. Sample includes 297 publicly traded banks.
Source: FR Y-9C, Call Reports, S&P Global Market Intelligence, and Author Calculations.

Summary Statistics

Table 1: Balance sheet composition statistics before and after SVB's failure

	2022:Q4	2023:Q2
Cash / Assets	6.08	7.62
AFS Sec / Assets	14.12	13.14
HTM Sec / Assets	8.42	8.12
Loans / Assets	60.83	60.84
Other Assets / Assets	10.55	10.28
Insured Deposits / Assets	44.14	46.32
Uninsured Deposits / Assets	31.61	28.10
Non Deposits / Assets	14.76	15.85
Total Liabilities / Assets	90.51	90.27
Equity / Assets	9.49	9.73

Note: Includes publicly-traded banks with at least $1 billion in assets. Ratios are expressed as percentages.
Source: FR Y-9C and Call Reports.

Table 2: Vulnerability measures by LFL group

	Low LFL 2022:Q4	High LFL 2022:Q4
Cash	2.71	6.71
Useable AFS	8.88	14.81
Uninsured Deposits	39.60	30.09
ST Wholesale Funding	6.75	6.06
LFL Ratio	*25.01*	*59.53*
CET1 Ratio	10.30	10.94
MACET1 Ratio	*5.73*	*6.44*
NIM	3.49	3.90
ROA	1.27	1.29

Note: Includes publicly-traded banks with at least $1 billion in assets. Ratios are expressed as percentages.
Source: FR Y-9C, Call Reports, S&P Global Capital IQ Pro, Author Calculations.

Regressions

Table 3: Correlations of Cumulative Excess Returns Prior to SVB's Failure (March 3 – March 8, 2023)

	(1)	(2)	(3)
LFL < Bottom quartile	-0.002	-0.002	-0.002
	(0.003)	(0.003)	(0.003)
LFL	-0.001	-0.001	-0.002*
	(0.001)	(0.001)	(0.001)
Capacity	-0.000	-0.000	0.001
	(0.002)	(0.002)	(0.002)
Uninsured > Avg.	-0.009**	-0.009**	-0.006*
	(0.004)	(0.004)	(0.003)
MACET1 < 7.0	-0.006*	-0.006*	-0.006*
	(0.003)	(0.003)	(0.003)
Uninsured > Avg. # MACET1 < 7.0	-0.002	-0.001	0.004
	(0.005)	(0.005)	(0.004)
4Q Growth in VC Rev.		0.001***	0.001
		(0.000)	(0.000)
Share of Crypto Phrases		-0.001	0.000
		(0.001)	(0.001)
8Q Growth in Assets			-0.000
			(0.000)
1Q Growth in NIM			0.002**
			(0.001)
Nonint Income / Total Assets			0.002**
			(0.001)
Log Assets			-0.007***
			(0.001)
Excess Return KRX (2022)			0.014**
			(0.006)
Obs.	297	297	297
Adj. R-squared	0.072	0.072	0.304

Note: Includes publicly-traded banks with at least $1 billion in total assets. Dependent variable in all columns is 2023 bank excess returns relative to the KRX from March 3 – March 8). All control variables use 2022:Q4 data, unless otherwise noted. Column 1 includes novel sector risk controls. Column 2 adds specific business model controls. Column 3 includes controls for other fundamentals. LFL is the ratio of cash and useable AFS securities to uninsured deposits and other runnable funding. MACET1 ratios are equal to CET1 ratios less fair value losses on all securities and loans. Borrowing capacity is the the sum of cash, loans, and securities less pledged loans and securities to the sum of uninsured deposits and other runnable funding. Share of crypto phrases is equal to the fraction of paragraphs that reference crypto and related phrases from banks' 2022 earnings call transcripts. Results are shown with robust standard errors. Significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Source: FR Y-9C, Call Reports, S&P Global Capital IQ Pro, S&P Global Market Intelligence, Transcripts Data Feed, Author Calculations.

Table 4: Correlations of Cumulative Excess Returns (Pre-SVB, Pre-BTFP, and Post-BTFP)

