Preliminary. Comments Welcome.

Adverse Selection in Deposit Insurance Following the 2023 Banking Crisis

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Abstract

We examine whether banks whose uninsured deposits were subject to greater risk of loss prior to the March 2023 banking crisis used institutional mechanisms to expand their deposit insurance coverage after the crisis. Based on a sample of over 4,500 U.S. banks, we construct bank-level measures of pre-crisis uninsured depositor risk using bank financial statements, unrealized security losses, and estimates of unrealized loan losses due to interest rate risk. We show that this risk measure predicts a bank's post-crisis loss in uninsured deposits and then analyze whether riskier banks sought higher post-crisis insured deposits using reciprocal deposits networks, insured deposit sweep programs, fully-insured brokered deposits, and listing service deposits. We find that riskier small and mid-sized banks tended to utilize reciprocal, sweep, and brokered deposits, but not listing service deposits, at greater rates relative to their lower risk peers. Relatively risky large banks had a greater likelihood of attracting only sweep deposits. Overall, our results are indicative of adverse selection in the post-crisis expansion of federal deposit insurance.

1. Introduction

Depositor runs that led to the sudden failures of Silvergate Bank, Silicon Valley Bank (SVB), and Signature Bank in March of 2023 sent shockwaves across the U.S. banking system. Bank creditors, including uninsured depositors, became increasingly aware that the recent rise in interest rates had reduced the fair market values of many banks' securities and loans sufficient to wipe out the book values of their equity capital.[1] In response to fears that depositor runs and failures would spread to additional banks, U.S. federal banking regulators announced that the Federal Deposit Insurance Corporation (FDIC) would guarantee the uninsured deposits of SVB and Signature Bank under the systemic risk exception of the 1991 FDIC Improvement Act.[2] Despite this policy that temporarily expanded deposit insurance coverage for some banks, other banks experienced deposit outflows, including First Republic Bank which failed in May 2023.[3]

This paper analyzes whether U.S. banks that were riskier and more vulnerable to uninsured depositor runs at the end of 2022 responded after the March 2023 crisis by employing various institutional schemes to expand their insured deposits. It investigates whether banks with greater uninsured depositor run risk were subsequently more likely to seek insured deposits via: (a) reciprocal deposit networks; (b) sweep deposits programs; (d) deposit brokers; and (c) deposit listing services. Such behavior would indicate adverse selection in the expansion of FDIC insurance that could reduce depositor discipline and exacerbate bank moral hazard incentives.

Our paper begins by developing a novel measure of an individual bank's uninsured depositor run risk that combines an estimate of the bank's fair market value leverage with its proportion of

[1] See Jiang et al. (2023) for empirical evidence that the monetary tightening of 2022 along with the long duration of many banks' loans and securities led to sufficient fair market value losses to negate their net worth.
[2] The FDIC estimated that its cost of protecting the uninsured deposits of SVB and Signature Bank to be $16.3 billion. See FDIC Special Assessment Pursuant to Systemic Risk Determination, *Federal Register* 29 November 2023. Holding company Silvergate Capital voluntarily liquidated Silvergate Bank with no loss to depositors.
[3] JPMorgan Chase acquired all of First Republic's deposits and most of its assets under a purchase and assumption transaction that protected uninsured depositors but cost the FDIC of $15.6 billion.

short-term uninsured liabilities. Calculating this run risk measure for individual U.S. banks as of the end of 2022, we first show that it predicts a bank's loss of uninsured deposits in 2023 for banks of all size categories: small (total assets below $5 billion); midsize/regional (total assets between $5 billion and $100 billion); and large (total assets above $100 billion). Second, we then analyze whether this same uninsured depositor run risk measure predicts a bank's use of various institutional mechanisms for expanding its FDIC insurance coverage. We examine this behavior both at the intensive margin (i.e., for banks that had already used these institutional arrangements in 2022) and at the extensive margin (i.e., for banks that initiated use of these arrangements in 2023).

The results of our analysis show that, compared to safer banks that were less subject to runs, riskier small and midsize/regional banks were more likely to gain insured deposits during 2023 via reciprocal deposit networks, deposit sweep programs, and, to a lesser extent, brokered deposits. Riskier large banks were more likely to expand only their sweep deposit programs.[4] We find no evidence that riskier banks of any size were more likely to expand their listing service deposits. Midsized regional banks subject to relatively high levels of run risk, which were the epicenter of the banking crisis, were especially likely to increase their insurance coverage using reciprocal deposits and sweep deposits. Their preference may have been heighted by a 2018 regulatory policy change that reclassified most reciprocal deposits as "core" deposits, rather than brokered deposits, thereby reducing the likelihood that reciprocal deposits would be subject to higher FDIC assessment rates.

[4] Our finding that relatively risky large banks differed from relatively risky small and midsize/regional banks by not expanding reciprocal and brokered deposits might reflect depositors' view that large banks were "too big to fail." Consistent with such a perception, Caglio, Dlugosz, and Rezende (2024) find that during the 2023 crisis, large banks, even riskier ones, experienced relatively higher deposit growth than small and regional banks.

Our finding that riskier banks of all sizes gathered more insured sweep deposits during the 2023 post-crisis period relative is notable. As investments in stocks, mutual funds, and ETFs have become more widespread, brokerage firms may be channeling more insured sweep deposits to these banks. Since most sweep deposits are also not categorized as brokered deposits, risky banks may also be employing them to gain greater FDIC coverage while avoiding the payment of higher assessment rates.

Our empirical evidence should be of interest to academics, bank regulators, and bank policy-makers because they relate to the objectives and efficacy of federal deposit insurance. While one objective of deposit insurance is to enhance financial stability, another is to limit its protection to "small" depositors who tend to be financially unsophisticated and lack the capacity to evaluate and monitor their bank's condition (FDIC, 2023). Private, institutional mechanisms for expanding deposit insurance are arguably inconsistent with this limitation since they can expand a depositor's insurance protection far beyond the current FDIC limit of $250,000.[5] Yet some have advocated these institutional mechanisms be encouraged, or even required, by bank regulators.[6]

The rationale for limiting the amount of FDIC coverage is that large depositors should be able to bear the fixed costs of collecting and analyzing information on banks and monitoring their financial condition. If a bank becomes too risky, uninsured depositors can require that it pay a higher deposit rate and/or withdraw their deposits, actions that impose depositor discipline and mitigate the bank's incentive to take excessive risks. For example, the theory of Calomiris and Kahn (1991) shows that uninsured depositors who can monitor their bank at low cost can discipline

[5] For example, Security Bank of Tulsa Oklahoma, a participant in IntraFi Network Deposits, advertises FDIC insurance coverage on certificates of deposits (CDs) up to a maximum of $50 million and sweep accounts up to a maximum of $100 million. See https://www.sbtulsa.bank/Services/IntraFi-Network-Deposits .

[6] See Brian P. Brooks and M. Todd Henderson "The FDIC Should Act Like a Real Insurer," *The Wall Street Journal* March 29, 2023. https://www.wsj.com/articles/the-fdic-should-act-like-a-real-insurer-reciprocal-deposit-arrangement-spreading-risk-svb-moral-hazard-dac7e312 .

it by withdrawing their funds if it does not act in their best interests. If, instead, these depositors had full insurance coverage, they would have little incentive to monitor and discipline their bank. Thus, institutional schemes that facilitate full FDIC coverage for large depositors are at odds with this beneficial role of depositor discipline.[7]

Empirical evidence supports the notion that expanding deposit insurance reduces depositor discipline and has deleterious effects on bank stability. Lambert, Noth, and Schüwer (2017) examine the effects of legislation in 2008 that expanded FDIC insurance from a maximum of $100,000 to $250,000 per account. They find that banks whose deposit insurance coverage expanded made riskier loans and raised their probabilities of failure, especially if they were initially less capitalized. Calomiris and Jaremski (2019) also find that the establishment of pre-FDIC, state-level deposit insurance schemes removed depositor discipline and led to an increase in insured-banks' insolvency risks. Similarly, Ioannidou and Penas (2010) find that after deposit insurance was introduced in Bolivia, banks were more likely to initiate riskier loans, while a cross-country study by Nier and Baumann (2006) shows that banks are lower capitalized when they have fewer uninsured liabilities and their governments provide greater safety nets.[8]

If bank monitoring and depositor discipline decline when large depositors use institutional mechanisms to expand their FDIC insurance, might bank regulators and supervisors raise the intensity of their monitoring to offset the loss? Experience does not provide much confidence that this will happen. Many economically-insolvent banks are closed or bailed-out only after depositor runs force regulators into action. Examples include Continental Illinois in 1984, IndyMac,

[7] FDIC (2023, page 27) notes this adverse consequence: "Although larger, institutional depositors are better equipped than smaller depositors to perform due diligence, they may also use their resources to expand their deposit insurance coverage beyond the $250,000 limit by using deposit services such as brokered deposits, reciprocal deposits, and sweep accounts."

[8] Other studies supporting a beneficial role for depositor discipline include Park and Peristiani (1998), Billett, Garfinkel, and O'Neal (1998), Martinez-Peria and Schmukler (2001), Goldberg and Hudgins (2002), and Bennett, Hwa, and Kwast (2015).

Washington Mutual, and Wachovia in 2008, Spain's Banco Popular in 2017, and SVB, Signature, First Republic, and Credit Suisse in 2023.

A prime reason that regulators appear incapable of promptly closing weak and insolvent banks is their focus on regulatory capital measures that are based on book values reflecting historical costs. In contrast, uninsured bank creditors and investors are concerned with fair market values since these metrics are most relevant to the loss that they (and a deposit insurer) would suffer when a bank fails. The aforementioned bank failures were cases where each bank exceeded its regulatory capital requirement prior to its demise but creditors and/or the government ultimately sustained losses. Haldane (2011) shows that regulatory capital ratios were actually higher, on average, for banks that failed or required government bailouts during the 2008 financial crisis relative to banks that did not fail or require government support.[9] However, market-value estimates of the failed or bailed-out banks' capital were substantially lower, on average, compared to banks that survived without a bailout.[10] Notably, White (2023) advocates expanding deposit insurance to mitigate depositor runs but only after requiring that banks fully implement fair market value accounting.

