Bank Branch Density and Bank Runs

EFRAIM BENMELECH, JUN YANG, and MICHAL ZATOR[☆]

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ABSTRACT

Bank branch density, defined as the number of a bank's branches to its total deposits, declined significantly between 2010 and 2022 due to branch closures and a near doubling of deposits. Although banks with low branch density initially benefited from large deposit inflows, their stock prices plummeted during the 2023 Banking Crisis, when they faced significant outflows of uninsured deposits. Our results suggest that by offering digital banking services and higher deposit rates, low-density banks grew faster and attracted large uninsured deposits, yet when economic conditions worsened, those deposit inflows took the form of "hot money" that changed course.

JEL : E44, E52, G20, G21, G28.
Keywords: bank runs, bank branch density, uninsured deposits

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Bank branch density, defined as the number of bank branches to total deposits, has declined significantly over the past decade. This decline was fueled by a confluence of an approximately 20% reduction in bank branch numbers and an almost twofold increase in total deposits between 2010 and 2022. During this period, banks with low branch density (low-density banks) benefited from large deposit inflows, which led to even lower branch density. But the virtuous cycle of deposits growth in low-density banks stopped spinning when investors became wary about their financial health. In this paper we study the relation between branch density, deposit flows, and bank performance during the U.S. Banking Crisis of 2023 and analyze how investment in technology and high deposit rates that helped in attracting deposit flows in the prior years could drive these relations.

All three bank failures in March and May 2023 involved banks with low branch density. Silicon Valley Bank (SVB) failed on March 10, 2023; with $175 billion in deposits, it was ranked as the 15th largest bank in the United States, but it had only 17 branches. Similarly, Signature Bank of New York, which state regulators closed on March 12, 2023, was the 32nd largest bank in the country, with total deposits of $104 billion and only 38 branches; First Republic Bank, which failed on May 1, 2023, had only 87 branches but was ranked as the nation's 19th largest bank, with a total of $166 billion in deposits.[1] The branch densities of Silicon Valley Bank, Signature Bank, and First Republic Bank were 0.10, 0.36, and 0.53, respectively—well below the 10th percentile of the branch density distribution, which was 1.95 in 2022.

This paper provides systematic evidence about the relation between low branch density, stock returns, and deposit inflows. First, using an event study methodology, we show that stock prices of banks with low branch density declined around the failures of Silicon Valley Bank, Signature Bank, and First Republic Bank. Second, using bank regulatory financial data, we find that during the first quarter (Q1) of 2023, low-density banks suffered large withdrawals of deposits—in particular, large, uninsured deposits.

We argue that the large and rapid deposits withdrawals at banks with low branch density were driven largely by clientele effect. Our analysis reveals that depositors of low-density banks were more likely to be corporations and sophisticated, affluent households. To attract these depositors, low-density banks invested heavily in information technology (IT) and offered higher

[1] The rank is calculated based on total assets. The total assets, number of branches, and total deposits are obtained from the FDIC Summary of Deposits as of June 30, 2022.

deposit rates. The digital channel combined with appealing deposit pricing enabled low-density banks to grow faster and attract uninsured deposits during relatively calm times. But when interest rates increased and economic conditions worsened, those large deposit inflows took the form of "hot money" that changed course.

Traditionally, brick-and-mortar branches played a key role in the deposit taking and lending model of banks, which offered customers a host of financial services through a local branch (Becker (2007)). Recent technological advances in online banking enabled banks to attract deposits from nonlocal customers. On the lending side, banks formerly specialized in collecting information on local borrowers, and branches played an important role in the production of local "soft" information (Petersen and Rajan (2002), Liberti and Petersen (2019)).

The number of bank branches in the United States increased steadily until 2009 and declined slightly until 2013 (see Figure 1, Panel A). Beginning in 2013 and until 2016, the number of bank branches began to decline at an annual rate of -1.4%. The rate of decline accelerated to -2% in 2017 and reached -3.2% in 2022. By June 2022, the number of bank branches reached their lowest level since 2000 at 79,185, representing a 20% decline relative to the peak of 99,550 in 2009. At the same time, total deposits grew every year after 2010 and surged during the Covid-19 pandemic. Overall, between 2010 and 2022, the number of U.S. bank branches decreased substantially relative to their total deposits, leading to diminishing branch density. Low-density banks achieved fast growth before 2023, further lowering density. Yet these same banks experienced significant difficulties during the 2023 Banking Crisis.

We assert that the decline in branch density contributed to the banking calamity in 2023. We are not arguing that lower branch density per se causes bank failures; rather, the failures result from the banks' underlying business models and the resulting nature of the clientele. Banks with lower branch density tend to rely heavily on digital technologies and to offer attractive deposit rates that appeal to tech-savvy and financially sophisticated households and corporations with large funds to deposit. These strategies enabled low-density banks to grow deposits faster with fewer physical branches from 2010 to 2022. Yet at the same time other factors, such as interest rate risk mismanagement and exposure to the cryptocurrency sector, made these banks more fragile, and the virtuous cycle of deposit growth became a vicious cycle when a bank run began.

Using data on stock prices from CRSP, we analyze the relation between branch density and banks' stock returns. We conduct two event studies around the March 2023 failures of Silicon

Valley Bank and Signature Bank and the end-of-April 2023 failure of First Republic Bank. Across different empirical specifications, we uncover a positive and statistically significant relation between bank branch density and stock returns around both bank failure events. Our results are robust to an inclusion of a host of control variables and suggest that around the collapse of SVB, a one standard deviation decrease in branch density is associated with 4 percentage points lower returns—corresponding to approximately 30% of the sample mean stock returns. Similarly, during the failure of First Republic Bank, a one standard deviation decrease in branch density is associated with 1.4 percentage points lower returns, corresponding to about 20% of the sample mean stock returns.

After documenting the negative relation between branch density and stock returns during the two episodes of bank failures in 2023, we analyze the relation between branch density and deposit flows. We hypothesize that branch density positively predicts returns because banks with higher branch density are less likely to experience large deposit outflows. We test the relation between branch density and deposit flows during Q1 2023 using data from regulatory Call Reports. We measure the change in (i) *uninsured deposits*; (ii) *insured deposits*; and (iii) *total deposits* at the bank holding company (BHC) level between Q4 2022 and Q1 2023. We also define indicator variables for large uninsured or insured deposit outflows during that period.

We find that branch density is positively correlated with deposit flows during Q1 2023. A one standard deviation decrease in branch density is associated with a 4.4% net outflow of uninsured deposits. Some banks with low branch density continued to attract insured deposits even in 2023, and thus their total deposits did not significantly change. However, among those banks that experienced net deposit outflows, low-density banks suffered larger outflows.

One potential explanation for the poor performance of banks with low branch density in 2023 is based on their depositors' composition. We show that low-density banks have higher average deposits per account and a depositor base skewed toward corporations. In addition, their retail customers are more likely to be urban, wealthier, younger, and more educated, based on the demographic characteristics of their branch locations. Corporations and tech-savvy, financially sophisticated households with large funds to deposit could be attracted by the convenience and speed provided by digital banking as well as higher deposit rates. We test this clientele channel by examining banks' IT investment, website traffic, and deposit rates.

Using data on bank IT investment from SWZD Aberdeen, we find that banks that made large investments in IT had higher deposit growth and *lower* branch density in 2022, with a one standard deviation increase in IT investment corresponding to 1.4 fewer branches per $1 billion of deposits (15% of the unconditional mean of branch density). We also find that large investment in IT is correlated with lower stock returns around the failures of Silicon Valley Bank and First Republic Bank.

Although digital banking helps banks attract deposits during booms, it may be a double-edged sword, since it may enable depositors to flee and swiftly move their deposits elsewhere when economic conditions deteriorate. To test the relation between digital traffic and bank performance, we use data on bank website traffic from Semrush—a platform used for keyword research and online ranking data. Total traffic to bank websites increased in March 2023, when Silicon Valley Bank and Signature Bank collapsed, and the increase was particularly pronounced for banks with lower branch density. Banks with branch density that is one standard deviation lower experienced 29% higher traffic in March relative to February. The change in online traffic, in turn, negatively and significantly predicts stock returns around the SVB and First Republic Bank collapses, but the effect of branch density remains significant even when web page traffic change is included in the regression. These results are consistent with both declines in stock returns and increases in online banking web traffic being proxies for the instability of deposits.

Banks with low branch density offered higher deposit rates in the period before the banking panic. A one standard deviation decrease in branch density is associated with almost 20 basis points higher deposit rates in 2022, which corresponds to over 60% of the average deposit rate in the sample. As with IT investment, deposit prices negatively predict stock returns around the SVB and First Republic collapses.

Both digital banking and higher deposit rates significantly influence the clientele structure of banks with low branch density. These two channels are closely connected. Banks that emphasize digital banking over physical branches may be able to offer higher deposit rates due to reduced overhead costs and increased agility. These banks also tend to attract technologically and financially sophisticated customers who are more sensitive to deposit rates. Consistent with these arguments, the data reveal a strong positive correlation between IT investment and deposit rates. Thus, disentangling the role of these two mechanisms in driving bank performance is challenging. However, when the two variables are simultaneously included in the stock returns regression, the

effect of IT investment dominates, suggesting that digital orientation and reliance on tech-savvy customers is a more prominent explanation of low-density bank business strategy and performance.

The rise of digital banking and the decline of physical branches increase the use of brokered deposits, which allows banks to obtain funding beyond their local service markets. We document that brokered deposits accounted for over 10% of total deposits for banks in the lowest decile of branch density, compared to only 2% for the median bank. However, we find that when banks with lower branch density experienced financial difficulties in early 2023, brokered deposits fell less than other forms of deposits and became an important alternative funding source.[2]

Our study contributes to several strands of the literature on the role that bank branches play in attracting deposits. Traditionally, brick-and-mortar bank branches have been a venue for depositors, making deposits local by nature (Gilje (2019), Gilje, Loutskina, and Strahan (2016), Yang (2022)). Furthermore, the local nature of deposits and the relationship between banks and depositors rendered deposits as a stable source of finding for banks (Iyer and Puri (2012), Iyer, Puri, and Ryan (2016)). The location of bank branches also plays a critical role in their lending activities. Proximity of borrowers and lenders facilitates close monitoring and soft information production. And even though the distance between lenders and borrowers has increased as technology has advanced (Petersen and Rajan (2002)), the physical presence of bank branches still matters (Degryse and Ongena (2005), Agarwal and Hauswald (2010), Nguyen (2019)).

But the role of bank branches in the confluence of deposit taking and lending has been challenged by recent developments in technology and competition brought by online banks and fintech lenders (Haendler (2022), Jiang, Yu, and Zhang (2022)). Our paper highlights the importance of branch density and its implications for deposits stability. Lower branch density allows banks to attract deposit flows and expand funding capacity. However, it also lessens the value of the bank-depositor relationship—shifting the depositor base to corporations and tech-savvy depositors with large, mostly uninsured deposits. These changes to the composition of the

[2] Although brokered deposits have been criticized and labeled as "unstable" and are under tight scrutiny by regulators, the evidence on whether brokered deposits contribute to bank failure is mixed. One advantage of brokered deposits is that they are less prone to runs, given their predetermined maturity and their restrictions on early withdrawals (Barth et al. (2020)). Our results are consistent with FDIC Vice Chairman Travis Hill's (2023) statement on the stickiness of brokered deposits in the 2023 Banking Crisis.

depositor base turn out to be detrimental during market downturns: banks with lower branch density experience larger deposit outflows and worse stock performance.

This paper is part of a burgeoning literature on the 2023 Banking Crisis. Researchers have identified various factors that contributed to banks' fragility in late 2022 and early 2023, including interest rate hikes (Drechsler at al. (2023), Jiang et al. (2023)), accounting rules such as held-to-maturity securities (HTM) (Granja (2023)), unbooked losses (Flannery and Sorescu (2023)), and deposits stability (Haddad, Hartman-Glaser, and Muir (2023)). Caglio, Dlugosz, and Rezende (2023) show that even though depositors left regional banks, large banks that were considered safe experienced deposit inflows.

Our paper is closely related to recent papers studying deposits behavior in digital banks. Koont, Santos, and Zingales (2023) examine the effect of mobile banking on deposit stickiness and its connection to the 2023 Banking Crisis. They classify banks as digital based on the popularity of their mobile applications at the Apple and Android app stores. Similarly, Erel et al. (2023) study the transmission of monetary policy through online banks. Their definition of online banks is based on a classification by Nerdwallet, a consumer finance website.

Whereas those two papers study the response of deposits to changes in interest rates, we focus on the 2023 Banking Crisis by analyzing banks' stock prices and deposit flows during the crisis. We propose a straightforward and effective measure of branch density, which captures both the decline of brick-and-mortar branches and the growth of deposits. The measure reflects banks' depositor clientele, which is a result of their overall business strategy in organizing branch networks and obtaining funding. Indeed, using data on IT investment and deposit rates, we show that low branch density is associated with both large IT investments and higher deposit rates. To wit: our measure encompasses the overall business strategy that could alter the composition of banks' depositor base, potentially fueling the growth of deposits during normal times and raising the risk of runs during downturns.

The rest of the paper is organized as follows. Section I describes our data and provides summary statistics. Section II describes the decline of bank branches and the rise in deposits. Sections III and IV document the relation between branch density and stock returns and deposit flows during the 2023 Banking Crisis. Sections V through VII examine the relation between branch density, bank clientele, and business strategy. Section VIII discusses the role that brokered deposits played in the 2023 Banking Crisis. Section IX concludes.

I. Data and Summary Statistics

To construct our main explanatory variable: *bank branch density*, we obtain data from the Summary of Deposits (SOD), an annual survey of branch office deposits as of June 30 for all FDIC-insured institutions, including U.S. branches of foreign banks. We aggregate the number of bank branches and deposits at the bank holding company level in our empirical analysis.[3] We define branch density as the ratio of the number of bank branches to total deposits measured in billions of dollars. Similar to Acharya and Mora (2015), we obtain data on insured deposits at the bank level from Call Reports and then aggregate it to the BHC level. In addition, we obtain total deposits and number of deposit accounts from Call Reports and aggregate them to the BHC level. We calculate the average account size by dividing total deposits by the number of deposit accounts at the BHC level (*AvgDep*). To measure corporate deposits, we use information from Schedule RC-E Part I of the Call Reports.

Following Jiang et al. (2023), we measure mark-to-market (MTM) losses using Call Reports data as:

$$MTM\ losses = \sum_m (RMBS_m + Mortgages_m) \times Multiplier \times \Delta TreasuryPrice_m + \sum_m Treasury\ and\ Other\ Securities\ and\ Loans\ \times \Delta TreasuryPrice_m,$$

where *m* represents the maturity and repricing breakdowns in the Call Reports: three months or less, over three months through 12 months, over one year through three years, over three years through five years, over five years through 15 years, and over 15 years. $\Delta TreasuryPrice_m$ indicates the change in Treasury Bond prices for maturity *m* from Q1 2022 to Q1 2023 (see Figure 1c in Jiang et al. (2023)). *Multiplier* is the ratio of the change in the iShares MBS ETF over the change in the S&P Treasury Bond Index between 2022 and 2023.[4] As in Cookson et al. (2023), we aggregate this measure to the BHC level. Finally, we scale the negative of MTM losses by the total assets value in Q1 2022.

We also use data on investment in IT by banks. The IT investment data is obtained from SWZD Aberdeen (originally known as Harte-Hanks). The dataset covers all industries and company sizes and was created by surveying establishments on their IT budget. The data, which Aberdeen sells to technology companies for sales and marketing purposes, are considered the main

[3] We include all FDIC-insured banks in our figures where data is available.
[4] See Jiang et al. (2023) for a more detailed description of the construction of MTM changes in banks' asset value.

source for IT investment.[5] The data cover the years 2010 to 2017. In 2018, Aberdeen changed its data collection methodology from surveys of IT budgets to imputations of IT investment using proprietary models, and so we use Aberdeen data only through 2017. We first match Aberdeen's IT data to bank branches and then aggregate IT investment at the BHC level.

We obtain data on bank website traffic from Semrush, a platform used for keyword research and online ranking data. Semrush collects information on online keywords gathered from search engines to help businesses improve their online visibility and marketing strategy. We manually collect website traffic analyses reports at a monthly level for our sample of publicly traded banks.

Deposit rates are obtained from RateWatch, which collects deposit rates for various deposit products weekly at the branch level. We use the deposit rates for a 12-month CD with a minimum deposit of $10,000 (12MCD10K). This deposit product is well populated in the data and is commonly used in the literature. As an alternative, we also consider the deposit rates for another well-surveyed product, a 24-month CD with a minimum deposit of $100,000. We first match RateWatch branch-level data with branches in Summary of Deposits. Then we average across all branches within a BHC over the entire year of 2022.

Last, to conduct event studies of the response of banks' stock prices to the failures of Silicon Valley Bank, Signature Bank, and First Republic Bank, we measure banks' stock returns around those events. Silicon Valley Bank failed on Friday, March 10, 2023, and state regulators closed Signature Bank on Sunday, March 12, 2023. We obtain data on stock prices from CRSP and measure returns as the change of the close price between March 8, 2023, and March 13, 2023. Similarly, for the second event—the collapse of First Republic Bank, which the California Department of Financial Protection and Innovation closed on Monday, May 1, 2023—we measure returns as the change in the close stock price between Friday, April 28, 2023, and Tuesday, May 2, 2023.

[Insert Table I Here]

Table I presents the summary statistics for the main variables used in the analysis. Variables are defined in Table AI. Our key variable of interest, *branch density,* exhibited a

[5] See He et al. (2022) for a detailed description of the SWZD Aberdeen data. Other papers that have used the Aberdeen data include Bloom, Draca, and Van Reenen (2016) and Tuzel and Zhang (2021). Ahnert et al. (2022) use an alternative measure of banks' IT investment that results in a value of zero for the IT spending of many banks.

significant decrease over time: starting from a mean of 20 branches per $1 billion deposits in 2010, it declined by 54% to a mean of 9.2 branches per $1 billion deposits in 2022. In 2022, the median branch density was 9.0, and the 25th and 75th percentiles were 5.0 and 13.0, respectively. As of June 2022, a typical sample bank has a deposits/assets ratio of 80%, and 63% of its total deposits are FDIC-insured deposits. On average, corporate deposits account for 41% of total deposits in domestic offices, which is in line with the notion that uninsured deposits are more likely to be corporate deposits. Due to the Covid-19 pandemic, deposits increased by over 50% between 2019 and 2022 for an average bank. Banks poured significant resources into information technology in recent years: IT budgets more than tripled between 2010 and 2017. During the same period deposit rates were low, with the median bank paying a rate of 20–25 basis points on deposits.

