The Fundamental Role of Uninsured Depositors in the Regional Banking Crisis*

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Abstract

We re-examine the role of uninsured depositors through the lens of fundamentals and the idea that uninsured depositors are valuable clients who demand loans. We provide new stylized facts showing that banks with more uninsured deposits — who experienced greater equity value declines *during the crisis of 2023* — had greater stock price risk, profitability, market valuations, and executive pay *before the crisis*. To explain these facts, we develop a model where banks better at risk-taking attract large uninsured depositors who have loan demand. Rising interest rates and decreased loan demand reduce lending-relationship values, leading to outflows from riskier banks.

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The high level of uninsured deposits of Silicon Valley Bank (SIVB) has naturally led to a narrative of flighty uninsured depositors worried about bank defaults as a main driver of the regional banking crisis of 2023. However, SIVB was also an important bank for Silicon Valley, with lending relationships to large corporate clients with uninsured deposits. Indeed, Sequoia Capital partner Michael Moritz penned an op-ed describing how "For those of us who have worked in Silicon Valley for the past forty years, SVB has been our most important business partner" (Moritz, 2023). S&P Market Intelligence observed that:

> Meanwhile, large corporate depositors that may have balances well above the Federal Deposit Insurance Corp.'s insured limit may use their deposit account to pay payroll, collect money from vendors, and for other regular corporate operations, and may be well-integrated with treasury management services provided by the bank, which would make moving deposit accounts to another financial institution a significant undertaking. (Hayes, 2023)

In this paper, we re-examine the role of uninsured depositors by taking into account the loan demand attached to uninsured deposits. In particular, we propose a fundamentals-based view emphasizing that greater bank risk-taking and uninsured deposits go together in equilibrium. To start, we provide reduced-form evidence from the cross-section of regional banks consistent with this view: banks with more uninsured deposits had bigger equity value declines *during the crisis* but were also riskier, had higher market valuations, and greater executive pay *before the crisis*. To explain these facts, we then develop a model where banks better at taking risks attract large uninsured depositors who demand loans to finance risky projects. We then work out the implications for how changes in interest rates and loan demand lead depositors to reallocate across banks.

Specifically, we establish five stylized facts that point to the importance of lending relationships among uninsured deposits. First, banks with greater uninsured deposits experienced worse returns and greater stock price risk than other banks in the period January 2022-March 2023. For example, Figure 1 establishes the importance of uninsured deposits as an important predictor of which regional banks experienced trouble during the peak crisis period. Second, even before 2022, banks with greater uninsured deposits tend to be riskier in the cross-section. Third, and focusing our remaining attention on this prior period, banks

with greater uninsured deposits were also more profitable, had greater valuation ratios, and experienced greater deposit growth. Fourth, these banks did not seem significantly riskier according to capital ratios and other balance sheet measures. Fifth, these banks had similar or greater executive pay and incentives, which were themselves related to greater risk-taking.

These facts build a case that banks such as SVB took on uninsured deposits and risky strategies for fundamental reasons. While the emerging narrative after the crisis emphasizes the importance of uninsured deposits in bank runs (Fact 1), this perspective leaves open why uninsured depositors (who are presumably worried about bank defaults) would attach themselves to risky banks as they do even before the crisis (Fact 2). Indeed, during this pre-crisis period, banks with greater uninsured deposits were more profitable, valuable, and experienced inflows (Fact 3) despite their greater risk, suggesting that they have valuable underlying business strategies. Fact 4 indicates that uninsured deposits capture a dimension of risk beyond those captured by what is on the balance sheet. Fact 5 further supports the idea that risk-taking was part of a business strategy since such strategies at financial firms require high executive pay and strong incentives to execute in equilibrium (Cheng, Hong, and Scheinkman, 2015).

We develop a model of the fundamentals-based view to demonstrate why risk-taking and uninsured deposits go together in equilibrium and what drives deposit flows. There is a continuum of ex-ante identical uninsured depositors who demand loans for risky projects and have working capital (exceeding the deposit insurance limit) to deposit in a bank. After an uninsured depositor chooses a bank, that bank receives an informative signal about the project's success, e.g., through a better understanding of the project cash flows, and decides whether to invest. There is a continuum of banks with heterogeneous abilities to understand risky projects, modeled through heterogeneous signal precisions, as well as total deposit-taking capacity. Banks post loan and deposit rates ex-ante, decide whether to invest in projects, and face a reduced-form convex cost of holding risk. All depositors match with a bank through market clearing.

The model makes two sets of predictions that align with the above facts (with a straight-

forward extension capturing Fact 5). First, banks that attract greater uninsured depositors in equilibrium also take more risks and are more valuable than other banks. Intuitively, these are more specialized banks who have a better ability to screen projects and thus generate higher returns than the less specialized banks. They are thus willing to take on more risky projects despite paying a greater total cost of holding that risk, attracting more uninsured deposits in the process.

Second, a decline in the return of risky projects coupled with an increase in the risk-free rate leads to outflows from more specialized banks toward less specialized banks. That is, a risky, high-uninsured deposit bank such as SVB should experience an outflow of uninsured depositors and fall in value after such a shock. This effect occurs because that bank's screening advantage becomes less valuable, which no longer justifies the high cost of risk-taking. This decline in the match value between an entrepreneur and a risk-taking bank leads to a reallocation of depositors away from that bank. This prediction provides a rationale for outflows from banks like SVB grounded in fundamentals.

We contribute to the literature by re-examining the role of uninsured depositors in bank risk-taking, why they are important for bank value, and why the deposit flows we saw were rooted in an equilibrium reallocation of depositors across banks. The fundamentals-based view is consistent with the literature emphasizing the importance of the deposit franchise for bank value (Drechsler, Savov, and Schnabl, 2017, 2021; Egan, Lewellen, and Sunderam, 2021) and points toward a need to account for the value of uninsured depositors in the discussion of future policy and bank regulation (Barr, 2023). We emphasize that it complements and does not exclude the ideas from a large literature that bank runs, contagion, and potential mismanagement at banks with significant uninsured deposits are important, especially in explaining the unfolding of the regional bank crisis (Cookson et al., 2023; Diamond and Dybvig, 1983; Drechsler et al., 2023; Egan, Hortaçsu, and Matvos, 2017; Goldstein and Pauzner, 2005; Haddad, Hartman-Glaser, and Muir, 2023; Iyer and Puri, 2012; Jiang et al., 2023b). Outflows can spark wider contagion, and we intentionally abstract from contagion and bank runs since the literature has already clearly established their importance.

1 Motivation and data

1.1 Motivation

We propose a fundamentals-based role of uninsured depositors for regional banks. This view holds that SVB was at the tip of a systematic pattern of banks requiring large, uninsured deposits to support banking relationships underlying their specialized risk-taking strategies.

In SVB's case, plenty of background evidence shows how it specialized in serving relationships with the technology sector. SVB's largest depositors, each of whom had several hundred million dollars in deposit at the bank, were tech companies such as Roku, Marqeta, IntraFi, Circle Internet, and the venture capital firm Sequoia Capital (Chapman and Leopold, 2023). It often had deep ties with these tech companies: Sequoia partner Michael Moritz penned a Financial Times op-ed describing how "SVB provided for tech when everyone else ignored us...For those of us who have worked in Silicon Valley for the past forty years, SVB has been our most important business partner" (Moritz, 2023). Others have also documented that SVB specialized in making loans to, and taking deposits from, the tech industry (Gompers, 2023; Chow, 2023). On the loan side, company materials describe the bank "serv[ing] the innovation economy...There are few banks that truly understand venture debt and many that don't" (Argueta, 2023). On the deposit side, companies often used their large deposit accounts for working capital management (Hayes, 2023). Several startups experienced difficulty making payroll in the aftermath of SVB's failure (Stokes et al., 2023).

SVB was not alone among regional banks pursuing risky, specialized strategies financed with large, uninsured deposits. Signature Bank embraced cryptocurrencies and, according to its CEO, became a "preeminent player in that space" (DiCamillo, 2021). First Republic Bank specialized in making large loans to wealthy entrepreneurs and bankers that subsequently lost significant value (Eisen, Ackerman, and Driebusch, 2023), and its executives famously declared that "to get best relationship pricing, we want the full deposit relationship...it's a very key focus for us and one of the reasons we've been able to grow deposit balances so quickly" (Delevingne, 2023). Several other banks, such as Bank of Hawaii and Western

Alliance, also accumulated significant loan losses (Weil, 2023).

One narrative emerging after the crisis emphasizes the role of flighty uninsured depositors in precipitating its fatal bank run, consistent with the prior literature on run-prone uninsured depositors in inducing fragility (Jiang et al., 2023b; Egan, Hortaçsu, and Matvos, 2017). An expanded version of this narrative further emphasizes that SVB, with its high concentration of uninsured deposits, was a mismanaged, outlier bank that spread contagion to other banks who only posed a "passing resemblance" (Ip, 2023; Salmon, 2023). The Federal Reserve Board (Fed), in its report on SVB's collapse, wrote that SVB was a "textbook case of mismanagement" that, "in some respects, was an outlier" due to its "concentrated business model, interest rate risk, and high level of reliance on uninsured deposits" (Barr, 2023). Continuing, the Fed noted that SVB spread contagion even though it was "not extremely large, highly connected to other financial counterparties, or involved in critical financial services."

In contrast, the fundamentals-based view emphasizes that the concentration of uninsured deposits at risk-taking banks such as SVB, First Republic, and others was not accidental, but rather the outcome of valuable equilibrium matches; furthermore, that the fundamental origins of the crisis lay in a decline in match values due to rising interest rates and declining risky opportunities. While allowing for a role for contagion and bank runs to exacerbate these outflows, this view emphasizes the equilibrium relationship between uninsured deposits and risk-taking. In plainer words, SVB was less an outlier, and more a fundamentally risky business whose uninsured depositors were a critical part of its franchise value.

Motivated by this view, we document five stylized facts that lay the foundation and build the case for the equilibrium model we develop. The first fact focuses on the role of uninsured deposits in explaining bank risk after 2022, while the latter four facts focus on the role in explaining risk and other attributes in the five years prior to 2022. We divide our analysis around the start of 2022 since it was the turning point for when Treasury yields began to increase sharply and risky investment opportunities such as those in the tech sector began to decline, as Figure 2 depicts.