Our results also raise concerns that adverse selection in the expansion of deposit insurance via private, institutional mechanisms will lead to greater future losses to the FDIC. Because we find that relatively risky banks were more likely to access reciprocal, sweep, and brokered deposits following the 2023 crisis, the average risk of the FDIC's pool of insured deposits may have

[9] Such behavior is consistent with accounting choices by banks to avoid recognizing and revealing market value losses that would lower their regulatory capital ratios. For example, Bischof, Laux, and Leuz (2021) find that during the 2007-2009 financial crisis, banks were slow to recognize ultimately realized loan losses in accounting statements but these losses were reflected in market estimates. Fuster and Vickery (2018) show that when the fair market value of some banks' available-for-sale securities were required to be reflected in their regulatory capital, they shifted these securities to a hold-to-maturity classification that isolated their fair market values from regulatory capital. Banks were especially likely to do so for securities with high interest rate risk, which was particularly relevant for SVB bank that had substantial unrealized losses on its hold-to-maturity securities at the time of its failure.

[10] Similarly, Blankespoor et al. (2013) show that fair market value leverage measures better predict a bank's default risk compared to regulatory capital leverage measures.

increased. Moreover since these risky banks were previously subject to uninsured depositor discipline that has now been replaced by FDIC protection, there is reason to believe that moral hazard incentives may lead these banks to become even riskier.[11] Furthermore, because regulatory rules no longer penalize banks with higher assessments on their reciprocal and sweep deposits, the FDIC may not recoup sufficient premium revenue to cover its greater liability from more costly bank failures.

The plan of the remainder of our paper is as follows. Section 2 provides background information and related research on private, institutional methods for expanding deposit insurance coverage. Section 3 describes our data, the variables used in our empirical tests, and summary statistics. Section 4 discusses the specifications of our empirical tests while Section 5 presents our empirical results. Conclusions are given in Section 6.

2. Background and Related Literature

In this section, we first describe various institutional mechanisms that banks can use to expand their insured deposits. We then briefly discuss selected research related to our paper's topic.

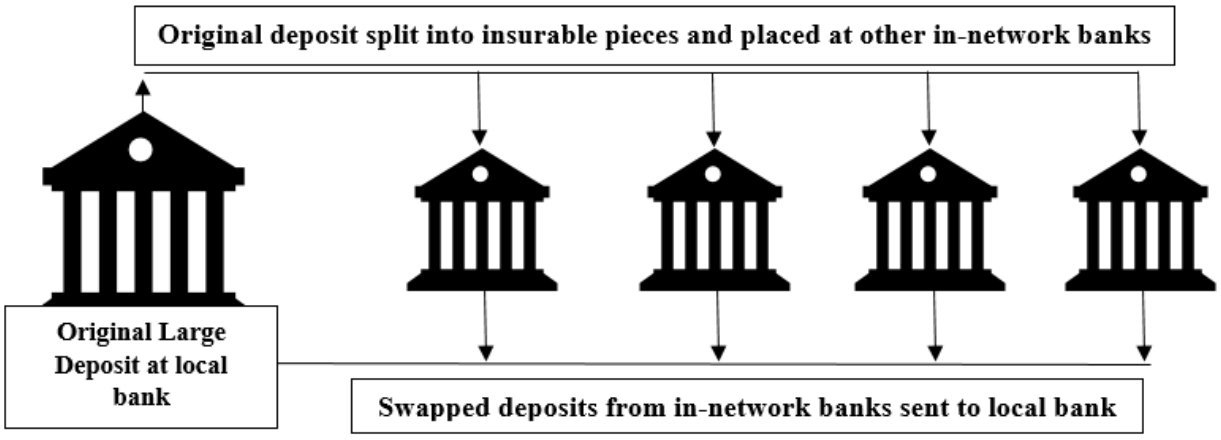
2.1. Reciprocal Deposit Networks

The FDIC defines reciprocal deposits as deposits received by an agent institution through a deposit placement network with the same maturity (if any) and in the same aggregate amount as covered deposits placed by the agent institution in other network member banks.[12] The term "deposit placement network" means a network which an insured depository institution participates, together with other insured depository institutions, for the processing and receipt of reciprocal

[11] Chang, Cheng, and Hong (2023) develop a model where, in equilibrium, banks that take more risk attract more uninsured depositors. In the presence of full deposit insurance coverage, Marcus (1984) and Keeley (1990) provide another rationale for why insured banks may vary in their risk-taking incentives. If banks differ in the amount of their "charter" or "franchise" value, low charter value banks have greater incentives to take risk.
[12] See https://www.fdic.gov/regulations/laws/rules/1000-3000.html .

deposits.

To provide a simplified illustration of how reciprocal deposit networks function, consider a single customer that places a $1,250,000 deposit at a local bank. If the local bank did not participate in a reciprocal deposit network, then only 20% or the first $250,000 of that customer's deposit would be covered by FDIC insurance. However, if the local bank participated in a reciprocal deposit network, with the customer's authorization it could split the initial $1,250,000 into five distinct deposits, retaining a $250,000 insured portion and exchanging the second, third, fourth, and fifth portions for similar deposits from other banks participating in the placement network. The result would be that the entire original $1,250,000 deposit would be covered by federal deposit insurance.



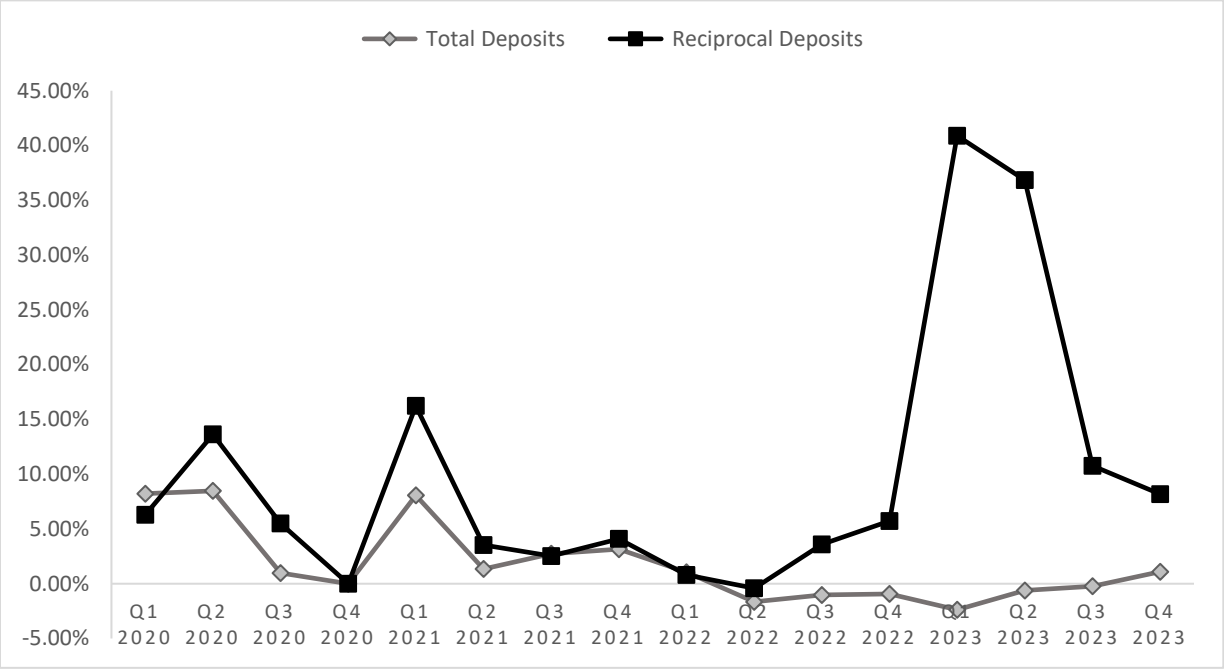
On a global basis, it appears that the FDIC is unique in terms of being a deposit insurer that permits, and even encourages, reciprocal deposits because reciprocal deposit networks that automatically split a bank customer's large deposit do not seem to exist in other countries.[13]

[13] Raisin is an online bank operating a platform that allows individual and business customers to place deposits at European partner banks. But the customer must choose the type and amount of each partner bank deposit that can be at different interest rates and maturities. Hence, it operates similar to a deposit broker.

Reciprocal deposits effectively allow banks to circumvent the FDIC limited insurance coverage scheme that was originally meant to protect only small and potentially unsophisticated depositors. In 2018, the FDIC changed the regulatory treatment of reciprocal deposits in accordance with the Economic Growth, Regulatory Relief, and Consumer Protection Act that became law in the same year. If a bank's total reciprocal deposits are less than $5 billion or are less than 20% of its total liabilities, its reciprocal deposits would no longer be classified as "brokered deposits," but, rather, "core" deposits. This was a potentially important change because, as will be discussed below, brokered deposits can be subject to higher FDIC insurance assessment rates and can be restricted at banks that are not well-capitalized.