In the 2023 Banking Crisis, following the collapse of Silicon Valley Bank and First Republic Bank, the stock price of the average bank in our sample declined 13.5% and 7.3%, respectively. Despite the stress in the U.S. banking industry in Q1 2023, an average bank still experienced a 1% deposit increase relative to Q4 2022, but uninsured deposits declined by 4.6% on average. The average bank experienced 13.2% MTM implied asset value losses between Q1 2022 and Q1 2023—stemming mostly from rising interest rates. Website traffic to the average bank increased by 27% in March 2023 relative to February 2023.

II. The Decline of Bank Branches and the Rise of Deposits

The number of bank branches in the United States increased steadily until 2009 despite technological advances that enabled digital banking through banks' websites and apps (Anenberg et al. (2018)). Beginning in 2010, the number of bank branches declined annually, and the rate of decline accelerated over time, reaching around 2% annually in the second half of the 2010s and over 3% per year following the Covid-19 pandemic. By June 2022, the number of bank branches reached its lowest level since 2000 at 79,185, corresponding to a 20% reduction relative to the peak of 99,550 branches in 2009. Figure 1 depicts the decline in the total number of bank branches in the United States.

[Insert Figure 1 Here]

Figure 1, Panel A, also demonstrates that the decline in the number of bank branches was not accompanied by a decline in total deposits. In fact, between 2010 and 2022, total deposits in U.S. banks almost doubled in real terms, increasing from a level of $7.55 trillion in 2010 to $13.29 trillion in 2022, both in 2009 dollars. Deposits grew from $10.75 trillion in 2019 to $12.92 trillion

in 2020, reflecting the increase in U.S. household saving rates and large government stimulus payments during the Covid-19 pandemic (Levine et al. (2021)).

[Insert Figure 2 Here]

Rising deposits and reductions in the number of branches resulted in higher levels of deposits per branch. We demonstrate the correlation between rising deposits and declining number of branches in Figure 2. To construct the figure, we run the following cross-sectional regressions of bank-level total deposits on the number of bank branches in a given year *t*:

$$Deposits_i = \alpha + \beta \times Number\ of\ Branches_i + \epsilon_i. \quad (1)$$

The analysis is conducted at the bank level and includes all FDIC-insured banks. Total deposits are adjusted for inflation and are expressed in 2009 dollars.

Figure 2 plots the R^2s from each of the cross-sectional regressions (left axis) as well as β— the coefficient on the number of branches in each regression (right axis). As illustrated by the dashed line in Figure 2, in 2010, each branch accounted for about $100 million in deposits. Deposits level per branch increased over time, and by 2022, a branch accounted on average for over $240 million in 2009 dollars. As the solid line in the figure illustrates, the explanatory power of the number of branches in the deposits regressions has declined significantly over time. In 2010, the number of bank branches accounted for over 90% of variation in banks' deposits. The explanatory power of branches in deposits regressions declined to less than 80% in 2022.

The decline in the number of bank branches is also evident in the bank-level regression. Table AII demonstrates that the decline happened among medium and large banks (columns (3) and (4)), whereas the number of branches of small banks grew (column (2)). On average, there are more than 600 branch closures a year during our sample period, with an additional 4,000 branch closures during the Covid-19 pandemic (column (1)).

A. The Evolution of Branch Density

The reduction in the number of bank branches and the rise in total deposits led to a decline in branch density over time. The average bank in our sample has a branch density of 9.2 branches per $1 billion of deposits as of June 2022. Banks in the lowest decile of branch density have fewer than two branches per $1 billion of deposits—with the bottom 15 banks having 0.2 branches per $1 billion of deposits or less.

[Insert Table II Here]

Using data on bank-level deposits and branches from SOD, we categorize banks based on their branch density as of 2022 into three groups: (i) *very low density*: banks with branch density below or equal to the 10th percentile of branch density; (ii) *low density*: banks with branch density greater than the 10th percentile but no more than the 50th percentile of branch density; and (iii) *high density:* banks with branch density higher than the 50th percentile of branch density.

Table II lists the 10 leading banks within each of the three groups in a descending order of their number of branches. As the table shows, the category of *very low density* banks includes both smaller banks such as Customers Bancorp (total assets of $20.3 billion and 12 branches) and giant financial institutions such as Morgan Stanley (total assets of $1.17 trillion and 5 branches) and Goldman Sachs (total assets of $1.6 trillion and 5 branches). It's worth noting that Silicon Valley Bank, Signature Bank, and First Republic Bank are included in the *very low density* group, and so is Western Alliance Bancorporation, whose share price plummeted more than 80% during the 2023 Banking Crisis.

The group of *low density* banks includes some of the largest banks in the United States, such as JPMorgan Chase, Wells Fargo, and Bank of America, as well as other large regional banks (PNC, U.S. Bancorp, Truist Financial Corporation, Citizens Financial Group, Fifth Third Bancorp, and Huntington Bancshares). The list of *high density* banks includes mostly smaller banks with total assets that are between $4 and $46 billion as well as a medium-sized bank (Regions Financial Corporation, with $161 billion in total assets and 1,294 branches). As the bottom panel of Table II demonstrates, the three banks that failed during the Banking Crisis of 2023 (SVB, Signature, and First Republic) as well as banks that experienced significant stock prices declines or massive deposit outflows (PacWest, Western Alliance, and Silvergate Capital) had mostly *very low* branch densities.

[Insert Figure 3 Here]

Branch density exhibits significant variations across bank size. Figure 3, Panel A, demonstrates the decline of branch density for all FDIC-insured banks at the bank level, whereas Figure 3, Panel B, depicts the trend for all sample bank holding companies. Banks (or BHCs) are categorized into three groups based on their total assets value as of 2010: greater than or equal to $1 trillion, greater than or equal to $10 billion and less than $1 trillion, and below $10 billion. The largest group in both figures includes Bank of America, JPMorgan Chase, Wells Fargo, and Citi. The levels of branch density as of 2022 for each group are annotated at the end of each line. As

Figure 3 shows, large and medium banks have experienced significant decline in branch density, whereas the drop among small banks is relatively mild.[6]

[Insert Figure 4 Here]

In Figure 4, we compare deposits growth across banks with different densities of bank branches. As before, we categorize banks into three branch density groups: *very low, low,* and *high density.* Branch density is calculated every year. Figure 4, Panel A, displays the average growth in total deposits over time within each of these three branch density groups.[7] As Panel A illustrates, banks with lower branch density experienced higher growth rates in total deposits between 2010 and 2022: the very low density group exhibits the fastest growth rates among all three, while the low density group grew faster than the high density group. The average growth rates of deposits in 2019, relative to 2010, are 82%, 33%, and 15% for the very low, low, and high branch density groups, respectively. Starting in 2020, and as a result of the Covid-19 pandemic, the average growth rate in deposits, once again relative to 2010, accelerates to 101% for the very low density group, compared to 49% for the low density group and 28% for the high density group. Further, we decompose total deposits into (i) insured and (ii) uninsured deposits and conduct similar analyses. As visualized in Figure 4, Panels B and C, the relation between branch density and deposit growth persists, regardless of whether the deposits are insured. Moreover, the growth rates of uninsured deposits are higher than those of insured deposits for all density groups.

[Insert Figure 5 Here]

The important role of uninsured deposits in driving the decline of low branch density is also depicted in Figure 5. The number of bank branches to *uninsured* deposits declined more rapidly compared to the number of bank branches to *insured* deposits. Figure 5 suggests that the expansion of deposits without a corresponding growth in the number of branches was driven largely by the growth in uninsured deposits.

Overall, the evidence presented in Figures 2–5 shows that between 2010 and 2022, the number of branches of U.S. banks declined substantially relative to banks' total deposits, leading to declining branch density. Moreover, banks with lower branch density experienced faster deposit growth.

[6] In assessing the differences between small banks in Figure 3, it is important to keep in mind that our sample captures mostly larger banks.

[7] Deposits are adjusted to inflation using 2009 dollars. For each branch density group, we regress the log of deposits on a series of year indicators. The coefficients on the year indicator variables are displayed in the figure.

III. Branch Density and Stock Returns during the 2023 Banking Crisis

During the 2010s, U.S. banks were able to grow their deposits with fewer branches. However, while banks with low and very low branch density were able to attract deposit inflows before 2023, they experienced significant difficulties during the first several months of 2023. In March 2023, two medium-sized American banks failed: Silicon Valley Bank and Signature Bank. Consequently, regional banks suffered large stock price declines in March and April, and eventually a third bank, First Republic Bank, whose shares fell by 62% on March 13, 2023, suffered significant liquidity problems that led to its closure and the disposal of its assets to JPMorgan Chase Bank.

Interestingly, as illustrated in Table II, all three troubled banks had extremely low branch densities as of June 2022, which would place them in our very low density group (i.e., branch density is less than or equal to the 10th percentile, 1.95, in 2022). For instance, Silicon Valley Bank had only 17 branches and around $175 billion of deposits—denoting a very low branch density of 0.097. Similarly, the branch densities of Signature Bank and First Republic were 0.36 and 0.53, respectively.[8]

We conjecture that the decline in branch density, driven by both the reduction in branches and the rapid growth in deposits during the years 2010 to 2022, contributed to the banking calamity in 2023. Clearly, multiple factors affected these banks, including interest rate risk mismanagement and exposure to the cryptocurrency sector. However, it is possible that the *virtuous* cycle of deposits growth became a *vicious* cycle once a banking run began. We are not arguing that low branch density per se caused these bank failures. Rather, lower branch densities reflect the nature of these banks' deposits clientele, one that is more likely to run on the bank during difficult times.

To test our conjecture, we conduct two event studies around the March failures of Silicon Valley Bank and Signature Bank and the end-of-April failure of First Bank Republic. Figure 6 exhibits the relation between bank branch density and stock returns around the SVB (Panel A) and First Republic (Panel B) failures. We plot the stock return between March 8, 2023, and March 13, 2023, for the SBV event and the returns between April 28, 2023, and May 2, 2023, for the First Republic event. The sample includes all 294 publicly traded BHCs with branch and stock price information available.

[8] Figure A1 depicts the evolution of branch density for First Republic Bank, Signature Bank, and Silicon Valley Bank.

[Insert Figure 6 Here]

As Figure 6 demonstrates, there is a positive and significant relation between stock returns and bank branch density during these two bank failure events. Both Panels A and B of Figure 6 highlight the names of some banks that performed particularly poorly during the 2023 Banking Crisis, such as PacWest and Western Alliance. Banks that suffered dramatic declines in their stock prices were also characterized by very low branch density.

To further explore the relation between branch density and stock price performance during the 2023 Banking Crisis, we conduct a multivariate analysis of banks' stock returns during the two events of bank failures in March and May 2023.

Specifically, we run the following regressions:

$$\begin{aligned} \text{Return}_{\text{i}} \quad = \quad & \beta \times \text{BranchDensity}_{\text{i}} + \alpha_1 \times \frac{Dep_i}{Asset_i} + \alpha_2 \times \frac{Insured\ Dep_i}{Total\ Dep_i} + \\ & \alpha_3 \times \text{MTMLosses}_{\text{i}} + \alpha_4 \times \text{Dep Growth}(2019-2022)_{\,i} + \\ & \alpha_5 \times \log(Assets)_i + \alpha_6 \times \text{SizeBin}_{\text{i}} + \epsilon_i \end{aligned} \tag{2}$$

where return is defined as in Figure 6 and branch density is as of June 2022 at the BHC level. In addition, we control for bank size measured by the logarithm of banks' total assets and five size-quintile indicator variables. We control for deposits-to-assets ratio, for insured deposits scaled by total deposits, and for estimates of MTM losses on banks investment, constructed following Jiang et al. (2023). Last, to capture a potential effect of abnormal deposits growth in the years leading to the crisis, we control for the change in deposits between 2019 and 2022. The results are presented in Table III.

[Insert Table III Here]

We uncover a positive and statistically significant relation between bank branch density and stock returns around both the SVB (Panel A) and the First Republic collapse (Panel B) through all specifications. Adding the control variables to the regressions has little impact on the key coefficient of interest and, in fact, makes it stronger in some specifications. The coefficients on branch density are also economically significant. Using the estimates in column (5), a one standard deviation lower branch density (5.78) corresponds to around 4 percentage points (= 5.78 * 0.688) lower returns around the collapse of SVB, which represents approximately 30% (= -4%/-13.5%) of the sample mean of stock returns. Similarly, during the failure of First Republic Bank, a one standard deviation lower branch density is associated with 1.4 percentage points (= 5.78 * 0.237)

lower returns, corresponding to about 20% (= -1.4%/-7.3%) of the sample mean of stock returns. As for the effects of the control variables: banks with higher ratios of deposits to assets experience lower returns. A higher share of insured deposits, which implies a more stable base, is associated with higher returns, mostly during the SVB collapse. Banks that suffered higher MTM losses have significantly lower stock returns after the First Republic collapse, with an effect of one standard deviation change being similar in magnitude to the effect of branch density.[9]

Since our event study methodology hinges on cross-sectional variation, we are unable to control for bank fixed effects in our regressions. This may raise the concern that the relation between branch density and stock returns is driven by unobserved bank-specific time-invariant characteristics. To alleviate this problem, and to shed more light on the effect of the evolution of branch density of stock returns, we decompose *branch density* into the two components: (1) branch density measured at the beginning of the sample, June 2010; and (2) the change in branch density between 2010 and 2022 (i.e., $\Delta Branch\ Density$: branch density in 2022 minus branch density in 2010). As an alternative, we also explicitly include the log change in the number of branches $\Delta Log(Branches)$ and total deposits $\Delta Log(Deposits)$. We report the results in Table IV.

[Insert Table IV here]

Columns (1) and (3) in Table IV show that both branch density in 2010 and the change of branch density between 2010 and 2022 significantly and positively predict stock returns, suggesting that the relation between branch density and stock return during the 2023 distress episodes is not driven by some fixed unobservable bank characteristics. A one standard deviation decrease in Branch Density 2010 (10.23) is associated with a 4.6 percentage points (=10.23*0.448) drop in stock returns around the SVB failure and a 2% (=10.23*0.192) decline in stock returns around the collapse of First Republic Bank. A one standard deviation change in $\Delta Branch\ Density$ is related to a 2.3 and 1.5 percentage points lower stock returns around the SVB and First Republic failures, respectively. These magnitudes are similar to those observed in Table III.

Columns (2) and (4) in Table IV show that both within-bank changes in the number of branches and in the value of deposits contribute to the effect of changing branch density. As expected, the coefficients on $\Delta Log(Branches)$ and $\Delta Log(Deposits)$ have opposite signs, and both are significant predictors of returns during the 2023 Banking Crisis.

[9] Columns (1) and (2) in Table AIV show the robustness of our results to the inclusion of additional bank covariates: (i) the ratio of commercial real estate loans to assets; and (ii) the share of nonperforming loans.

In Table AIII we employ alternative definitions of branch density, which we calculate by dividing the number of branches by (i) the value of uninsured deposits and (ii) the value of brokered deposits. The measure based on brokered deposits is highly skewed since for many banks brokered deposits are very small, and so we use the log of the number of bank branches to brokered deposits as our dependent variable. Both measures yield similar results to those obtained in the main specification: the coefficients have the same signs and significance and are of similar magnitudes given a one standard deviation change in the measures.

Our results show that banks with low branch density performed significantly worse during the two episodes of bank collapses, which we interpret as evidence that the financial markets perceive their deposits to be less stable and thus that these banks are more prone to runs. Low branch density does not appear to be a proxy for some long-standing unobservable differences between banks but seems rather to reflect banks' different business strategies and their resulting clientele. We hypothesize that the reliance on digital banking and differential deposit pricing policy could be important factors influencing the composition of depositors and, consequently, banks' performance. We explore these hypotheses in Sections V through VII.

IV. Branch Density and Deposit Outflows

Having documented the positive relation between branch density and stock returns during the bank failures of March and May 2023, we now analyze the relation between branch density and deposit flows. We hypothesize that branch density positively predicts returns because banks with higher branch density are less likely to experience large deposit outflows. We test this relation between branch density and deposit flows during Q1 2023 using bank regulatory data and the following specification:

$$\begin{aligned} \text{Deposit Flow}_{\text{i}} \;=\; & \beta \times \text{BranchDensity}_{\text{i}} + \alpha_1 \times \frac{Dep_i}{Asset_i} + \alpha_2 \times \frac{Insured\ Dep_i}{Total\ Dep_i} + \\ & \alpha_3 \times \text{MTMLosses}_{\text{i}} + \alpha_4 \times \text{Dep Growth}(2019-2022)_{\,i} + \\ & \alpha_5 \times \log(Assets)_i + \alpha_6 \times \text{SizeBin}_{\text{i}} + \epsilon_i, \end{aligned} \tag{3}$$

where the dependent variable *Deposit Flow*$_i$ is the change in: (i) uninsured deposits; (ii) insured deposits; or (iii) total deposits between Q4 2022 and Q1 2023. We also define indicator variables for large uninsured or insured deposit outflows during this period. These indicator variables take the value of one for changes that are below the 10th or 25th percentile of the deposit flow

distribution, and zero otherwise. All explanatory variables are the same as in specification (2), in the previous section. Table V reports the results from estimating regression (3).

[Insert Table V Here]

As column (1) in Table V illustrates, branch density is positively correlated with uninsured deposit flows. A one standard deviation lower branch density is associated with 4.4% higher outflow of uninsured deposits, which corresponds to 95% of the average net outflow of uninsured deposits in Q1 2023 and to 31% of the standard deviation of uninsured deposits change in that period. Conversely, lower branch density corresponds to higher inflow of insured deposits, with a one standard deviation higher branch density leading to 7% higher inflow of insured deposits, which corresponds to 80% of the mean and 40% of the standard deviation. It is worth noting that a median change of uninsured deposits during Q1 2023 was -6.2%, while a median change of insured deposits was +4.8%. Thus, the results in columns (1) and (2) of Table V suggest that higher branch density alleviates outflow of uninsured deposits while also being associated with a slower pace of continued growth in insured deposits. On average, branch density has no effect on total deposits (column (3)), but among banks that do experience a net outflow of deposits during Q1 2023, branch density significantly alleviates the outflow (column (4)), with one standard deviation of branch density reducing the net outflow by 1.1 percentage points (34% of the average outflow among banks experiencing below-zero net flows).

Columns (5)–(8) demonstrate that low branch density is associated with a higher likelihood of large outflow of uninsured deposits while having no effect or a negative effect on the likelihood of an abnormally low flow of insured deposits. We define large outflow as changes that correspond to the lowest 10th percentile (columns (5) and (6)) or lowest 25th percentile (columns (7) and (8)) of the Q1 2023 deposit flows distribution. For uninsured deposits, the 10th and 25th percentile thresholds correspond to uninsured deposit flows of -14.3% and -9.5%, respectively. For insured deposits, the 10th and 25th percentile thresholds correspond to insured deposit flows of -0.3% and 1.6%, respectively.