1.2 Data sources and summary statistics

Our sample of consists of U.S. publicly-traded banks classified as regional banks under the eight-digit Global Industry Classification Standard (GICS) code #40101015. We select these banks using the historical lists of GICS codes from Compustat and match their stock price data from the Center for Research in Security Prices (CRSP) database using the standard CRSP-Compustat link. Our data on Treasury yields and equity factor returns come from the U.S. Treasury and Ken French's website, respectively.[1]

We obtain data on bank deposits from the quarterly bank call reports available through the Federal Financial Institutions Examination Council (FFIEC, Forms 031 and 041). We link the bank to its bank holding company (BHC) using the FFIEC bank relationship map, and then link the BHC to CRSP using the CRSP-FRB link maintained by the Federal Reserve Bank of New York. To cleanly link bank-level depositor composition to BHC-level stock price data, we require each BHC contain only one entity for which it has a direct relationship and that it have a 100% equity stake in that entity, which we determine using the FFIEC bank relationship map.[2]

We obtain our other balance sheet and income statement data from a combination of the bank call reports and Compustat. Data about executive pay comes from ExecuComp, and data about boards of directors comes from Institutional Shareholder Services (ISS).

Our sample includes 179 regional banks. We require data on total assets, depositor composition, and market capitalization as of the start of 2022, an observed return during the March 8–13, 2023 crash, and a 5-year monthly market beta from 2017-2021 estimated with a minimum of 48 months. We further screen out illiquid stocks where our price-based risk measures might be less reliable by requiring that a stock's average price exceed $5,

[1] Available online at `https://home.treasury.gov/policy-issues/financing-the-government/interest-rate-statistics` and `https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html`, respectively.

[2] We rely on the bank-level call reports instead of the consolidated BHC Form FR Y-9C call reports since only the former contain detailed information about depositor composition. The FFIEC bank relationship map is available online at `https://www.ffiec.gov/npw/FinancialReport/DataDownload`. The CRSP-FRB link is available online at `https://www.newyorkfed.org/research/banking_research/crsp-frb`. The CRSP-FRB maps some bank-level call reports directly to CRSP firm identifiers, and it is not necessary to map the bank to a BHC in this case.

that its Amihud (2002) illiquidity ratio (average daily absolute return/dollar volume) be less than 10% (per $1MM dollar volume), and that the stock trade at least 90% of days, over the course of 2021. These screens yield a single cross-section of banks for which we can assess pre-2022 and 2022-onward stock price risk cleanly.

Table 1 reports summary statistics. Our key variable of interest is the "uninsured deposit fraction," defined as the fraction of deposit dollars in accounts with balances over the deposit insurance limit of $250,000 from Schedule RC-O on the call reports. We focus on the gross total dollars in these accounts rather than the amount in excess of the insurance limit, although our main results are similar with either. On average, the uninsured deposit fraction was 55% as of the end of 2021, while the five year average from 2017-2021 was 48%.[3]

Regional banks are small: median total assets, deposits, and market capitalization at the end of 2021 equal $7, 6, and 1 billion, respectively. We obtain total assets and deposits from the call reports and market capitalization from CRSP as of calendar year-end. We apply our liquidity screens to mitigate biases that may occur due to small stock illiquidity (Ibbotson, Kaplan, and Peterson, 1997). After applying our screens, the median illiquidity ratio and percentage of days without trade are 0.5% and 0.8%, respectively. We discuss additional summary statistics in the course of documenting our five facts below.

2 Five facts about the cross-section

2.1 The facts

Fact 1. *Regional banks with greater uninsured deposits were riskier after the start of 2022 compared with other regional banks.*

We focus on stock price risk and calculate returns, return volatilities, market betas, and rate betas between 2022 and 2023:03 using daily returns, applying the Dimson (1979) method

[3]Prior to 2008-Q4, the deposit limit was $100,000 for non-retirement deposit accounts and $250,000 for retirement accounts; prior to 2006-Q2 and going back to 1980, the limit was $100,000. For a brief history of changes in deposit insurance limits, see the announcements by the Federal Deposit Insurance Corporation at `https://archive.fdic.gov/view/fdic/4000` and `https://archive.fdic.gov/view/fdic/2789`.

to account for possible asynchronous trading. Rate betas equal the estimated coefficient from a regression of stock returns on changes in the average Treasury yield in the term structure and is our measure of interest rate risk. The idea is that a firm's equity is immunized from interest rate risk if its equity value is insensitive to unexpected interest rate movements, although our measure ignores the expected component for simplicity.[4]

Regional banks performed poorly on average in this period. From Table 1, the average (1-s.d.) return in the 4-day window from March 8-13, 2023 equalled -16% (11.3%), and the broader return over the 2022-onward period equalled -20% (26%). Average (1-s.d.) realized return volatility, market beta, and rate beta equaled 32% (12%), 0.6 (0.3), and –2.7 (2.5), respectively.

Figure 3 illustrates our first fact by plotting market betas and return volatilities against the uninsured deposit fraction as of the start of 2022 (end of 2021). Evidently, banks with greater uninsured deposits had greater realized betas and volatilities.

Table 2 investigates in more detail and reports ordinary least squares (OLS) estimates of the following empirical specification:

$$y_{i,2022/23} = a + b_0\, UNINS_{i,2021} + b_1\, logAssets_{i,2021} + B \times liquidity_{i,2021} + u_i, \qquad (1)$$

where $y_{i,2022/23}$ are risk measures estimated from 2022-2023 and $UNINS_{i,2021}$ is the uninsured deposit fraction as of the start of 2022 (end of 2021), our principal variable of interest, and u_i is the bank-level error term. We include, $logAssets_{i,2021}$, the natural logarithm of bank assets, because greater bank size is correlated with greater uninsured deposits (ρ=0.37), perhaps naturally. We include $liquidity_{i,2021}$ to complete our three-pronged approach to mitigate illiquidity biases, where the other two prongs are our initial screen-out of extremely illiquid stocks and the use of the Dimson (1979) method in estimating betas. We include quintile indicators of Amihud (2002) illiquidity and, separately, the percentage of days with no trade in $liquidity_{i,2021}$.

[4]We estimate rate betas through March 7, 2023 to capture the effect of the general upward trend in rates from 2022-onward on bank stock prices that we discuss in our model.

The estimates show that banks with greater uninsured deposits had greater realized risk. The economic magnitudes are large: a bank with an uninsured deposit fraction that was one-s.d. (14%) greater than another bank was associated with a 0.43-s.d. worse return (5% over 4 days) during the peak crisis period and 0.37-s.d. worse return (9% annualized) over 2022:01-2023:03. That same bank was also associated with a 0.27-s.d. greater return volatility, 0.21-s.d. greater market beta, and 0.20-s.d. more negative rate beta.

Fact 2. *Before 2022, regional banks with greater uninsured deposits were also riskier compared with other regional banks.*

We calculate returns, return volatilities, market betas, and rate betas in the five years from 2017 through the end of 2021 using monthly raw returns from CRSP. Regional banks had an average annual return of 9% (1-s.d.: 7%) from Table 1. Average (1-s.d.) return volatility, market beta, and rate beta equaled 29% (6%), 1.0 (0.35), and 26.0 (7.5), respectively.

Figure 4 illustrates our second fact that uninsured deposits and risk are correlated in the five-year period leading up to 2022, analogous to the 2022-onward period. The figure plots five-year market betas and volatilities against the five-year average uninsured deposit fraction over 2017-21. As in Figure 3, banks with greater uninsured deposits had greater betas and volatilities.

Table 3 reports OLS estimates of the following specification that relates 5-year average uninsured deposits and risk contemporaneously during the pre-2022 period:

$$y_{i,2017/21} = a + b_0\, UNINS_{i,2017/21} + b_1\, logAssets_{i,2017/21} + B \times liquidity_{i,2017/21} + u_i. \quad (2)$$

We define variables analogously to those in Equation 1, with the exception that all variables represent averages or sensitivities calculated over the five-year period.

The correlation between uninsured deposits and risk is positive and economically large, analogous to the 2022-onward period. A bank with a five-year average uninsured deposit fraction that was 1-s.d. greater than another bank was associated with a 0.17-s.d. greater

stock return (1% annualized) during the 2017-2021 stock price boom, although the slope estimate is not statistically reliably different from zero. The same bank would have been associated with a 0.22-s.d. greater return volatility, 0.29-s.d. greater market beta, and 0.19-s.d. greater rate beta.

Fact 3. *Regional banks with greater uninsured deposits were more profitable and valuable, and experienced greater deposit growth, compared with other regional banks.*

We calculate return on equity (assets) as pre-tax income scaled by stockholder equity (assets). We abstract from taxes to focus on bank operating profits, although results are similar if we use after-tax net income. Market equity / book equity equals market capitalization divided by total stockholder equity. The market value of assets equals book assets less book equity plus market capitalization, while book assets equals total assets. We calculate these values at the BHC level (from Compustat) and take the last fiscal year value reported each calendar year. We calculate deposit growth as the log change in the deposit base reported from the bank's balance sheet. We winsorize these variables at the 1% and 99% levels and calculate five-year averages requiring a minimum three years of data.

Average (1-s.d.) regional bank pre-tax return on equity before 2022 equalled 12% (3%), with a return on assets of 1.4% (0.3%), from Table 1. Average (1-s.d.) equity valuation ratios equalled 1.3 (0.4), asset valuation ratios equalled 1.04 (0.04), and deposit growth equalled approximately 4% (2%).

Table 4 reports OLS estimates of the following specification that relates 5-year averages of uninsured deposits to profitability, valuation ratios, and deposit growth contemporaneously during the pre-2022 period:

$$y_{i,2017/21} = a + b_0\, UNINS_{i,2017/21} + b_1\, logAssets_{i,2017/21} + u_i. \tag{3}$$

The estimates suggest that a bank with 1-s.d. greater uninsured deposits was associated with a 0.21-s.d. greater return on equity, 0.12-s.d. greater return on assets, 0.21-s.d. greater ME/BE ratio, 0.16-s.d. greater MA/BA ratio, and 0.22-s.d. greater annual deposit growth in

the 2017-2021 period. The estimates on ROE, ME/BE, and deposit growth are statistically reliably different from zero at the 5% level.

Fact 4. *There is little evidence that greater uninsured deposits were associated with greater traditional balance sheet measures of risk before 2022.*

We relate the uninsured deposit fraction to regulatory capital ratios and a balance-sheet based measure of the maturity gap between assets and liabilities. We obtain data on regulatory capital ratios directly from Schedule RC-R on the call reports, "Regulatory Capital." Each bank reports its common equity Tier 1 (CET1), Tier 1, and total capital ratios (all divided by risk-weighted assets) alongside the regulatory leverage ratio (which ignores risk-weights). From Table 1, average regulatory capital ratios were 13-14%, indicating healthy capitalization levels.

