Open to All Comers: How Shifts in Supply of Deposits Affect Banks

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Abstract

Deposits are an important source of capital in the economy and the main form of bank financing. However, unlike other liabilities, not all deposit flows stem from a bank actively seeking them. In this paper, we estimate these deposits, and show that banks that experience them improve profitability while increasing risk. When the Fed funds rate rises, this increased risk exposes them to bigger losses and deposit outflows. This mechanism also plays a key role in understanding the 2022–2023 U.S. bank fragility episode, as the risk exposures of banks were amplified following deposit inflows in 2020–2021.

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Deposits are an important source of capital in the economy and the main form of bank financing. Banks find it optimal to rely on deposits because they are a source of cheap funding. However, deposits introduce uncertainty regarding the bank's leverage, as they can be driven by depositor decisions—for example, changes in the liquidity of households and firms—rather than the bank actively managing them (Drechsler, Savov, and Schnabl, 2021; Jermann and Xiang, 2023; Bolton, Li, Wang, and Yang, 2025). We estimate these shifts in the supply of deposits and show their importance to the banking system.

In this paper, we empirically investigate the effect of the marginal outward supply shift in deposits from depositors on bank behavior. Our hypothesis is that these deposit inflows lead banks to seek higher profitability by increasing risk. The premise behind this hypothesis is that because outward supply shifts in deposits raise the bank's leverage uncertainty, the bank is more likely to issue additional equity. Such issuances are costly to current shareholders because of adverse selection concerns (Myers and Majluf, 1984).[1] To compensate shareholders, banks seek to generate higher returns. Exploring the universe of U.S. banks over the past two decades, we show that those that experience outward supply shifts in deposits achieve higher profitability by increasing their interest rate risk and credit risk. We provide empirical evidence that equity issuance concerns drive these changes.

We then study the resulting implications of higher risk on bank performance and deposit flows following monetary policy tightening. As rising interest rates typically lead to losses on existing security exposures and higher borrower default risk, riskier banks are expected to experience more negative outcomes. Indeed, we find that banks that experienced larger outward deposit supply shifts face more severe losses on securities and loans, as well as deposit outflows during periods of monetary tightening.

Outward supply shifts in deposits play a key role in understanding the 2022–2023 U.S. bank fragility episode. Profits increased and bank risk exposures were amplified following significant COVID-related supply-driven deposit inflows in 2020–2021. The risk amplification led to larger

[1] Equity issuance costs are key ingredients in banking models which consider leverage (e.g., He and Krishnamurthy, 2012; Brunnermeier and Sannikov, 2014; Hugonnier and Morellec, 2017; Bolton, Li, Wang, and Yang, 2025).

losses and deposit outflows following the sharp rise in the Fed funds rate in 2022–2023. Our results point to an underlying mechanism that helps explain the observed results documented in recent papers and the media coverage of the recent fragility episode. More generally, high deposit inflows can serve as an early indicator for changes in bank risk and future deposit outflows in periods of monetary tightening.

Our paper examines how banks use deposit inflows that arise independently of their own actions. We study these inflows by estimating supply and demand curves for deposits within an industrial organization (IO) framework in the style of Berry (1994).[2] In our framework, depositors' willingness to place funds in a bank defines the supply of deposits, while banks' funding models, investment opportunities, and scale determine their demand. This structure allows us to distinguish exogenous supply shifts, such as those driven by changes in savings, income, or liquidity needs, from banks' active demand for deposits.

To estimate these curves, we instrument for deposit rates using rate pass-through estimates, BLP-style instruments (Berry, Levinsohn, and Pakes, 1995), and Bartik-like instrumental variables. With this approach, we can isolate depositor-driven shocks from supply reactions to banks' own policies, such as adjustments in rates, branch networks, or advertising expenditures.

We confirm the validity of the results from our main identification strategy in several ways. First, we use an alternative IO model for bank deposit demand. Second, we employ three Bartik-style instruments that isolate supply-driven variation directly from observed deposit flows. Third, we show that our findings are not explained by other bank characteristics that may be correlated with supply shifts, such as market power, competition, investment opportunities, deposit stickiness, or marketing. Finally, we use a difference-in-differences design that exploits the unexpected surge in deposits during COVID and traces its effects on bank risk and subsequent outflows following the 2022 monetary tightening.

Analyzing the U.S. banking system from 2001–2022, we explore what banks do with outward supply shifts in deposits. Banks can utilize the new deposits to expand credit supply, hold more

[2]Similar approaches have been used in a bank deposit context by Egan, Hortaçsu, and Matvos (2017), Xiao (2019), and Egan, Lewellen, and Sunderam (2022).

long-term securities, or increase holdings of short-term assets. We find that the additional funds are used to expand credit supply and hold more long-term securities. Banks with larger outward supply shifts in deposits improve their gross income and ROA. A one standard deviation outward supply shift increases both of these income measures by magnitudes comparable to their sample means.

These banks also increase their interest rate and credit risk. Our primary measure of interest rate risk is the maturity gap (following English, Van den Heuvel, and Zakrajšek, 2018).[3] A one standard deviation outward supply shift raises the maturity gap by 29% of the mean quarterly change. This response suggests banks do not fully hedge against interest rate changes, consistent with prior research (Begenau, Piazzesi, and Schneider, 2015; Drechsler, Savov, Schnabl, and Wang, 2023; McPhail, Schnabl, and Tuckman, 2023). For credit risk, we use risk-weighted assets to total assets and find that it rises following deposit inflows. A one standard deviation outward supply shift in deposits results in a nearly nine-fold rise relative to the mean quarterly change.

We argue that these changes reflect banks' efforts to compensate shareholders for costly future equity issuances. Supporting this, we show that banks are more likely to issue equity following outward shifts in deposit supply.[4] Next, we formally examine the role of equity issuance concerns in risk-taking among banks experiencing outward shifts in the supply of deposits. First, we focus on banks with lower equity ratios, which are closer to regulatory thresholds and thus face a greater likelihood of costly equity issuance when leverage increases. These banks show larger increases in profitability and risk, compared to well-capitalized banks. Second, we exploit a 2019 regulatory change that introduced the Community Bank Leverage Ratio (CBLR) framework, replacing four capital requirements with a single tier 1 leverage ratio. This eased capital requirements for qualifying community banks, allowing us to perform a difference-in-differences analysis. With lower equity issuance concerns among the qualifying community banks, we show that they engage in less profitability seeking and risk-taking following deposit inflows.

[3]See also Flannery and James (1984) and Hutchison and Pennacchi (1996) on asset and deposit maturity and interest rate risk.

[4]For instance, in 2020, the banking system saw large supply-driven deposit inflows, particularly at Silicon Valley Bank (SVB), First Republic Bank, and Signature Bank. These banks all raised substantial equity in 2021. See `https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/us-banks-raise-1-33b-in-common-equity-in-the-first-2-months-of-2021-63133532`.