The results demonstrate that depositors of banks with low branch density were likely concerned about their stability and more likely to withdraw their uninsured deposits. Interestingly, although deposit insurance reduced outflows of smaller deposits, there is no evidence that it had positive spillovers on the behavior of uninsured depositors, as suggested by the estimates of coefficient on the *Insured Dep/Total Dep* variable in columns (1) and (5).

The negative coefficient of branch density in the insured deposits regression (column (2)) may be related to insured depositors' continued movement to banks with low branch density even in Q1 2023, since they were not concerned about bank financial stability. This is consistent with the findings in Martin, Puri, and Ufier (2018). This result also aligns with the estimate of the effect of the deposit growth in the years 2019 to 2022, which indicates that insured deposits continued to grow in Q1 2023—in particular in banks that were growing faster in those years. The effect of branch density on the insured deposit flows may also in part reflect a reduction in the value of deposits in banks with low branch density so that they fall under FDIC limits, which reduces uninsured deposits while increasing the number of insured accounts.

[Insert Figure 7 Here]

Figure 7 demonstrates that banks with low branch density relied on uninsured deposits to a greater extent than banks with high branch density. In the lowest decile of branch density, the share of uninsured deposits was almost 50%, whereas for median banks it did not exceed 30%. Taken together, the results in Table V and Figure 7 suggest that outflows of uninsured deposits during Q1 2023 were particularly disconcerting to the stability of low-density banks.

V. Branch Density and Depositors' Characteristics

Banks with lower branch density tend to rely heavily on digital technologies, offering attractive deposit rates that appeal to tech-savvy and financially sophisticated households and corporations with large funds to deposit. We argue that although this strategy was successful in fostering low-density banks' deposits growth between 2010 and 2022, it also contributed to the deposits outflows and Banking Crisis of 2023. In this section we present evidence on the relation between branch density and the characteristics of bank depositors. Table VI presents the results of regressions relating deposits and depositors' characteristics to bank branch density.[10]

[Insert Table VI Here]

In the first two columns of Table VI, we use corporate deposits as a fraction of total deposits and the average deposit amount per account (*log(Avg Dep)*) as dependent variables. As columns (1) and (2) illustrate, banks with lower branch density have a higher share of corporate deposits and larger average deposit amounts per account. A one standard deviation lower branch density

[10] We use similar explanatory variables to those used in regressions (2) and (3).

translates into 6.3 percentage points higher share of corporate deposits, which corresponds to 15% of the sample mean. A one standard deviation decrease in branch density is associated with over 0.6 log points/over 80% higher average value of a deposit. Corporations and households holding substantial deposits are generally more sophisticated and vigilant regarding their investments. Consequently, their disproportionate presence among low-density banks' depositors renders these banks' deposits less stable during periods of uncertainty.

In columns (3)–(6) we analyze the relation between bank-level proxies for clientele demographics and branch density. Using data from the American Community Survey at the county level, we delineate four key variables: (1) *Urban,* denoting counties with populations exceeding 100,000; (2) *Log County Income,* defined as the natural logarithm of the median income in a county; (3) *Age 60+,* defined as the proportion of a county's population aged 60 or older; and (4) *Higher Education,* indicating the percentage of a county's populace holding a bachelor's degree or higher. Next, we formulate bank-specific clientele metrics as weighted averages of these county-level characteristics, with weights determined by the bank's deposits within each county. Although we do not know the identities of individual bank depositors, we presume that the demographic characteristics of counties of banks branches' location are correlated with depositors' characteristics. Even though these are arguably noisy measures for banks' clientele demographics, in particular for banks that rely heavily on digital banking, it is still reasonable to assume that even banks with low branch density are likely to keep their branches in proximity to their customers' locations.

The results reported in columns (3)–(6) suggest that banks with low branch density tend to have customers who are more likely to live in an urban area and are richer, younger, and more educated. The disparities observed in clientele attributes between banks categorized as low and high branch density are significant. A one standard deviation decrease in branch density is associated with a 15% increase in the likelihood of locating in urban areas, which corresponds to 58% of the sample standard deviation. Similarly, a one standard deviation decrease in branch density is associated with an increase in log county income equal to 47% of the sample standard deviation, a 62% rise in the share of the highly educated population, and a 37% reduction in the proportion of the population aged 60 and over.

The results presented in Table VI are consistent with a clientele channel—one in which customers of banks with low branch density are likely more educated and financially savvy and

hence are more attentive to their investments and quicker to withdraw their money in times of crisis. We next turn to analyze the role that digital technology and deposit rates play in attracting corporate and financially savvy depositors to low-density banks.

VI. Branch Density and Digital Technology

The growth of virtual, or digital, banks is noted in the literature and often linked to the extent of information technology investment (Haendler (2022), He et al. (2022)) and to the rise of fintech institutions (Berg, Fuster, and Puri (2021)). Digital banking services have no geographical boundaries and require only a few physical branches while providing convenience and speed that traditional in-person bank teller services cannot match.[11] These features potentially enable banks that rely on digital banking to attract more sophisticated customers such as corporations or tech-savvy individuals nationwide and gain a competitive advantage.

To investigate the role that digital technology plays in the business strategies of banks with low branch density, we test the relation between branch density and IT investment intensity at the BHC level. Column (1) in Table VII shows that increases in IT investment between 2010 and 2017 are correlated with lower branch density in 2022, consistent with the idea that low-density banks used digital banking to grow their business. Columns (2) and (3) in Table VII demonstrate that the change in IT investment between 2010 and 2017 is negatively correlated with banks' stock returns around the Silicon Valley Bank and First Republic Bank collapses.

[Insert Table VII Here]

Whereas digital banking may help banks attract deposits during normal market conditions, it could alter banks' depositor composition and therefore contribute to banks' deteriorating performance during distress episodes for several reasons.[12] First, digital services tend to attract large uninsured deposits from corporations and tech-savvy individuals who also have access to digital news platforms and as such follow financial media and respond to financial news

[11] As in Figure 4, we plot deposit growth by IT investment in Figure A2, which shows that banks which invested heavily in IT between 2010 and 2017 exhibited faster growth in deposits. As in Table II, we list top banks by IT investment categories in Table AV.

[12] In Table AVII, we show that branch density is robust to the addition of IT investment (or deposit pricing) into the regression. This suggests that branch density is a more comprehensive measure that captures the clientele effects beyond IT investment and deposit pricing.

instantaneously. Second, digital service by nature allows clients to transact quickly and with ease, enabling depositors to withdraw at their (literally) fingertips. Third, the lack of in-person interaction could lower customers' engagement and damage valuable bank-client relationships.

The analysis presented in Table VII suggests that banks with lower branch density exhibit higher IT spending, suggesting a propensity toward offering more extensive digital banking services, which may negatively affect the stability of their deposits. However, the explanatory power of the IT investment mechanism in explaining the underperformance of banks with low branch density during the 2023 Banking Crisis encounters two significant challenges. First, it is likely that all banks within our sample provide online banking services, regardless of branch density. Second, the association between heightened IT budgets and reliance on digital customers is not unequivocal, since IT expenditure may encompass other operational banking services unrelated to deposits management.

To address both challenges, we use data on web page traffic on banks' websites at the end of 2022 and beginning of 2023 as a more direct measure of customer-oriented digital banking exposure and usage.

[Insert Figure 8 Here]

Figure 8 displays the coefficient from regressing the natural logarithm of the number of web page visits on indicator variables for each month between November 2022 and April 2023 and bank fixed effects. The sample starts in October 2022, which is the omitted category. As Figure 8 shows, when Silicon Valley Bank and Signature Bank collapsed in March 2023, online traffic was on average 15% higher than in October 2022. And although, as evident from Figure 8, website traffic in each of the first four months of 2023 was somewhat elevated, the coefficients are not statistically significant for any other month except March, which displays a jump also relative to February. This pattern demonstrates that a modern banking crisis may have less to do with depositors queuing outside bank branches and more to do with depositors flooding bank websites to transfer their money online. Online money transfer to other banks is faster and more convenient, which is especially important when depositors are concerned about the safety of their deposits. Online banking thus makes running on a bank easier.

[Insert Table VIII Here]

We analyze the relation between web page traffic, branch density, and stock returns during distressed times and report the results in Table VIII. As column (1) of Table VIII demonstrates,

banks with lower branch density experienced significantly higher web page traffic increase in March 2023 relative to February 2023. The magnitude of the estimated effect is large: a one standard deviation lower branch density corresponds to a 29% increase in online traffic in March 2023, accounting for more than 100% of the average increase in traffic and 27% of the standard deviation of traffic changes.

The change in online traffic, in turn, negatively predicts stock returns around the Silicon Valley Bank and First Republic Bank collapses (columns (2) and (4)), with a one standard deviation increase in traffic corresponding to returns that are lower by 2% and 0.75% during the SVB and First Republic failures, respectively, although these effects are not precisely estimated. Yet even when online traffic change is directly controlled for in the stock returns regressions (columns (3) and (5)), the coefficient of branch density continues to be positive and significant, and its magnitude changes by less than 10% compared to the baseline estimates from Table III. These results are consistent with both stock returns and increases in online banking web traffic being proxies for deposits instability. Indeed, columns (6) and (7) of Table VIII demonstrate that an increase in web traffic is associated with larger outflows of uninsured deposits. Nonetheless, even if the change in traffic is included as a control, the effect of branch density on uninsured deposit flows remains positive and significant, with a magnitude of almost 80% of the baseline estimates in Table V.

In addition to using changes in online traffic, we proxy online banking usage with the ratio of online visits to bank website to total deposits. Consistent with the composition of clientele before the crisis, analyzed in Table VI, suggesting that low-density banks are likely associated with higher technological and financial sophistication of their customers, Table AVI shows that at the end of 2022, customers of banks with low branch density and banks that have heavily invested in IT were more likely to use online banking. Lower branch density and higher IT investment are associated with higher online traffic per one dollar of deposits. One standard deviation of both branch density and IT budget increase corresponds to around 0.02 change in the traffic per deposit measure, which constitutes almost 50% of its baseline average. The effects of branch density are significant at the 10% level, while the effects of IT budgets, though similar in magnitude, are estimated more precisely.

VII. Branch Density and Deposit Rates

To attract a sophisticated clientele, banks with low branch density may also offer higher deposit rates. To the extent that financially savvy depositors are more price sensitive, they may be willing to forgo the convenience of a larger bank network in exchange for the ability to earn higher interest.

Table IX analyzes the relation between branch density and deposit rates. The data on rates are obtained from RateWatch, which provides weekly surveyed deposit pricing at the branch level. We first match weekly deposit rates at the branch level to banks and then aggregate to the BHC level by taking a simple average. We analyze the average of all 2022 weekly rates for 12-month and 24-month CD deposits with deposit amounts of $10,000 or above (12MCD10K) and $100,000 or above (24MCD100K), which exhibit high correlation with deposit rates inferred from Call Reports. Similar results are obtained for other maturities and deposit amounts.

Columns (1) and (2) demonstrate that banks with low branch density pay, on average, higher deposit rates. A one standard deviation decrease in branch density is associated with around 20–25 basis points higher deposit rates, which is close to the median deposit rates and represents almost 60% of the sample mean rates for both maturities and deposit sizes. These large effects are feasible because many banks during 2022 were offering nearly zero deposit rates, while only a subset of banks offered more competitive remuneration to depositors (Kundu et al., 2024).

[Table IX Here]

In columns (3)–(6) of Table IX we test whether deposit rates are correlated with the lower performance of banks during the 2023 banking panic. All columns confirm that deposit rates do have explanatory power for banks' stock performance, consistent with more price-sensitive clientele being more likely to withdraw their funds.

A. Disentangling IT and Deposit Pricing

Which of these explanations—more extensive digital services or higher deposit pricing—is the primary factor enabling banks with low branch density to attract financially sophisticated clients who are more prone to withdraw their funds during crises? This is a challenging question, because the two mechanisms are closely linked, both conceptually and in the data. Column (1) of Table X demonstrates that banks with higher IT investment growth also paid higher deposit rates. This correlation suggests a plausible causal relation between the two factors rather than mere coincidence. First, from the banks' standpoint, operating online without physical branches reduces overhead costs, allowing them to pass on these savings to depositors in the form of higher deposit

rates. Online operations also enhance agility, enabling banks to adjust rates in response to market conditions and funding requirements. Moreover, offering competitive rates serves as a key component of online banks' marketing and growth strategies, compensating for their lack of physical presence and appealing to online customers who may be more price sensitive than traditional brick-and-mortar depositors. Second, from the customers' perspective, particularly among more sophisticated individuals both financially and technologically, the appeal of online banks lies in the convenience and accessibility offered by digital channels, alongside the allure of higher deposit rates. These customers are willing to forego traditional branch networks in favor of seamless digital banking experiences and better returns on their deposits.

[Insert Table X Here]

Despite the close link between digital technologies and deposit pricing, we attempt to test the relative importance of the two mechanisms for explaining the effect of branch density by horse-racing the two explanations in the stock returns regressions. Columns (2) and (3) of Table X show the results of regressing stock returns in the SVB collapse and First Republic collapse episodes on the standardized values of IT investment growth and deposit rate. In both events IT growth shows a statistically significant effect on stock performance, while the effect of deposit rates is insignificant. Because the two variables are standardized to have a mean of zero and a standard deviation of one, the coefficients can be directly compared. In the SVB episode, the effect of IT investment is about three times larger based on the point estimates. In the First Republic episode, however, the two point estimates are almost identical.

The comparison of the roles that IT investment and deposit pricing play in explaining the worse performance of banks with low branch density yields suggestive evidence that the first channel is more prominent. However, the positive correlation between measures of IT investment and deposit pricing in the data makes any strong statements in that regard unwarranted, while their close conceptual connection limits the extent to which such statements could be meaningful.

VIII. The Role of Brokered Deposits

We now turn to discussing the role that brokered deposits played in the 2023 Banking Crisis and their relation to banks with low branch density. The FDIC (2011) classifies a brokered deposit to be "any deposit that is obtained, directly or indirectly, from or through the mediation or assistance of a deposit broker." Brokered deposits became relevant in the early 1960s, and as banking

technology developed further, relying on brokered deposits became a feasible alternative to owning and operating physical branches. Figure IA1 in the Internet Appendix demonstrates that banks with lower branch density have a higher share of brokered deposits in their total deposits. Specifically, for banks in the lowest decile of branch density, brokered deposits constitute over 10% of total deposits, compared to only 2% for the median bank. Figure IA2 in the Internet Appendix plots the growth of brokered deposits by branch density over the sample period. Banks with lower branch density experienced higher growth in brokered deposits over time. Compared to 2010, the value of brokered deposits for banks in the *Very low density* group increased by approximately 100% by 2020 while remaining roughly unchanged for other banks and even declining for banks with high branch density. The value of brokered deposits declined in the years 2021 and 2022 as federal stimulus money flooded banks with regular deposits and lowered their demand for brokered deposits. Yet for banks in the *Very low density* group, brokered deposits remained 50% higher than their levels in 2010, while *low density* and *high density* banks experienced significant declines in brokered deposits.

Brokered deposits have been historically perceived as a volatile source of funding and are commonly associated with excessive risk taking by banks. For example, the FDIC has expressed concerns over brokered deposits for decades and indeed regulates brokered deposits differently than core deposits. However, the evidence on whether the reliance on brokered deposits affects bank performance, especially bank failure, is mixed (see Barth et al. (2020) for a review). Indeed, the FDIC (2011) recognizes that brokered deposits per se are not a problem and rather recommends that "the proper use of such deposits should not be discouraged."

In terms of bank run risk, brokered deposits can be viewed as more stable than core deposits.[13] Core deposits are exposed to on-demand, immediate withdrawals, whereas brokered deposits have predetermined maturity and do not permit early withdrawals unless the depositor dies or is declared legally incompetent. In addition, when faced with the prospects of large withdrawals, some banks resort to brokered deposits as a fast, yet more expensive, alternative source of funding (Heeb and Eisen (2023)). For instance, Western Alliance, one of the banks that suffered severe stock price drops during the 2023 Banking Crisis, showed an increase in its brokered deposits from $4.79 billion (or 8.89% of total deposits) in Q4 2022 to $18.28 billion (or

[13] FDIC Vice Chairman Travis Hill (2023) has recognized the stickiness of brokered deposits: "Far from being 'hot money,' these deposits are so cold they are virtually frozen in place."

35.64% of total deposits) in Q2 2023. We next formally test the relation between branch density, brokered deposits, and deposit outflows.

We regress (i) the share of brokered deposits; (ii) the change in the brokered deposits share between Q4 2022 and Q2 2023; and (iii) the log change in the value of brokered deposits over the same period on our measure of branch density and the set of control variables used in our main specification. The results are reported in Table IAI in the internet appendix reports the results. Brokered deposits account for a higher fraction of funding for banks with lower branch density (column (1)), and this pattern becomes more pronounced following the banking turmoil in early 2023 (column (2)), especially if we restrict our sample to banks that experienced an increase in the share of brokered deposits (column (3)). A one standard deviation decrease in branch density corresponds to a 3.4 percentage point increase in the share of brokered deposits, which amounts to 10% of the mean and 25% of the median share. However, the increase in the share of brokered deposits does not imply that low-density banks proactively increased the level of brokered deposits. Combined with the results in column (4), which shows the relative decline in the level of brokered deposits for banks with lower branch density, brokered deposits also experienced outflows, though not as severe as other sources of funding.

IX. Conclusion

We analyze the effect of branch density, defined as the number of bank branches per $1 billion of deposits, on the performance and stability of banks during banking crises. We show that the number of bank branches has declined between 2010 and 2022. The decline was fueled by a confluence of a reduction in the number of branches and the almost doubling of total deposits between 2010 and 2022. During this period, banks with low branch density benefited from large deposit inflows, which led to even lower branch density.

However, during the Banking Crisis of 2023, banks with fewer branches relative to their deposits experienced significantly lower stock returns and larger outflows of uninsured deposits. We argue that the decline in branch density, driven by both the decline in the number of branches and the rapid growth in deposits during the years 2010 to 2022, contributed to the banking calamity in 2023. Although digital banking and high deposit rates help banks attract deposits during booms, these services may be a double-edged sword that results in a clientele that is more likely to flee and swiftly move their deposits elsewhere when economic conditions deteriorate.