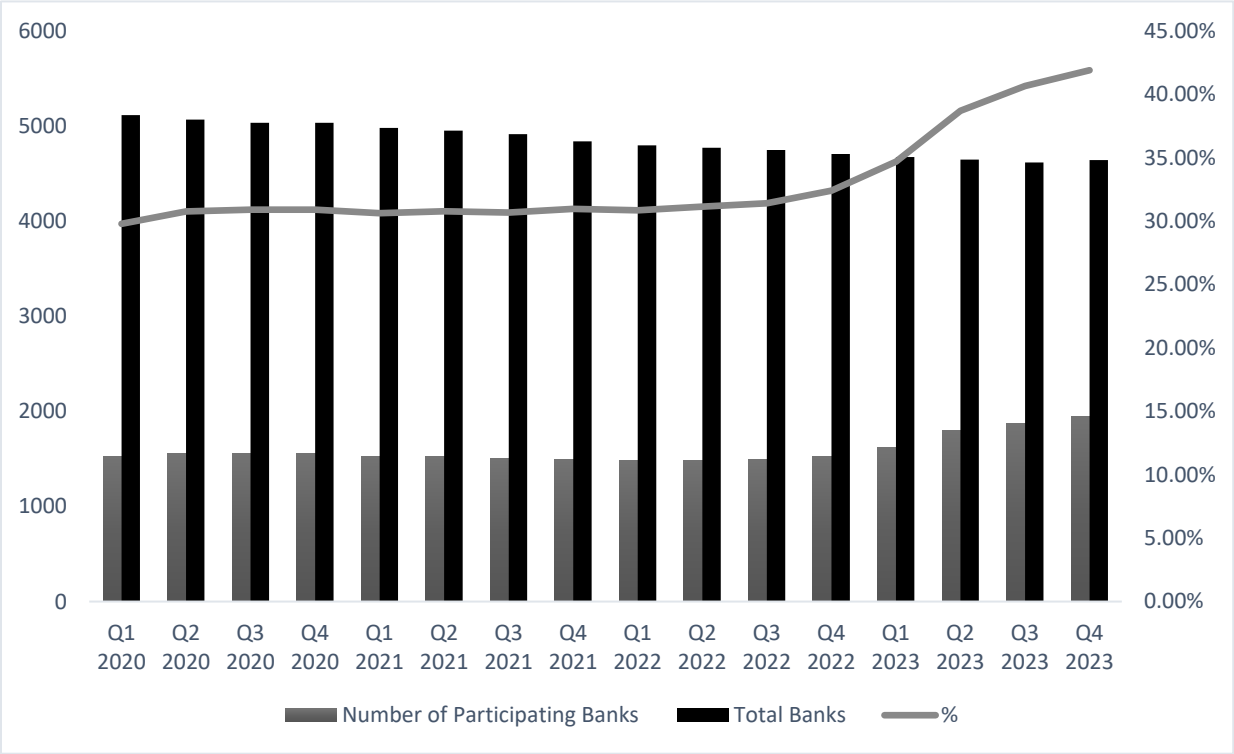
As is illustrated in Figure 1, total U.S. bank deposits decreased by $597.5 billion (-7.8%) over the first 9 months of 2023, rebounding over the last quarter to end down by $381 billion (-2.1%) relative to year-end 2022. In contrast, banks' reciprocal deposits grew substantially, evidenced by an unprecedented increase of $205.9 billion (+131%) during 2023.

Figure 1: Reciprocal Deposit Growth Rate



Moreover, the number of banks participating in reciprocal deposit networks increased significantly during 2023, growing by over 420 banks (+27.56%) with 41.85% of all commercial banks participating in reciprocal deposit networks (Figure 2).

Figure 2: Bank Participation in Reciprocal Deposits



2.2. Sweep Deposit Programs

An attractive strategy for brokerage firms with client cash from settlement activities is to "sweep" their customers' settlement account balances into FDIC-insured bank deposits. To gain maximum FDIC deposit insurance protection on large balances, sweeps can involve fund transfers to several different banks. For example, the brokerage firm Vanguard offers a bank sweep program offering FDIC insurance up to $1.25 million for an individual customer brokerage account and up to $2.50 million for a joint account. With established customer authorization, it could sweep $1.25 million of funds to five different $250,000 insured, interest-bearing deposit accounts at five

different participating banks.[14]

In many cases, banks need not classify their sweep deposits as "brokered" deposits, thereby avoiding the potentially higher costs and restrictions on brokered deposits. The FDIC's 2021 Brokered Deposits Final Rule can exclude sweeps from the brokered deposit category if there is no third party involved in placing the brokerage firm's funds in a bank.[15]

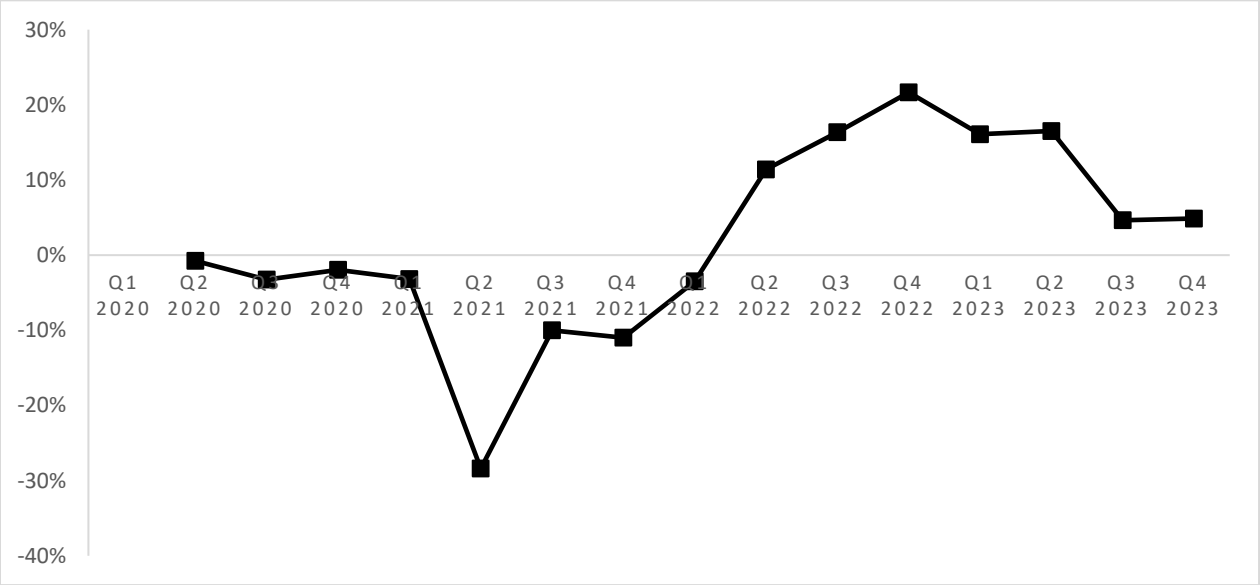
2.3. Fully Insured Brokered Deposits

A brokered deposit is a deposit obtained by a bank directly or indirectly from or through the mediation or assistance of a deposit broker. A deposit broker is any person engaged in the business of placing deposits of third parties with insured depository institutions.[16] Fully-insured brokered deposits typically take the form of Certificates of Deposits (CDs) issued by banks and sold through a registered broker.

Section 29 of the Federal Deposit Insurance Act restricts institutions that are less than "well capitalized" from accepting brokered deposits (with specific waivers available). Brokered deposits can also raise a bank's FDIC assessment rate.[17] Based on bank Call Reports, Figure 3 shows that fully-insured brokered deposits grew substantially in 2022 and 2023. They increase in 2023 by approximately $388 billion (48.4%).

[14] See https://investor.vanguard.com/investment-products/cash-investments .
[15] See https://www.fdic.gov/news/financial-institution-letters/2022/fil22030.html .
[16] See https://www.ecfr.gov/current/title-12/chapter-III/subchapter-B/part-337/section-337.6
[17] See https://www.fdic.gov/resources/deposit-insurance/deposit-insurance-fund/dif-assessments.html .

Figure 3: Fully Insured Brokered Deposit Growth Rate

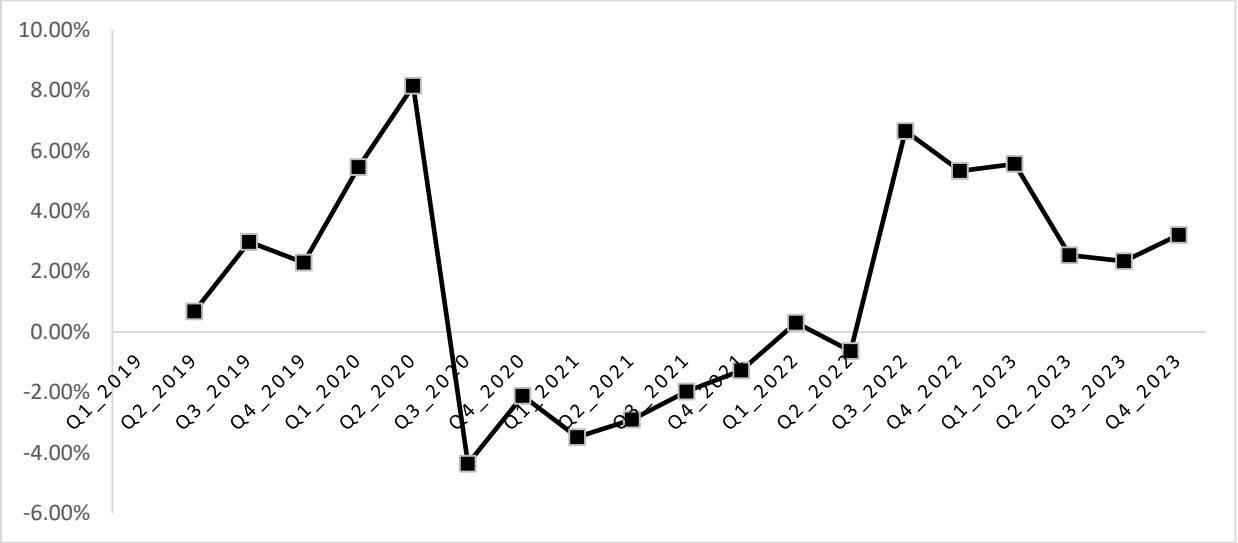


2.4. Deposit Listing Services

A deposit listing service differs from brokered deposit networks in that a listing service is a company that restricts itself to the compilation and publication of information about deposit accounts at many different banks for consideration by interested depositors. This information typically includes interest rates offered by various banks. Simply put, a listing service does not directly place deposits but provides information to potential depositors. The more passive nature of a deposit listing service is its main difference relative to a deposit broker.