The fact that the marginal deposit inflow leads banks to expand their balance sheets makes sense if it increases their profits. However, the rise in risk is less obvious. One may find it more straightforward for banks that are concerned about their equity ratio to cut assets. In this paper, we do not claim that this effect does not exist. Our contribution is to provide evidence of an opposing effect driven by equity issuance concerns, which dominates for the marginal outward shift in deposit supply.

Having established that outward shifts in deposit supply lead to higher bank profitability and risk, we show that increased risk negatively affects bank performance in periods of monetary policy tightening. We utilize these periods to analyze the implications of the bank's risk decisions following deposit inflows, as rising interest rates typically lead to losses on banks' security exposures and hamper borrowers' ability to repay their debts. For an increase of one percentage point (pp) in the Fed funds rate, banks with one standard deviation outward shifts in deposit supply exhibit increased losses on their securities portfolio equal to 9.4% of the sample mean. For credit losses, the increase in nonperforming loans (NPLs) is equal to 98% of the sample mean. The higher risk and the negative outcomes during monetary tightening increase bank solvency concerns, making them more prone to deposit outflows. Indeed, we find a positive relationship between the outward supply shift in deposits and the scale of deposit outflows in periods of monetary tightening.

Our mechanism helps explain the 2022–2023 U.S. bank fragility episode. Equity issuance concerns are especially relevant during periods of large deposit inflows, such as the COVID period in 2020–2021. We use the first two quarters of 2020, when deposits surged unexpectedly (Levine, Lin, Tai, and Xie, 2021), and examine their impact on bank risk and subsequent outflows following the 2022 monetary tightening. These inflows mainly resulted from heightened risk aversion and government stimulus rather than bank actions or depositor responses to bank-specific characteristics. To further rule out endogenous inflows, we match banks on observables and conduct a difference-in-differences analysis. This approach provides an additional identification strategy for the effect of the outward shift in the supply of deposits and allows us to examine how COVID-era inflows contributed to the 2022–2023 banking fragility.

Similar to our full sample results, we find that the treated banks increased their profitability, interest rate risk, and credit risk. Following the heightened deposit inflows in 2020Q1–Q2, the treated banks raise their gross income, maturity gap, and risk-weighted assets during 2020Q3–2021Q4 by 5.3%, 17.3%, and 44.1% of the sample standard deviation, respectively. Subsequently, treated banks experienced 2.5 pp higher deposit outflows in 2022.

Our results have important implications for depositors, bankers, stakeholders, and policymakers. Shifts in deposit supply affect banks of all sizes and across most years. Large outward shifts in deposit supply can serve as an early indicator for changes in bank profitability and risk, its deposit franchise, and future deposit outflows.

Our paper complements several strands of literature on banks' demand for deposits. Prior research explores why banks rely on deposits, citing their liquidity premium or mispriced deposit insurance (Gorton and Pennacchi, 1990; Allen, Carletti, and Marquez, 2015; DeAngelo and Stulz, 2015). Deposit rate setting reflects banks' market power and its effects on local economies and consumer welfare (Begenau and Stafford, 2023; d'Avernas, Eisfeldt, Huang, Stanton, and Wallace, 2023; Granja and Paxião, 2023; Dlugosz, Gam, Gopalan, and Skrastins, 2024; Kundu, Muir, and Zhang, 2024). Banks use deposits to expand risky assets (e.g., Kashyap, Rajan, and Stein, 2002; Gu, Mattesini, Monnet, and Wright, 2013), maintain stable net interest margins (Drechsler, Savov, and Schnabl, 2021), and create market value through deposit collection and lending efficiency (Egan, Lewellen, and Sunderam, 2022). Deposits also boost loan origination and lending resilience during crises (e.g., Berger and Bouwman, 2009; Ivashina and Scharfstein, 2010; Gilje, Loutskina, and Strahan, 2016). We show the importance of supply shifts in deposits and their effect on bank profitability and risk-taking, independent of banks' deposit demand and endogenous risk-taking.

Another important contribution of our paper is the novel measure of supply shifts in deposits. It allows us to show empirically the implications of these deposit inflows on bank profitability, risk, and susceptibility to losses and deposit outflows in periods of monetary tightening. These findings relate to existing theoretical literature on the dynamics of deposits and banks' inability to perfectly control deposit flows (Jermann and Xiang, 2023; Bolton, Li, Wang, and Yang, 2025) and how deposit reliance exposes the banking system to outflows and panic-based runs (Diamond and Dybvig, 1983; Kashyap, Rajan, and Stein, 2002; Goldstein and Pauzner, 2005; Blickle, Li, Lu, and Ma, 2024; Martin, Puri, and Ufier, forthcoming).

Our study complements recent studies on monetary policy and banking (e.g., Drechsler, Savov, and Schnabl, 2017; Di Tella and Kurlat, 2021; Drechsler, Savov, and Schnabl, 2021; Supera, 2021; Wang, Whited, Wu, and Xiao, 2022; Haddad, Hartman-Glaser, and Muir, 2023). Banks experiencing an outward shift in deposits face greater exposure to monetary tightening, affecting their lending capacity, monetary policy transmission, and financial stability. Prolonged high rates could also increase credit losses, echoing the Savings and Loan (S&L) crisis of the 1980s.[5]

We also contribute to recent studies that analyze U.S. banks' exposure to the 2022–2023 monetary tightening and the SVB failure with implications for financial stability (Flannery and Sorescu, 2023; Jiang, Matvos, Piskorski, and Seru, 2023), uninsured deposit outflows (Drechsler, Savov, Schnabl, and Wang, 2023), commercial lending specialization (Blickle, Parlatore, and Saunders, 2023), unrealized losses on held-to-maturity (HTM) portfolios (Dursun-de Neef, Ongena, and Schandlbauer, 2023; Granja, 2023), and bank interest rate risk (Abdymomunov, Gerlach, and Sakurai, 2023). As the supply of deposits increased during the COVID period, these deposit flows had a significant effect on the banking system following the recent monetary tightening.

I. Model of Deposits

To identify shifts in the supply of deposits driven by depositor actions, we adopt an IO framework to model the underlying supply and demand curves. We treat deposits as a differentiated product (Berry, 1994). Similar approaches have been used by Egan, Hortaçsu, and Matvos (2017), Xiao (2019), and Egan, Lewellen, and Sunderam (2022).

[5] During the S&L crisis, higher rates exposed problems among borrowers, which led to a crisis within American thrifts. See https://www.economist.com/finance-and-economics/2023/03/16/how-deep-is-the-rot-in-americas-banking-industry.

I.A. Supply of Deposits from Depositors

As our focus is on the bank's use of deposit inflows that it does not actively seek, we consider the customers' preferences to deposit money in a bank as the bank's *supply* curve of deposits from depositors.