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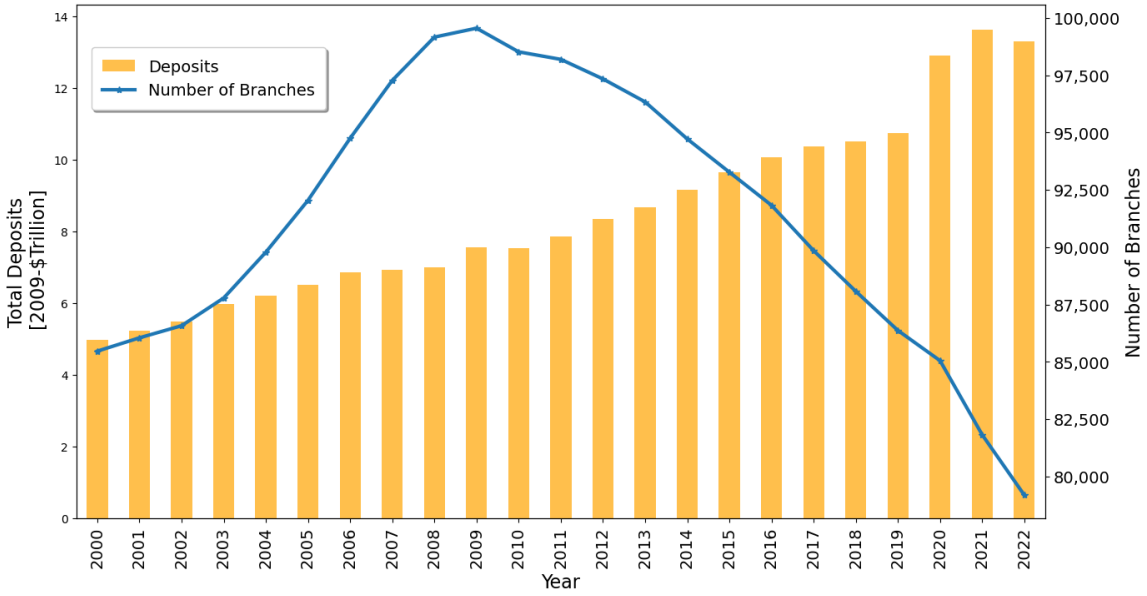
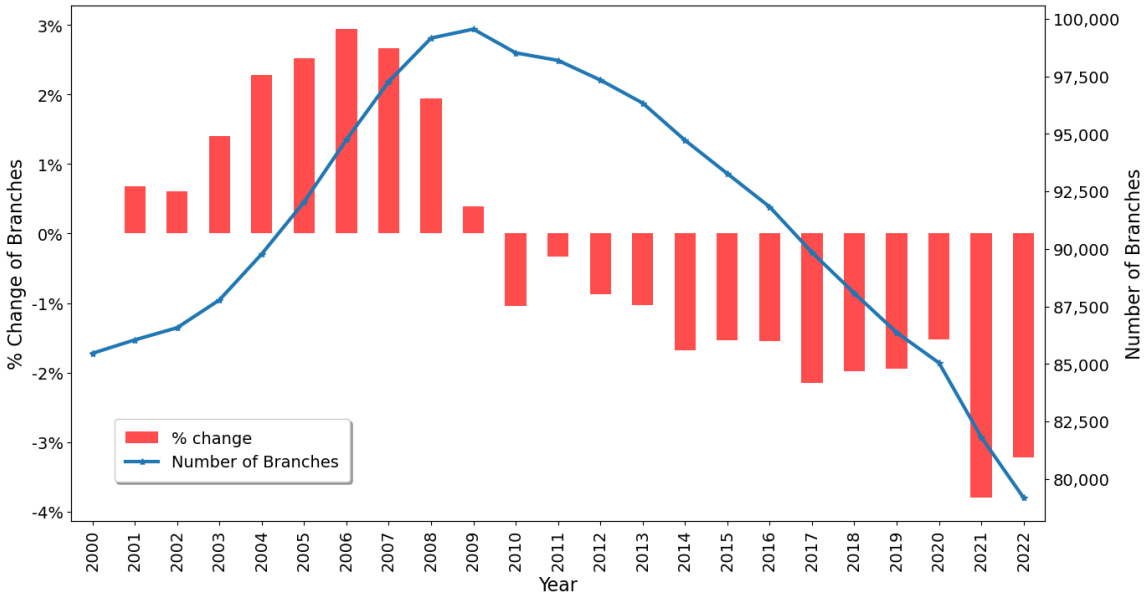
Figures and Tables



Panel A. Bank branches and total deposits in the United States



Panel B. Evolution of bank branches over time

Figure 1. Branches and deposits. Panel A shows the decline of bank branches (right axis) and the rise of total deposits (left axis) over the period 2010–2022. Total deposits are adjusted for inflation, and the values are in 2009 dollars. Panel B shows the evolution of bank branches over the same period. The line represents the number of bank branches, and the bar represents the annual percentage change in the number of branches. The sample includes all FDIC-insured banks. Source: Summary of Deposits.

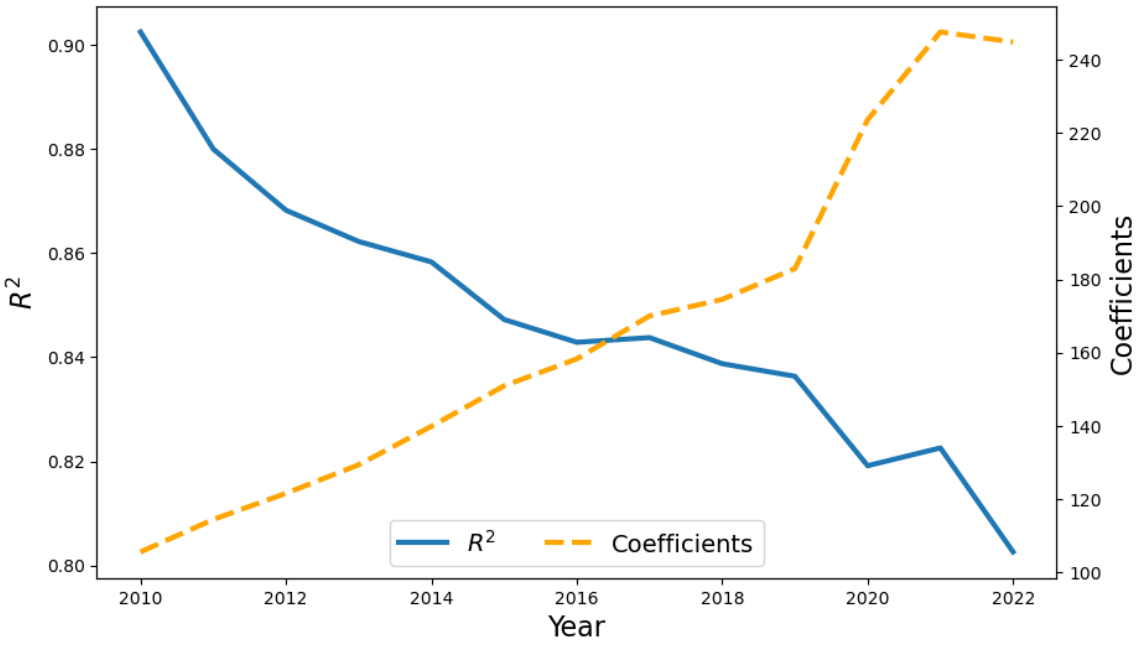
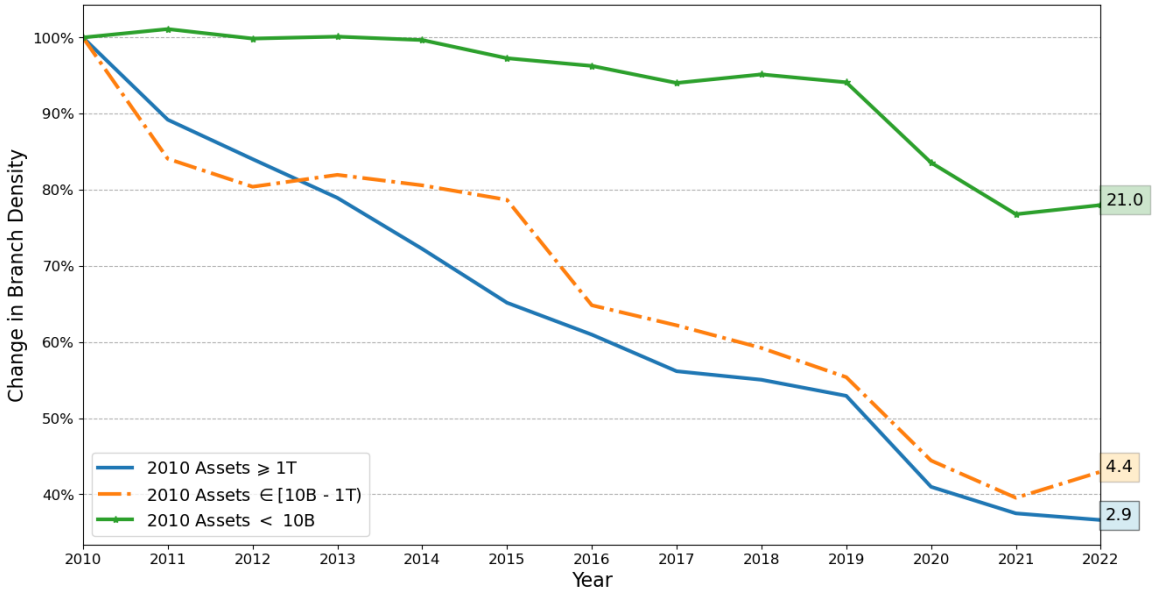
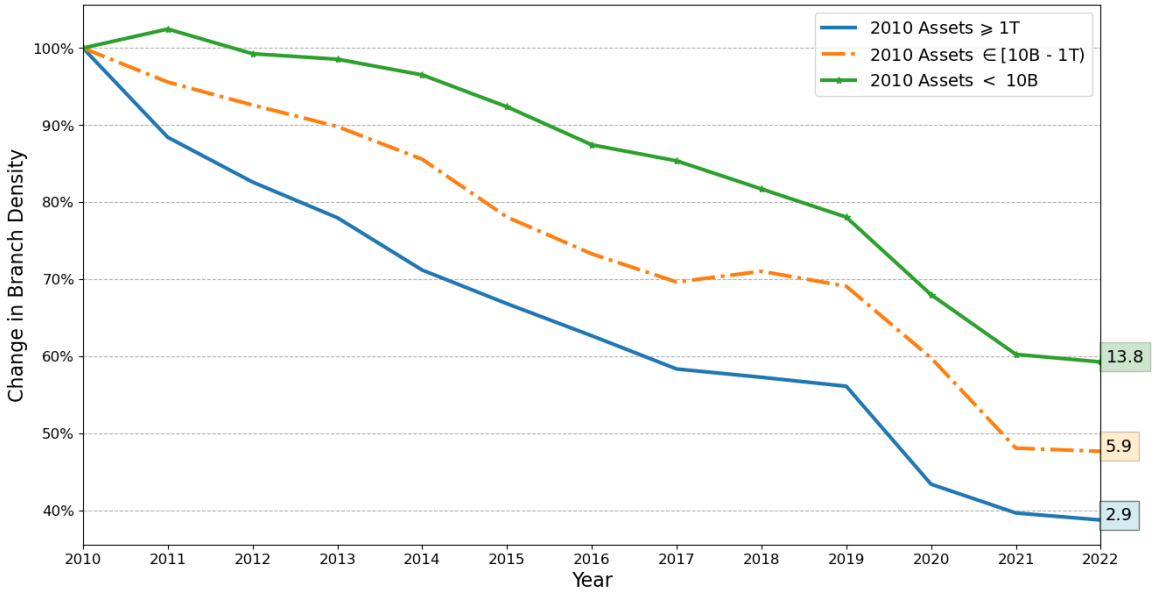


Figure 2. The explanatory power of bank branches. This figure plots the coefficients (right axis) and R^2 (left axis) of equation (1) from 2010 to 2022. Deposits are in millions. The sample includes all FDIC-insured banks. Source: Summary of Deposits.

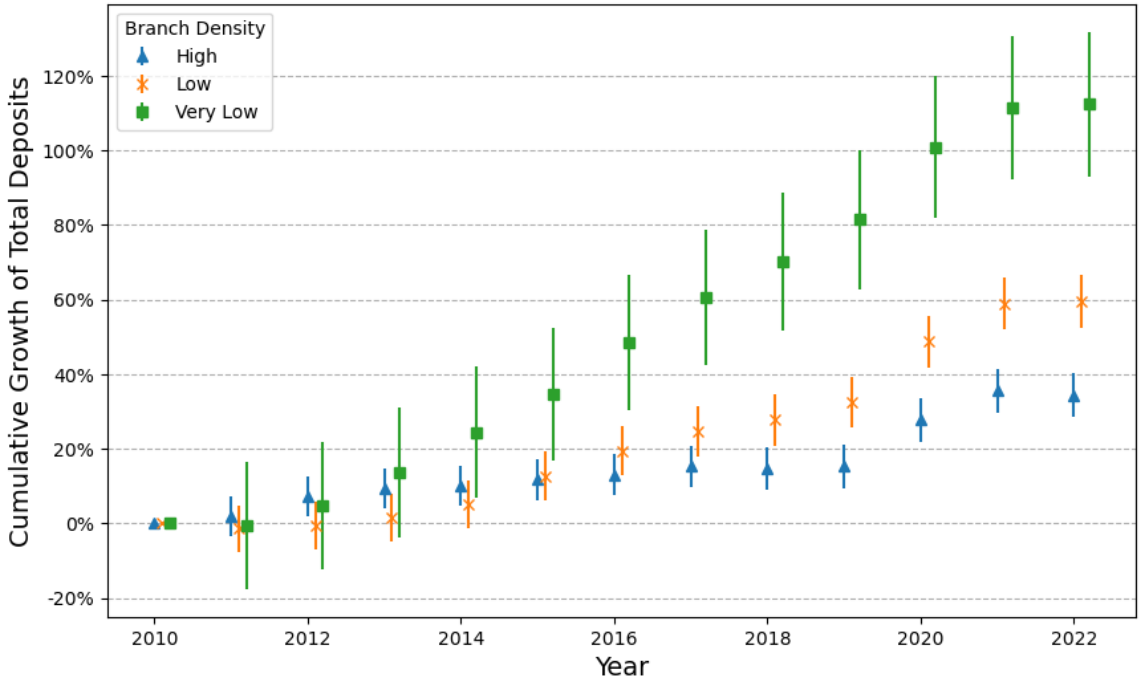


Panel A. All FDIC-insured banks

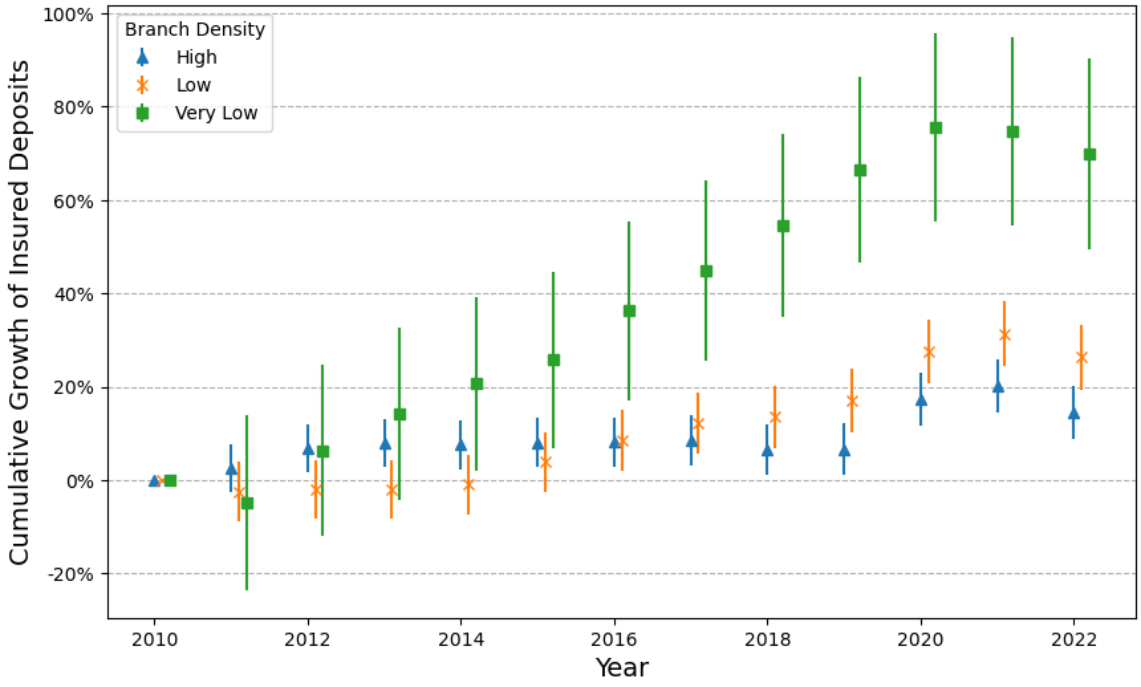


Panel B. Sample bank holding companies

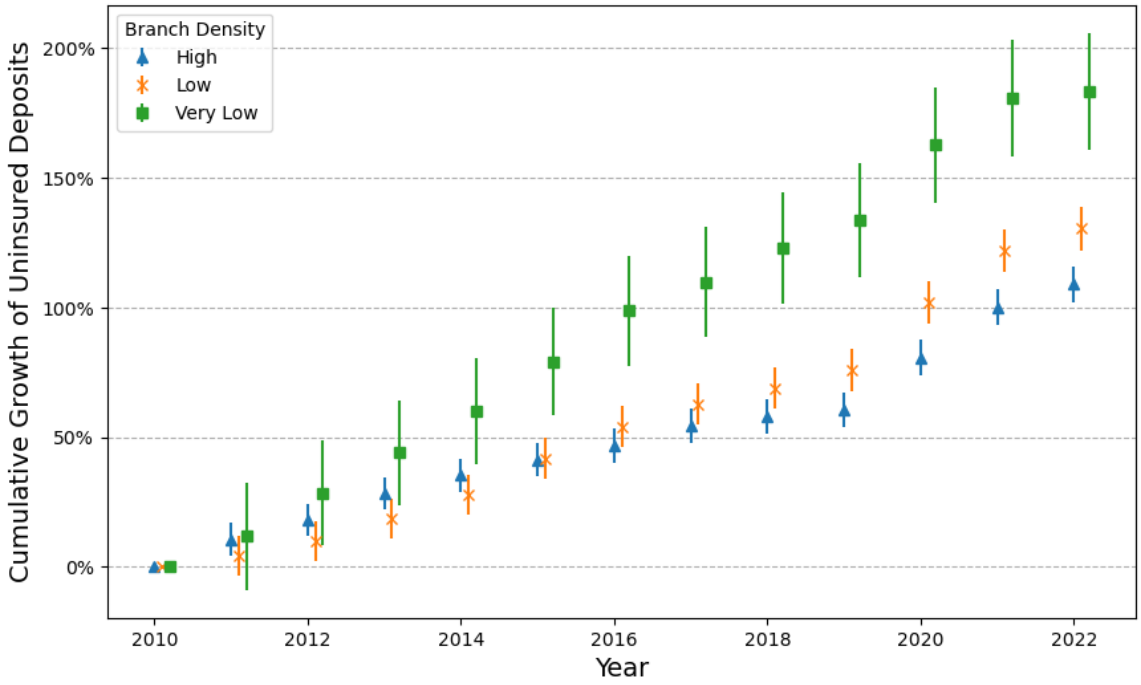
Figure 3. The evolution of branch density by bank size. The figures demonstrate the decline of branch density across various groups. Branch density is defined as the number of branches per $1 billion deposits. Banks are categorized into size groups by their 2010 total assets value, and the median of branch density within each group is plotted. Panel A includes all FDIC-insured banks, and Panel B captures all sample bank holding companies.