We calculate the bank maturity gap following English, Van den Heuvel, and Zakrajšek (2018) using data from Schedules RC-B (Securities), RC-C (Loans and leases), RC-E (Deposits in Domestic Offices) and RC-F (Deposits in Foreign Offices). The maturity gap equals the weighted-average maturity of assets—securities (including Treasuries, U.S. agency debt, and mortgage-backed securities) and loans—less the weighted-average maturity of deposits, assuming a contractual maturity of zero for demand deposits. The average maturity gap equalled 3.5 years.[5]

We additionally calculate the dollar value of a basis point (DV01) scaled as a percentage of CET1, which has the interpretation of the percentage of capital depleted when interest

[5]As English, Van den Heuvel, and Zakrajšek (2018) discuss, the measure has several caveats as a balance sheet measure of interest rate risk: it does not account for embedded options in instruments such as residential mortgages, does not account for the relative dollar value of assets versus liabilities, does not cover all assets and liabilities, focuses on maturity rather than duration, and does not include hedges. Following their method,, we use the midpoint of each maturity for each bin reported in the call reports with a maturity of 20 (5) years when the bin indicates securities with maturity or next repricing over 15 (3) years away. For example, for RMBS securities with maturity or next repricing date of over 5 years through 15 years, we assume a maturity of 10 years. When calculating the weights for each bin, we use total assets or total liabilities in the denominator even though not all assets on the balance sheet have maturity break-outs. On average, the assets with maturity break-outs cover 87% of total assets for banks in our sample, and liabilities with maturity break-outs (counting demand deposits as zero maturity) cover 92% of total liabilities. Our regression inferences are unchanged if we use the total of only assets and liabilities with maturity break-outs in the denominator when calculating weights.

rates rise by 1 basis point. We calculate DV01 as the weighted-average maturity of assets multiplied by asset value less the same quantity for deposit liabilities. Our calculated DV01 measure likely overestimates the true underlying DV01 since the underlying durations of assets are likely less than the maturities. Finally, we also calculate whether or not the bank uses interest rate swaps from Schedule RC-L. The average DV01/CET1 equals 0.29%, and an average of 70% of banks use interest rate swaps.

Regulatory capital ratios showed little correlation with our risk measures. Table 5 reports OLS estimates of Equation 3 but where the dependent variables are these regulatory capital ratios. Point estimates do suggest that greater uninsured depositors are associated with slightly lower capital ratios—greater risk—although the estimates are not statistically distinguishable from zero. In terms of economic significance, a bank with 1-s.d. greater uninsured deposit fraction was associated with 0.05-0.10-s.d. (0.2-0.3%) lower capital ratios and little movement in the regulatory leverage ratio.

Column 5 shows that, if anything, banks with greater uninsured deposits had a lower maturity gap than other banks. The economic significance is substantial in terms of cross-sectional movement: a bank with 1-s.d. greater uninsured deposits was associated with a 0.32-s.d. lower maturity gap. However, the effect in terms of risk may be modest—a 0.2-year decline in the gap. Studying DV01 values in column 6 leads to the similar conclusion that banks with greater uninsured deposits had lower interest rate exposure relative to capital than other banks. There is some suggestive evidence in column 7 that banks with greater uninsured deposits are less likely to hedge using interest rate swaps, although the effect is not statistically reliably different from zero. Economically, a bank with 1-s.d. greater uninsured deposits was 5% less likely to hedge using interest rate swaps.

Fact 5. *Banks with greater uninsured deposits had similar or greater pay and incentives, and pay is related to risk.*

We next investigate whether uninsured deposits are linked to pay and incentives, and whether these latter variables help explain risk-taking. Total top-5 executive compensation equals the average total direct compensation (TDC1 in Execucomp) to the top-5 most highly

paid executives listed in the company's proxy statement plus the CEO (if not already included). Executive ownership includes the sum of all share ownership by executives including delta-weighted options divided by shares outstanding, where we calculate option deltas in a manner similar to Coles, Daniel, and Naveen (2013) from the Execucomp outstanding awards tables. We calculate the percentage of board members that ISS classifies as independent well as the average share ownership of independent directors.

Table 6 panel A reports estimates of Equation 3 but where the dependent variables are average pay and ownership of top-5 executives, the fraction of the board that is independent, and the average ownership of independent directors. Including $logAssets_{i,2017/21}$ in Equation 3 is particularly important in these regressions given the well-known relationships between pay, incentives, and size (Baker and Hall, 2004). Our sample relating uninsured deposits, pay, and risk-taking contains only 73 banks because several banks do not fall within the S&P 1500 coverage of Execucomp. We therefore concentrate on point estimates and remain cautious about statistical significance.

The estimates suggest that banks with greater uninsured deposits had similar or greater pay and incentives. A bank with 1-s.d. greater uninsured deposits is associated with 0.08-s.d. greater pay and 0.33-s.d. greater insider ownership, the latter statistically significant at the 5% level. Boards of banks with greater uninsured deposits are slightly less independent, but its independent directors have slightly greater share ownership.

Table 6 panel B reports estimates from a specification that relates risk to pay:

$$y_{i,2017/21} = a + b_0\, Top5Pay_{i,2017/21} + b_1\, logAssets_{i,2017/21} + u_i. \tag{4}$$

The estimates show that, even in the limited sub-sample, executive pay is correlated with risk, with large economic magnitudes. A bank with 1-s.d. greater pay (residual from size) was associated with 0.44-s.d. greater return volatility, 0.32-s.d. greater beta, and 0.43-s.d. greater rate beta. Panel C reports that insider ownership tends also to be positively correlated with risk.

2.2 Summary and discussion

The facts suggest that SVB was part of a pattern where banks take risks financed by uninsured deposits as part of their business strategy. Fact 1 emphasizes the importance of uninsured depositors in explaining which banks ran into trouble from 2022 onward. This evidence is consistent with Egan, Hortaçsu, and Matvos (2017), Haddad, Hartman-Glaser, and Muir (2023), Iyer and Puri (2012), Iyer, Puri, and Ryan (2016), Jiang et al. (2023b), and Martin, Puri, and Ufier (2023) who emphasize the role of uninsured deposits in bank runs such as the one we saw starting March 8, 2023. However, the evidence will also be consistent with our model of a fundamentals-based view to the extent that the broader 2022-onward period was associated with declining risky opportunities coupled with rising interest rates.

Fact 2 shows that there was also a strong relationship between uninsured deposits and risk in the five years before 2022. Banks with greater uninsured deposits were associated with significantly greater equity risk. The positive average rate beta suggests that increases in interest rates were typically associated with bank stock price increases. This finding is consistent with a correlation between rate increases (decreases) and good (bad) economic news and banks earning high spreads over deposit rates (Drechsler, Savov, and Schnabl, 2017, 2021; Hutchison and Pennacchi, 1996; Koont, Santos, and Zingales, 2023). Interestingly, stock prices of banks with greater uninsured deposits were more positively sensitive to interest rates before 2022 but were more negatively sensitive to interest rates from 2022 onward. Our model below can explain this shift.

Fact 3 shows that banks with greater uninsured deposits also tended to be more profitable, valuable, and attracted more deposits, despite their greater risk, compared with other banks during this prior period. This evidence suggests that greater uninsured deposits were linked to valuable underlying business strategies. It also supports the anecdotes of banks like SVB and First Republic pursuing risky strategies to generate more profits and attract uninsured deposits. Greater bank profits during good times, particularly greater ROE, also indicate greater underlying bank risk (Meiselman, Nagel, and Purnanandam, 2020).

Fact 4 suggests that greater uninsured deposits capture a dimension of risk not captured

by balance sheet capital ratios and maturity mismatches. It is also consistent with the literature that suggests these measures may be only weakly informative of bank risk potentially due to manipulation (Begley, Purnanandam, and Zheng, 2017). Our results on interest rate swaps are consistent with Jiang et al. (2023a), who find mixed evidence on interest rate swap usage among banks with greater uninsured deposits. More broadly, Fact 4 opens the door to other risk channels beyond those captured by these balance sheet measures.

Fact 5 further supports the idea that risk-taking was part of a business strategy since risk-taking strategies at financial firms require high executive pay and strong incentives to execute in equilibrium (Cheng, Hong, and Scheinkman, 2015). Others, including the Fed, have suggested that uninsured deposits and bank failures were due to mismanagement or governance failures (Barr, 2023; Warmbrodt, 2023). While not ruling out aspects of mismanagement—SVB notoriously did not have a chief risk officer for several months leading up to the crisis (Johnson, Rosenblatt, and Dolmetsch, 2023)—the evidence rules in the possibility that banks with uninsured deposits compensated their executives for taking risks.

3 A fundamentals-based model of uninsured deposits

3.1 Motivation and preview of key results

Why do greater uninsured deposits and greater bank risk-taking go together? This may not be altogether obvious for a risk-averse depositor worried about bank defaults.

Our insight is that banks who specialize in financing risky projects compete to attract large deposit accounts in the interests of establishing a relationship with, and obtaining better information about, each client. Relationships with uninsured depositors allow the bank to better screen and fund risky projects. Through this channel, the relationship between a bank and an uninsured depositor affects both the asset and liability side of bank.

Our model intentionally does not feature runs or contagion, forces that other papers have studied extensively. Instead, we highlight fundamental forces that describe the equilibrium allocation of depositors across banks and how reallocation occurs. Contagions and runs likely

exacerbate many of these forces, but lie outside of our model.

3.2 Setup

There are three types of agents: a unit measure of uninsured depositors (UD), a unit measure of banks, and a large measure of insured depositors. Uninsured depositors need to deposit $d_u < 1$ at a bank, where d_u exceeds the deposit insurance limit. They are potential entrepreneurs who each have an investment project with i.i.d. probability λ. Each project requires an investment of \$1 alongside an exogenous amount of d_u working capital.

Banks differ in two dimensions (D, b): their total dollar deposit-taking capacity D as well as their ability to screen the risky asset b, which we describe in detail shortly. We think of b as representing the bank's specialization in understanding risky projects. Let $g(D, b)$ represent the density function of different banks. The purpose of D is to provide independent variation of bank size from depositor composition in the model.