I.A.1. Consumer's Preferences for Deposits

In this differentiated product approach, individual depositors are assumed to use the bank that provides the highest utility, estimated using revealed preferences. We model the indirect utility of depositor k from bank j in quarter t as

$$u_{jkt} = \alpha r_{jt} + \beta x_{jt-1} + \varsigma_{jt} + \varepsilon_{jkt}. \tag{1}$$

Here we assume the utility depends on the deposit rate r_{jt} and various non-price factors x_{jt-1}. These non-price factors include bank operational decisions, such as the number of branches, employees, and advertising. Controlling for these factors ensures that the shift in supply is not driven by bank actions to attract deposits, such as adding physical locations, providing monetary non-rate benefits to depositors (e.g., promotions or other benefits), or advertising. The term ς_{jt} represents other specific characteristics associated with that bank in a quarter that provide utility to depositors, but may not be captured by x_{jt-1}, such as a bank's reputation.

Each depositor selects the bank among the set of banks $j = 1, ..., J$ that maximizes her utility. We also assume that there exists an outside option, which is not to deposit funds in a bank, with utility normalized to zero ($u_0 = 0$). Under the common assumption that the shock to utility ε_{jkt} follows a Type 1 Extreme Value distribution, the probability that a depositor selects bank j follows a multinomial logit distribution. Following the IO convention, s_{jt} represents the bank's overall deposit market share at the aggregate level:

$$s_{jt} = \frac{\exp(\alpha r_{jt} + \beta x_{jt-1} + \varsigma_{jt})}{1 + \sum_{l=1}^{J} \exp(\alpha r_{lt} + \beta x_{lt-1} + \varsigma_{lt})}. \tag{2}$$

I.A.2. Estimating the Supply Curve

To estimate the supply curve, we use the following equation:

$$\ln(s_{jt}) = \alpha r_{jt} + \beta x_{jt-1} + \varsigma_t + \varsigma_j + \xi_{jt}. \tag{3}$$

This equation considers the log of the deposit market share ($\ln(s_{jt})$) of bank j in quarter t as a function of price (r_{jt}) and non-price characteristics (x_{jt-1}), bank and quarter fixed effects (ς_j, ς_t), and a residual term (ξ_{jt}).[6]

As the deposit rate is endogenous in our setting, Equation (3) can be estimated using 2SLS. Following Egan, Hortaçsu, and Matvos (2017) and Egan, Lewellen, and Sunderam (2022), we use as instruments the estimated bank-level pass-through of short-term interest rates and a set of instruments in the style of Berry, Levinsohn, and Pakes (1995). These instruments include the average and the square of competitors' total number of branches, employees per branch, and advertising. The argument is that these instruments affect the bank's chosen deposit rate, but are not otherwise related to the utility derived by depositors at that bank. The results of this estimation are provided in Column 1 of Appendix Table A.2. We find that, in addition to higher deposit rates, a larger branch network and more employees per branch are associated with higher market shares.

As our purpose is to identify changes in deposits that are driven by depositor actions and not the bank's actions, we estimate the supply of deposits the bank would have received assuming the deposit rate and other non-price characteristics are unchanged from the prior quarter:

$$\hat{Q}_{jt}(r_{jt}, x_{jt-1}) = Q_t \times \hat{s}_{jt}(r_{jt}, x_{jt-1}) \times e^{\hat{\sigma}^2/2}, \text{ assuming } \Delta r = 0, \Delta x = 0, \tag{4}$$

where Q_t is the aggregate amount of deposits in quarter t and $\hat{\sigma}^2$ is the estimated variance of the residuals from Equation (3).[7] From Equation (4), we calculate the growth in deposits driven by

[6] By including bank and quarter fixed effects, the term ς_{jt} in Equations (1) and (2) is captured by $\varsigma_t + \varsigma_j + \xi_{jt}$. As noted by Egan, Lewellen, and Sunderam (2022), including a time fixed effect also captures the term $\ln(1 + \sum_{l=1}^{J} \exp(\alpha r_{lt} + \beta x_{lt-1} + \varsigma_{lt}))$, which is constant across banks in a given quarter.

[7] The term $e^{\hat{\sigma}^2/2}$ accounts for using the estimated share rather than the log of the estimated share in the equation.

changes in consumers' supply of deposits as the supply shift:

$$\Delta \ln(Q_{jt}) = \ln(\hat{Q}_{jt}(r_{jt}, x_{jt-1}) - \ln(Q_{jt-1}). \tag{5}$$

I.B. Bank Demand for Deposits

By design, the supply shift estimated in Equation (5) is exogenous to changes in the bank demand for deposits. Nevertheless, to provide a comprehensive picture and add richness to our results, we use our methodology to estimate shifts in the bank's demand for deposits. Starting with a demand version of Equation (3) for the market share s_{jt} of bank j in quarter t:

$$\ln(s_{jt}) = \tilde{\alpha} r_{jt} + \gamma \tilde{x}_{jt-1} + \delta_t + \delta_j + \theta_{jt}, \tag{6}$$

where $\tilde{\alpha}$ captures the sensitivity of the bank's demand for deposits to changes in the deposit rate. We include the bank's fixed asset expense, number of branches, employees per branch, deposit ratio, and loan growth as bank-level variables that could influence demand ($\tilde{x}_{jt}$). The reason is that banks with higher overhead costs and a historical reliance on deposit collection will have a greater ongoing need for deposits. Recent loan growth serves as a proxy for changes in the bank's investment opportunities that would drive additional deposit demand.

As our demand equation includes time fixed effects, $\tilde{\alpha}$ captures the bank's demand sensitivity to the deposit rate or, equivalently, its sensitivity to the deposit rate spread from the Fed funds rate, the average bank rate, or some other economy-wide rate that banks may use for price setting. Similar to the supply equation, the deposit rate or deposit spread is endogenous in our setting. Therefore, we estimate the bank's demand for deposits using an instrument that affects the deposit rate but does not directly influence the bank's demand. In this case, we use the Bartik instrument constructed for each bank as the sum of its lagged market share multiplied by these aggregate deposit flows (more details about its construction presented in Section IV.C).[8] The estimates from Equation (6)

[8] We use the Bartik instrument for the current quarter and the prior quarter. We find similar results if we only use the current quarter.

are provided in Column 2 of Appendix Table A.2.

Once we have the coefficient estimates from Equation (6), we capture the total change in the bank's demand for deposits ($\Delta \ln(Q_{jt})$) assuming that the deposit rate does not change. Here we allow the other bank-specific control variables (x) to change in each quarter. This step differs from the supply shift estimation, as in that case we are interested in isolating the change in supply coming from depositors unrelated to the bank's actions (thus we assumed no change in other bank-specific non-price characteristics). However, for the demand side, we aim to capture the whole change.

I.C. Example of Supply and Demand Curves

Figure 1 provides some intuition for our measures of supply and demand shifts. As an example, we plot the estimated curves for Buffalo Prairie Bank in 2010Q2 and 2010Q3, which has close to median shifts in its supply and demand curves. Using the estimates from Equations (3) and (6), the figure plots the curve for the supply of deposits from firms and households and the bank's demand curve for deposits.[9] The observed intersections of the curves in 2010Q2 and 2010Q3 are given by points A and B, respectively.