Panel A. Cumulative growth of total deposits

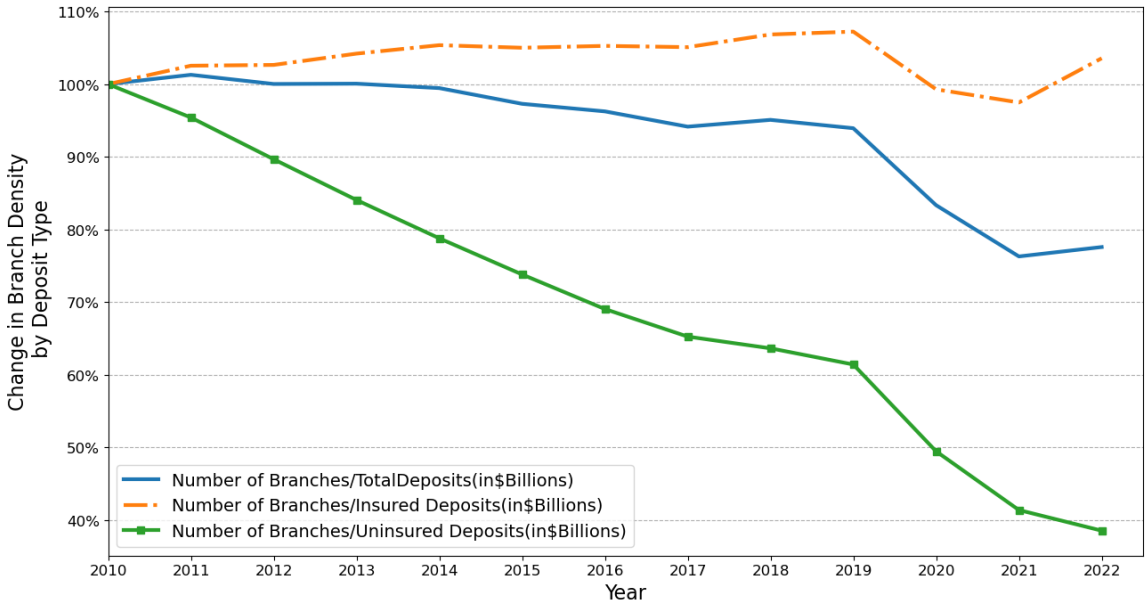


Panel B. Cumulative growth of insured deposits

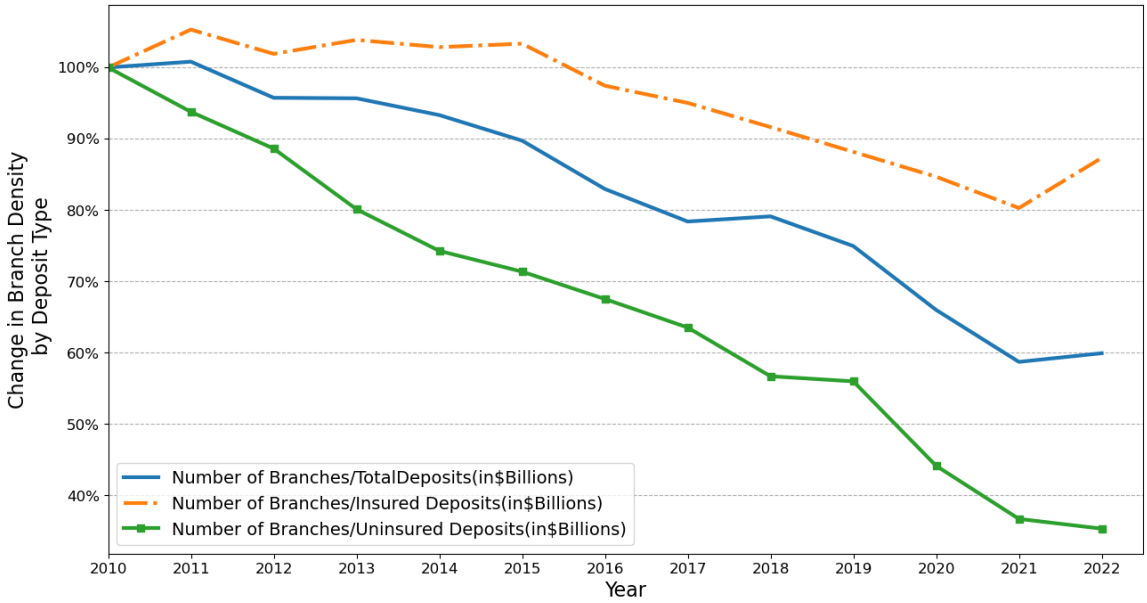


Panel C. Cumulative growth of uninsured deposits

Figure 4. Deposits growth and branch density. This figure shows the growth of total deposits (Panel A), insured deposits (Panel B), and uninsured deposits (Panel C) for all FDIC-insured banks with various branch density. Total deposits, insured deposits, and uninsured deposits are in real term (2009 dollars) and are log transformed. Branch density is constructed at the bank-year level by dividing the number of branches by total deposits (in billions). Banks with branch density less than or equal to the 10th percentile are categorized as *Very Low Density*, while banks with branch density higher than the 50th percentile are classified as *High Density*. The remaining banks are in the *Low Density* group. For each group, we regress log(deposits) (or log(insured deposits), log(uninsured deposits)) on indicators for years and plot the coefficients. The bars indicate the 95% confidence interval.

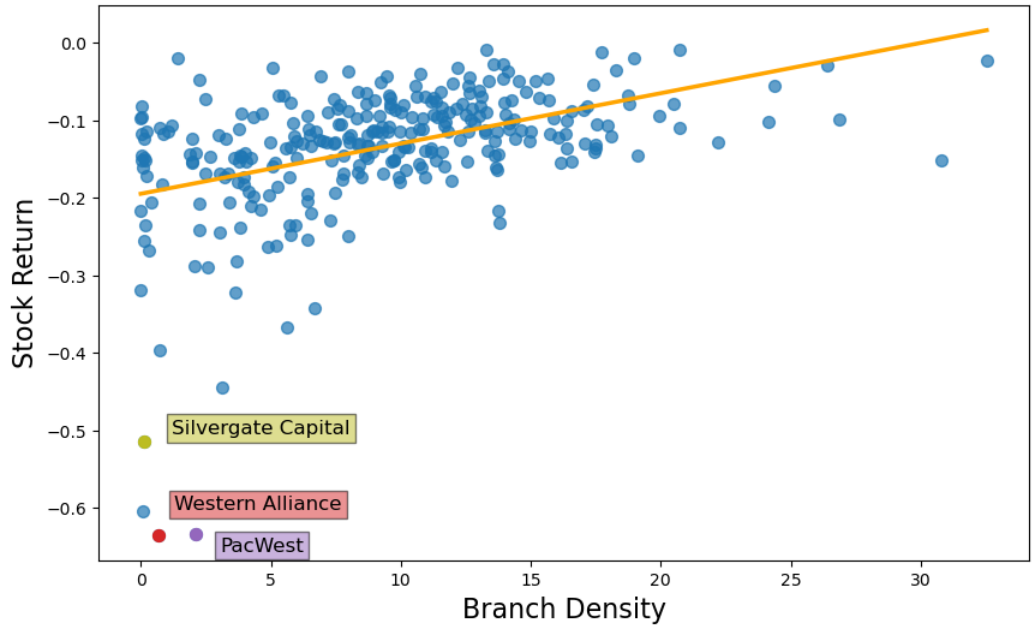


Panel A. All FDIC-insured banks

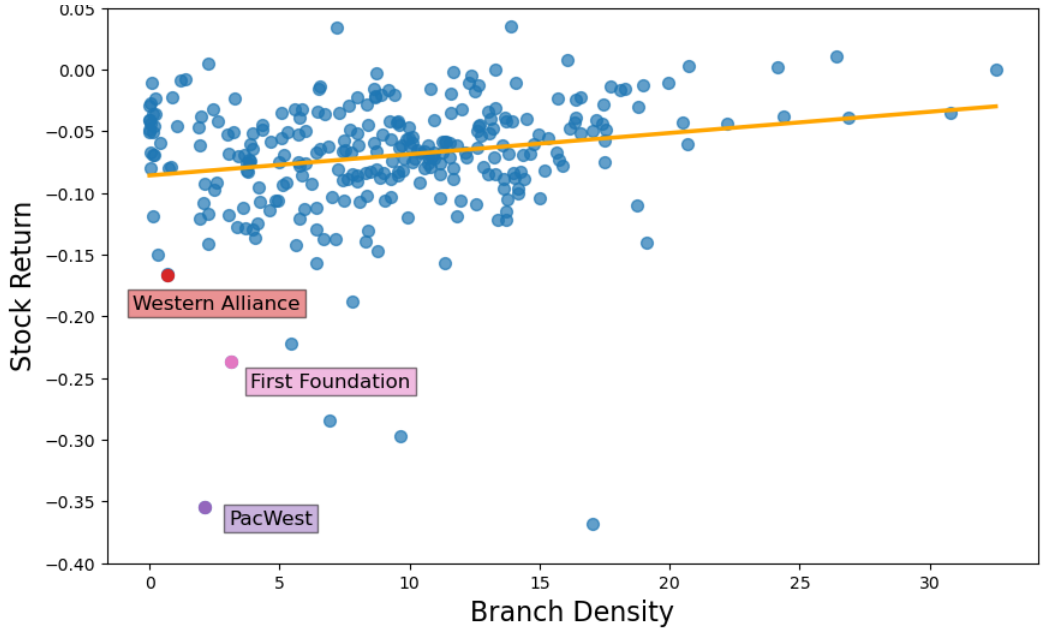


Panel B. Sample bank holding companies

Figure 5. Branch density by deposit types. The figure demonstrates the change of branch density when different types of deposits are considered. Branch density is defined as the number of branches per $1 billion deposits (or insured deposits or uninsured deposits). Panel A includes all FDIC-insured banks, and Panel B captures all sample bank holding companies.



Panel A. Silicon Valley Bank collapse



Panel B. First Republic Bank collapse

Figure 6. Branch density and stock return during the 2023 distress. This figure shows the relation between branch density and stock return around two distress episodes in 2023: the collapse of Silicon Valley Bank (Panel A) and the failure of First Republic Bank (Panel B). Branch density is defined as the number of branches per $1 billion of deposits as of June 2022. Stock returns are calculated as the change in stock price between March 8 and March 13 in Panel A and April 28 to May 2 in Panel B. The sample includes 294 publicly traded bank holding companies. Banks that performed particularly poorly are labeled.

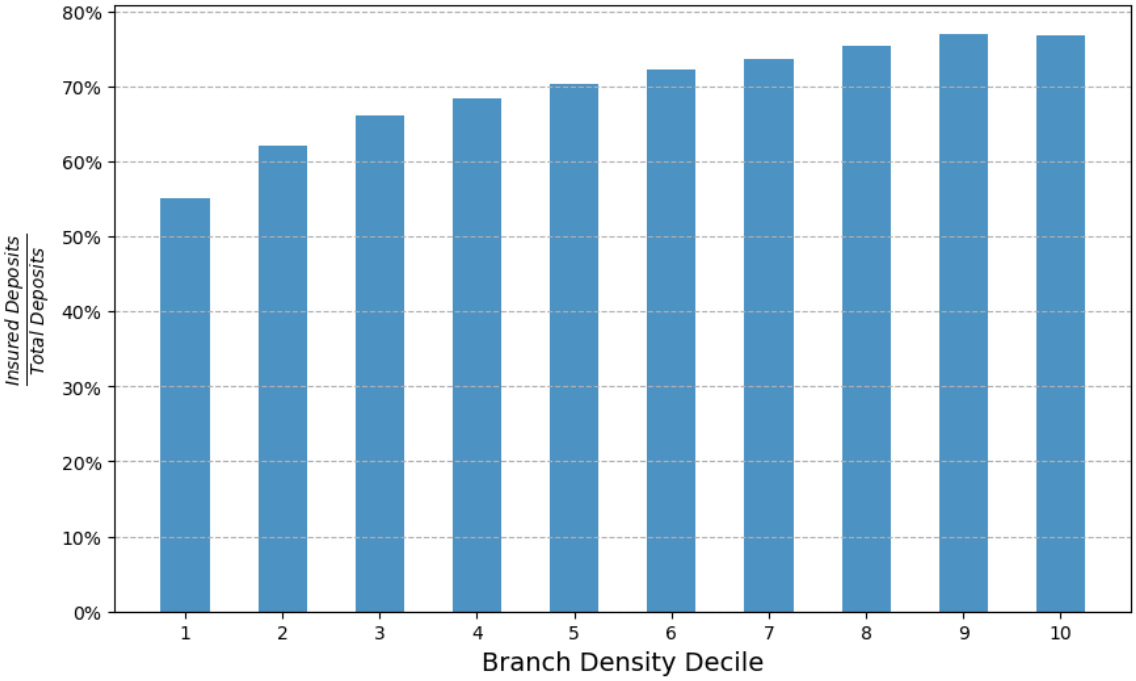


Figure 7. Insured deposits by branch density. This figure displays the share of insured deposits in total deposits across branch density deciles. Branch density is defined as the total number of branches per $1 billion deposits. The sample includes all FDIC-insured banks, and the sample period is 2010 to 2022.

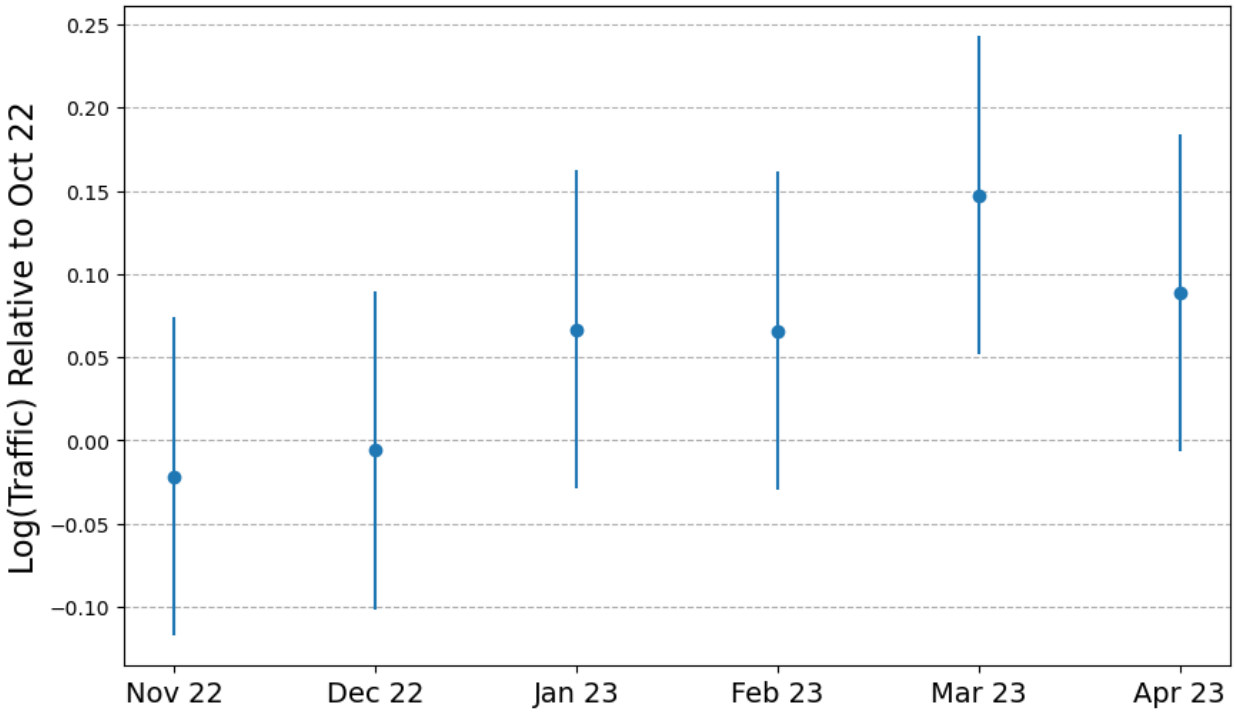


Figure 8. Website traffic. This figure displays the volume of website traffic to our sample banks relative to the level in October 2022. Using October 2022 as the baseline (omitted category), we regress the natural logarithm of the number of web page visits on binary indicators for each month between November 2022 and April 2023, with bank fixed effects. The bar represents 95% confidence interval.