	Before SVB (1)	After SVB (2)	After BTFP (3)
LFL < Bottom quartile	-0.002	-0.012***	-0.047***
	(0.003)	(0.005)	(0.016)
LFL	-0.002*	-0.001	0.000
	(0.001)	(0.002)	(0.008)
Capacity	0.001	-0.002	0.030**
	(0.002)	(0.003)	(0.013)
Uninsured > Avg.	-0.006*	0.005	0.001
	(0.003)	(0.005)	(0.020)
MACET1 < 7.0	-0.006*	0.007	-0.055***
	(0.003)	(0.005)	(0.019)
Uninsured > Avg. & MACET1 < 7.0	0.004	-0.012*	0.003
	(0.004)	(0.007)	(0.028)
4Q Growth in VC Rev.	0.001	0.003***	0.007*
	(0.000)	(0.001)	(0.004)
Share of Crypto Phrases	0.000	-0.010***	-0.009
	(0.001)	(0.003)	(0.006)
8Q Growth in Assets	-0.000	0.001	0.001
	(0.000)	(0.001)	(0.006)
1Q Growth in NIM	0.002**	0.002	0.007
	(0.001)	(0.002)	(0.006)
Nonint Income / Total Assets	0.002**	-0.001	-0.014*
	(0.001)	(0.003)	(0.007)
Log Assets	-0.007***	-0.010***	0.007
	(0.001)	(0.002)	(0.006)
Excess Return KRX (2022)	0.014**	0.045***	-0.031
	(0.006)	(0.014)	(0.055)
Obs.	297	297	297
Adj. R-squared	0.304	0.369	0.177

Note: Includes publicly-traded banks with at least $1 billion in total assets. Dependent variable is 2023 bank excess returns relative to the KRX for three distinct periods: 1) before SVB's failure (March 3 – March 8), after SVB's failure (March 8 – March 10), and after BTFP (March 10 – May 31). All control variables use 2022:Q4 data, unless otherwise noted. LFL is the ratio of cash and useable AFS securities to uninsured deposits and other runnable funding. MACET1 ratios are equal to CET1 ratios less fair value losses on all securities and loans. Borrowing capacity is the sum of cash, loans, and securities less pledged loans and securities to the sum of uninsured deposits and other runnable funding. Share of crypto phrases is equal to the fraction of paragraphs that reference crypto and related phrases from banks' 2022 earnings call transcripts. Results are shown with robust standard errors.
Significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Source: FR Y-9C, Call Reports, S&P Global Capital IQ Pro, S&P Global Market Intelligence, Transcripts Data Feed, Author Calculations.

Table 5: Correlations of Reciprocal Deposit Growth After SVB's Failure

	(1)	(2)	(3)
Excess Return KRX (Post-SVB)	-0.419***	-0.424**	-0.411**
	(0.134)	(0.181)	(0.198)
Excess Return KRX (2022)	0.187	0.307**	0.173
	(0.133)	(0.152)	(0.163)
LFL		-2.928***	-3.229***
		(1.017)	(1.098)
Capacity		0.694**	0.855**
		(0.297)	(0.366)
MACET1 < 7.0		0.212	0.300
		(0.521)	(0.537)
Uninsured > Avg.		0.834*	0.532
		(0.449)	(0.581)
MACET1 < 7.0 # Uninsured > Avg.		-0.291	-0.245
		(0.586)	(0.591)
NIM		0.141	0.524
		(0.149)	(0.339)
MACET1		0.261*	0.313*
		(0.156)	(0.168)
4Q Growth in VC Rev.		-0.100	-0.109
		(0.108)	(0.115)
Share of Crypto Phrases		0.192	0.228*
		(0.119)	(0.121)
1Q Growth in Assets			-20.535
			(23.191)
Nondeposit Liabilities / Total Assets			-2.669
			(2.761)
Uninsured Deposits / Total Assets			0.204
			(0.298)
Nonint Income / Total Assets			0.489
			(0.345)
Log Assets			-0.080
			(0.119)
Obs.	297	296	296
Pseudo R-squared	0.031	0.103	0.121

Note: Includes publicly-traded banks with at least $1 billion in total assets. Dependent variable in all columns is a dummy variable indicating banks within the top quartile of reciprocal deposit growth from 2023:Q1 to 2023:Q2. All control variables use 2022:Q4 data, unless otherwise noted. Column 1 includes controls for individual bank excess returns relative to the KRX in 2022, and excess returns from March 8th – March 31st. Column 2 adds novel sector and business model controls. Column 3 adds other fundamentals. LFL is the ratio of cash and useable AFS securities to uninsured deposits and other runnable funding. MACET1 ratios are equal to CET1 ratios less fair value losses on all securities and loans. Borrowing capacity is the sum of cash and the fair value of loans and securities less pledged loans and securities to the sum of uninsured deposits and other runnable funding. Share of crypto phrases is equal to the fraction of paragraphs that reference crypto and related phrases from banks' 2022 earnings call transcripts. Results are shown with robust standard errors. Significance: * p < 0.1, ** p < 0.05, *** p < 0.01.
Source: FR Y-9C, Call Reports, S&P Global Capital IQ Pro, S&P Global Market Intelligence, Transcripts Data Feed, Author Calculations.