In Figure 1, we can separately measure the shift in the supply of deposits available to the bank and its demand for them across periods. By calculating the point on the 2010Q3 supply curve assuming the bank's deposit rate remains unchanged from 2010Q2, we can quantify the shift that comes from the change in the supply of deposits. Although the supply shift is by construction exogenous to the bank's demand, we can quantify the shift in the bank's demand for deposits through a similar procedure.[10] We use these differences in log deposits across periods as our measures of shifts in deposit supply and demand.

[9] In line with Equations (4) and (5), we transform from market shares to log deposits for each bank.

[10] We keep the bank's non-price factors in Equations (3) fixed when estimating the supply shift, whereas the non-price factors vary for the demand shift. Therefore, for the purpose of the main analysis, the new supply curve does not necessarily pass through B but instead the point estimated using fixed non-price characteristics. We find similar results if we allow the non-price characteristics to vary when estimating the new supply curve.

II. Data and Variable Definitions

Our data cover the universe of U.S. banks from 2001 to 2022. We use the quarterly Report of Condition and Income (Call Reports), which contains data on the income statements, balance sheets, detailed supporting schedules, and off-balance sheet items for U.S. banks. We use the FDIC's Summary of Deposits data for information on the number and location of bank branches and deposits. The effective Fed funds rate is taken from the St. Louis Fed's Federal Reserve Economic Data (FRED). We use the rate at the end of each quarter to calculate the quarterly change.

II.A. Supply Shift Variable

Our main measure of shifts in the supply of deposits is derived from the model in Section I. The average supply shift is 4.48% with a standard deviation of 17.6% (see summary statistics in Table I). These statistics compare to an average total deposit growth of 1.27% and a standard deviation of 5.32%.

Changes in the supply of deposits could stem from aggregate changes in the economy, as well as from idiosyncratic household changes or firm-specific situations. Figure 2 plots the average supply shift each quarter for all banks in our sample (left axis) and aggregate personal and corporate savings growth (right axis). When households and firms have more savings, we expect some of this capital to be directed to banks as deposits, apart from the banks' demand for deposits. Supportive of this reasoning, the figure shows a positive correlation between shifts in deposit supply and the growth in aggregate savings. As our analysis includes time fixed effects, we explore the cross-sectional differences in the shifts in deposit supply among banks within each year-quarter.

To complement our main supply shift measure, we also generate an estimate of shifts in deposits driven by changes in bank demand. This variable's construction is described in Section I.B.

II.B. Other Variables

Bank activity variables include quarterly growth in total loans and securities, with securities divided into longer-term (over three months to maturity) and shorter-term (three months or less to maturity) due to the latter's cash-like liquidity. We also scale quarterly changes in loans and securities by lagged assets. As measures of profitability, we use changes in gross income to assets and ROA. Interest rate risk is measured by the quarterly change in the bank's maturity gap, following English, Van den Heuvel, and Zakrajšek (2018). For credit risk, we use changes in risk-weighted assets as our principal measure.

As a measure of securities performance, we use the total losses on the bank's securities portfolio scaled by the prior quarter's total assets. Total losses include both the stated realized losses and any unrealized losses on both available-for-sale and held-to-maturity securities. For loan performance, we use the quarterly change in nonperforming loans scaled by lagged assets. For deposit outflows, we use the quarterly growth rate in total deposits.

The analysis uses lagged common bank-level variables such as the natural logarithm of total assets, equity to assets, and deposits to assets. We include the net interest margin (NIM) and ROA as measures of bank profitability. We also use the bank's average annual loan growth over the past three years. To estimate deposit shifts, we use a bank's fixed asset expense, number of branches, employees per branch, and advertising expenses per branch.

The definitions of the variables are reported in Table A.1.

III. The Effect of Outward Supply Shifts in Deposits on Bank Behavior

We start the analysis by exploring what banks do with deposit inflows that stem from supply shifts. Banks can utilize new deposits to expand credit supply, hold more long-term securities, or increase holdings of short-term assets. To this end, we estimate different versions of the following baseline specification:

$$\text{Y}_{it} = \beta_1 \text{Supply Shift}_{it-1} + \beta_2 \text{Bank Controls}_{it-1} + \alpha_i + \gamma_t + \varepsilon_{it} \quad (7)$$

Here Y represents different balance sheet and risk variables of bank i in quarter t. We first analyze changes in lending and securities holdings. Then, we study the changes in the bank's earnings and risk. For earnings, we use changes in gross income to assets and changes in ROA as outcome variables. For interest rate risk, we use the change in the bank's maturity gap and for credit risk, we use changes in the bank's risk-weighted assets.

Our main measure of deposit inflows is *Supply Shift* as derived from the model in Section I.A. *Bank Controls* include the bank's size, net interest margin (NIM), loan growth, ROA, and equity ratio. We also include the deposit ratio to account for the overall bank's reliance on deposits as a fraction of assets, separate from the effect of any inflows. We include bank fixed effects to account for any time-invariant bank characteristics and year-quarter fixed effects to control for macroeconomic factors that influence all banks and depositors in a given quarter. To ease interpretation, we standardize all continuous independent variables by their sample standard deviations. Standard errors are clustered by bank, and the sample period is from 2001 to 2022.

Table II presents the results for the securities and loans portfolios. We find positive and statistically significant coefficients, meaning that banks utilize the additional funds to expand credit supply and hold more securities. The magnitudes are also meaningful. Banks with one standard deviation outward supply shift in deposits in the prior quarter expand their loan portfolios and longer-dated securities (maturity greater than 3 months) in the current quarter by 17% and 205% of the sample mean, respectively (Columns 2 and 4). We do not see any significant change in short-term securities holdings (maturity of 3 months or less).

The balance-sheet expansion is accompanied by increased profitability and risk. We find that banks that exhibit outward supply shift in deposits improve their ROA and gross income, but also increase their interest rate risk and credit risk. Table III presents the results. We estimate the bank's change in profitability using the change in its gross income to assets ratio (Column 1), as it indicates the changes in the bank's income before netting the expenses (that might be affected by the deposit inflows). As an additional measure, we use the change in the bank's ROA (Column 2). We find positive and statistically significant coefficients, meaning that banks that experience deposit inflows improve profitability. A one standard deviation larger outward supply shift in deposits is associated with a 0.006 pp increase in the bank's gross income to assets ratio, and a 0.014 pp increase in ROA.

These effects are comparable in magnitude to 38.1% of the average change in gross income and 7.2 times the average change in ROA.

Next, we show that these inflows also coincide with more risk. We measure interest rate risk using the bank's maturity gap (Column 3). A one standard deviation larger outward supply shift in deposits increases the maturity gap by 29% of the mean quarterly change. We choose to use changes in the maturity gap as our main measure of interest rate risk as it captures deviations in the maturity gap from the bank's ex-ante position, regardless of whether the bank was previously hedged against interest risk (Begenau, Piazzesi, and Schneider, 2015; Drechsler, Savov, and Schnabl, 2021; Drechsler, Savov, Schnabl, and Wang, 2023; McPhail, Schnabl, and Tuckman, 2023). This measure also allows us to capture immediate changes in interest rate risk.