As shown in Figure 4, bank Call Reports indicate that banks used listing services to increase their insured deposits over the second half of 2022 and throughout 2023, increasing by 20.4% from 2022Q2 to 2023Q4.

Figure 4: Deposit Listing Service Growth Rates



2.5. Related Literature

There is relatively little academic research on reciprocal deposit networks. Li and Shaffer (2015) examine bank Call Report data over the period 2009Q2 to 2012Q4 and find mixed evidence on whether banks with greater reciprocal deposit balances posed more risk to the FDIC. More recently, Ryfe and Saretto (2023) note that, in aggregate, U.S. banks' reciprocal deposits have grown steadily since 2018, and they increased dramatically following the March 2023 banking crisis. Their high growth in 2023 helped to reverse what had been a decline in the share of banks' insured deposits relative to their uninsured deposits.

Research on sweep deposits is also limited. Barth, Mitchell, and Sun (2023) identified a robust inverse relationship between stock market performance and bank deposits where sweep deposits are a primary driver. During stock market downturns, investors who liquidate their stock holdings often have their proceeds swept into insured deposit accounts. Consequently, due to deposit insurance, sweep deposits may encourage cash inflows into banks during periods of high systemic stress (Gatev and Strahan (2006), Pennacchi (2006)).

There is more extensive research on brokered deposits since they have long been a concern of policymakers due to brokered deposits' role in bank failures occurring during the 1980s (Harless (1984)). Barth, Lu, and Sun (2020) provide a review of the brokered deposit literature and find mixed evidence as to whether banks' use of brokered deposits increased their likelihood of failure or whether brokered deposits increased the FDIC's cost of bank failures.

The literature on listing service deposits is sparse, but an important paper relating to the topic is Martin, Puri, and Ufier (2022). They provide a detailed study of deposit outflows and inflows of a distressed bank that failed in 2009. Prior to failure, the bank suffered significant outflows of uninsured deposits. However, these outflows were largely offset by inflows of insured deposits, with a large proportion of these insured deposits obtained through internet deposit listing services. Hence, listing services appear to play a large role in mitigating the market discipline of this bank's uninsured depositor runs.

The focus of our paper is to consider whether the recent 2023 rise in insured deposits obtained through institutional mechanisms was disproportionately centered on banks whose uninsured depositors faced greater expected losses, making these banks more vulnerable to runs. Thus, we seek to test whether the post-crisis expansion in insured deposits was indicative of adverse selection. In summary, the general hypothesis tested by our paper is whether banks with higher levels of pre-March 2023 balance sheet risk used reciprocal deposit networks, sweep deposit programs, brokered deposits, and/or deposit listings services more than their lower-risk peers for the purpose of expanding their insured deposits following the March 2023 banking crisis.

3. Sample and Data Description

The availability of Call Report data on banks' use of reciprocal deposits, sweep deposits, brokered deposits, and listing service deposits is relatively recent. This information, along with

individual banks' financial statement information and market interest rate changes, comprise the main data used in our study.

The Federal Financial Institutions Examination Council (FFIEC) Central Data Repository's Public Data Distribution provides quarterly Call Reports. The quarter before the March 2023 banking crisis, namely 2022Q4, serves as the base year for our calculation of a measure of each bank's uninsured depositor run risk. The subsequent quarters of 2023 allow us to examine each bank's change in its uninsured deposits and its responses in terms of the change in its issuance of reciprocal deposits, sweep deposits, brokered deposits, and listing service deposits. Our sample size over the four quarters of 2023 averages around 4,656 different banks.

We exclude from our sample those banks which were the center of the banking crisis and failed before or shortly after the end of the first quarter of 2023, namely, Silvergate Bank, Silicon Valley Bank, Signature Bank, and First Republic Bank. In addition, we eliminated "de novo" banks, defined as banks established within the last three years, since these banks tend to have financial performance that differ substantially from that of established banks.[18]

Call Reports provide data on individual banks' reciprocal deposits, brokered deposits, and listing service deposits every quarter. However, small banks are only required to report their fully-insured sweep deposits semi-annually, at the ends of the second and fourth quarters. Hence our tests using sweep deposits are limited to amounts reported for 2023Q2 and 2023Q4.

As discussed below, our tests use a measure of individual banks' risk of loss to their uninsured depositors, which we refer to as "balance sheet risk." Our measure uses a bank's financial statement data to calculate its market value of assets. For a bank's assets in the form of securities, we use the bank's reported "fair values," rather than its book or par values, that are available on

[18] Jones, Myers, and Wilkinson (2022).

Call Reports. Equivalently, we deduct these securities' unrealized losses from their par values to calculate their market values.

However, banks report only the par values, rather than the market values, for most of their loans. To estimate these loans' unrealized losses, and hence their market values, we use each banks' reported amounts of loans in different maturity buckets and estimate their market value losses due to the significant rise in market interest rates that occurred over the course of the 2022 calendar year. Details of this procedure are given in the Appendix.

3.1. Uninsured Depositor Balance Sheet Risk

Our measure of uninsured depositor risk is based on an estimate of uninsured depositors' expected default losses, which depends on their bank's likelihood of insolvency and the depositors' exposure to losses from the insolvency. We refer to this measure as Balance Sheet Risk (*BSR*). *BSR* is calculated as:

$$BSR = \underbrace{\frac{TDT}{TA - UL}}_{\text{Likelihood of Insolvency (Leverage)}} \times \underbrace{\frac{UD + STB}{TD + STB + LTD + PS - FHLB}}_{\text{Uninsured Depositor Loss Given Default}} \quad (1)$$

where *TDT* is total debt, *TA* is the book value of total assets, and *UL* is unrealized market (fair) value losses on assets. *UD* denotes uninsured deposits while *STB* equals short term borrowings. *TD* equals total deposits and *LTD* equals long-term debt. *PS* is preferred equity (stock) while *FHLB* is Federal Home Loan Bank Advances.

Equation (1) indicates that *BSR* can be viewed as the product of two terms: Likelihood of Insolvency (default) and Uninsured Deposit Loss Given Default. The likelihood of insolvency is modeled by a leverage ratio, namely, the ratio of total promised debt (*TDT*) to the market value of assets (book assets value minus unrealized losses or *TA*-*UL*).

The term Uninsured Depositor Loss Given Default presumes that a bank's uninsured deposits and its short-term borrowings (e.g., federal funds purchased) are similar in that they are short-term funding that is likely to be withdrawn, or attempted to be withdrawn, around the time of a bank's failure. The denominator indicates other categories of bank debt that are less likely to be withdrawn and would share in losses during a bank resolution. An exception is Federal Home Loan Bank Advances which have a senior (secured) claim on bank assets (e.g., mortgages). Hence, they are subtracted from other liabilities which are junior to them.

Our *BSR* measure has similarities, and some differences, to other recently proposed measures of uninsured depositor run risk. Curti and Gerlach (2024) calculate a bank's regulatory leverage ratio in the presence of runs based on the amount of unrealized losses that would need to be realized from selling securities and loans if all runnable liabilities (those with maturities of less than 1 year) were withdrawn. Our measure differs by assuming that insured deposits are unlikely to run and by using a measure of leverage where all assets are marked-to-market, an assumption also made by Flannery and Sorescu (2023). While Flannery and Sorescu (2023) differ from us by not modeling run risk based on uninsured creditors' short-term liabilities, the Appendix shows that our estimates of bank asset losses used in our leverage measure are similar to theirs.

Our measure of each bank's 2022Q4 *BSR* is used to explain its growth in uninsured deposits, reciprocal deposits, sweep deposits, brokered deposits, and listing service deposits from the end of 2022 to the ends of different quarters in 2023. In each case, the growth rate for a particular category of deposits is calculated as the change in the amount of the particular deposit from 2022Q4 to 2023Q1, Q2, Q3, or Q4 divided by the bank's total deposits in 2022Q4.

3.2. Summary Statistics

Summary statistics shown in Table 1 categorizes banks based on their total asset size as of 2022Q4: small banks (banks with domestic offices only and total assets less than $5 billion); midsize/regional banks (banks with domestic offices only and assets between $5 billion and $100 billion); and large banks (banks with foreign offices, or banks with domestic offices only and assets greater than $100 billion).

Table 1 shows that at year-end 2022, small banks, which account for approximately 94.7% of our sample, tended to have slightly lower *BSR* compared to midsized/regional banks that made up about 4.3% of our sample. Large banks, less than 1% of the sample, had the highest level of *BSR* which might be expected since they tend to have higher leverage and rely on a greater proportion of short-term uninsured liabilities, c.f., Chacko (2015). As shown in Table 1 and Figure 5, *BSR* is bounded at zero and has an extreme right-tailed skew. Approximately 25 banks have a *BSR* measure that exceeds 0.80.