Table I
Summary Statistics

Variable Name	N	Mean	Std	25%	50%	75%
Stock Return (SVB)	294	-13.521	8.433	-15.448	-12.040	-8.905
Stock Return (First Republic)	294	-7.310	7.349	-8.850	-6.487	-4.141
Branch Density	294	9.230	5.783	4.970	9.026	13.001
ΔBranch Density	229	-10.720	6.717	-14.533	-10.662	-6.533
Branch Density 2010	229	20.041	10.225	12.552	20.212	26.839
Dep Change Q422–Q123	291	1.131	9.031	-2.497	0.195	3.149
Uninsured Dep Change Q422–Q123	291	-4.602	13.972	-9.475	-6.203	-0.492
Insured Dep Change Q422–Q123	291	9.019	17.972	1.591	4.756	11.213
Insured Dep/Total Dep	294	62.589	17.099	52.654	63.564	75.524
Brokered Dep/Total Dep	293	4.634	6.791	0.000	1.649	6.617
Corporate Dep/Total Dep	212	41.487	17.864	31.562	39.246	50.858
Avg Dep [$000]	293	204.616	1381.92	27.086	34.931	60.308
Dep/Assets	213	80.275	11.614	79.200	82.994	86.644
Dep Growth 2019–2022	289	53.272	47.406	26.531	41.834	66.793
Log(Assets)	213	16.565	1.560	15.540	16.166	17.250
MTM Losses	294	13.248	4.373	10.664	12.966	16.049
CRE Loans/Assets	213	30.498	15.931	19.958	33.018	40.691
NPL/Assets	213	0.348	0.333	0.153	0.253	0.456
IT Growth 2010–2017	194	321.550	78.481	271.165	315.461	363.950
Online Traffic Mar/Feb 23	182	1.275	1.085	0.789	1.040	1.364
Online Traffic/Total Dep	186	42.093	94.725	9.657	20.640	37.470
Deposit Rate 12M10K	279	0.328	0.422	0.100	0.200	0.350
Deposit Rate 24M100K	277	0.418	0.429	0.170	0.287	0.479
Urban	212	78.781	25.464	64.205	90.490	100
Log County Income	212	10.91	0.21	10.78	10.88	11.05
Aged 60+	212	17.96	2.55	16.31	17.91	19.63
Higher Education	212	30.78	7.35	25.47	30.04	35.02

Notes: This table reports summary statistics. Variables are defined at the BHC level. Stock return for SVB failure is from March 8 to March 13 and for First Republic from April 28 to May 2. All changes are expressed in percentage points. Deposit changes are from Call Reports. Branch density is for 2022, and ΔBranch Density represents within-bank change in branch density between 2010 and 2022. Log(Assets) and Dep/Assets are for 2022 and come from Y-9C. Insured Deposits and brokered deposits at the end of 2022 come from Call Reports and are aggregated at the BHC level. MTM Losses are mark-to-market losses (Jiang et al. (2023b)) scaled by assets in 2022Q1 at the BHC level. CRE Loans and Non-Performing Loans (NPL) are the ratios of commercial real estate loans or non-performing loans to assets. Dep Growth 2019–2022 is the 3Y growth rate of total deposits based on Call Reports. IT Growth 2010–2017 is the increase in total IT budget from Aberdeen IT investment data aggregated to the BHC level. Online traffic Mar/Feb 23 is the ratio of the number of visits to banks' websites in March 2023 and February 2023 based on Semrush data, while Online Traffic/Total Dep is based on December 2022 data. Deposit Rate comes from RateWatch and is the average of all weeks across all branches for a 12-month CD with a minimum $10K deposit and a 24-month CD with a minimum $100K deposit during 2022. County characteristics come from American Community Survey and are aggregated to BHC level by taking weighted average across branches. See Table AI for detailed descriptions.

Table II
Banks by Branch Density in 2022

	Bank Name	Total Assets($B)	Total Deposits($B)	# Branches	Branch/ $1B Dep
	Very Low Density (Top 10 by the Number of Branches)				
1	First Republic Bank*	197.91	165.65	87	0.53
2	BNY Mellon Corporation	452.62	240.48	49	0.20
3	Signature Bank*	115.97	104.14	38	0.36
4	WesternAlliance Bancorporation	66.06	54.03	36	0.67
5	SVB Financial Group	214.40	174.96	17	0.10
6	Customers Bancorp, Inc.	20.26	17.03	12	0.70
7	Texas Capital Bancshares, Inc.	32.34	25.76	11	0.43
8	Stifel Financial Corp.	36.48	26.03	6	0.23
9	Morgan Stanley	1173.78	352.20	5	0.01
10	Goldman Sachs Group, Inc.	1601.22	343.13	5	0.01
	Low Density (Top 10 by the Number of Branches)				
1	JPMorgan Chase & Co.	3841.31	2128.46	4819	2.26
2	Wells Fargo & Company	1881.14	1464.84	4768	3.25
3	Bank of America Corporation	3111.61	1988.03	3906	1.96
4	PNC Financial	541.01	446.68	2615	5.85
5	U.S. Bancorp	591.38	455.31	2251	4.94
6	Truist Financial Corporation	545.12	435.44	2118	4.86
7	Citizens Financial Group, Inc.	227.19	181.57	1167	6.43
8	M&T Bank Corporation	204.03	173.08	1110	6.41
9	Fifth Third Bancorp	206.78	166.58	1090	6.54
10	Huntington Bancshares, Inc.	178.78	148.69	1080	7.26
	High Density (Top 10 by the Number of Branches)				
1	Regions Financial Corporation	160.95	139.56	1294	9.27
2	First Community Bancshares	3.94	3.52	345	97.98
3	F.N.B. Corporation	41.75	33.77	341	10.10
4	First Interstate Bancsystem	32.06	26.86	311	11.58
5	Prosperity Bancshares, Inc.	37.42	29.95	298	9.95
6	Southstate Corporation	46.21	38.96	289	7.42
7	Old National Bancorp	45.75	36.07	272	7.54
8	Simmons First National Corporation	27.23	22.24	241	10.84
9	Community Bank System, Inc.	15.49	13.61	232	17.04
10	Home Bancshares, Inc.	24.25	19.94	230	11.54
	Affected Banks				
1	First Republic Bank*	197.91	165.65	87	0.53
2	PacWest Bancorp	40.95	34.35	72	2.10
3	Signature Bank*	115.97	104.14	38	0.36
4	Western Alliance Bancorporation	66.06	54.03	36	0.67
5	SVB Financial Group	214.40	174.96	17	0.10
6	Silvergate Capital Corporation	15.90	13.51	2	0.15

Notes: Bank holding companies are sorted by branch density measured as of June 2022 (i.e., number of branches per $1B deposits). *Very Low Density* represents the bottom 10% of the distribution, *Low Density* includes banks between the 10th and 50th percentile, and *High Density* includes banks above the 50th percentile. For each group, banks are sorted by the number of branches and the top 10 are presented. Banks denoted with * are not bank holding companies, and therefore bank-level data from Call Reports is used for these banks.

Table III

Branch Density and Stock Prices during the 2023 Banking Crisis

	(1)	(2)	(3)	(4)	(5)
	Panel A: Stock Return (SVB)				
Branch Density	0.712***	0.821***	0.722***	0.750***	0.688***
	(0.130)	(0.136)	(0.121)	(0.125)	(0.119)
Dep/Assets		-0.239***	-0.234***	-0.220***	-0.258***
		(0.059)	(0.065)	(0.066)	(0.060)
Insured Dep/			0.079*	0.081*	0.088**
Total Dep			(0.046)	(0.046)	(0.040)
MTM				-0.187	-0.174
Losses				(0.152)	(0.148)
Dep Growth					-0.048***
2019–2022					(0.016)
N	213	213	213	213	212
R^2	0.189	0.256	0.274	0.281	0.331
Size Control	X	X	X	X	X
	(6)	(7)	(8)	(9)	(10)
	Panel B: Stock Return (First Republic)				
Branch Density	0.191***	0.234***	0.197***	0.240***	0.237***
	(0.068)	(0.070)	(0.065)	(0.065)	(0.064)
Dep/Assets		-0.095***	-0.093***	-0.072**	-0.078**
		(0.027)	(0.030)	(0.033)	(0.035)
Insured Dep/			0.030	0.032	0.032
Total Dep			(0.021)	(0.022)	(0.022)
MTM				-0.286***	-0.287***
Losses				(0.094)	(0.094)
Dep Growth					-0.004
2019–2022					(0.007)
N	213	213	213	213	212
R^2	0.068	0.105	0.115	0.166	0.169
Size Control	X	X	X	X	X

Notes: The sample includes all U.S. bank holding companies for which returns and branch density are available. Return around SVB collapse is the relative change of average close price from March 8 to March 13; return around First Republic collapse is the relative change from April 28 to May 2. Branch density is the number of bank branches per $1B of deposits as of June 2022; Deposits to assets ratio and share of FDIC-insured deposits are measured at the end of 2022. MTM losses, expressed as a percentage of assets in Q1 2022, are calculated following Jiang et al. (2023). All columns include control for logarithm of total assets and for fixed effects for five total assets quintiles. Robust standard errors in parentheses. * - 10% significance; ** - 5%; *** - 1%.

Table IV
Separating the Role of Branches and Deposits over Time

	(1)	(2)	(3)	(4)
	Stock Return (SVB)		Stock Return (First Republic)	
Δ Branch Density	0.350**		0.220***	
	(0.168)		(0.083)	
Branch Density 2010	0.448***	0.211***	0.192***	0.045
	(0.120)	(0.058)	(0.065)	(0.032)
ΔLog(Branches)		3.665***		0.870**
		(1.327)		(0.432)
ΔLog(Deposits)		-4.384***		-1.206**
		(1.428)		(0.514)
Dep/Assets	-0.243***	-0.234***	-0.064**	-0.063**
	(0.062)	(0.065)	(0.031)	(0.031)
Insured Dep/ Total Dep	0.130***	0.136***	0.045*	0.053**
	(0.046)	(0.041)	(0.024)	(0.024)
MTM Losses	-0.203	-0.263	-0.262***	-0.279***
	(0.159)	(0.159)	(0.096)	(0.101)
Dep Growth 2019–2022	-0.055**	-0.040**	-0.002	0.002
	(0.023)	(0.017)	(0.008)	(0.009)
N	171	171	171	171
R^2	0.409	0.468	0.217	0.207
Size Control	X	X	X	X

Notes: Return around SVB collapse is the relative change of average close price from March 8 to March 13; return around First Republic collapse is the relative change in close price from April 28 to May 2. Changes in independent variables (branch density, defined as the number of branches per $1B of deposits; and logarithms of the number of branches and total deposits) are over the 2010 to 2022 horizon. All columns include control for logarithm of total assets and for fixed effects for five total assets quintiles, deposits/asset ratio, share of insured deposits, mark-to-market losses estimates, and 2019 to 2022 deposits growth. Robust standard errors in parentheses. * - 10% significance; ** - 5%; *** - 1%.

Table V
Branch Density and Deposit Outflows in Q1 2023

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Dep Change Q4 2022–Q1 2023			Bottom 10% of Dep Change Q422–Q123		Bottom 25% of Dep Change Q422–Q123	
	Uninsured	Insured	Total	Total	Uninsured	Insured	Uninsured	Insured
Branch Density	0.753***	-1.242***	0.022	0.199**	-1.902***	0.227	-2.052***	1.196
	(0.231)	(0.376)	(0.117)	(0.097)	(0.551)	(0.533)	(0.653)	(0.747)
Insured Dep /Total Dep	0.088	0.066	0.100***	-0.017	0.066	0.065	0.157	-0.077
	(0.063)	(0.109)	(0.028)	(0.023)	(0.161)	(0.153)	(0.210)	(0.184)
Dep/Assets	-0.069	0.095	-0.036	0.012	0.289	-0.245	-0.221	-0.475
	(0.114)	(0.108)	(0.075)	(0.028)	(0.215)	(0.246)	(0.400)	(0.373)
MTM Losses	-0.261	0.067	-0.040	0.005	0.822	-0.202	1.856**	0.101
	(0.196)	(0.211)	(0.119)	(0.058)	(0.516)	(0.516)	(0.795)	(0.773)
Dep Growth 2019–2022	0.015	0.051**	0.025	0.009	0.019	-0.075	0.018	-0.016
	(0.045)	(0.024)	(0.024)	(0.007)	(0.054)	(0.050)	(0.080)	(0.073)
Sample	Full	Full	Full	Net Outflow	Full	Full	Full	Full
N	209	209	209	105	209	209	209	209
R^2	0.078	0.167	0.078	0.106	0.091	0.069	0.074	0.068
Size Control	X	X	X	X	X	X	X	X

Notes: Dependent variables are relative changes of deposits—uninsured (column (1)), insured (column (2)), and total (columns (3) and (4))—between Q4 2022 and Q1 2023, and indicators for large uninsured (columns (5) and (7)) or insured (columns (6) and (8)) deposit outflows, which take a value of 100 for observations below the 10th percentile (columns (5) and (6)) or the 25th percentile of the distribution (columns (7) and (8)), and zero otherwise. In column (4) the sample is limited to banks that experienced a net outflow of deposits between Q4 2022 and Q1 2023. Silvergate Capital is excluded from the sample as an outlier. All columns include control for logarithm of total assets and for fixed effects for five total assets quintiles, deposits/asset ratio, share of insured deposits, mark-to-market losses estimates, and 2019 to 2022 deposits growth. Standard errors in parentheses. * - 10% significance; ** - 5%; *** - 1%.

Table VI
Characteristics of Bank Customers by Branch Density

	(1) Corporate Dep /Total Dep	(2) Log(Avg Dep)	(3) Urban	(4) Log County Income	(5) Age 60+	(6) Higher Education
Branch Density	-1.082***	-0.107***	-2.551***	-0.017***	0.164***	-0.785***
	(0.354)	(0.020)	(0.540)	(0.003)	(0.048)	(0.122)
Dep/Assets	0.315**	-0.041***	-0.094	-0.002*	0.020	-0.119***
	(0.155)	(0.007)	(0.145)	(0.001)	(0.015)	(0.044)
Insured Dep /Total Dep	-0.282**	-0.009	-0.242**	-0.001	0.009	-0.039
	(0.117)	(0.007)	(0.120)	(0.001)	(0.016)	(0.028)
MTM Losses	-0.490*	-0.011	0.344	0.007**	0.057	0.183
	(0.294)	(0.013)	(0.346)	(0.003)	(0.047)	(0.115)
Dep Growth 2019–2022	0.014	0.005***	-0.048*	-0.000	0.003	-0.008
	(0.027)	(0.002)	(0.028)	(0.000)	(0.004)	(0.010)
N	212	212	212	212	212	212
R^2	0.278	0.563	0.433	0.208	0.198	0.386
Size Control	X	X	X	X	X	X

Notes: In columns (1) and (2), dependent variables are the ratio of corporate deposits to total deposits and the logarithm of the average deposit per account. Dependent variables in columns (3)–(6) are bank-level weighted averages based on bank's branches with weights equal to value of a given branch's deposits. Urban represents a deposits-weighted share of bank branches in areas with population above 100,000; log income is the logarithm of median county income; Age 60+ is the share of county's population aged 60 or more; Higher Education is the share of county's population with a bachelor's degree or more. All columns include control for logarithm of total assets and for fixed effects for five total assets quintiles, deposits/asset ratio, share of insured deposits, mark-to-market losses estimates, and 2019 to 2022 deposits growth. Robust standard errors in parentheses. * - 10% significance; ** - 5%; *** - 1%.

Table VII
Branch Density and IT Investment

	(1)	(2)	(3)
	Branch Density	Stock Return (SVB Collapse)	Stock Return (First Republic Collapse)
IT Growth 2010–2017	-0.018***	-0.021***	-0.009***
	(0.004)	(0.007)	(0.003)
Dep/Assets	0.026	-0.252***	-0.070**
	(0.033)	(0.062)	(0.029)
Insured Dep /Total Dep	0.108***	0.194***	0.059**
	(0.023)	(0.048)	(0.025)
MTM Losses	0.055	-0.121	-0.252**
	(0.098)	(0.181)	(0.107)
Dep Growth 2019–2022	-0.006	-0.052**	-0.000
	(0.006)	(0.024)	(0.008)
N	157	157	157
R^2	0.498	0.406	0.259
Size Control	X	X	X

Notes: Branch density is the number of branches per $1B of deposits as of June 2022. The return around SVB collapse is the relative change of average close price from March 8 to March 13; return around First Republic collapse is the relative change in close price from April 28 to May 2. IT growth is the relative increase of banks' total IT budget between 2017 and 2010. All columns include control for logarithm of total assets and for fixed effects for five total assets quintiles, deposits/asset ratio, share of insured deposits, and mark-to-market losses estimates. Robust standard errors in parentheses. * - 10% significance; ** - 5%; *** - 1%.

Table VIII
Branch Density, Online Traffic, and Stock Returns

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Online Traffic Mar/Feb 23	Stock Return (SVB)		Stock Return (First Republic)		Uninsured Dep Change Q4 2022–Q1 2023	
Branch Density	-0.050***		0.594***		0.221***		0.579**
	(0.016)		(0.128)		(0.073)		(0.274)
Online Traffic Mar/Feb 23		-1.886*	-1.427	-0.694	-0.523	-2.485**	-2.033*
		(0.996)	(0.964)	(0.460)	(0.455)	(1.132)	(1.125)
Dep/Assets	0.019*	-0.155**	-0.200***	-0.063	-0.080*	-0.145	-0.186
	(0.010)	(0.067)	(0.066)	(0.045)	(0.046)	(0.153)	(0.157)
Insured Dep /Total Dep	-0.005	0.118***	0.065*	0.058**	0.038	0.214***	0.162**
	(0.006)	(0.040)	(0.038)	(0.026)	(0.026)	(0.078)	(0.069)
MTM Losses	-0.046*	-0.093	-0.187	-0.332***	-0.368***	-0.172	-0.264
	(0.026)	(0.172)	(0.173)	(0.107)	(0.109)	(0.227)	(0.234)
Dep Growth 2019-2022	0.005	-0.039***	-0.036***	-0.009	-0.008	-0.033	-0.031
	(0.003)	(0.013)	(0.013)	(0.007)	(0.007)	(0.025)	(0.025)
N	181	181	181	181	181	180	180
R^2	0.191	0.226	0.292	0.166	0.194	0.147	0.171
Size Control	X	X	X	X	X	X	X

Notes: Online traffic change is the ratio of the number of web page visits on bank's online banking website in March 2023 to the number of visits in February 2023. Return around SVB collapse is the relative change of average close price from March 8 to March 13; return around First Republic collapse is the relative change in close price from April 28 to May 2. Deposit change is the relative change of uninsured deposits between Q4 2022 and Q1 2023. All columns include control for logarithm of total assets and for fixed effects for five total assets quintiles, deposits/asset ratio, share of insured deposits, mark-to-market losses estimates, and 2019 to 2022 deposits growth. Robust standard errors in parentheses. * - 10% significance; ** - 5%; *** - 1%.

Table IX
Branch Density and Deposit Rates

	(1)	(2)	(3)	(4)	(5)	(6)
	Deposit Rate		Stock Return		Stock Return	
	12M10K	24M100K	(SVB)		(First Republic)	
Branch Density	-0.036***	-0.042***				
	(0.009)	(0.010)				
Deposit Rate 24M100K			-4.156**		-2.276***	
			(1.663)		(0.862)	
Deposit Rate 12M10K				-2.894**		-1.910***
				(1.337)		(0.708)
Dep/Assets	-0.013***	-0.015***	-0.162***	-0.157**	-0.077*	-0.076*
	(0.004)	(0.004)	(0.061)	(0.061)	(0.040)	(0.041)
Insured Dep /Total Dep	0.009***	0.009***	0.168***	0.146***	0.102***	0.100***
	(0.003)	(0.003)	(0.043)	(0.043)	(0.026)	(0.025)
MTM Losses	-0.011	-0.015*	-0.158	-0.148	-0.338***	-0.337***
	(0.008)	(0.008)	(0.151)	(0.150)	(0.094)	(0.094)
Dep Growth 2019–2022	-0.001	-0.001*	-0.035**	-0.035**	-0.012	-0.012
	(0.001)	(0.001)	(0.015)	(0.016)	(0.008)	(0.008)
N	201	200	200	201	200	200
R^2	0.349	0.349	0.176	0.190	0.187	0.176
Size Controls	X	X	X	X	X	X

Notes: Branch density is the number of branches per $1B of deposits as of June 2022. Return around SVB collapse is the relative change of average close price from March 8 to March 13; return around First Republic collapse is the relative change in close price from April 28 to May 2. Deposit Rate 12M10K is the average of APY of a 12-month CD with a minimum of $10K deposit at the BHC level during 2022, while the analogous 24M100K measure is the average for a 24-month CD with a minimum of $100K deposit. Robust standard errors in parentheses. * - 10% significance; ** - 5%; *** - 1%.