Further, we find a positive effect of the supply shift in deposits on credit risk. Using the bank's risk-weighted assets to total assets as an overall measure of credit risk, we find that it increases following deposit inflows (Column 4). A one standard deviation larger supply shift in deposits is associated with a 0.159 pp increase in risk-weighted assets to total assets.[11]

The fact that the marginal deposit inflow leads banks to take more risk is not obvious. In Section V, we discuss equity issuance concerns as an explanation for the bank response.

IV. Alternative Explanations and Measures

Our IO model isolates shifts in deposit supply from the bank's own strategic decisions to attract deposits for its profit and risk objectives. These deposits from households and firms are influenced by external factors like economic cycles and individual depositor needs, making them less predictable and not fully controlled by the bank. A potential concern is that our results may still be driven by simultaneous shifts in deposit demand, rather than supply shifts. We deal with this concern in three ways. First, we verify that the results hold after adding the estimated shift in demand from our IO model to the specification in Equation (7) (Section IV.A). Second, we perform the analysis using an alternative IO model (Section IV.B). Finally, in Section IV.C, we employ three types of Bartik-style

[11] Plosser and Santos (2018) discuss the incentives for banks to bias their internally generated risk estimates. Despite this potential bias, we find a rise in risk-weighted assets, indicating that our results may underestimate the full effect.

instruments as an alternative strategy to identify changes in deposit flows that are exogenous to the bank's deposit demand.

Additionally, we confirm that other factors, unrelated to interest rates but correlated with the supply shift of deposits (Section IV.D) do not explain the findings. Specifically, we address bank-specific and non-price factors, heterogeneity in deposit collection across markets, differences in local market power, and make sure that the results are not driven by specific periods.

IV.A. Controlling for Demand

Our focus is on how banks use unanticipated deposit inflows that stem from shifts in depositor supply, rather than from the bank's own actions. To isolate these supply shifts, our IO framework accounts for the bank's strategic choices by including its deposit rates, operational metrics (such as branches and employees), and advertising expenses. The framework also captures changes in the Fed funds rate and other economy-wide interest rates through time fixed effects. Consequently, the supply shift is, by construction, driven by changes in depositor preferences that are external to the bank's actions.

One benefit of our framework is that we also estimate shifts in deposits coming from changes in the banks' demand curve for deposits. As discussed in Section I.B, we estimate the bank's demand for deposits using its historical deposit share, investment opportunities, and branch presence.

To show that our results in Table III are not driven by bank demand, we include the bank's demand shift as an additional control variable. Panel A in Table IV presents the results. When the bank actively seeks new deposits (an outward shift in its demand curve), we observe statistically significant increases in profitability and risk. These findings are consistent with the bank taking new deposits to realize new investment opportunities and expand its balance sheet. At the same time, the effects of supply shifts remain and have similar magnitudes.

IV.B. Alternative IO Model

For our main IO model, we use specific sets of instruments to separately identify supply and demand curves. Another approach is to use a set of instruments to identify the supply curve and economically-motivated restrictions to identify the demand curve (instead of relying on a set of demand instruments). This allows us to verify that our main results do not rely on a specific modeling choice.

In this approach, we model the depositors' supply of deposits in the same manner as in Section I.A. For demand, we frame the bank's demand for deposits within a classic profit maximization framework. Similar to Xiao (2019), we model the bank as choosing a deposit rate r to maximize its profits:

$$\max_{r_j}((f+l_j)-r_j-\kappa_j)d_j(r_j|f), \tag{8}$$

where f is the Fed funds rate, l_j is the bank's lending spread, r_j is the deposit rate for the bank, κ_j is its marginal operating cost, and $d_j(r_j|f)$ is the function of deposit supply from consumers and households. The first-order condition gives the following pricing equation:

$$\underbrace{f-r_j}_{\text{Deposit spread } (p_j)} = \underbrace{\kappa_j+f-l_j}_{\text{Marginal costs } (c_j)} + \underbrace{\left(-\frac{\partial \ln(d_j(p_j|f))}{\partial p_j}\right)^{-1}}_{\text{Markup } (m_j)}. \tag{9}$$

The equation decomposes the spread p_j that banks pay for deposits into a marginal cost term c_j and a markup term m_j.

Under the assumption that banks use Equation (9) to set rates, combined with the modeling assumptions for the supply of deposits presented in Section I.A, we can identify the bank's demand curve. Focusing on the implied markup term:

$$m_j = \left(-\frac{\partial \ln(d_j(p_j|f)}{\partial p_j}\right)^{-1} = \frac{1}{\alpha(1-s_j)}, \tag{10}$$

where α is the depositor's sensitivity to deposit rates from Equation (3) and s_j is the observed market share of the bank. We can then rearrange Equation (9) in a more standard demand curve format:

$$s_j = 1 - \left(-\alpha(f - r_j - c_j)\right)^{-1}. \tag{11}$$

Using Equation (11), we can generate an implied deposit share s_j for a given deposit rate r_j. We can therefore trace out a demand curve consistent with the bank's first-order condition for different deposit rates. We note that the curve is identified via the economic restrictions placed on the bank's actions and the depositor's rate sensitivity captured by α.[12]

As a final step, we generate an alternative estimate of the bank's shift in demand for deposits based on Equation (11). Similar to the main demand shift estimate, we take the difference in log deposits ($\Delta \ln(Q_{jt})$) for the demand curve in this quarter and the prior quarter, assuming that the deposit rate does not change. In Panel B in Table IV, we present the results using this alternative demand model. We find that the effect of the *Supply Shift* variable remains statistically significant at the 1% level in all specifications and similar in magnitude to the results in Panel A, which uses the instrument-identified demand shift variable from the main IO model.

IV.C. Bartik-Style Instruments

We employ three different Bartik-style instruments (Bartik, 1991). They allow us to identify changes in the bank's deposit flows that are exogenous to the bank's deposit demand. In the context of loans and deposits, similar instruments have been employed by Greenstone, Mas, and Nguyen (2020), Schiantarelli, Stacchini, and Strahan (2020), Stulz, Taboada, and van Dijk (2023), and Diamond, Jiang, and Ma (2024). We construct these instruments in the following steps. First, we split the universe of banks into quintiles by size. For the first Bartik instrument, which uses bank-level Call Report data, we calculate each bank's share of deposits within its size quintile from five years prior. We calculate growth using aggregate quarterly deposit flows within each size quintile, excluding the

[12]We exclude any observations where Equation (11) implies a negative market share.

bank's own flows from these calculations. The first Bartik instrument for each bank is the sum of its lagged market share multiplied by these aggregate deposit flows.