Insured depositors have small deposits sizes d_0, receive exogenous deposit rate $\rho_o = \nu_l r_f$ where $\nu_l \leq 1$ and r_f is the risk-free rate, and are not strategic. The parameter ν_l represents a discount that the insured depositors are willing to take, which we take as given. In the special case where $\lambda = 0$, uninsured and insured depositors only differ in their deposit size. In this case, uninsured depositors do not generate additional value, as banks can substitute them with more insured depositors instead.

There are three periods, $t \in \{0, 1, 2\}$. At time $t = 0$, banks post rates and uninsured depositors choose a bank. At time $t = 1$, uninsured depositors find out if they have a project (with exogenous probability λ), and the bank receives their signal b about the project and chooses whether to invest. At time $t = 2$, project cash flows and payments are realized.

Information structure and loan decisions in period 1 At period 1, each entrepreneur has an investment project with i.i.d. probability λ. The project has a binary payoff that realizes at period 2 and depends on a latent state variable s (unknown to all agents). The variable s is distributed according to a cumulative density function F and is i.i.d. across

projects. Conditional on s, the project's payoff equals $(1+\sigma)$ if $s \geq z$ and $(1-\sigma)$ if $s < z$ for some exogenous threshold z. Thus, ex ante, the project succeeds with unconditional probability $1 - F(z)$ and fails with probability $F(z)$.

We assume that, if the project succeeds, the return is greater than the bank's exogenous outside option r_B. However, without any additional information, we assume z and σ are such that the project is negative NPV for the bank relative to their outside option r_B.[6] That is,

$$(1 - F(z))(1+\sigma) + F(z)(1-\sigma) = 1 + (1 - 2F(z))\sigma < (1 + r_B). \tag{5}$$

We think of $r_B = \nu_h r_f$ as representing the return on the loans or assets that a bank can potentially earn, where $\nu_h \geq 1$ represents the banks' ability to earn additional returns relative to the risk-free rate.

To capture the idea that the bank can learn more about the entrepreneurs if the bank has access to their accounts, we assume the bank receives an additional signal about the project at period 1 if and only if the entrepreneur has a deposit account with the bank. For simplicity, we assume the bank receives the signal only if the depositor deposits the full working capital amount d_u.[7]

For every entrepreneur that has a relationship with bank (b, D), the bank receives a noisy signal x about project success, and banks with greater b receive more informative signals. The structure of the signal is that $x = 0$ if and only if the project will fail, and $x = 1$ indicates project success but with false positives. Specifically, $x(s, b) = \mathbb{1}\{s \geq bz\}$, so that there there are false positives of $x = 1$ if $bz \leq s < z$. Thus, the parameter b captures the informativeness of the signal: a greater b means a more informative signal and lower probability of a false positive. By construction, whenever $x = 0$, the bank knows that the project is bad and will not invest.

[6] Because each project is negative NPV ex ante, an entrepreneur would never choose to deposit their working capital and apply for a project loan at two different banks.

[7] This assumption can be relaxed by assuming that the informativeness of a bank's signal is proportional to the amount of the working capital deposited. That is, suppose that an entrepreneur deposits $\frac{d_u}{n}$ across n banks. Then the precision of bank b's signal is $\frac{b}{n}$, and an entrepreneur can potentially receive a loan size of $\frac{1}{n}$ from each bank. One can show that it is always optimal to have one very precise bank instead of n moderately informed banks.

We assume that all banks receive signals that are sufficiently informative so that, for any bank, it is optimal to invest in the project conditional on getting positive news:

Assumption 1 (The project is positive NPV when $x = 1$.)**.** *All* $b \in [b^L, b^H]$ *satisfy* $b > \bar{b}$*, where* $\bar{b}$ *solves:*

$$\frac{1-F(z)}{1-F(\bar{b}z)}(1+\sigma)+\left(1-\frac{1-F(z)}{1-F(\bar{b}z)}\right)(1-\sigma)=1+r_B.$$

Putting it all together, bank (b, D) receives signal $x = 1$ with probability $1 - F(bz)$ for any given project, which is also the probability of investment for bank b. A project's excess return conditional on investment for bank b, denoted by $\alpha(b)$, equals:

$$\begin{aligned}\alpha(b) &\equiv \left(\frac{1-F(z)}{1-F(bz)}(1+\sigma)+\left(1-\frac{1-F(z)}{1-F(bz)}\right)(1-\sigma)\right)-(1+r_B)\\ &= (1-\sigma)+\frac{1-F(z)}{1-F(bz)}2\sigma-(1+r_B)=\frac{1-F(z)}{1-F(bz)}2\sigma-(\sigma+r_B),\end{aligned}$$

which increases with b as more informed banks are less likely to make mistakes. Given a project, a more informed bank with greater b invests with a lower unconditional probability and has a greater excess return conditional on investment.

Relationships in period 0 We now turn to the decision of forming relationships between banks and uninsured depositors. A bank offers loan rate R and deposit rate ρ_u. An entrepreneur chooses a bank to deposit their working capital accordingly, understanding that this relationship would improve her chance of getting a loan when the investment opportunity arrives. Recall that, by construction, without establishing the relationship, the project has negative NPV without information and thus will not be financed. Moreover, since a bank only receives a signal if they have access to all the working capital of an entrepreneur, an entrepreneur will choose only one bank.

Expected payoffs of uninsured depositors. Given any (R, ρ_u) offered by a bank (b, D), the

expected payoff of an entrepreneur equals:

$$W(R, \rho_u, b) = \lambda(1 - F(bz)) \left(\frac{1 - F(z)}{1 - F(bz)} (\sigma - R) \right) + (1 + \rho_u)\, d_u, \tag{6}$$

where the first term represents her expected value of the project, which she receives investment for with probability $\lambda(1 - F(bz))$, is successful with probability $\frac{1-F(z)}{1-F(bz)}$ conditional on investment, and receives net payoff $\sigma - R$ conditional on success. The second term represents the interest earned on her deposited working capital.

Expected payoffs of banks. We assume that a bank's cost of taking risk (e.g., through its cost of capital) is proportional to the bank's deposit-taking capacity D and is an increasing and convex function of the fraction of dollars the bank invests in risky projects. Specifically, let μ represent the number of uninsured depositors matched to the bank (which will be determined in equilibrium) so that the total dollar amount the bank invests in risky projects is $\lambda\,(1 - F(bz))\,\mu$. Denote the fraction of dollars invested in risky projects for a bank with capacity D by:

$$\chi(b, D, \mu) \equiv \frac{\lambda\,(1 - F(bz))\,\mu}{D}.$$

We assume that the cost is given by $C(\chi, D) = D r_f \xi(\chi)$, where $\xi(0) = 0, \xi'(0) = 0$, $\xi'(\chi) > 0$ $\forall \chi > 0$, and $\xi''(\chi) > 0$. That is, $C(\chi, D)$ is proportional to the capacity D, conditional on χ. We interpret this risk-taking cost as related to the cost of capital in the market, so that it also proportional to the risk-free rate. The cost is zero if the bank takes on zero risky projects (i.e., $\xi(0) = 0$).

Thus, the expected payoff of bank (b, D) conditional on having μ entrepreneurs equals:

$$\begin{aligned} V(b, D, \mu | R, \rho_u) = {} & (D - \lambda(1 - F(bz))\mu)\,(1 + r_B) \\ & + \lambda(1 - F(bz))\mu \left\{ \left(\frac{1 - F(z)}{1 - F(bz)} (1 + R) + \left(1 - \frac{1 - F(z)}{1 - F(bz)} \right) (1 - \sigma) \right) \right\} - C(\chi, D) \\ & - (1 + \rho_u)\mu d_u - (1 + \rho_o)(D - \mu d_u). \end{aligned} \tag{7}$$

The first line represents the return on deposit money the bank invests in its outside option.

The second line represents the expected return of the banks' loans on the risky projects net of the cost of holding risk. Specifically, if a bank puts $\lambda(1-F(bz))\mu$ dollars into risky projects, it will receive $1+R$ for each project that succeeds and $1-\sigma$ if the project fails, and pay cost $C(\chi, D)$. The final line represents payments to μd_u uninsured depositors paid deposit rate ρ_u and $D-\mu d_u$ insured depositors paid exogenous deposit rate ρ_o. Note that if the bank does not attract any uninsured depositors and $\mu = 0$, then banks simply earn the net spread of the outside option return over the insured deposit rate, $V(D, b, 0) = D(\nu_h - \nu_l)r_f$.

Equilibrium. We solve for a competitive equilibrium. The endogenous equilibrium quantities are an allocation function $\mu^*(b, D)$ that determines the quantity of uninsured deposits at each bank as well as a loan rates $R(b, D)$ and deposit rates $\rho_u(b, D)$ offered by each bank. Entrepreneurs choose banks optimally, and banks choose investments, loan rates, and deposit rates optimally. Market-clearing for deposits demands $\int \mu^*(b, D)\, g(b, D)\, db\, dD = 1$. For simplicity, we focus on the parameter space that will generate interior solutions with $\mu(b, D)d_u/D < 1$ so that no bank has only uninsured deposits.

3.3 Characterization

We sketch the intuitions that characterize the unique equilibrium and provide the formal solution in the Appendix. Since entrepreneurs are identical ex ante, they must earn the same expected payoff in equilibrium, denoted by W^*. In equilibrium, banks compete and adjust loan/deposit rates until the marginal benefit of attracting one more entrepreneur equals the marginal cost.

We simplify the problem by observing that, from Equation 7, the equilibrium χ must be independent of capacity D. That is, if two banks have the same b, the fraction of risky investment is the same but the bank with a larger capacity will attract more uninsured deposits: $\mu^*(b, D) = D\mu^*(b, 1)\ \forall(D, b)$. Thus, we can solve for $\chi^*(b) \equiv \chi(b, 1, \mu^*(b, 1))$ directly.

Allocation of Uninsured Depositors. In equilibrium, the allocation $\chi^*(b)$ is such that:

$$\lambda(1 - F(bz)) \left(\alpha(b) - r_f \xi'(\chi^*(b))\right) - (W^* - (1 + \rho_o)d_u) = 0 \; \forall b. \tag{8}$$

The first term represents the marginal change in the bank's utility of adding one uninsured depositor through potentially adding a project, which equals the excess return of a risky project $\alpha(b)$ net of the marginal cost of risk times the probability of investing $\lambda(1 - F(bz))$. The second term represents the effective price that the bank must pay per uninsured depositor relative to d_u insured depositors.