Figure 5: Balance Sheet Risk

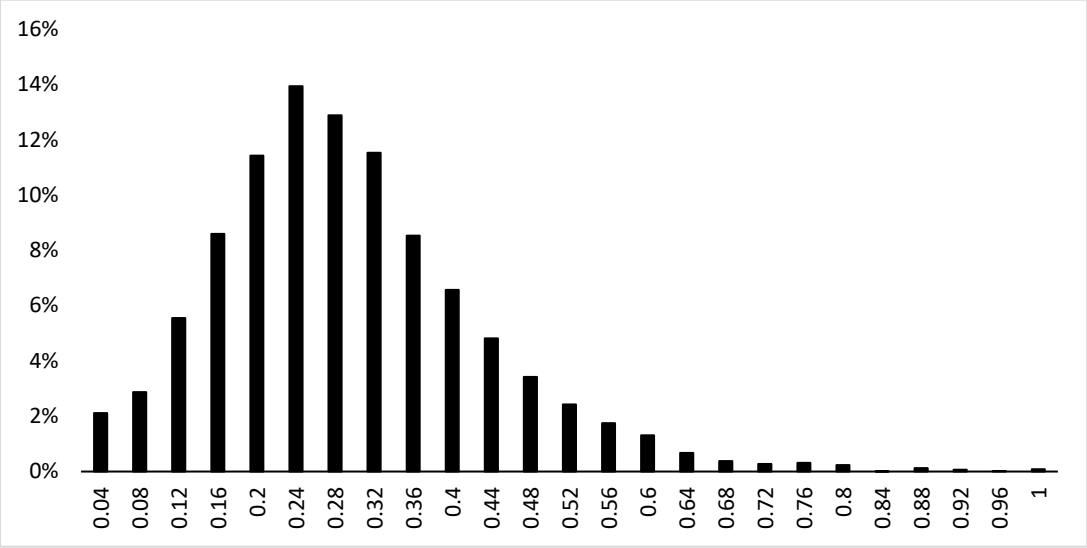


Table 1 also provides summary statistics for the growth rates of various categories of deposits, where each growth rate for a given bank and a given category of deposit is calculated as the

particular deposit's change from 2022Q4 to 2023Q4 normalized by the bank's total 2022Q4 deposits. Table 1 shows that banks across all size categories tended to lose uninsured deposits during 2023, but the loss was especially great for midsized/regional banks. In contrast, during 2023 small and midsized/regional banks saw significant growth, on average, for reciprocal, sweep, and brokered deposits while large banks expanded only their sweep deposits. Listing service deposit growth was negligible, on average, for banks of all sizes.

4. Empirical Test Specifications

We employ linear regression models to analyze the relationships between a bank's pre-crisis 2022Q4 *BSR* and its post-crisis growth rates of uninsured deposits and four different classes of its insured deposits (reciprocal deposits, insured sweep deposits, insured brokerage deposits, and listing service deposits). We measure a growth rate as the change in a particular deposit class relative to its 2022Q4 pre-crisis level and normalize this change by the bank's 2022Q4 total deposits. We examine these changes over four different quarterly horizons ending in 2023Q1, 2023Q2, 2023Q3, or 2023Q4. Finally, our regression specification allows for different responses for three different size categories of banks: small, midsized (regional), and large.

For example, the form of our linear regression model for the case of reciprocal deposits is:

$$\frac{R_{b,t} - R_{b,2022Q4}}{D_{b,2022Q4}} = \alpha_1 + \alpha_2 IR_{b,2022Q4} + \alpha_3 IL_{b,2022Q4} + \beta_1 BSR_{b,2022Q4} + \beta_2 BSR_{b,2022Q4} \times IR_{b,2022Q4} + \beta_3 BSR_{b,2022Q4} \times IL_{b,2022Q4} + \beta_4 X_{b,2022Q4} + \varepsilon_{b,t} \quad (2)$$

where

$R_{b,t}$ is bank b's reciprocal deposits at the end of quarter t, t =2023 Q1, Q2, Q3, or Q4.

$D_{b,2022Q4}$ is bank b's total deposits at the end of 2022Q4.

$IR_{b,2022Q4}$ = 1 if bank b's 2022Q4 assets are between \$5 billion and \$100 billion, 0 otherwise.

$IL_{b,2022Q4}$ = 1 if bank b's 2022Q4 assets are over \$100 billion, 0 otherwise.

$BSR_{b,2022Q4}$ is bank b's measure of uninsured depositor balance sheet risk as of 2022Q4.

$X_{b,2022Q4}$ is a vector of controls for bank b, e.g., ln(total assets).

In equation (2), α_1 and β_1 represent reciprocal deposit growth's intercept and sensitivity to *BSR*, respectively, for a small bank. Thus, α_2 and β_2 represent reciprocal deposit growth's incremental intercept and sensitivity to *BSR*, respectively, for a mid-sized (regional) bank relative to a small bank. Similarly, α_3 and β_3 represent reciprocal deposit growth's incremental intercept and sensitivity to *BSR*, respectively, for a large bank relative to a small bank.

At the end of 2022Q4, some banks had positive amounts of reciprocal deposits while many other banks reported zero reciprocal deposits, indicating that the former banks were already participants in a reciprocal deposit network while the latter banks were non-participants. To gain more insight into banks' reactions to the 2023 banking crisis, we run our tests based on subsamples of 2022Q4 participating banks and 2022Q4 non-participating banks. Tests using the 2022Q4 participating subsample allow us to see how the March 2023 crisis affected reciprocal deposit growth at the intensive margin. Similarly, tests based on the 2022Q4 non-participating subsample allow us to see how the March 2023 crisis affected reciprocal deposit growth at the extensive margin. Thus, we categorized banks based on:

1) Banks with $R_{b,2022Q4} > 0$. (Intensive margin)
2) Banks with $R_{b,2022Q4} = 0$. (Extensive margin)

Note that 2022Q4 participating banks could have 2023Q1,2,3, or 4 – 2022Q4 changes in their levels of reciprocal deposits that were either positive or negative, so that the dependent variable in equation (2) could be positive or negative. Hence, we estimate equation (2) for intensive margin banks using ordinary least squares. However, since, by definition, nonparticipating banks had 2022Q4 reciprocal deposits equal to zero, their dependent variable in equation (2) could be no less than zero. Therefore, we estimate equation (2) for extensive margin banks using a Tobit regression

with a lower bound of zero. The above discussion pertains to our tests examining reciprocal deposits. We repeated these tests substituting a bank's reciprocal deposits with its uninsured deposits, sweep deposits, brokered deposits, or listing service deposits.

5. Results

5.1 Uninsured Deposits and Balance Sheet Risk

To examine whether our ex-ante uninsured depositor run risk measure conforms with actual ex-post uninsured depositor behavior, we test how banks that reported uninsured deposit balances in 2022Q4, which includes almost all banks, experienced a change in these deposits in relationship to their *BSR*. The results are reported in Table 2 and indicate that small banks with higher *BSR* saw greater reductions in uninsured deposits. For example, one standard deviation increase in a small bank's *BSR* (0.138) tended to decrease the level of uninsured deposits ratio held at the bank at 2023Q4 by 0.138×(-0.134) = -1.85%.

Uninsured deposits' sensitivity to *BSR* was significantly greater at midsize /regional banks. A one standard deviation increase in a midsized bank's *BSR* would decrease its ratio of 2023Q4 uninsured deposits per 2022Q4 total deposits by 0.138×(-0.134 -0.142) = -3.81%. Relatively risky large banks experienced a loss in uninsured deposits similar to that of small banks. A one standard deviation increase in *BSR* would lead to a loss of 2023Q4 uninsured deposits per 2022Q4 total deposits of 0.138×(-0.134-0.003) = -1.89%.

5.2 Reciprocal Deposits

Table 3 reports our test results on reciprocal deposit growth for intensive margin banks; that is, banks with pre-existing reciprocal deposit balances in 2022Q4. Focusing on the estimated coefficients for *BSR*, we see that small and midsized banks with greater *BSR* were significantly more likely to increase their reciprocal deposits.

For example, a one standard deviation increase in a small bank's *BSR* (0.138) would tend to raise its ratio of 2023Q4 reciprocal deposits per 2022Q4 total deposits by 0.138×0.116 = 1.60%. The effect for midsize/regional banks is even greater. A one standard deviation increase in a midsized bank's *BSR* would increase its ratio of 2023Q4 reciprocal deposits per 2022Q4 total deposits by 0.138×(0.116+0.095) = 2.91%. However, we see no tendency for more risky large banks to have greater growth in their reciprocal deposits, as the sum of the coefficients on *BSR* and *BSR*×*IL* is statistically insignificant.

Table 4 shows qualitatively similar findings for extensive margin small and midsize/regional banks. Large banks were excluded from these Tobit regressions because of too few observations where large banks initiated a reciprocal deposit program in 2023. For a small bank, our estimates imply that a one standard deviation increase in *BSR* would tend to raise its ratio of 2023Q4 reciprocal deposits per 2022Q4 total deposits by 2.35%. For the case of midsize/regional banks, a one standard deviation increase in a bank's *BSR* would tend to raise its ratio of 2023Q4 reciprocal deposits per 2022Q4 total deposits by the very substantial amount of 4.00%. Taken together, this evidence is consistent with the effects of the 2023 banking crisis being centered on risky regional banks, and they were mostly likely to respond by growing their reciprocal deposits.

5.3 Sweep Deposits

Tables 5 and 6 report the results of similar tests that examine how banks' pre-crisis *BSR* affected the growth in their fully-insured sweep deposits. Table 5 shows that, at the intensive margin, riskier banks of all sizes were significantly more likely to increase their sweep deposits, with the effect being greatest for midsize/regional banks. A one standard deviation increase in uninsured depositors' *BSR* raised small, midsized, and large banks' ratio of 2023Q4 sweep deposits per 2022Q4 total deposits by 1.24%, 3.64%, and 255%, respectively.

At the extensive margin, Table 6 indicates that both risky small and midsized banks were more likely to begin participating in sweep deposits.[19] It shows that a one standard deviation rise in *BSR* led to an increase in small and midsized banks' ratio of 2023Q4 sweep deposits to 2022Q4 total deposits of 1.87% and 4.55%, respectively.