The identifying assumption of this instrument is that the bank deposit share from five years ago is exogenous to shocks to the bank's current risk-taking behavior (ε_{it} in Equation (7)), conditional on the other control variables and bank and year fixed effects (Goldsmith-Pinkham, Sorkin, and Swift, 2020). To avoid a finite sample bias, we exclude the bank's own deposit growth from the growth component of the instrument. The idea behind the instrument is to avoid unobserved bank policy changes that affect both the flow of supply-driven deposits and the bank's risk-taking.

The second and third Bartik instruments leverage the Summary of Deposits (SOD) data to introduce a geographical component. Here, we use the bank's share of its total deposits in a given county (second instrument) or state (third instrument) from five years prior, and multiply these shares by the current annual deposit flows. For the deposit flows, we calculate the annual deposit growth within each size quintile, excluding any flows in that specific county (second instrument) or state (third instrument). We also exclude the bank's own deposit flows from the calculation. The instrument is aggregated to the bank level using the county deposit weights (second instrument) or state deposit weights (third instrument). Given the SOD data, the instruments are calculated on an annual basis through June of each year.

Table V reports results for the main bank variables (changes in gross income to assets, ROA, maturity gap, and risk-weighted assets) using these different instruments. Each row presents the main coefficient for a given specification. Column 1 shows the first-stage estimates, indicating that banks with a larger historical deposit share receive higher supply-driven deposit inflows. For the second and third instruments, based on annual county-level and state-level data, we use the annual version of supply-driven deposit flows from the SOD data and restrict bank outcome analysis to the third quarter, following the June deposit measurements. Columns 2–4 present the second-stage results, showing significant effects of supply-driven deposits on bank outcomes. The instrumented estimates are a similar order of magnitude as the IO model-based results in Table III, suggesting that our baseline estimates may understate the impact of supply-driven deposits on bank risk-taking.

IV.D. Non-Rate Factors and Additional Measures

In this section, we discuss additional alternative explanations to support our main results and mechanism. First, a potential concern is that depositors may choose to increase deposits at certain banks more than others because of changing bank characteristics, influencing both deposit flows and bank risk-taking. We address this in our baseline specification (Equation (7)) by controlling for key bank characteristics such as size, profitability, loan growth, and equity. Additionally, we conduct a separate analysis using nearest neighbor matching to further account for this concern. Following prior studies on deposit flows (Acharya and Mora, 2015; Egan, Hortaçsu, and Matvos, 2017; Chen, Goldstein, Huang, and Vashishtha, 2022, 2024), we match banks receiving outward supply shifts with similar banks that do not, based on a comprehensive set of financial characteristics.[13] Row 1 of Table VI presents the results using this matched sample, confirming that supply-driven deposits lead to increased bank profitability and risk taking. The magnitude of these effects remains consistent with the full-sample findings in Section III.

A different concern is that heterogeneity across banks' market power drives the shifts in the supply of deposits, and even alters deposit-collection behavior (Drechsler, Savov, and Schnabl, 2017). To address this, we add to the baseline specification (Equation (7)) the bank's deposit HHI as a control variable. Row 2 of Table VI presents the results, which are consistent with the main measure in Table III.

Further, we verify that the rise in deposits is not a mechanical result of credit line withdrawals or utilizing established loan commitments (Li, Strahan, and Zhang, 2020). The demand for precautionary liquidity by households and firms might affect their usage of loans and credit lines. This usage translates into larger deposits in the bank, which raises the concern that the rise in deposits is not driven by new funds. To deal with this concern, we add to the baseline specification in Equation (7) control variables for changes in credit lines: the lagged commitments to assets ratio and the contemporaneous change in commitments. We also add comparable variables for loans, i.e.,

[13] Matching variables include lagged ROA, ROE volatility, deposit rate, deposits to assets, equity to assets, bank size, loan composition, NIM, loan growth, and two lags of quarterly changes in the Fed funds rate and CRSP value-weighted stock market return. See Appendix Table A.3 for the initial matching regression.

the lagged loans to assets ratio and the contemporaneous change in loans. Our main results remain robust in row 3 of Table VI.

In Appendix A, we discuss some additional concerns and associated robustness tests. These concerns include sticky deposits and differences in investment opportunities across banks. We also confirm that periods of low interest rates or quantitative easing, the COVID period, or the implementation of the Temporary Liquidity Guarantee Program (TLGP) do not drive the results.

V. Equity Issuance Concerns

The result that outward shifts in the supply of deposits lead to banks taking additional risk is not obvious, as a marginal deposit inflow does not necessarily require banks to take more risk. However, consistent with a class of leverage-related banking models (e.g., Brunnermeier and Sannikov, 2014; Hugonnier and Morellec, 2017; Bolton, Li, Wang, and Yang, 2025), we argue that the increase in bank risk is related to future equity issuance costs.

Generally, banks find it beneficial to finance themselves with deposits due to their unique characteristics compared to other liabilities. However, deposit levels are not under the full control of the bank, and the maturities of the deposits are not predetermined (Drechsler, Savov, and Schnabl, 2021; Bolton, Li, Wang, and Yang, 2025). This leads to uncertainty regarding its leverage and is particularly acute for outward shifts in the supply of deposits, as the bank is not actively seeking these deposits and does not expect the change in leverage. We argue that these additional deposits raise the concern that the bank would need to raise additional equity. Such issuances are costly to the bank and current shareholders because of adverse selection concerns (Myers and Majluf, 1984), and current shareholders will demand additional return to compensate for this expected cost.

V.A. Equity Issuance Activity

First, we provide evidence that equity issuance concerns are more likely to be realized following deposit inflows. Figure 3 plots the percent of equity issued as a function of the prior quarter's deposit flow. The figure shows that banks with higher deposit inflows issue more common and preferred equity (net of retirements) in the following quarter. Since the figure provides univariate evidence for all deposit flows, in Appendix Table A.6 we run regression specifications similar to Equation (7). We find that even with additional controls and bank and year-quarter fixed effects, an increase in last quarter's deposits is associated with a larger fraction of equity issued (Column 1). If we instead use our principal supply shift measure and separately control for demand shifts in deposits, we find a similar effect on the fraction of equity issued (Column 2). Both results are statistically significant at the 1% level.

As further anecdotal evidence, in 2020, the banking system experienced large deposit inflows, and banks such as Silicon Valley Bank, First Republic Bank, and Signature Bank exhibited significant deposit inflows. These banks all raised equity in 2021.[14]

V.B. Equity Issuance Concerns: Analysis by Equity Ratio

Next, we show more formally the key role of equity issuance concerns for banks that experience supply-driven deposit inflows. First, we split banks by their equity ratios. Banks that are closer to the regulatory threshold are more affected by any unexpected deposit inflows. We define the least capitalized banks as those in the bottom tercile of the lagged equity to assets distribution each quarter. We compare them to the most capitalized banks, which are in the top tercile of lagged equity to assets. In Panel A of Table VII, we reestimate our baseline specification for four measures of bank profitability and risk, splitting the sample by equity. We also include the demand shift variable as an additional control. We find that the effect of outward shifts in the supply of deposits is uniformly stronger for the low equity banks (Columns 1, 3, 5, and 7) than for the high equity banks (Columns 2, 4, 6, and 8). With the exception of changes in the maturity gap, these differences are statistically significant at the 1% level.