Table X
Horseracing IT and Deposit Rates

	(1) Deposit Rate	(2) Stock Return (SVB)	(3) Stock Return (First Republic)
IT Growth 2010–2017 (standardized)	0.173***	-1.558***	-0.531*
	(0.035)	(0.529)	(0.270)
Deposit Rate (standardized)		-0.552	-0.532
		(0.849)	(0.390)
Dep/Assets	-0.011**	-0.191***	-0.101***
	(0.006)	(0.069)	(0.034)
Insured Dep /Total Dep	0.005*	0.144***	0.100***
	(0.003)	(0.042)	(0.028)
MTM Losses	-0.011	-0.127	-0.285***
	(0.009)	(0.177)	(0.106)
Dep Growth 2019–2022	-0.001	-0.015	-0.005
	(0.001)	(0.019)	(0.008)
N	150	150	150
R^2	0.349	0.314	0.265
Size Control	X	X	X

Notes: Deposit Rate is the average APY of a 12-month CD with a minimum of $10K deposit at the BHC level in 2022. IT Growth is the growth of IT investment between 2010 and 2017. Both Deposit Rate and IT Growth are standardized for easy comparison. Return around SVB collapse is the relative change of average close price from March 8 to March 13; return around First Republic collapse is the relative change in close price from April 28 to May 2. All columns include control for logarithm of total assets and for fixed effects for five total assets quintiles, deposits/asset ratio, share of insured deposits, mark-to-market losses estimates, and 2019 to 2022 deposits growth. Robust standard errors in parentheses. * - 10% significance; ** - 5%; *** - 1%.

Appendix

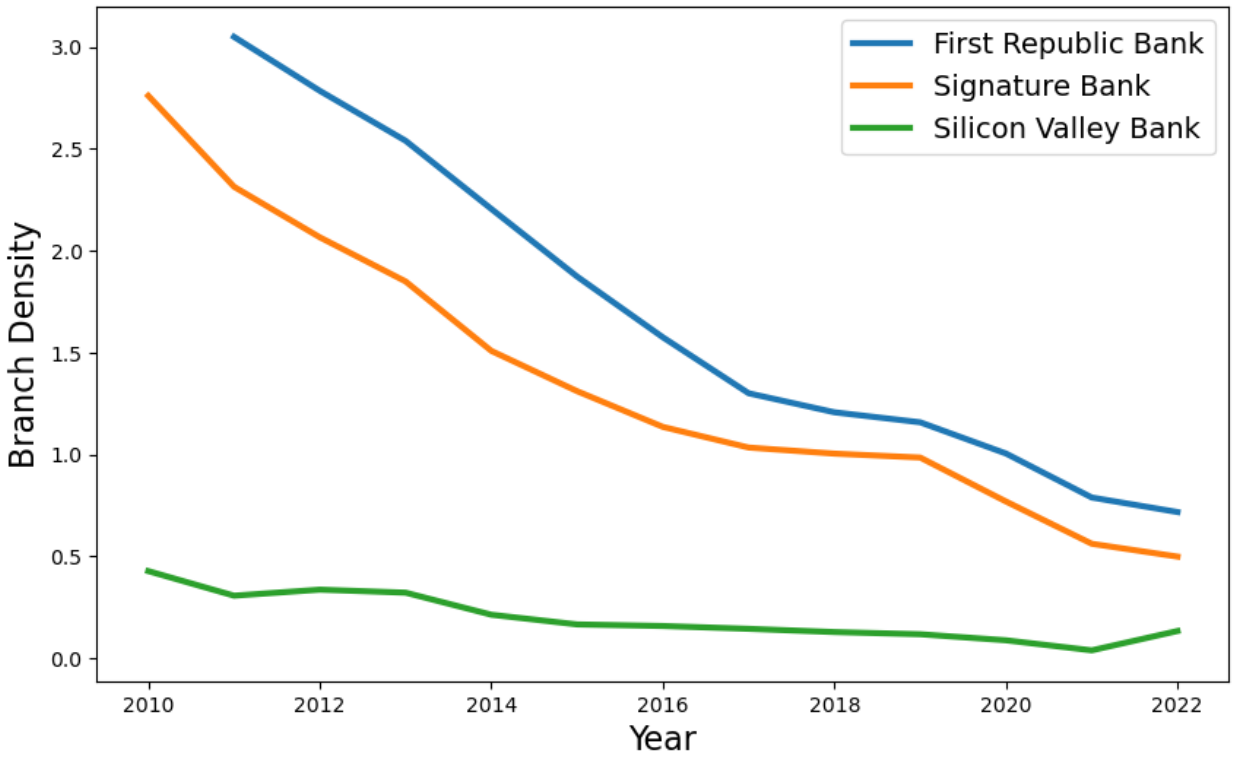
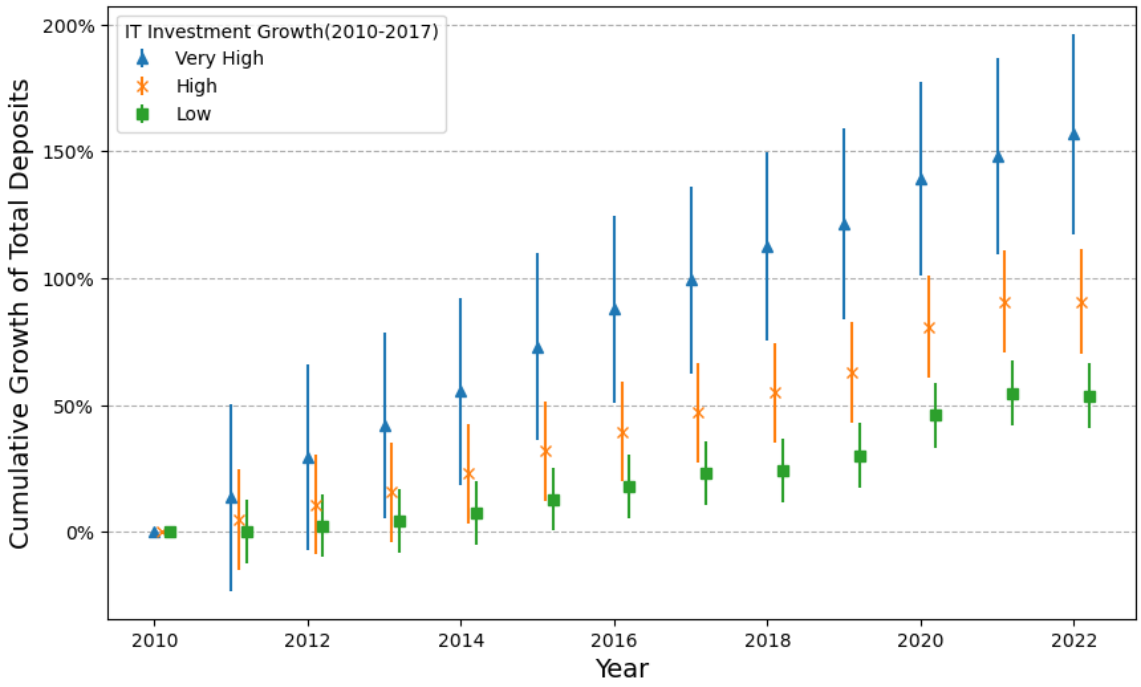
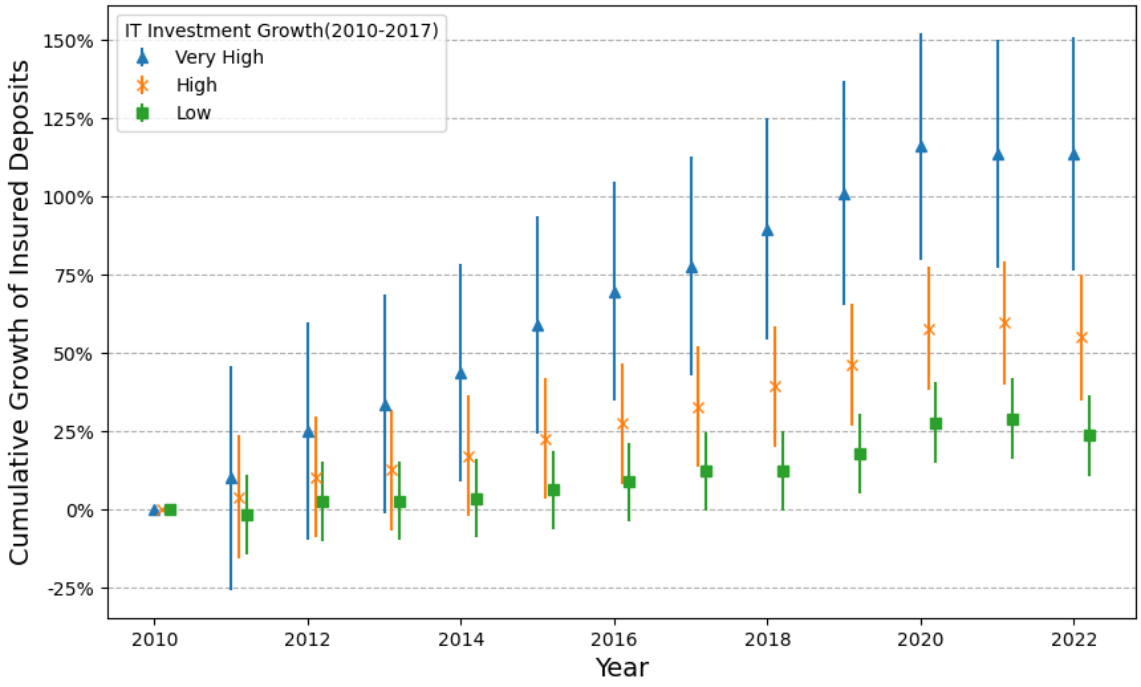


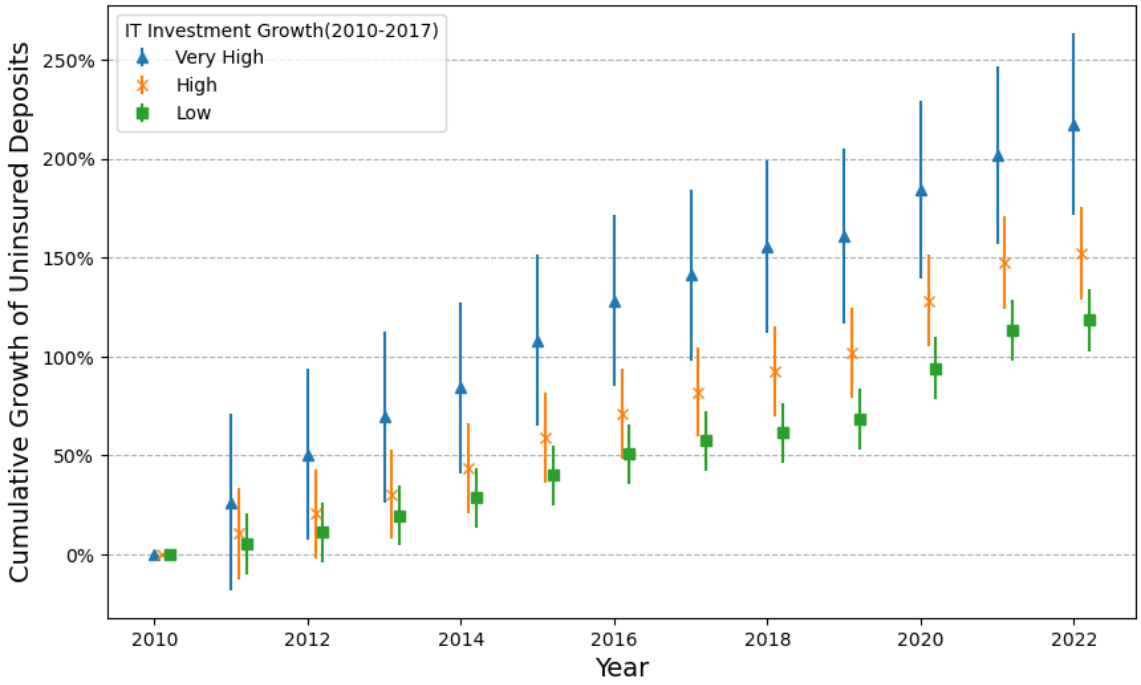
Figure A1. Branch density of failed banks. This figure displays the branch density of First Republic Bank, Signature Bank, and Silicon Valley Bank from 2010 to 2022. Branch density is defined as the number of branches per $1B of deposits. Deposits are adjusted for inflation and are in 2009 dollars. First Republic Bank was established in July 2010, and therefore the data was available only from 2011 onward. Source: Summary of Deposits.



Panel A. Cumulative growth of total deposits



Panel B. Cumulative growth of insured deposits



Panel C. Cumulative growth of uninsured deposits

Figure A2. Deposits growth and IT investment. This figure plots the cumulative growth rate of deposits, insured deposits, and uninsured deposits for all FDIC-insured banks. IT investment is calculated as the log-change of IT Budget from 2010 to 2017. Banks are classified into three groups based on their IT investment: Very High (>=90th percentile), High (>=50th percentile but < 90th percentile), and Low (< 50th percentile). Within each group, we regress deposits (or insured/uninsured deposits) in log transformation on a series of indicators for years and plot the coefficients. The bars represent the 95% confidence interval.

Table AI

Variable Definitions and Data Sources

Variable	Descriptions	Source
Stock Return (SVB Failure)	Relative change of the close price from March 8, 2023, to March 13, 2023.	CRSP
Stock Return (First Republic Failure)	The change in the close price between April 28, 2023, and May 2, 2023.	CRSP
Dep Change Q4 2022–Q1 2023	Percentage change of total deposits in Q1 2023 relative to the total deposits in Q4 2022. Bank-level data are aggregated at the BHC level.	Call Reports
Uninsured Dep Change Q4 2022–Q1 2023	Percentage change of uninsured deposits in Q1 2023 relative to uninsured deposits in Q4 2022. Uninsured deposits are calculated by subtracting insured deposits from total deposits. Bank-level data are aggregated at the BHC level.	Call Reports
Insured Dep Change Q4 2022–Q1 2023	Percentage change of insured deposits in Q1 2023 relative to insured deposits in Q4 2022. We follow Acharya and Mora (2015) and define insured deposits as the sum of RCONF049 and RCONF045 in the bank-level call reports. Bank-level data are then aggregated at the BHC level.	Call Reports
Branch Density	Number of branches scaled by total deposits as of June 2022. Bank-level data are aggregated at the BHClevel.	Summary of Deposits (SOD)
ΔBranch Density	Branch density in June 2022 minus branch density measured in June 2010.	SOD
Branch Density 2010	Branch density as of June 2010.	SOD
Log(Assets)	Log of total assets.	Y-9C
Insured Dep/Total Dep	The fraction of insured deposits out of total deposits. The bank-level data are aggregated at the BHC level.	Call Reports
Brokered Dep/Total Dep	The fraction of brokered deposits out of total deposits. Bank-level data are aggregated at the BHC level.	Call Reports
Dep/Assets	Total deposits scaled by total assets.	Y-9C
MTM Losses	Mark-to-market losses scaled by total assets measured in Q1 2022. For details of MTM losses, please see Jiang et al. (2023). As in Cookson et al. (2023), we aggregate bank-level data to the BHC level.	Call Reports
Commercial Real Estate Loans (CRE)	The ratio of the value of commercial real estate loans to assets	Y-9C
Non-performing Loans	The ratio of the value of non-performing loans to assets.	Y-9C
Dep Growth 2019–2022	Growth rate in total deposits from the end of 2019 to the end of 2022. Bank-level data are aggregated at the BHC level.	Call Reports
IT Growth 2010–2017	Percentage change in IT budget from 2010 to 2017. We match IT data from Aberdeen with summary of deposits first and then aggregate data to the BHC level.	Aberdeen
Online Traffic Mar/Feb 23	The ratio of online traffic in March 2023 relative to the online traffic in February 2023.	Semrush

Online Traffic/Total Dep	The ratio of online traffic (visits to bank website) in December 2022 to the total value of deposits at the end of 2022.	Semrush/Call Reports
Corporate Dep/Total Dep	Transaction accounts total (RCONB549) – total deposits in those noninterest-bearing and interest-bearing transaction account deposit products intended primarily for individuals for personal, household, or family use (RCONP753+RCONP754) + components of nontransaction account deposit products that are NOT intended primarily for individuals for personal, household, or family use (RCONP757 + RCONP759). We scale corporate deposits by total deposits in domestic offices. See https://www.fdic.gov/resources/bankers/call-reports/crinst-031-041/2021/2021-12-rc-e.pdf for item definitions.	Call Reports
Log(Avg Dep)	Logarithm of total deposits divided by number of accounts.	Call Reports
Urban	Indicator for a county being an urban area based on population above 100,000. Bank-level data are aggregated by averaging values for all branches with weights equal to the value of branch's deposits.	American Community Survey (ACS)
Log County Income	Logarithm of county's median income. Bank-level data are aggregated by averaging values for all branches with weights equal to the value of branch's deposits.	ACS
Age 60+	Share of county's population aged 60 or more. Bank-level data are aggregated by averaging values for all branches with weights equal to the value of branch's deposits.	ACS
Higher Education	Share of county's population with bachelor's degree or higher level of education. Bank-level data are aggregated by averaging values for all branches with weights equal to the value of branch's deposits.	ACS
Deposit Rate 12MCD10K and 24MCD100K	The average of APY of 12-month (24-month) CD with a minimum of $10K (12MCD10K) or $100k (24MCD100K) deposity during 2022 at the BHC level.	RateWatch

Table AII
The Evolution of Bank Branches in the United States

	(1)	(2)	(3)	(4)
	Number of Branches			
	All Banks	Small Banks	Medium Banks	Large Banks
Year	-611.0***	0.181***	-2.587**	-109.7***
	(150.6)	(0.007)	(1.019)	(20.7)
Covid Years	-4201.3**	0.194***	2.347	-159.4
	(1337.6)	(0.061)	(9.490)	(134.6)
N	13	54402	1142	39
R^2		0.969	0.978	0.875

Notes: The sample covers the years 2010 to 2022. The regression in column (1) is at the year level, while that in column (2) is at the bank-quarter level. The dependent variable is the number of branches in all banks (column (1)) or of a given bank (columns (2)–(4)). Year is a continuous variable, while Covid Years is an indicator for year 2020 and beyond. The sample in columns (2)–(4) is limited based on the average level of banks' deposits from 2010 to 2022. Column (2) includes banks with average deposits of less than $10B, column (3) includes those with average deposits between $10B and $1T, and column (4) includes those above $1T. Significance levels: * - 10%, ** - 5%, *** - 1%. Robust standard errors in parentheses in columns (2)–(4).