5.4 Brokered Deposits

We now analyze the relationship between a bank's pre-crisis uninsured depositor *BSR* and its post-crisis growth in fully-insured brokered deposits. There are some reasons to believe that risky banks would be less likely to use the brokered deposit channel to increase their insured deposits. First, Section 29 of the Federal Deposit Insurance Act restricts institutions that are less than well capitalized from accepting brokered deposits (with specific waivers available). Second, for banks with total assets exceeding $10 billion, significant holdings of brokered deposits can raise a bank's FDIC deposit insurance assessment rate.

Consistent with risky midsize/regional and large banks suffering potential penalties from issuing brokered deposits, Table 7 shows consistent, statistically significant evidence that only risky small banks were more likely increase their brokered deposits in the post-crisis period. A one standard deviation increase in *BSR* raised small banks' 2023Q4 brokered deposits per 2022Q4 total deposits by 0.53% and 1.26%, respectively. Riskier midsize/regional banks seemed to issue more brokered deposits in 2023Q2, but then this tendency subsided afterwords.[20]

At the extensive margin, Table 8 indicates that only small banks with greater *BSR*s were likely to initiate issuance of insured brokered deposits. However, the effect is mild: a one standard

[19] Large banks were excluded from these Tobit regressions because of too few observations of banks initiating sweep deposit programs.
[20] A one standard deviation increase in a midsize/regional bank's *BSR* would raise its 2023Q2 brokered deposits per 2022Q4 total deposits by 1.41%.

deviation increase in *BSR* would lead to a small bank's ratio of 2023Q4 brokered deposits to 2022Q4 total deposits of 0.75%.

5.5 Deposit Listing Services

Finally, Tables 9 and 10 report our findings on whether banks with greater uninsured depositor *BSR* were more likely to increase their insured deposits via listing services. We find scant evidence of any significant relationships, either at the intensive margin or the extensive margin. In summary, it appears that listing service deposits were not utilized by risky banks to raise their insured deposits. This is consistent with Table 1 which shows that few banks showed any growth in listing service deposits during 2023.

6. Conclusions

This paper analyzed reactions of U.S. banks to the March 2023 banking crisis. It examined whether banks whose uninsured deposits were subject to greater risk just prior to the crisis, and hence were more likely to run, used various institutional channels to expand their insured deposits after the crisis. These channels included reciprocal deposit networks, insured deposit sweep programs, fully-insured brokered deposits, and listing service deposits.

Compared to safer banks that were less subject to runs, riskier small and midsized banks were more likely to gain insured deposits via reciprocal deposits, sweep deposits, and to a less extent, brokered deposits. Risky midsize/regional banks, which were at the epicenter of the banking crisis, were especially likely to expand their deposit insurance coverage using reciprocal and sweep deposits. Riskier large banks limited their expansion of insured deposits to only sweeps, perhaps because of perception that they were too big to fail. Uninsured depositor discipline may have been exacted mainly on small and midsize/regional banks.

That riskier banks chose to exploit primarily reciprocal and sweep deposits is consistent with recent regulatory policy that reclassifies them as core deposits and not brokered deposits. By removing most of their restrictions and reducing the possibility of higher FDIC assessment rates, reciprocal and sweep deposits appear to now be subject to greater adverse selection.

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Appendix

This Appendix provides details of the procedure that was used to calculate the unrealized gain/loss on each bank's loans due to interest rate changes that occurred during the calendar year 2022. It uses data on the market prices of various maturity Treasuries and, based on Call Report data, each bank's reported par amounts of loans in different maturity buckets. It also assumes that all loans with a maturity greater than one year are amortized loans.

Let A_0 be the market value of an amortized bank loan at date 0, such as a mortgage or car loan. For simplicity, it is assumed to make annual payments of C at the ends of the next n years. Then if $y_{0\tau}$ is the date 0 continuously-compounded yield on a zero-coupon bond that matures in τ years, the market value of the loan is

$$A_0 = C\sum_{\tau=1}^{n} e^{-y_{0\tau}\tau} \tag{A.1}$$

Now suppose that at the date 0 beginning of the year, a bank's loan is selling at its par value of $A_0 = 100$ which would be the case if the loan was originated at the beginning of the year. Given the term structure at the beginning of the year, we can calculate the annual payments, C, required to make the loan sell at par:

$$C = \frac{A_0}{\sum_{\tau=1}^{n} e^{-y_{0\tau}\tau}} = \frac{100}{\sum_{\tau=1}^{n} e^{-y_{0\tau}\tau}} \tag{A.2}$$

Given the value of C determined in equation (A.2), we next calculate the amortized loan's beginning of year annualized yield to maturity, Y, using the annuity formula:

$$A_0 = \frac{C}{Y}\left[1 - \frac{1}{(1+Y)^n}\right] \tag{A.3}$$

or

$$\frac{Y}{1-\frac{1}{(1+Y)^n}}=\frac{C}{100} \tag{A.4}$$

Given C, Y can be solved numerically, for example, using Excel's Rate function. Then based on these values of C and Y, we calculate the amortized loan's par or book value at the end of the year. At the end of the year, the payment C has been made, which is composed of an interest payment of $Y\times100$ and a principal payment of C- $Y\times100$. Hence, the remaining principal or end-of-year book or par value of the loan, Par_1, is

$$Par_1 = 100-\left(C-Y\times100\right)=\left(1+Y\right)100-C \tag{A.5}$$

However, the market value of the loan at the end of the year, which will now have n-1 payments remaining, depends on the term structure at the end of the year. If $y_{1\tau}$ is the end of year date 1 continuously-compounded yield on a zero-coupon bond that matures in τ years, the market value of the loan is

$$A_1 = C\sum\nolimits_{\tau=1}^{n-1} e^{-y_{1\tau}\tau} \tag{A.6}$$

Hence, the unrealized gain at the end of the year equals the difference between the market and book (par or amortized value) of the loan, A_1 - Par_1:

$$\begin{aligned}\text{Unrealized Gain } &= C\sum\nolimits_{\tau=1}^{n-1} e^{-y_{1\tau}\tau}-\left(1+Y\right)100+C \\ &= C\left(1+\sum\nolimits_{\tau=1}^{n-1} e^{-y_{1\tau}\tau}\right)-100\left(1+Y\right)\end{aligned} \tag{A.7}$$

The unrealized gain as a proportion of each \$1 of initial par value is the above divided by 100:

$$\text{Unrealized Gain per \$Par} = \frac{C}{100}\left(1+\sum\nolimits_{\tau=1}^{n-1} e^{-y_{1\tau}\tau}\right)-\left(1+Y\right) \tag{A.8}$$

We multiply the quantity in equation (A.8) by a bank's amount of loans in each maturity bucket given in its Call Report, assuming that all loans having a maturity of one year or less have

no unrealized gains or losses. In addition, we assume that loans of maturities between 1-3 years have a maturity of 2 years, loans of maturities between 3-5 years have a maturity of 4 years, loans of maturities between 5 and 15 years have a maturity of 10 years, and loans of maturities over 15 years have a maturity of 20 years.

We obtain data on $y_{0\tau}$ and $y_{1\tau}$ for various maturities, τ, using continuously-compounded zero- coupon Treasury bond yields available at https://www.federalreserve.gov/data/nominal-yield-curve.htm under Nominal Yield Curve and SVENY. We assume the initial term structure is 12/31/2021 and the end of year 2020 term structure is the last trading day 12/30/2022.

The calculations described above can be done to obtain proportional losses for each maturity bucket. The last column below shows the calculations of the unrealized gains (losses) per $1 Par.

Maturities	C Payment, $Par_0 = 100$	Rate, Y	Par_1	A_1	Unrealized Gain	Unrealized Gain per $Par
2	50.484796	0.006457	50.16091	48.16551	-1.9954	-0.01995
4	25.597095	0.009509	75.35376	70.39375	-4.96001	-0.04960
10	10.773794	0.013786	90.60480	79.86671	-10.7381	-0.10738
20	5.9277993	0.016789	95.75108	77.38152	-18.3696	-0.18370

Our general procedure for calculating unrealized losses on securities and loan losses as of 2022Q4 is similar to Flannery and Sorescu (2023).[21] We both assume bank loans are amortized and their maturities are at the mid-points of each maturity bucket. Their estimates of unrealized losses per $Par (which they refer to a "Haircut factor" in their Table 6 Panel B) are comparable to ours. Their percentage loss estimates versus ours in the above table for the 2-, 4-, and 10-year buckets are (2.1 vs 2.00), (4.52 vs. 4.96), and (9.38 vs 10.73), respectively. They differ from us by assuming loans in the bucket with maturities over 15 years have a maturity of 16 years while we assume a maturity of 20 years. Hence their estimate of percentage unrealized losses for this bucket versus ours is (13.3 vs 18.4).

[21] One difference is that Flannery and Sorescu (2023) assumes a credit spread on all loans based on the prime rate.

Table 1: Summary statistics

This table presents summary statistics of data used in the baseline empirical analysis. It shows summary statistics for Balance Sheet Risk and total assets as of 2022Q4. It also shows summary statistics for individual banks' 2022Q4 to 2023Q4 changes in uninsured deposits and various categories of insured deposits, normalized by 2022Q4 total deposits.