To further examine the impact of equity issuance concerns, we exploit a regulatory change that altered capital requirements for community banks. Since 2013, U.S. banks have been required to comply with four separate capital requirements: Common Equity Tier 1 Capital Ratio, Tier

[14]See `https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/us-banks-raise-1-33b-in-common-equity-in-the-first-2-months-of-2021-63133532`.

1 Capital Ratio, Total Capital Ratio, and Tier 1 Leverage Ratio. In 2018, Congress passed the Economic Growth, Regulatory Relief, and Consumer Protection Act, in which Section 201 instructs regulators to simplify these requirements for community banks. Accordingly, regulators introduced the Community Bank Leverage Ratio (CBLR) framework in 2019 through the final rule titled "Regulatory Capital Rule: Capital Simplification for Qualifying Community Banking Organizations." This rule replaced the four capital requirements with a single Tier 1 Leverage Ratio requirement, effective January 1, 2020.

Under the final rule, community banks were able to opt into the CBLR framework if their total consolidated assets are less than $10 billion, tier 1 leverage ratio exceeds 9 percent, average total off-balance sheet exposures are 25 percent or less of average total consolidated assets, trading assets and liabilities are 5 percent or less of average total consolidated assets, and the bank is not an advanced approaches institution.

This regulatory change relaxed regulatory capital requirements for community banks that had a high enough tier 1 leverage ratio by eliminating the need to comply with four different measures simultaneously. These banks should have fewer equity issuance concerns when experiencing deposit flows.[15] We analyze its impact using the following difference-in-differences approach:

$$
\begin{aligned}
\mathrm{Y}_{it} = {} & \delta_1 \text{Treated}_i \times \text{Post}_t \times \text{Deposit Flow}_{it-1} + \delta_2 \text{Treated}_i \times \text{Post}_t \\
& + \delta_3 \text{Treated}_i \times \text{Deposit Flow}_{it-1} + \delta_4 \text{Post}_i \times \text{Deposit Flow}_{it-1} \\
& + \delta_5 \text{Deposit Flow}_{it-1} + \delta_6 \text{Bank Controls}_{i,2019Q4} \times \text{Post}_t + \alpha_i + \gamma_t + \varepsilon_{it} \qquad (12)
\end{aligned}
$$

Here, Y denotes bank-level outcomes for bank i in quarter t: changes in gross income to assets, ROA, maturity gap, and risk-weighted assets. *Treated* equals one for community banks that potentially qualify for the regulatory change based on their total assets, off-balance sheet exposures, and trading assets and liabilities. The control group includes banks with $10–50 billion in total consolidated

[15] Given the small sample and the short time window, we are not able to clearly identify the effect of only outward shifts in the supply of deposits in this analysis. Thus, we include all deposit flows to provide further evidence of the equity issuance concerns mechanism on bank risk-taking.

assets (the next asset-size group for banks, as classified by the Fed).[16] Additionally, we perform nearest neighbor matching between treated and control banks at the end of 2019 using the same set of characteristics as in Appendix Table A.3. Using a tight four-year window around the implementation of the rule, *Post* equals one for 2020–2021 and zero for 2018–2019. The other variables are as defined in Equation (7). To avoid the "bad controls" problem (Angrist and Pischke, 2009), we fix the control variables at their 2019Q4 values and interact them with the *Post* indicator.[17]

Panel B of Table VII presents the results of this specification. We present only the coefficients of the main explanatory variable, *Treated* × *Post* × *Deposit Flow*, but include all the interactions between these variables. The triple interaction term is consistently negative and frequently statistically significant. In line with the previous results, the reduction in the equity issuance concerns among the treated banks led them to reduce riskiness following deposit flows.

VI. Bank Performance and Deposit Outflows in Periods of Monetary Tightening

In this section, we show the consequences of the increased risk-taking during monetary policy tightening. We utilize monetary tightening periods to analyze the implications of the bank's actions after outward shifts in the supply of deposits, as rising interest rates typically lead to losses on existing security exposures and higher default risk for existing borrowers. To this end, we perform a similar specification as in Equation (7), but interact our main explanatory variable *Supply Shift* with the quarterly change in the Fed funds rate, as follows:

$$\begin{aligned} \text{Y}_{it} = {} & \beta_1 \text{Supply Shift}_{it-1} + \beta_2 \text{Supply Shift}_{it-1} \times \Delta \text{ FF Rate}_{t-1} \\ & + \beta_3 \text{Bank Controls} + \beta_4 \text{Bank Controls} \times \Delta \text{ FF Rate}_{t-1} + \alpha_i + \gamma_t + \varepsilon_{it} \end{aligned} \tag{13}$$

[16] We choose to exclude the community banks that did not qualify for the regulatory change, as banks could adjust their asset and liability composition in response to the regulation. In unreported tests, including these banks in the control group yields similar results.

[17] We find similar results if we allow these controls to enter with a lag rather than fixing them and interacting them with the *Post* indicator.

Here Y represents different performance measures of bank i in quarter t. We focus on total securities losses (realized and unrealized) out of lagged assets, and on the change in nonperforming loans scaled by lagged assets (as the main proxy for credit losses). Bank controls are the same as in Equation (7), with a few additions. We include the demand shift variable from Section I.B. For the analysis of securities losses and nonperforming loans, we include the lagged ratios of securities to assets and loans to assets. These inclusions allow us to determine whether outward shifts in the supply of deposits affect performance outcomes, separate from the amount of securities and loans the bank holds. All bank controls are interacted with the change in the Fed funds rate. This additional layer of robustness makes sure that the monetary tightening effect is operating through the recent outward shift in the supply of deposits, and not some other bank characteristic.[18]

Table VIII presents the results. In Columns 1 and 2, we find that the interaction terms are positive and statistically significant, meaning that banks exhibit bigger losses in periods of monetary tightening following an outward shift in the supply of deposits in the prior quarter. For a one pp increase in the Fed funds rate, banks with a one standard deviation outward shift in the supply of deposits exhibit 9.4% and 98% higher securities and credit losses compared to their sample means, respectively.

The higher risk and the negative outcomes during monetary tightening lead to heightened concerns regarding the solvency of the banks, making them more prone to deposit outflows. Performing a similar specification as in Equation (13) with a different outcome variable—change in deposit growth—we find that banks experience larger deposit outflows when the Fed funds rate changes after an outward shift in the supply of deposits.[19] A bank with one standard deviation outward shift in the supply of deposits exhibits 0.095 pp more negative deposit growth, following a one pp increase in the Fed funds rate (Column 3 in Table VIII).