Proposition 1. *The equilibrium is unique and efficient. In equilibrium, the measure of uninsured depositors in bank is* $\mu^*(b, D) = D\left\{\frac{\chi^*(b)}{\lambda(1-F(bz))}\right\}$, *where* $\chi^*(b)$ *must satisfy (1) the following ODE:*

$$\frac{d\chi^*(b)}{db} = \frac{F'(bz)z\left\{(\frac{\sigma}{r_f} + \nu_h) + \xi'(\chi^*(b))\right\}}{(1 - F(bz))\xi''(\chi^*(b))} > 0. \tag{9}$$

and (2) $\int \left\{\frac{\chi^*(b)}{\lambda(1-F(bz))}\right\} D\, g(b, D)\, db\, dD = 1$. *The equilibrium playoff of uninsured depositors* W^* *is given by Equation 8.*

Equation 9 can be derived by differentiating Equation 8 with respect to b. Note that Equation 8 implies that the equilibrium is also efficient, as each bank takes on enough uninsured depositors so that the marginal value of each depositor equals its marginal cost.

Loan and Deposit Rates Given the allocation $\chi^*(b)$, Equation 9 pins down the payoff of uninsured depositors. Two observations are in order.

First, observe from Equation 6, the expected payoff of depositors W is independent of b conditional on the loan and deposit rate (R, ρ_u). This is because entrepreneurs gain only when the project succeeds, which happens with probability $1 - F(z)$ that is independent of b, and banks bear the cost of failed projects. Hence, we look for (R, ρ_u) that is also independent of b.

Second, the equilibrium pins down the payoff of uninsured depositors up to W, but there are generally different ways to compensate uninsured depositors with different combinations of loan rates R and deposit rates ρ_u. As such, we further impose that (R, ρ_u) is characterized by $\phi \in [0, 1]$ such that

$$\lambda (1 - F(z)) (\sigma - R) = \phi (W^* - (1 + \rho_o) d_u), \tag{10}$$

and:

$$(\rho_u - \rho_0) d_u = (1 - \phi) (W^* - (1 + \rho_o) d_u). \tag{11}$$

A higher ϕ means that uninsured depositors are compensated by lower loan rates instead of greater deposit rates. From Equation 10, $\phi > 0$ guarantees that uninsured depositors are rewarded if the project succeeds. From Equation 11, $\phi < 1$ guarantees that it is optimal for uninsured depositors not to divide their deposits into different banks even if they do not have an investment project at period 1.

3.4 Predictions

Banks' Valuation and Riskiness From Equation 9, one can directly see that higher-b banks have more uninsured depositors relative to their deposit size and take on more risks.

Proposition 2 (Correlation of bank risk, uninsured deposits, and valuations)**.** *$\chi^*(b)$, $\mu^*(b, D)$, and the valuation of a bank scaled by size $\frac{V(b,D,\mu^*(b,D))}{D}$, all increase with b.*

Note that, for a fixed number of uninsured depositors μ, a more informed bank with greater b will have lower χ as they are more selective in their projects. However, in equilibrium, $\mu^*(b, D)$ increases quickly enough with b so that bank risk $\chi^*(b) = \lambda(1 - F(bz))\mu^*(b, D)/D$ increases with b. Lastly, while greater-b banks take on more risk, which is costly, they have greater valuations than lower-b banks because they are better at screening projects and creating value from each depositor.

Flows of Uninsured Depositors We now study comparatives statics to establish which banks experience outflows of uninsured depositors when parameters change. We also study valuations $V(b)$ and scaled valuations $V(b)/r_f$. We scale valuations $V(b)$ by the risk-free rate to account for the basic level effect within the model where an increase in interest rates associated with better investment opportunities increases all banks' valuations. Specifically, we show that if the project return moves proportionally with the risk-free rate (i.e., $\frac{\sigma}{r_f}$ remains the same), then the allocation of uninsured depositors remains unchanged while $V(b)$ increases for all banks. On the other hand, $V(b)/r_f$ remains unchanged. We define the change in scaled valuations as $\Delta(b) \equiv \frac{\tilde{V}(b)}{\tilde{r}_f} - \frac{V(b)}{r_f}$, where $\frac{\tilde{V}(b)}{\tilde{r}_f}$ represents bank b's valuation under a new set of parameters.

Proposition 3 (Deposit flows and valuation changes.)**.** *For a decrease in $\frac{\sigma}{r_f}$, there exists $\hat{b} \in (b_L, b_H)$ such that there is a deposit outflow (inflow) for $b > \hat{b}$ ($b < \hat{b}$). Moreover, $\Delta(b) < 0$ if and only if $b > \hat{b}$, and banks with greater $b' > b > \hat{b}$ experience greater scaled valuation declines: $\Delta(b') < \Delta(b) < 0$.*

Since the equilibrium is efficient, one can understand the result from the viewpoint of a planner: a lower $\frac{\sigma}{r_f}$ lowers the value of risky projects, which in turn lowers the value of bank expertise. Since the cost of holding risk is convex in χ, it is optimal to make uninsured depositors more evenly distributed across banks. As a result, more (less) specialized banks experience outflows (inflow) of uninsured depositors.

Relationship to empirical facts Propositions 2 and 3 provide a fundamentals-based rationale for the facts we document in Section 2. The environment in the five years prior to 2022 were arguably associated with period of large or increasing σ/r_f as the economy boomed and even the pandemic offered new, risky opportunities for many companies. The two propositions suggest that banks with greater uninsured deposits such as SVB and First Republic should be riskier, more profitable, more valuable, and should receive inflows compared with other banks during this period. The facts suggest that this was the case. On the other hand, the 2022-onward period of interest rate increases coupled with a decline in

risky opportunities (especially in the technology sector) is arguably characterized by lower or declining σ/r_f. The propositions suggest that this decline in σ/r_f triggered the greatest loss in valuation and outflow of uninsured depositors we observed at banks such as SVB.[8]

4 Conclusion

We provide reduced-form evidence and a model supporting a fundamentals-based role for uninsured depositors in the regional banking crisis. Rather than emphasize their susceptibility to runs, we point out that uninsured deposits and bank risk-taking go together in an efficient equilibrium. Banks more specialized in understanding risky projects take on greater uninsured deposits and risky projects despite the greater cost of holding that risk because they create more value from uninsured deposits than other banks. As interest rates increase and risky opportunities decline, these banks experience outflows and declines in valuations as deposits reallocate across banks. Accounting for a fundamentals-based role for uninsured depositors suggests important trade-offs when discussing future policy and bank regulation surrounding depositor composition.

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[8]The evidence on rate betas is particularly interesting. Banks like SVB had lower-than-average rate betas (often negative) from 2022 onward but higher-than-average (positive) rate betas prior to 2022. This is consistent with interest rate increases being associated with declining σ/r_f from 2022 onward but increasing σ/r_f prior to 2022.

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Appendix A Mathematical Proofs

A.1 Proof for Proposition 1

Proof. Observe from Equation 6, $W(R, \rho_u, b)$ is independent of b given (R, ρ_u), we thus use $W(R, \rho_u)$ denote the promised payoff to the depositors under (R, ρ_u). Equation 7 can be further rewritten as

$$V(D, b, \mu | R, \rho_u) = D \underbrace{\left\{ (1 + r_B) + \chi\alpha(b) - r_f\xi(\chi) - \frac{\chi}{\lambda(1 - F(bz))} \left(W(R, \rho_u) - (1 + \rho_o) d_u \right) - (1 + \rho_o) \right\}}_{\equiv v(b,\chi)}, \tag{A.1}$$

where $\chi(b, D, \mu) = \frac{\lambda(1-F(bz))\mu}{D}$.

Observe that $V_\mu(D, b, \mu) = v_\chi(b, \chi) D \frac{\lambda(1-F(bz))}{D}$, which is independent of D. Hence, the equilibrium allocation and payoff $\{\chi^*(b), W^*\}$ must be such that for all $\chi^*(b) > 0$,

$$v_\chi(b, \chi^*(b)) = \alpha(b) - r_f\xi'(\chi^*(b)) - \frac{1}{\lambda(1 - F(bz))} \left(W^* - (1 + \rho_o) d_u \right) = 0. \tag{A.2}$$

That is, given W^*, the marginal benefit and cost of adding one uninsured depositor is equalized for all active banks. If this condition does not satisfy, a bank can lower (raise) W in order to attract less (more) UD. Lastly, since $v_{\chi\chi}(b, \chi) = -r_f\xi''(\chi) < 0$, it means that $\chi^*(b)$ that satisfies Equation A.2 is unique and $\chi^*(b) = \arg\max v(b, \chi)$.

To guarantee the interior solutions, where uninsured depositors allocate across different banks, we assume that

$$\lambda(1 - F(b^H z))\alpha(b^H) - r\xi' \left(\lambda(1 - F(b^H z)) \frac{1}{d_u} \right) < 0$$

That is, for the most informed bank b^H, the cost of capital is high enough so that it is not optimal to have uninsured depositors only. That is, together with the fact that $\xi'(0) = 0$, it means that there must be some uninsured depositors in other bank $b < b^H$ in equilibrium.

Hence, for any banks with $\chi^*(b) > 0$, we thus have

$$\lambda \left(1 - F\left(z\right)\right) 2\sigma - \lambda(1 - F(bz)(\sigma + r_B) - \lambda(1 - F(bz)) r_f \xi'(\chi^*(b)) = \left(W^* - (1 + \rho_o) d_u \right),$$

Hence,

$$\frac{d\chi}{db} = \frac{F'(bz) z \left\{ \sigma + r_B + r_f\xi'(\chi) \right\}}{(1 - F(bz)) r_f \xi''(\chi)} \equiv \Lambda(b, \chi)$$

which gives Equation 9. The market clearing condition of $\mu^*(b, D)$ implies that

$$\int \left\{ \frac{\chi^*(b)}{\lambda(1 - F(bz))} \right\} D\, g(b, D)\, db\, dD = 1.$$

■

A.2 Proof for Proposition 2

Proof. Equation 9 implies that $\frac{d\chi(b)}{db} > 0$. The measure of uninsured depositors $\mu^*(b, D) = D\left\{\frac{\chi^*(b)}{\lambda(1-F(bz))}\right\}$ also increases in b, as $1 - F(bz)$ decreases in b. Lastly, since

$$V^*(b, D) = \max_{\chi} Dv(b, \chi),$$

we thus have $\frac{dV^*(b,D)}{db} = Dv_b(b, \chi^*(b)) > 0$. ■

A.3 Proof for Proposition 3

Proof. Let $\theta \equiv \frac{\sigma}{r_f}$ and $\chi^\theta(b)$ denote the allocation under θ. First of all, for any $\theta' > \theta$, it must be the case that $\chi^{\theta'}(b)$ and $\chi^\theta(b)$ only cross once at b^*. To see this, since $\chi^\theta(b) = \frac{\lambda(1-F(bz))\mu(b)}{D}$, $\chi^{\theta'}(b)$ and $\chi^\theta(b)$ must cross at least once, otherwise it must violate market-clearing condition. That is, if $\chi^{\theta'}(b) > \chi^\theta(b)\ \forall b$, then it means that $\mu^{\theta'}(b) = \frac{\chi^{\theta'}(b)}{\lambda(1-F(bz))} > \frac{\chi^\theta(b)}{\lambda(1-F(bz))} = \mu^\theta(b)$.