Table AIII
Alternative Measures of Branch Density

	(1) Return (SVB)	(2) Return (First Republic)	(3) Uninsured Dep Change	(4) Insured Dep Change	(5) Large Drop Uninsured Dep	(6) Large Drop Insured Dep
			Panel A			
Branches /Uninsured Dep	0.167*** (0.049)	0.093*** (0.022)	0.310* (0.158)	-0.396*** (0.142)	-0.543*** (0.192)	0.214 (0.220)
Dep/Assets	-0.227*** (0.062)	-0.082** (0.037)	-0.046 (0.113)	0.046 (0.100)	0.208 (0.210)	-0.249 (0.244)
Insured Dep /Total Dep	0.092** (0.045)	0.025 (0.023)	0.046 (0.058)	0.096 (0.118)	0.090 (0.172)	0.012 (0.159)
MTM Losses	-0.169 (0.154)	-0.310*** (0.093)	-0.343 (0.225)	0.125 (0.215)	0.868 (0.536)	-0.308 (0.533)
Dep Growth 2019–2022	-0.050** (0.021)	-0.000 (0.008)	0.024 (0.045)	0.043* (0.025)	0.010 (0.056)	-0.065 (0.049)
N	211	211	209	209	209	209
R^2	0.285	0.180	0.097	0.151	0.070	0.077
Size controls	X	X	X	X	X	X
			Panel B			
Log(Branches /Brokered Dep)	1.269*** (0.300)	0.359** (0.141)	1.262** (0.549)	-1.611*** (0.425)	-3.164* (1.703)	-0.670 (0.717)
Dep/Assets	-0.266*** (0.082)	-0.071* (0.043)	-0.090 (0.185)	0.146 (0.166)	0.414 (0.452)	-0.079 (0.245)
Insured Dep /Total Dep	0.148*** (0.040)	0.082*** (0.027)	0.177** (0.071)	-0.094 (0.114)	-0.175 (0.203)	0.066 (0.170)
MTM Losses	-0.160 (0.190)	-0.426*** (0.132)	-0.258 (0.276)	0.077 (0.323)	1.153 (0.801)	0.234 (0.691)
Dep Growth 2019-2022	-0.049*** (0.017)	-0.003 (0.008)	0.022 (0.053)	0.067** (0.029)	0.027 (0.068)	-0.124*** (0.045)
N	168	168	167	167	167	167
R2	0.321	0.205	0.087	0.144	0.087	0.105
Size controls	X	X	X	X	X	X

Notes: Columns (1), (2), (7), and (8) present specifications analogous to columns (5) and (10) in Table IV, while columns (3)–(6) and (9)–(12) present specifications analogous to columns (1), (2), (5), and (6) from Table VII for alternative measures of bank branch density: number of branches/value of uninsured deposits (mean 21.5, std dev 13.9) in columns (1)–(6), and logarithm of number of branches/value of brokered deposits in columns (7)–(12) (mean 0.81, std dev 2.92).

Table AIV
Additional Controls for Banks' Risk

	(1)	(2)	(3)	(4)	(5)	(6)
	Return (SVB)	Return (First Republic)	Uninsured Dep Change	Insured Dep Change	Large Drop Uninsured Dep	Large Drop Insured Dep
Branch Density	0.694***	0.217***	0.759***	-1.196***	-1.793***	0.247
	(0.117)	(0.060)	(0.231)	(0.390)	(0.540)	(0.561)
Dep/Assets	-0.259***	-0.073**	-0.065	0.079	0.226	-0.266
	(0.061)	(0.034)	(0.119)	(0.100)	(0.226)	(0.248)
Insured Dep /Total Dep	0.088**	0.030	0.099	0.075	0.048	0.045
	(0.041)	(0.021)	(0.069)	(0.110)	(0.167)	(0.163)
MTM Losses	-0.176	-0.278***	-0.281	0.060	0.880*	-0.160
	(0.152)	(0.091)	(0.200)	(0.210)	(0.529)	(0.510)
Dep Growth 2019–2022	-0.049***	-0.002	0.008	0.040	0.014	-0.067
	(0.017)	(0.007)	(0.047)	(0.029)	(0.059)	(0.051)
CRE Loans /Assets	0.022	-0.072***	0.062	0.160	0.218	-0.031
	(0.047)	(0.027)	(0.101)	(0.111)	(0.179)	(0.204)
NPL /Assets	-0.095	0.380	-2.312	-0.377	8.023	5.207
	(2.365)	(1.089)	(2.647)	(3.032)	(8.674)	(8.247)
N	212	212	209	209	209	209
R^2	0.332	0.204	0.084	0.182	0.105	0.073
Size controls	X	X	X	X	X	X

Notes: Columns (1) and (2) present specifications analogous to columns (5) and (10) in Table IV, while columns (3)–(6) present specifications analogous to columns (1), (2), (5), and (6) from Table VII with additional control variables included: share of commercial real estate loans in bank's assets and share of provisions for bad loans in bank's assets.

Table AV
Banks by IT Investment Level

	Bank Name	Assets ($B)	Total Dep ($B)	# Branches	IT Growth
Very High IT Spending (Top 10 by the Number of Branches)					
1	Capital One Financial Corporation	443.0	399.0	297	4.54
2	Pacific Premier Bancorp, Inc.	21.7	18.1	61	4.35
3	MidWestOne Financial Group, Inc.	6.4	5.6	60	4.99
4	Northern Trust Corporation	161.0	54.6	58	4.30
5	Nicolet Bankshares, Inc.	8.1	6.3	55	4.50
6	Business First Bancshares, Inc.	5.7	4.7	50	4.87
7	ServisFirst Bancshares, Inc.	14.6	11.8	23	5.17
8	Eagle Bancorp, Inc./MD	11.0	9.2	18	4.93
9	Texas Capital Bancshares, Inc.	30.6	25.8	11	5.01
10	Bridgewater Bancshares, Inc.	4.0	3.2	8	4.41
High IT Spending (Top 10 by the Number of Branches)					
1	JPMorgan Chase & Co.	3810	2130	4819	3.42
2	Bank of America Corporation	3120	1990	3906	3.30
3	U.S. Bancorp	613	455	2251	3.46
4	Truist Financial Corporation	548	435	2118	3.17
5	Fifth Third Bancorp	208	167	1090	3.45
6	Huntington Bancshares, Inc.	179	149	1080	3.36
7	Keycorp	187	149	999	3.25
8	Citigroup, Inc.	2390	764	678	3.58
9	Comerica, Inc.	87	77	433	3.47
10	Prosperity Bancshares, Inc.	38	30	298	4.15
Low IT Spending (Top 10 by the Number of Branches)					
1	Wells Fargo & Company	1890	1460	4768	3.06
2	PNC Financial	550	447	2615	2.60
3	Regions Financial Corporation	160	140	1294	2.67
4	First Citizens Bank	109	89	586	3.14
5	First Horizon Corporation	83	72	415	2.06
6	F.N.B. Corporation/FL	43	34	341	3.09
7	First Interstate BancSystem	32	27	311	2.87
8	Synovus Financial Corp.	58	50	261	2.55
9	Valley National Bancorp	53	44	240	2.75
10	Community Bank System, Inc.	16	14	232	3.15

Notes: Banks are sorted by the log-change of IT budgets from 2010 to 2017, which is shown in the last column. Very high IT spending means top 10% of the distribution, high IT spending means banks between 50th and 90th percentile, and low IT spending means banks below 50th percentile. Within each group, banks are ranked by the number of branches and the top 10 banks are presented.

Table AVI
Online Banking Usage, Branch Density, and IT Investment

	(1)	(2)	(3)	(4)	(5)	(6)
	Online Traffic/Total Dep					
Branch Density	-3.943*	-3.111*	-3.450*			
	(2.098)	(1.874)	(1.984)			
IT Growth 2010-2017				0.284**	0.252**	0.279**
				(0.117)	(0.103)	(0.109)
Dep/Assets	-0.770	-0.492	-0.822	-1.201	-0.375	-0.221
	(1.285)	(1.283)	(1.151)	(2.016)	(1.788)	(1.819)
Insured Dep /Total Dep	2.360***	2.379***	2.402***	2.528***	2.591***	2.560***
	(0.845)	(0.836)	(0.831)	(0.855)	(0.819)	(0.832)
MTM Losses		-4.542**	-4.502**		-5.820**	-5.706**
		(1.971)	(1.938)		(2.414)	(2.397)
Dep Growth 2019-2022			-0.322*			-0.260
			(0.181)			(0.177)
N	186	186	185	133	133	133
R2	0.231	0.267	0.288	0.289	0.341	0.352
Size controls	X	X	X	X	X	X

Notes: The outcome is the ratio of online visits to bank website in December 2022 to the value of bank deposits at the end of 2022. Branch Density is the number of branches per $1 billion in total deposits. IT growth is the relative increase of banks' total IT budget in 2017 and the budget in 2010. All columns include control for logarithm of total assets and for fixed effects for five total assets quintiles, deposits/asset ratio, share of insured deposits, mark-to-market losses estimates, and 2019 to 2022 deposits growth. Robust standard errors in parentheses. * - 10% significance; ** - 5%; *** - 1%.

Table AVII
IT Investment, Deposit Pricing, and Branch Density

	(1)	(2)	(3)	(4)
	Stock Return (SVB)		Stock Return (First Republic)	
Branch Density	0.401***	0.616***	0.162**	0.183***
	(0.125)	(0.115)	(0.075)	(0.067)
IT Growth 2010-2017	-0.013**		-0.006*	
	(0.006)		(0.003)	
Deposit Rate 12M10K		-1.525		-1.495*
		(1.565)		(0.902)
Dep/Assets	-0.263***	-0.163***	-0.074**	-0.078*
	(0.063)	(0.058)	(0.029)	(0.040)
Insured Dep/Total Dep	0.150***	0.082**	0.042	0.076***
	(0.049)	(0.039)	(0.026)	(0.027)
MTM Losses	-0.143	-0.205	-0.261**	-0.352***
	(0.174)	(0.144)	(0.106)	(0.094)
Dep Growth 2019-2022	-0.050**	-0.026*	0.001	-0.010
	(0.023)	(0.014)	(0.008)	(0.008)
N	157	201	157	201
R2	0.436	0.268	0.227	0.209
Size controls	X	X	X	X

Notes: Branch density is the number of branches per $1B of deposits as of June 2022. Return around SVB collapse is relative change of average close price from March 8 to March 13; return around First Republic collapse is relative change in close price from April 28 to May 2. IT growth is the relative increase of banks' total IT budget between 2017 and 2010. Deposit Rate 12M10K is the average of APY of 12-month CD with a minimum of $10K at the BHC level during 2022. All columns include control for logarithm of total assets and for fixed effects for five total assets quintiles, deposits/asset ratio, share of insured deposits, and mark-to-market losses estimates. Robust standard errors in parentheses. * - 10% significance; ** - 5%; *** - 1%.

Internet Appendix for "Bank Branch Density and Bank Runs" by Efraim Benmelech, Jun Yang and Michal Zator.

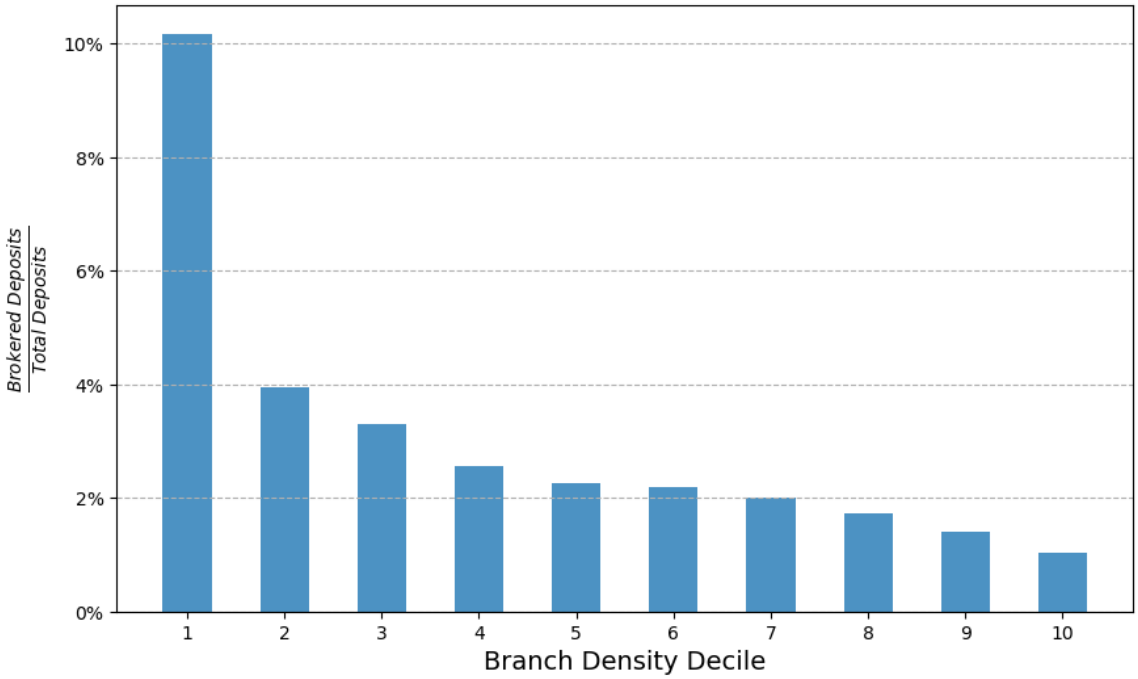


Figure IA1. Brokered deposits and branch density. This figure plots the share of brokered deposits in total deposits by branch density for all FDIC-insured banks from 2010 to 2022. Branch density is defined as the number of branches divided by total deposits (in billions). Each bar represents the mean of brokered deposits as a percentage of total deposits within each branch density decile.

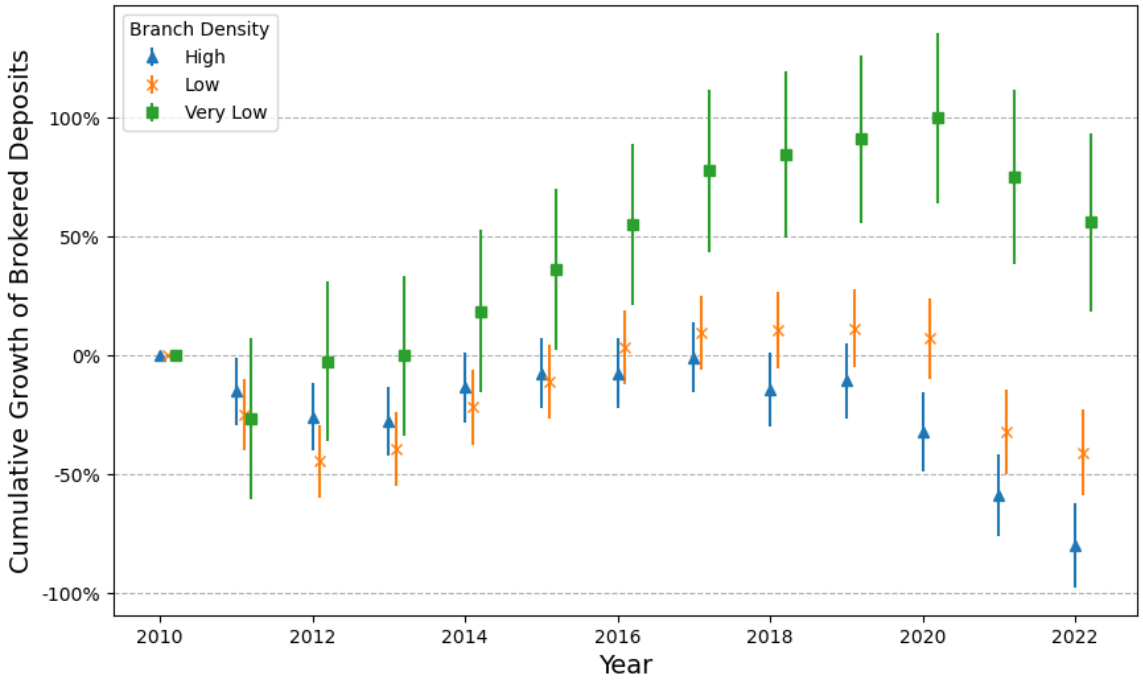


Figure IA2. Growth of brokered deposits and branch density. This figure shows the cumulative growth of brokered deposits by branch density for all FDIC-insured banks. Brokered deposits are in real term (2009 dollars) and are log transformed. Branch density is constructed at the bank-year level by dividing the number of branches by total deposits (in billions). Banks with branch density less than or equal to the 10th percentile are categorized as *Very Low Density*, while banks with branch density higher than the 50th percentile are classified as *High Density*. The remaining banks are in the *Low Density* group. For each group, we regress log(brokered deposits) on indicators for years and plot the coefficients. The bars indicate the 95% confidence interval.

Table IAI

Branch Density and Brokered Deposits

	(1)	(2)	(3)	(4)
	Brokered Dep /Total Dep	ΔBrokered Dep/Total Dep Q4/22-Q2/23		Δlog(Brokered Dep) Q4/22 – Q2/23
Branch Density	-0.591***	-0.072	-0.144**	0.031**
	(0.108)	(0.049)	(0.064)	(0.016)
Dep/Assets	-0.071	0.010	-0.048*	0.006
	(0.056)	(0.018)	(0.027)	(0.007)
Insured Dep	0.077**	-0.009	0.007	-0.003
/Total Dep	(0.031)	(0.012)	(0.018)	(0.004)
MTM	-0.189*	-0.037	-0.033	-0.016
Losses	(0.111)	(0.041)	(0.054)	(0.016)
Dep Growth	-0.010	0.006	0.008	-0.001
2019-2022	(0.013)	(0.004)	(0.006)	(0.002)
N	211	208	127	162
R2	0.268	0.060	0.161	0.122
Size controls	X	X	X	X
Sample	All	All	Y>0	All

Notes: The outcome variables are the fraction of brokered deposits of total deposits (column (1)), change of brokered deposits as a fraction of total deposits from Q4 2022 to Q2 2023 (columns (2) and (3)), change in the logarithm of the amount of brokered deposits from Q4 2022 to Q2 2023. All outcome variables are multiplied by 100 to improve coefficient readability. Changes in the share of brokered deposits and in log of brokered deposits are winsorized at the 1st and 99th percentile. Branch Density is the number of branches per $1 billion in total deposits. All columns include control for logarithm of total assets and for fixed effects for five total assets quintiles, deposits/asset ratio, share of insured deposits, mark-to-market losses estimates, and 2019 to 2022 deposits growth. Robust standard errors in parentheses. * - 10% significance; ** - 5%; *** - 1%.