	Observations	Mean	Median	Standard Deviation	25th Percentile	75th Percentile
Balance Sheet Risk (BSR) 2022Q4						
Small Banks	4,468	0.252	0.234	0.133	0.161	0.323
Midsize (Regional) Banks	203	0.336	0.346	0.151	0.237	0.426
Large Banks	31	0.413	0.399	0.199	0.290	0.515
Total Assets ($ millions) 2022Q4						
Small Banks	4,468	533	260	755	117	582
Midsize (Regional) Banks	203	16,704	10,410	15,584	6,639	19,996
Large Banks	31	371,971	169,348	500,039	129,790	354,959
Uninsured Deposit Growth 2023Q4						
Small Banks	4,306	-0.010	-0.012	0.082	-0.044	0.017
Midsize (Regional) Banks	212	-0.022	-0.021	0.089	-0.064	0.013
Large Banks	29	-0.018	-0.027	0.085	-0.049	-0.004
Reciprocal Deposit Growth 2023Q4						
Small Banks	4,306	0.015	0.000	0.043	0.000	0.011
Midsize (Regional) Banks	212	0.037	0.021	0.055	0.000	0.050
Large Banks	29	0.004	0.000	0.016	0.000	0.002
Fully-Insured Sweep Growth 2023Q4						
Small Banks	4,306	0.010	0.000	0.039	0.000	0.000
Midsize (Regional) Banks	212	0.029	0.000	0.080	0.000	0.053
Large Banks	29	-0.017	-0.002	0.046	-0.009	0.000
Fully-Insured Brokered Growth 2023Q4						
Small Banks	4,306	0.012	0.000	0.050	0.000	0.001
Midsize (Regional) Banks	212	0.031	0.014	0.079	0.000	0.042
Large Banks	29	0.021	0.016	0.027	0.006	0.033
Listing Service Deposit Growth 2023Q4						
Small Banks	4,306	0.001	0.000	0.021	0.000	0.000
Midsize (Regional) Banks	212	0.002	0.000	0.016	0.000	0.000
Large Banks	29	0.002	0.000	0.006	0.000	0.000

Table 2: Uninsured Deposits

This table presents results of OLS regressions where the dependent variable, $UD_{b,2023Qt}$, equals a given bank's change in uninsured deposits from 2022Q4 to 2023Q*t*, normalized by 2022Q4 total deposits, for $t = 1, 2, 3,$ or 4. $BSR_{b,2022Q4}$ is the bank's 2022Q4 Balance Sheet Risk. Regressions include indicator variables for midsize regional banks, $IR_{b,2022Q4}$, and large banks, $IL_{b,2022Q4}$. Each regression reports p-values of the test $\beta_{BSR} + \beta_{IX} = 0$ where β_{BSR} is the coefficient on $BSR_{b,2022Q4}$ and β_{IX} is the coefficient on $BSR_{b,2022Q4} \times IX$, $X = R$ or L. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	$UD_{b,Q1\ 2023}$	$UD_{b,Q2\ 2023}$	$UD_{b,Q3\ 2023}$	$UD_{b,Q4\ 2023}$
Intercept	0.0017 (0.008)	0.007 (0.010)	0.010 (0.012)	0.014 (0.013)
$IR_{b,2022Q4}$	0.010 (0.010)	0.002 (0.011)	0.004 (0.013)	0.000 (0.014)
$IL_{b,2022Q4}$	-0.014 (0.024)	-0.051* (0.027)	-0.037 (0.032)	-0.045 (0.035)
$BSR_{b,2022Q4}$	-0.105*** (0.006)	-0.157*** (0.007)	-0.144*** (0.008)	-0.134*** (0.009)
$BSR_{b,2022Q4} \times IR_{b,2022Q4}$	-0.177*** (0.025)	-0.202*** (0.029)	-0.189*** (0.034)	-0.142*** (0.036)
$BSR_{b,2022Q4} \times IL_{b,2022Q4}$	-0.009 (0.051)	-0.035 (0.059)	-0.006 (0.006)	-0.003 (0.075)
Ln (Assets)	-0.000 (0.000)	-0.001 (0.000)	-0.000 (0.000)	-0.000 (0.001)
$\beta_{BSR} + \beta_{IR} = 0$	<0.001	<0.001	<0.001	<0.001
$\beta_{BSR} + \beta_{IL} = 0$	0.027	0.032	0.032	0.068
R^2	0.073	0.105	0.066	0.046
Observations	4,646	4,621	4,589	4,547

Table 3: Reciprocal Deposits – Intensive Margin Banks

This table presents results of OLS regressions where the dependent variable, $R_{b,2023Qt}$, equals a given bank's change in reciprocal deposits from 2022Q4 to 2023Q*t*, normalized by its 2022Q4 total deposits, for t = 1, 2, 3, or 4. $BSR_{b,2022Q4}$ is the bank's 2022Q4 Balance Sheet Risk. Regressions include indicator variables for midsize regional banks, $IR_{b,2022Q4}$, and large banks, $IL_{b,2022Q4}$. Each regression reports p-values of the test $\beta_{BSR} + \beta_{IX} = 0$ where β_{BSR} is the coefficient on $BSR_{b,2022Q4}$ and β_{IX} is the coefficient on $BSR_{b,2022Q4} \times IX$, $X = R$ or L. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	$R_{b,2023Q1}$	$R_{b,2023Q2}$	$R_{b,2023Q3}$	$R_{b,2023Q4}$
Intercept	-0.009 (0.011)	-0.027 (0.017)	-0.036 (0.019)	-0.042** (0.021)
$IR_{b,2022Q4}$	0.001 (0.009)	0.005 (0.013)	0.002 (0.015)	-0.006 (0.016)
$IL_{b,2022Q4}$	-0.012 (0.054)	0.007 (0.077)	-0.002 (0.089)	-0.005 (0.097)
$BSR_{b,2022Q4}$	0.061*** (0.007)	0.113*** (0.010)	0.120*** (0.012)	0.116*** (0.013)
$BSR_{b,2022Q4} \times IR_{b,2022Q4}$	0.039* (0.023)	0.072** (0.033)	0.078** (0.038)	0.095** (0.042)
$BSR_{b,2022Q4} \times IL_{b,2022Q4}$	0.035 (0.130)	0.001 (0.185)	-0.000 (0.216)	-0.015 (0.234)
Ln (Assets)	0.000 (0.000)	0.001 (0.001)	0.002* (0.001)	0.003** (0.001)
$\beta_{BSR}+\beta_{IR}=0$	<0.001	<0.001	<0.001	<0.001
$\beta_{BSR}+\beta_{IL}=0$	0.458	0.538	0.578	0.667
R^2	0.051	0.087	0.076	0.066
Observations	1,495	1,487	1,476	1,469

Table 4: Reciprocal Deposits – Extensive Margin Banks

This table presents results of Tobit regressions where the dependent variable, $R_{b,2023Qt}$, equals a given bank's reciprocal deposits in 2023Q*t* normalized by its 2022Q4 total deposits, for t = 1, 2, 3, or 4. $BSR_{b,2022Q4}$ is the bank's 2022Q4 Balance Sheet Risk. Regressions include indicator variables for midsize regional banks, $IR_{b,2022Q4}$. Each regression reports p-values of the test $\beta_{BSR} + \beta_{IR} = 0$ where β_{BSR} is the coefficient on $BSR_{b,2022Q4}$ and β_{IR} is the coefficient on $BSR_{b,2022Q4} \times IR$. Large banks were excluded from the regressions because of too few observations of banks initiating reciprocal deposit programs. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	$R_{b,2023Q1}$	$R_{b,2023Q2}$	$R_{b,2023Q3}$	$R_{b,2023Q4}$
Intercept	-0.315*** (0.038)	-0.357*** (0.028)	-0.407*** (0.030)	-0.412*** (0.030)
$IR_{b,2022Q4}$	0.000 (0.007)	-0.009 (0.006)	-0.008 (0.006)	-0.005 (0.006)
$BSR_{b,2022Q4}$	0.152*** (0.021)	0.153*** (0.017)	0.163*** (0.018)	0.170*** (0.018)
$BSR_{b,2022Q4} \times IR_{b,2022Q4}$	0.115*** (0.043)	0.085** (0.036)	0.116*** (0.040)	0.120*** (0.040)
Ln (Assets)	0.011*** (0.002)	0.017*** (0.002)	0.020*** (0.002)	0.021*** (0.002)
$\beta_{BSR}+\beta_{IR}=0$	<0.001	<0.001	<0.001	<0.001
R^2	0.021	0.029	0.028	0.032
Observations	3,140	3,120	3,092	3,077

Table 5: Fully-Insured Sweep Deposits – Intensive Margin Banks

This table presents results of OLS regressions where the dependent variable, $S_{b,2023Qt}$, equals a given bank's change in sweep deposits from 2022Q4 to 2023Q*t*, normalized by 2022Q4 total deposits, for $t = 2$ or 4. $BSR_{b,2022Q4}$ is the bank's 2022Q4 Balance Sheet Risk. Regressions include indicator variables for midsize regional banks, $IR_{b,2022Q4}$, and large banks, $IL_{b,2022Q4}$. Each regression reports p-values of the test $\beta_{BSR} + \beta_{IX} = 0$ where β_{BSR} is the coefficient on $BSR_{b,2022Q4}$ and β_{IX} is the coefficient on $BSR_{b,2022Q4} \times IX$, $X = R$ or L. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	$S_{b,2023Q2}$	$S_{b,2023Q4}$
Intercept	0.022 (0.021)	0.013 (0.029)
$IR_{b,2022Q4}$	-0.006 (0.012)	-0.029* (0.016)
$IL_{b,2022Q4}$	-0.026 (0.018)	-0.063* (0.024)
$BSR_{b,2022Q4}$	-0.096*** (0.013)	0.090*** (0.018)
$BSR_{b,2022Q4} \times IR_{b,2022Q4}$	0.125*** (0.028)	0.174*** (0.027)
$BSR_{b,2022Q4} \times IL_{b,2022Q4}$	0.067 (0.035)	0.095 (0.065)
Ln (Assets)	0.000 (0.001)	0.000 (0.002)
$\beta_{BSR}+\beta_{IR}=0$	<0.001	<0.001
$\beta_{BSR}+\beta_{IL}=0$	<0.001	<0.001
R^2	0.084	0.061
Observations	978	969