Moreover, observe that From Equation 9 $\frac{d\chi(b)}{db}$ increases with θ, hence, at any point when these two functions cross, it must be the case that $\frac{d\chi^{\theta'}(\hat{b})}{db} > \frac{d\chi^\theta(\hat{b})}{db}$. In other words, $\chi^{\theta'}(b)$ must cross cross $\chi^\theta(b)$ from below, and thus these two functions can cross at most once. Thus, we have $\chi^{\theta'}(b) > \chi^\theta(b)$ iff $b > \hat{b}$. Thus, for any $\theta' > \theta$, $\mu^{\theta'}(b) - \mu^\theta(b) > 0$ iff $b > \hat{b}$. ■

To understand the effect of interest rate, we first establish that, without any reallocation (i.e., fixing θ), $\upsilon^*(b, \theta) \equiv \frac{v^*(b)}{r_f}$ remains constant. Then, we show that a decrease in θ results in a larger drop for the more informed banks, where the change in the valuation is defined as $\Delta(b) \equiv \upsilon^*(b, \theta') - \upsilon^*(b, \theta)$.

Lemma A1. *(Scaling effect w.o reallocation) Conditional on the ratio of $\theta \equiv \frac{\sigma}{r_f}$, the payoffs of all agents are scaled by the risk-free rate. That is, if $\tilde{r}_f = \gamma r_f$ and $\tilde{\sigma} = \theta\tilde{r}_f, \tilde{\rho}_u = \gamma\rho_u, \tilde{R} = \gamma R, \tilde{V}(b) = \gamma V(b)$ and $\Delta(b) = 0\ \forall b$.*

Proof. Note that $\chi^*(b)$ remains the same conditional on $\frac{\sigma}{r_f}$. Let

$$\omega^* \equiv W^* - (1 + \rho_0)d_u = \lambda\left(1 - F(z)\right)(\sigma - R) + (\rho_u - \rho_0)\, d_u$$

$\omega^* \equiv W^* - (1 + \rho_0)d_u$, Banks' valuation can thus expressed as

$$\begin{aligned}\frac{V^*(b, D)}{D} \equiv v(b, \chi^*(b)) &= r_f(\nu_h - \nu_l) + \chi^*(b)\left(\frac{1 - F\left(z\right)}{1 - F\left(bz\right)}2\sigma - (\sigma + \nu_h r_f)\right) - r_f\xi(\chi^*(b)) - \frac{\chi^*(b)}{\lambda(1 - F(bz))}\omega^* \\ &= r_f\left((\nu_h - \nu_l) + \chi^*(b)\left(\frac{1 - F\left(z\right)}{1 - F\left(bz\right)}2\frac{\sigma}{r_f} - (\frac{\sigma}{r_f} + \nu_h) - \xi(\chi^*(b))\right) - \frac{\chi^*(b)}{\lambda(1 - F(bz))}\frac{\omega^*}{r_f}\right)\end{aligned}$$

Since ρ_0 is scaled with r_f ($\rho_0 = \nu_l r_f$), by guess and verify, one can see that ω^*,ρ_u and R is also scaled with r_f and $\frac{v(b,\chi^*(b))}{r_f}$ is the same conditional on $\theta = \frac{\sigma}{r_f}$.

■

Lemma A2. *(Distributional effect under reallocation) For $\theta' < \theta$, $\upsilon^*(b, \theta') - \upsilon^*(b, \theta) < 0\ \forall b > \hat{b}$ and $\upsilon^*(b, \theta') - \upsilon^*(b, \theta) > 0$ for $b < \hat{b}$. Moreover, $\Delta(b') < \Delta(b) < 0\ \forall b' > b > \hat{b}$.*

Proof. Given $\theta' < \theta$, there exists $\hat{b}$ such that $\chi^*(\hat{b})$ remains the same. Moreover, one can show that $\frac{v(\hat{b},\chi^*(\hat{b}))}{r_f}$ remains the same as well, as

$$\frac{v(\hat{b},\chi^*(\hat{b}))}{r'_f} - \frac{v(\hat{b},\chi^*(\hat{b}))}{r_f} = \chi^*(\hat{b}) \left\{ \left(\frac{1-F(z)}{1-F\left(\hat{b}z\right)} 2\left(\theta'-\theta\right) - (\theta'-\theta) \right) - \frac{1}{\lambda(1-F(bz))} \left(\frac{\omega^*_{\theta'}}{r'_f} - \frac{\omega^*_{\theta}}{r_f} \right) \right\} = 0,$$

where we use the fact that

$$\lambda\left(1-F\left(z\right)\right)2\theta' - \lambda(1-F(\hat{b}z)(\theta'+v_h) - \lambda(1-F(\hat{b}z))\xi'(\chi^*(\hat{b})) = \frac{\omega^*}{r_f} \tag{A.3}$$

must hold for θ and θ' for $\hat{b}$. In other words, let $\omega^*(\theta) \equiv \frac{w^*}{r_f}$ denote the equilibrium payoff to uninsured depositors relative to risk-free rate under θ, we have

$$\omega^*_\theta(\theta) = \lambda\left(1-F\left(z\right)+\left(F(\hat{b}z)-F(z)\right)\right) > 0.$$

That is, the change in $\omega^*(\theta)$ offsets the change in $\alpha(\hat{b})$ at the bank $\hat{b}$ so that bank $\hat{b}$ takes the same amount of risk $\chi^*(\hat{b})$. Bank's valuations can be expressed as

$$v^*(b,\theta) = \max_{\chi}\left((\nu_h-\nu_l) + \chi\left(\frac{1-F\left(z\right)}{1-F\left(bz\right)} 2\theta - (\theta+\nu_h) - \xi(\chi) \right) - \frac{\chi}{\lambda(1-F(bz))}\omega^*(\theta) \right),$$

hence, by Envelope theorem, we have

$$\begin{aligned} v^*_\theta(b,\theta) &= \chi^*(b)\left(2\frac{1-F\left(z\right)}{1-F\left(bz\right)} - 1 \right) - \frac{\chi^*(b)}{\lambda(1-F(bz))}\omega^*_\theta(\theta) \\ &= \chi^*(b)\left\{ \left(2\frac{1-F\left(z\right)}{1-F\left(bz\right)} - 1 \right) - \left\{ 2\frac{(1-F\left(z\right))}{(1-F(\hat{b}z))} 2 - 1 \right\} \right\}, \end{aligned}$$

which is positive if and only if $b > \hat{b}$. Hence, a decrease in θ means lower (higher) $\frac{v^*(b)}{r_f}$ if and only if $b > \hat{b}$.

Moreover, for $b > \hat{b}$, we thus have

$$\frac{v^*(b)}{r_f} = \frac{v^*(\hat{b})}{r_f} + \int_{\hat{b}}^{b} \frac{v^*_b(\tilde{b})}{r_f} d\tilde{b} = \frac{v^*(\hat{b})}{r_f} + \int_{\hat{b}}^{b} \chi^*(\tilde{b}) \frac{\alpha_b(\tilde{b})}{r_f} d\tilde{b},$$

where, by the envelope theorem, we have $\frac{v^*_b(\tilde{b})}{r_f} = \frac{\chi^*(\tilde{b})\alpha_b(\tilde{b})}{r_f} = \chi^*(\tilde{b}) \frac{F'(bz)z(1-F(z))}{(1-F(bz))^2} 2\theta$.

Hence,

$$\Delta(b) = \int_{\hat{b}}^{b} \left(\chi^*_{\theta'}(\tilde{b})\theta' - \chi^*_\theta(\tilde{b})\theta \right) \left(\frac{F'(\tilde{b}z)z\left(1-F\left(z\right)\right)}{\left(1-F\left(\tilde{b}z\right)\right)^2} \right) d\tilde{b}' < 0$$

and for any $b' > b \geq \hat{b}$ and $\theta' < \theta$, as $\chi^*_{\theta'}(b) - \chi^*_{\theta}(b) < 0$. We thus have

$$\Delta(b') - \Delta(b) = \int_b^{b'} \left(\chi^*_{\theta'}(\tilde{b})\theta' - \chi^*_{\theta}(\tilde{b})\theta \right) \left(\frac{F'(\tilde{b}z)z\left(1 - F\left(z\right)\right)}{\left(1 - F\left(\tilde{b}z\right)\right)^2} \right) d\tilde{b} < 0.$$

■

Lemma A1 establishes the scaling effect, fixing the ratio of $\theta \equiv \frac{\sigma}{r_f}$. Thus, in Proposition 3, we focus on the change in the scaled valuations, which follows from Lemma A2.

Table 1: Summary Statistics

This table reports summary statistics for our cross-section of regional banks. Data sources are bank call reports, CRSP daily and monthly stock files, ExecuComp, and RiskMetrics.

Variable	Units	Mean	Stdev	Median	25th pct.	75th pct.	N
A. Basic characteristics							
Start of 2022							
Uninsured deposit dollars	Fraction	0.55	0.14	0.54	0.46	0.63	179
Assets	$ billions	21.7	51.5	7.2	3.4	19.6	179
Deposits	$ billions	18.8	44.3	6.0	2.9	16.2	179
Market cap	$ billions	3.2	7.8	1.1	0.4	3.0	179
Illiquidity ratio	%/$1MM flow	1.5	2.1	0.5	0.1	2.1	179
Days with no trade	%	1.1	1.1	0.8	0.4	1.6	179
2017-2021 Average							
Uninsured deposit dollars	Fraction	0.48	0.14	0.46	0.38	0.56	179
Assets	$ billions	15.7	35.1	5.4	2.5	14.2	179
Deposits	$ billions	12.9	28.9	4.5	2.1	11.5	179
Market cap	$ billions	2.2	4.9	0.8	0.3	2.3	179
B. Price-based risk, 2022-onward							
Return, Mar 8-13 2023	%	-15.5	11.3	-13.1	-16.9	-9.9	179
Average return	%, annualized	-20.3	25.6	-15.6	-28.2	-7.2	179
Return volatility	%, annualized	31.6	11.8	28.7	25.7	32.9	179
Beta	Sensitivity	0.59	0.33	0.51	0.39	0.69	179
Rate beta	Sensitivity	-2.70	2.48	-2.34	-3.75	-1.22	179
C. Price-based risk, pre-2022							
Average return	%, annualized	9.0	6.9	7.6	4.6	11.7	179
Return volatility	%, annualized	28.9	5.5	28.2	24.7	31.1	179
Beta	Sensitivity	0.99	0.35	0.96	0.75	1.24	179
Rate beta	Sensitivity	26.03	7.52	25.66	20.79	30.71	179
D. Profitability and valuation							
Return on equity, pre-tax	%	12.4	3.4	12.2	10.2	14.3	179
Return on assets, pre-tax	%	1.4	0.3	1.4	1.2	1.6	179
Market Equity / Book Equity	Ratio	1.33	0.39	1.25	1.10	1.44	179
Market Assets / Book Assets	Ratio	1.04	0.04	1.03	1.01	1.05	179
Deposit growth, quarterly	Log points	0.04	0.02	0.03	0.02	0.04	179

Table 1, continued.

Variable	Units	Mean	Stdev	Median	25th pct.	75th pct.	N
E. Balance sheet measures							
Common equity tier 1 capital	%	13.1	2.9	12.5	11.7	13.7	178
Tier 1 capital	%	13.2	2.9	12.6	11.8	13.7	178
Total capital	%	14.2	3.0	13.5	12.8	14.8	178
Leverage ratio	%	10.2	2.1	9.8	9.2	10.7	179
Maturity gap	Years	3.5	1.6	3.2	2.2	4.2	179
DV01	% of CET1	0.29	0.18	0.26	0.15	0.40	179
Interest rate swap usage	Indicator	0.7	0.4	1.0	0.4	1.0	157
F. Compensation and governance							
Avg total compensation (top 5)	$ Thousands	1870.8	1165.5	1541.0	1075.7	2245.4	73
Total insider ownership (top 5)	%	1.4	1.5	1.0	0.5	1.4	73
Board independence	%	82.5	7.7	85.6	77.5	88.2	63
Average indep-director ownership	%	0.2	0.3	0.1	0.0	0.2	63

Table 2: Price-based risk, January 2022-March 2023

This table reports estimates of ordinary least square (OLS) regressions where the left-hand-side variables are stock returns and realized risk measured over January 2022-March 2023 and where the right-hand-side variables are the uninsured deposit fraction and control variables as of the end of 2021. Control variables include log assets and quintile indicators for Amihud (2002) illiquidity and the frequency of days with no trade. We measure all left-hand-side variables using daily returns and calculate sensitivities using the Dimson (1979) method, requiring 80% of possible observations in the period. The column headers indicate the left-hand-side variable of each regression. The four-day return in column 1 represents the return from March 8-13, 2023, inclusive, and is not annualized. The average return and volatility in column 2 are annualized. Robust standard errors are reported in brackets. */**/*** indicates significant at the 10%, 5% and 1% levels, respectively.

	4-Day Return	Average Return	Volatility	Beta	Rate beta
	(1)	(2)	(3)	(4)	(5)
UNINS	-35.350	-67.914	22.868	0.505	-3.541
	[7.141]***	[18.671]***	[8.163]***	[0.207]**	[1.715]**
N	179	179	179	179	179
R^2	0.432	0.257	0.398	0.507	0.265

Table 3: Price-based risk, 2017-2021

This table reports estimates of ordinary least square (OLS) regressions where the left-hand-side variables are stock returns and risk and the right-hand-side variables are the average uninsured deposit fraction and control variables, all measured over 2017-2021. We measure all left-hand-side variables using monthly returns and require 80% of possible observations in the period. Control variables include log of 5-year average assets, quintile indicators for Amihud (2002) illiquidity, and quintile indicators for the frequency of no-trade days. We measure the latter two variables using daily returns from 2017-2021. The column headers indicate the left-hand-side variable of each regression. */**/*** indicates significant at the 10%, 5% and 1% levels, respectively.

	Average Return	Volatility	Beta	Rate beta
	(1)	(2)	(3)	(4)
UNINS	8.489	8.829	0.726	10.552
	[5.446]	[3.772]**	[0.167]***	[4.491]**
N	179	179	179	179
R^2	0.099	0.184	0.487	0.300

Table 4: Profitability and valuation

This table reports estimates of ordinary least square (OLS) regressions where the left-hand-side variables are profitability and valuation measures, as well as annual deposit growth, and the right-hand-side variables are the average uninsured deposit fraction and log of average assets, all measured over 2017-2021. We measure accounting variables at the BHC level from Compustat and deposit growth at the bank level from the call reports. For Compustat variables, we take the last fiscal year value during each calendar year. The column headers indicate the left-hand-side variable of each regression. */**/*** indicates significant at the 10%, 5% and 1% levels, respectively.

	ROE	ROA	ME/BE	MA/BA	Deposit Growth
	(1)	(2)	(3)	(4)	(5)
UNINS	0.051	0.003	0.586	0.051	0.024
	[0.023]**	[0.002]	[0.269]**	[0.026]*	[0.010]**
N	179	179	179	179	179
R^2	0.041	0.015	0.041	0.028	0.038

Table 5: Balance sheet capital ratios and maturity gaps

This table reports estimates of ordinary least square (OLS) regressions where the left-hand-side variables are regulatory capital measures (columns 1-4), the maturity gap measured using the English et al. (2018) method, the DV01 measure described in the text, and an indicator for whether the bank has a positive notional value of interest rate swaps. The right-hand-side variables are the uninsured deposit fraction and log of assets. All variables are measured as averages (or the log of averages) over 2017-2021. The column headers indicate the left-hand-side variable of each regression */**/*** indicates significant at the 10%, 5% and 1% levels, respectively.

	CET1	T1	Total Capital	Leverage	Maturity Gap	DV01 / CET1	IR Swap Indicator
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
UNINS	-0.020	-0.020	-0.016	-0.001	-2.335	-0.291	-0.358
	[0.015]	[0.015]	[0.016]	[0.011]	[0.866]***	[0.102]***	[0.240]
N	178	178	178	179	179	179	157
R^2	0.015	0.011	0.006	0.000	0.044	0.043	0.168

Table 6: Pay and incentives

Panel A reports estimates of ordinary least square (OLS) regressions where the left-hand-side variables are the average top-5 executive pay (TDC1), total ownership by top-5 executives, the fraction of board that is independent, and the average independent director ownership. Right-hand-side variables are the average uninsured deposit fraction and log of average assets. Both left- and right-hand-side variables are measured over 2017-2021. Panel B reports estimates of OLS regressions where the left-hand-side variables are stock returns and risk and the right-hand-side variables are the average (across time) of average (across executives) top-5 executive pay and control variables, all measured over 2017-2021. We measure all left-hand-side variables using monthly returns and require 80% of possible observations in the period. Control variables include log of 5-year average assets, quintile indicators for Amihud (2002) illiquidity, and quintile indicators for the frequency of no-trade days. We measure the latter two variables using daily returns from 2017-2021. Data on executives comes from ExecuComp while data from directors comes from Institutional Shareholder Services, and for this data we take the last fiscal year value during each calendar year. We include the CEO in our top-5 calculation even if the CEO does not belong to the top-5 executives ranked by total pay. The column headers indicate the left-hand-side variable of each regression. */**/*** indicates significant at the 10%, 5% and 1% levels, respectively.

A: Pay vs uninsured deposits

	Exec Comp	Exec Ownshp	Indep. Directors	Max IndD Ownshp
	(1)	(2)	(3)	(4)
UNINS	0.315	0.036	-0.073	0.024
	[0.260]	[0.014]**	[0.074]	[0.014]
N	73	73	63	63
R^2	0.796	0.172	0.020	0.170

B: Risk vs pay

	Average Return	Volatility	Beta	Rate beta
	(1)	(2)	(3)	(4)
Top5Pay	1.996	9.644	0.450	12.816
	[3.864]	[2.985]***	[0.145]***	[3.957]***
N	73	73	73	73
R^2	0.145	0.256	0.379	0.379

Figure 1: Returns over March 8-13, 2023

This figure plots the cumulative return over March 8-13th, 2023 (vertical axis, non-annualized percentage points, dates inclusive) versus the 2021 fraction of uninsured deposits (horizontal axis, fraction) for 179 publicly traded U.S. regional banks meeting our sample criteria. The plot indicates tickers next to each data point. Data come from CRSP and quarterly bank call reports (FFIEC 031/041). The solid line is the best-fit line, and the dashed line is the best-fit line excluding Silicon Valley Bank.