Table 6: Fully-Insured Sweep Deposits – Extensive Margin Banks

This table presents results of Tobit regressions where the dependent variable, $S_{b,2023Qt}$, equals a given bank's sweep deposits in 2023Qt normalized by its 2022Q4 total deposits, for t = 2 or 4. $BSR_{b,2022Q4}$ is the bank's 2022Q4 Balance Sheet Risk. Regressions include indicator variables for midsize regional banks, $IR_{b,2022Q4}$. Each regression reports p-values of the test $\beta_{BSR} + \beta_{IR} = 0$ where β_{BSR} is the coefficient on $BSR_{b,2022Q4}$ and β_{IR} is the coefficient on $BSR_{b,2022Q4} \times IR$. Large banks were excluded from the regressions because of too few observations of banks initiating sweep deposit programs. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	$S_{b,2023Q2}$	$S_{b,2023Q4}$
Intercept	-0.570*** (0.051)	-0.617*** (0.045)
$IR_{b,2022Q4}$	0.006 (0.045)	-0.063 (0.004)
$BSR_{b,2022Q4}$	0.151*** (0.026)	0.136*** (0.025)
$BSR_{b,2022Q4} \times IR_{b,2022Q4}$	0.026 (0.111)	0.194* (0.106)
Ln (Assets)	0.028*** (0.003)	0.034*** (0.003)
$\beta_{BSR}+\beta_{IR}=0$	<0.001	<0.001
R^2	N/A	0.036
Observations	3,642	3,589

Table 7: Fully-Insured Brokered Deposits – Intensive Margin Banks

This table presents results of OLS regressions where the dependent variable, $B_{b,2023Qt}$, equals a given bank's change in brokered deposits from 2022Q4 to 2023Q*t*, normalized by its 2022Q4 total deposits, for $t = 1, 2, 3,$ or 4. $BSR_{b,2022Q4}$ is the bank's 2022Q4 Balance Sheet Risk. Regressions include indicator variables for midsize regional banks, $IR_{b,2022Q4}$, and large banks, $IL_{b,2022Q4}$. Each regression reports p-values of the test $\beta_{BSR} + \beta_{IX} = 0$ where β_{BSR} is the coefficient on $BSR_{b,2022Q4}$ and β_{IX} is the coefficient on $BSR_{b,2022Q4} \times IX$, $X = R$ or L. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	$B_{b,2023Q1}$	$B_{b,2023Q2}$	$B_{b,2023Q3}$	$B_{b,2023Q4}$
Intercept	-0.029** (0.012)	-0.017 (0.017)	-0.019 (0.020)	0.005 (0.023)
$IR_{b,2022Q4}$	0.002 (0.009)	0.005 (0.013)	0.007 (0.014)	0.012 (0.017)
$IL_{b,2022Q4}$	0.005 (0.020)	-0.020 (0.027)	0.013 (0.031)	0.018 (0.036)
$BSR_{b,2022Q4}$	0.030*** (0.009)	0.036*** (0.012)	0.042*** (0.014)	0.039** (0.016)
$BSR_{b,2022Q4} \times IR_{b,2022Q4}$	0.032 (0.023)	0.066** (0.031)	0.042 (0.035)	0.024 (0.040)
$BSR_{b,2022Q4} \times IL_{b,2022Q4}$	-0.032 (0.040)	-0.042 (0.055)	-0.043 (0.064)	-0.034 (0.074)
Ln (Assets)	0.002** (0.000)	0.001 (0.001)	0.002 (0.001)	0.000 (0.001)
$\beta_{BSR}+\beta_{IR}=0$	0.010	0.002	0.028	0.147
$\beta_{BSR}+\beta_{IL}=0$	0.966	0.916	0.988	0.943
R^2	0.022	0.026	0.016	0.007
Observations	1,573	1,571	1,563	1,552

Table 8: Fully-Insured Brokered Deposits – Extensive Margin Banks

This table presents results of Tobit regressions where the dependent variable, $B_{b,2023Qt}$, equals a given bank's brokered deposits in 2023Q*t* normalized by its 2022Q4 total deposits, for t = 1, 2, 3, or 4. $BSR_{b,2022Q4}$ is the bank's 2022Q4 Balance Sheet Risk. Regressions include indicator variables for midsize regional banks, $IR_{b,2022Q4}$. Each regression reports p-values of the test $\beta_{BSR} + \beta_{IR} = 0$ where β_{BSR} is the coefficient on $BSR_{b,2022Q4}$ and β_{IR} is the coefficient on $BSR_{b,2022Q4} \times IR$. Large banks were excluded from the regressions because of too few observations of banks initiating brokered deposit programs. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	$B_{b,2023Q1}$	$B_{b,2023Q2}$	$B_{b,2023Q3}$	$B_{b,2023Q4}$
Intercept	-0.522*** (0.057)	-0.509*** (0.049)	-0.501*** (0.046)	-0.532*** (0.048)
$IR_{b,2022Q4}$	-0.051 (0.053)	-0.017 (0.046)	-0.011 (0.045)	0.011 (0.049)
$BSR_{b,2022Q4}$	0.036 (0.027)	0.079*** (0.025)	0.038 (0.026)	0.054** (0.027)
$BSR_{b,2022Q4} \times IR_{b,2022Q4}$	0.006 (0.147)	0.048 (0.124)	-0.013 (0.012)	-0.113 (0.141)
Ln (Assets)	0.027*** (0.004)	0.026*** (0.003)	0.027*** (0.003)	0.029*** (0.003)
$\beta_{BSR}+\beta_{IR}=0$	0.497	0.201	0.330	0.583
R^2	0.015	0.018	0.012	0.013
Observations	3,064	3,044	3,019	3,002

Table 9: Listing Service Deposits – Intensive Margin Banks

This table presents results of OLS regressions where the dependent variable, $L_{b,2023Qt}$, equals a given bank's change in listing service deposits from 2022Q4 to 2023Q*t*, normalized by its 2022Q4 total deposits, for t = 1, 2, 3, or 4. $BSR_{b,2022Q4}$ is the bank's 2022Q4 Balance Sheet Risk. Regressions include indicator variables for midsize regional banks, $IR_{b,2022Q4}$, and large banks, $IL_{b,2022Q4}$. Each regression reports p-values of the test $\beta_{BSR} + \beta_{IX} = 0$ where β_{BSR} is the coefficient on $BSR_{b,2022Q4}$ and β_{IX} is the coefficient on $BSR_{b,2022Q4} \times IX$, $X = R$ or L. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	$L_{b,2023Q1}$	$L_{b,2023Q2}$	$L_{b,2023Q3}$	$L_{b,2023Q4}$
Intercept	0.000 (0.007)	0.000 (0.009)	0.008 (0.011)	0.017 (0.013)
$IR_{b,2022Q4}$	0.003 (0.006)	0.007 (0.008)	0.011 (0.009)	0.018 (0.011)
$IL_{b,2022Q4}$	0.004 (0.015)	0.010 (0.019)	0.021 (0.023)	0.026 (0.027)
$BSR_{b,2022Q4}$	-0.002 (0.005)	0.003 (0.006)	0.006 (0.007)	0.007 (0.009)
$BSR_{b,2022Q4} \times IR_{b,2022Q4}$	-0.008 (0.015)	-0.007 (0.021)	-0.006 (0.024)	-0.013 (0.028)
$BSR_{b,2022Q4} \times IL_{b,2022Q4}$	-0.011 (0.041)	-0.008 (0.005)	-0.006 (0.024)	-0.021 (0.073)
Ln (Assets)	0.000 (0.004)	0.000 (0.001)	0.000 (0.000)	0.001 (0.001)
$\beta_{BSR}+\beta_{IR}=0$	0.511	0.879	0.998	0.840
$\beta_{BSR}+\beta_{IL}=0$	0.734	0.927	0.810	0.850
R^2	0.001	0.002	0.003	0.005
Observations	1,023	1,016	1,008	1,000

Table 10: Listing Service Deposits – Extensive Margin Banks

This table presents results of Tobit regressions where the dependent variable, $L_{b,2023Qt}$, equals a given bank's listing service deposits in 2023Q*t* normalized by its 2022Q4 total deposits, for t = 1, 2, 3, or 4. $BSR_{b,2022Q4}$ is the bank's 2022Q4 Balance Sheet Risk. Regressions include indicator variables for midsize regional banks, $IR_{b,2022Q4}$. Each regression reports p-values of the test $\beta_{BSR} + \beta_{IR} = 0$ where β_{BSR} is the coefficient on $BSR_{b,2022Q4}$ and β_{IR} is the coefficient on $BSR_{b,2022Q4} \times IR$. Large banks were excluded from the regressions because of too few observations of banks initiating listing service deposit programs. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	$L_{b,2023Q1}$	$L_{b,2023Q2}$	$L_{b,2023Q3}$	$L_{b,2023Q4}$
Intercept	-0.214*** (0.046)	-0.211*** (0.040)	-0.219*** (0.047)	-0.198*** (0.048)
$IR_{b,2022Q4}$	-0.320* (0.021)	-0.397 (0.380)	-0.144 (0.100)	-0.025 (0.065)
$BSR_{b,2022Q4}$	0.025 (0.026)	0.021 (0.026)	0.028 (0.032)	0.036 (0.034)
$BSR_{b,2022Q4} \times IR_{b,2022Q4}$	0.259** (0.082)	0.112* (0.076)	0.265 (0.205)	0.060 (0.159)
Ln (Assets)	0.004 (0.002)	0.003 (0.003)	0.001 (0.003)	-0.001 (0.003)
$\beta_{BSR}+\beta_{IR}=0$	0.967	0.883	0.582	0.650
R^2	0.001	0.001	0.003	0.003
Observations	3,623	3,601	3,576	3,556