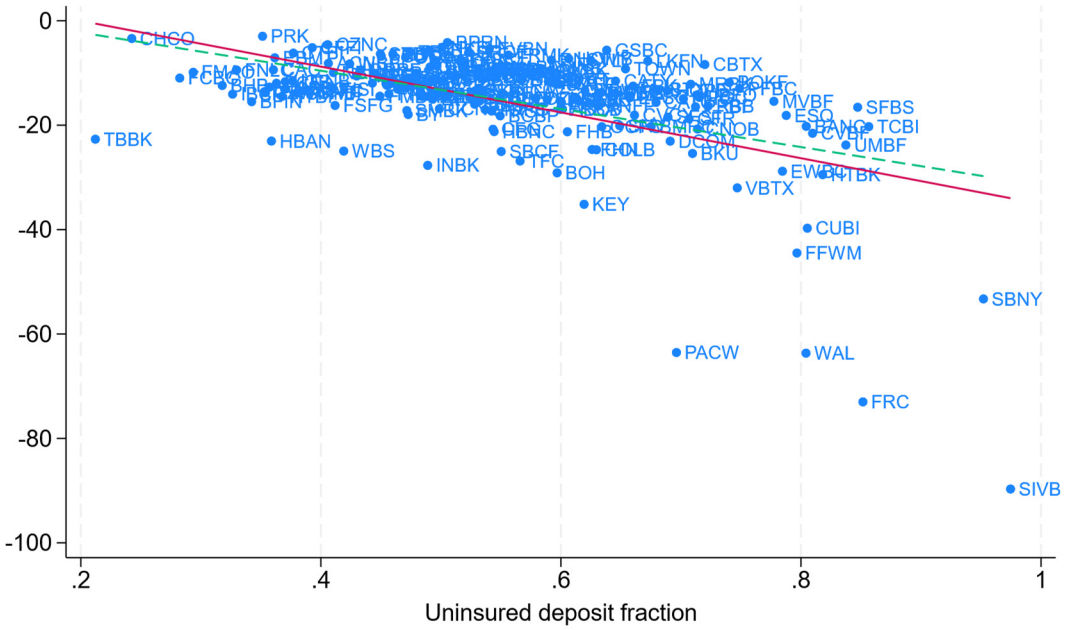


Figure 2: Stock market returns and Treasury yields, 2017-March 2023

This figure plots the cumulative return of the CRSP value-weighted index (left-hand axis, percentage points) and 3-month Treasury yield (right-hand axis, percentage points) from 2017-March 2023.

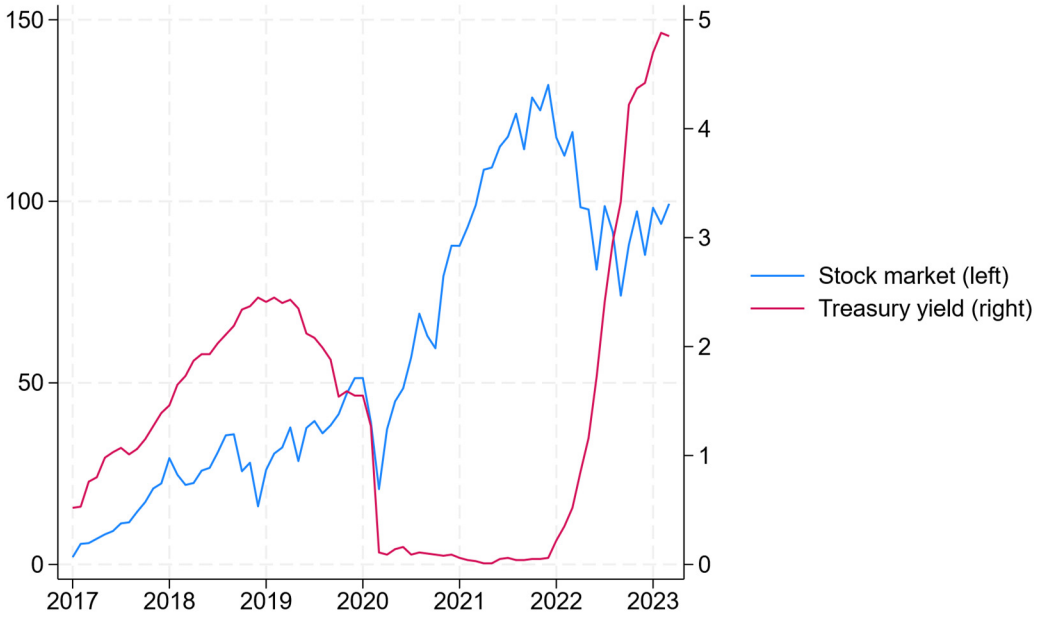
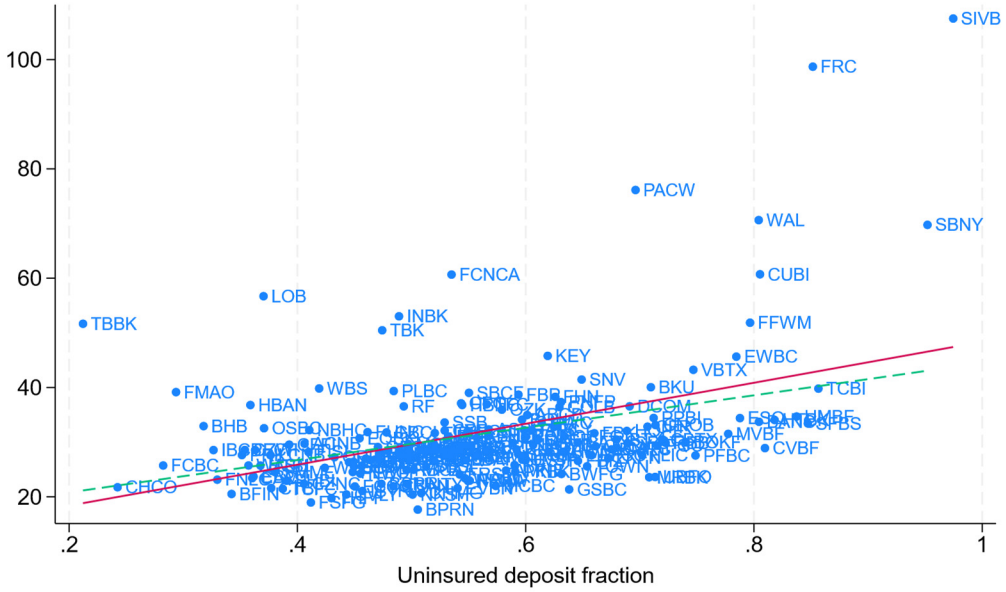


Figure 3: Price-based risk, January 2022-March 2023

This figure plots return volatility (panel A, vertical axis, annualized percentage points) and market beta (panel B, vertical axis) over January 2022-March 2023 versus the uninsured deposit fraction (horizontal axis) measured as of the end of 2021. We measure volatility and beta using daily returns and calculate beta using the Dimson (1979) method, requiring 80% of possible observations in the period. Data come from CRSP and quarterly bank call reports (FFIEC 031/041). The solid line is the best-fit line, and the dashed line is the best-fit line excluding Silicon Valley Bank.

A. Volatility



B. Beta

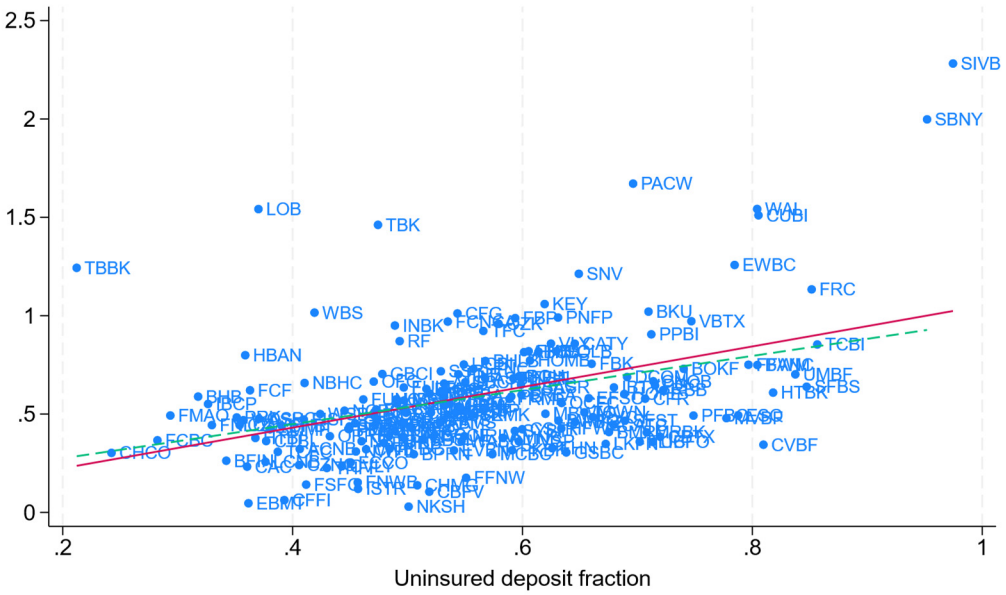
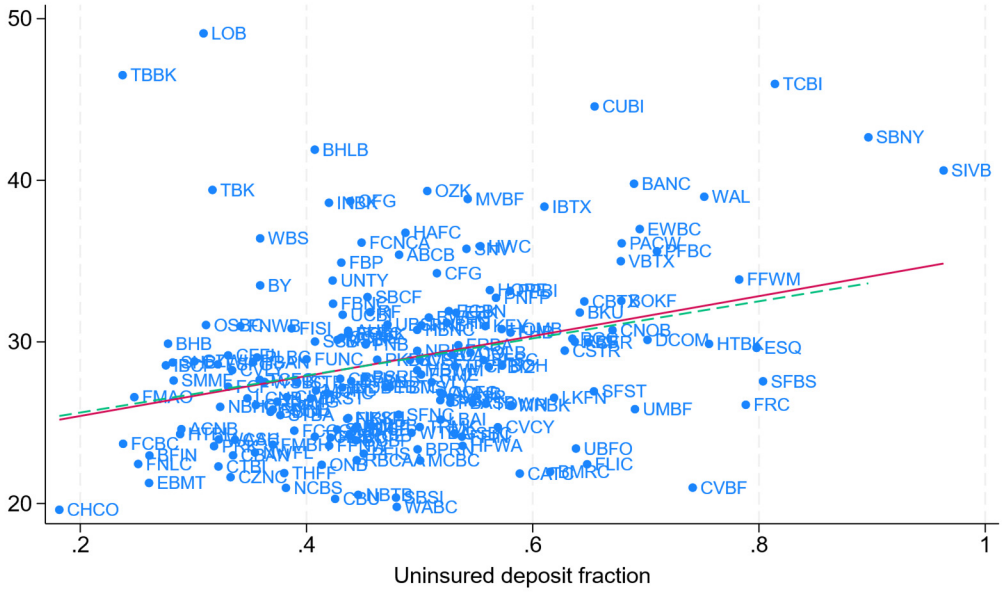


Figure 4: Price-based risk, 2017-2021

This figure plots return volatility (panel A, vertical axis, annualized percentage points) and market beta (panel B, vertical axis) versus the average uninsured deposit fraction (horizontal axis) and control variables, all measured over 2017-2021. We measure volatility and beta using monthly returns and require 80% of possible observations in the period. Data come from CRSP and quarterly bank call reports (FFIEC 031/041). The solid line is the best-fit line, and the dashed line is the best-fit line excluding Silicon Valley Bank.

A. Volatility



B. Beta