In sum, we establish that outward shifts in the supply of deposits raise equity issuance concerns, which lead to higher risk. In times of monetary tightening, the outcomes of these banks are more

[18]The securities losses and NPL measures are scaled by 100.

[19]We also include the lagged deposit rate as an additional control variable. We do not include the additional securities and loan control variables, although we obtain similar results if we include them.

negative, and they experience deposit outflows.

VII. The Effect of COVID Deposit Inflows on the 2022–2023 U.S. Bank Fragility

In this section, we show how the mechanism presented in the previous sections helps explain the 2022–2023 U.S. bank fragility episode. We argue that the seeds for the 2022–2023 bank fragility were planted during the COVID period in 2020–2021. Significant and unexpected deposit inflows occurred in 2020–2021, following a rise in risk-aversion of firms and households with the onset of the COVID pandemic, and subsequent government stimulus policies (Levine, Lin, Tai, and Xie, 2021). Equity issuance concerns were heightened by these large inflows.[20] Our claim is that these inflows led banks to increase profitability and take on additional risk in 2020–2021, which exposed them to the subsequent bank fragility observed following monetary tightening in 2022–2023.

The unexpected deposit inflows of 2020–2021 provide an opportunity to test our mechanism, as they were unlikely to result from bank decisions. However, unobserved factors may influence inflow heterogeneity. To address this, we take the following steps. First, we focus on deposit inflows during 2020Q1-Q2, when they were least anticipated. Second, we restrict the sample to banks receiving positive inflows during 2020Q1-Q2, excluding those with idiosyncratic outflow patterns. We define treated banks as those in the top tercile of deposit inflows and control banks as those in the bottom tercile—both experience inflows but differ in magnitude. Third, we perform nearest neighbor matching at the end of 2019 using the same bank characteristics as in Appendix Table A.3. These steps ensure treated and control banks are as similar as possible, except for the amount of deposit inflows they received in early 2020.

Both Silicon Valley Bank and Signature Bank, two of the bank failures in 2023, are classified in the treatment group. It also includes other banks that experienced significant deposit outflows later in 2023, such as PacWest, Western Alliance, and Charles Schwab. The treated banks have a larger presence in California and other areas with a relatively dominant high-tech industry that exhibited

[20]The leverage issue was sufficiently acute that the Federal Reserve temporarily relaxed the Supplementary Leverage Ratio rule in April 2020, which applies to banks over $250 billion in assets. See `https://www.federalreserve.gov/newsevents/pressreleases/bcreg20200401a.htm`. The relaxation ended on March 31, 2021.

stronger economic performance during the COVID period. Banks classified in the control group include New York Community, Barclays, and BankUnited.

Using this sample, we perform the following difference-in-differences analysis to capture the risk effects following the deposit inflows:

$$\text{Y}_{it} = \delta_1 \text{Treat}_i \times \text{Post}_t + \delta_2 \text{Bank Controls}_{i,2019Q4} \times \text{Post}_t + \alpha_i + \gamma_t + \varepsilon_{it} \quad (14)$$

Here, Y represents bank i's outcomes in quarter t, namely changes in gross income to assets, ROA, maturity gap, and risk-weighted assets. *Post* is an indicator for 2020Q3—2021Q4, the period before the Fed's interest rate hikes. *Bank Controls* include the same variables as in previous sections: size, equity to assets, NIM, profitability, loan growth, and deposits ratio. To avoid the "bad controls" problem (Angrist and Pischke, 2009), we fix controls at 2019Q4, just before the shock, and interact them with *Post* to capture their independent effects. These interactions control for a host of alternative channels that are correlated with but are not the exact mechanism in which we are interested. We also include bank and year-quarter fixed effects. The time window is 2019Q1–2021Q4.

Figure 4 presents the average deposit flow for the treatment and control banks. The deposit inflow shock occurs in 2020Q1–2020Q2. The figure shows that prior to 2020, the treated and the control groups had similar trends in deposit inflows. This strongly suggests that the treated and control banks did not have systematic differences which lead to different levels of deposit inflows before the shock. In 2020Q1–2020Q2, the deposit inflows to the treated banks rise significantly relative to the control group. While the differences in the subsequent quarters become much smaller, there is no evidence that the inflows reverse. Overall, the treated banks experience a large shock of deposit flows in the first half of 2020 that are not undone in the rest of 2020 and 2021.

Table IX presents the results for the change in gross income to assets (Column 1), ROA (Column 2), interest rate risk (Column 3), and credit risk (Column 4). Consistent with the earlier results, we find that the treated banks increase their profitability and risk significantly more than the control group. Relative to the control group, the magnitudes are meaningful. The treated banks increased gross income, maturity gap, and risk-weighted assets by 0.01 pp, 0.68 months, and 1.30 pp, respectively. All of these effects are much larger than the sample means and significant fractions of the sample standard deviations (5.3%, 17.3%, and 44.1%, respectively). We do not find significant effects for changes in ROA.[21]

Finally, we investigate if the same banks that increased risk in 2020–2021 experience deposit outflows when monetary policy tightens in 2022–2023. Figure 5 shows that banks with large deposit inflows during the COVID period are more likely to experience deposit outflows in 2022–2023, when the Fed funds rate increased from near zero to almost five percent. In Column 5 of Table IX, we consider the effect of the 2022 rate hikes on the outflows of total deposits. Here, the difference-in-differences setup is very similar to Equation (14) with a few adjustments. First, the sample window runs from 2019–2022 to include the rate increase. Second, the *Post* indicator equals one in 2022Q1–Q4, when the Fed's interest rate hikes begin. Otherwise, the treatment and control definitions, bank control variables, and sample matching are the same. We end the sample in 2022 to be conservative, as the failure of Silicon Valley Bank in 2023Q1 and the subsequent interventions by the FDIC and Federal Reserve may have altered depositor behavior.

In Column 5, we find that the treated banks have, on average, around 2.5 pp additional deposit outflows in 2022Q1–Q4 compared to the control banks, equivalent to 47% of the sample standard deviation.

VIII. Conclusion

This paper examines the impact of outward shifts in the supply of deposits—deposits that arise not from a bank actively seeking them, but from depositors increasing their balances for reasons unrelated to the bank. We show that these inflows prompt banks to compensate shareholders for more frequent, costly equity issuance by boosting profitability and taking on greater risk. As a result, during monetary tightening, banks with outward shifts in supply of deposits experience higher losses and greater deposit outflows.

[21] Appendix Table A.4 repeats this analysis but includes additional matching on geographic footprint, as discussed in Appendix A. Results are similar.

This mechanism also helps explain the 2022–2023 U.S. bank fragility episode, where banks' risk exposure was amplified by deposit inflows in 2020–2021, leading to larger losses and withdrawals following Fed rate hikes in 2022–2023. Our results point to an underlying mechanism that helps explain the observed results documented in papers and the media coverage of the recent fragility episode.

High deposit inflows can serve as an early indicator for understanding changes in bank risk and future deposit outflows—and even runs to the bank—assisting depositors, bankers, stakeholders, and policymakers.

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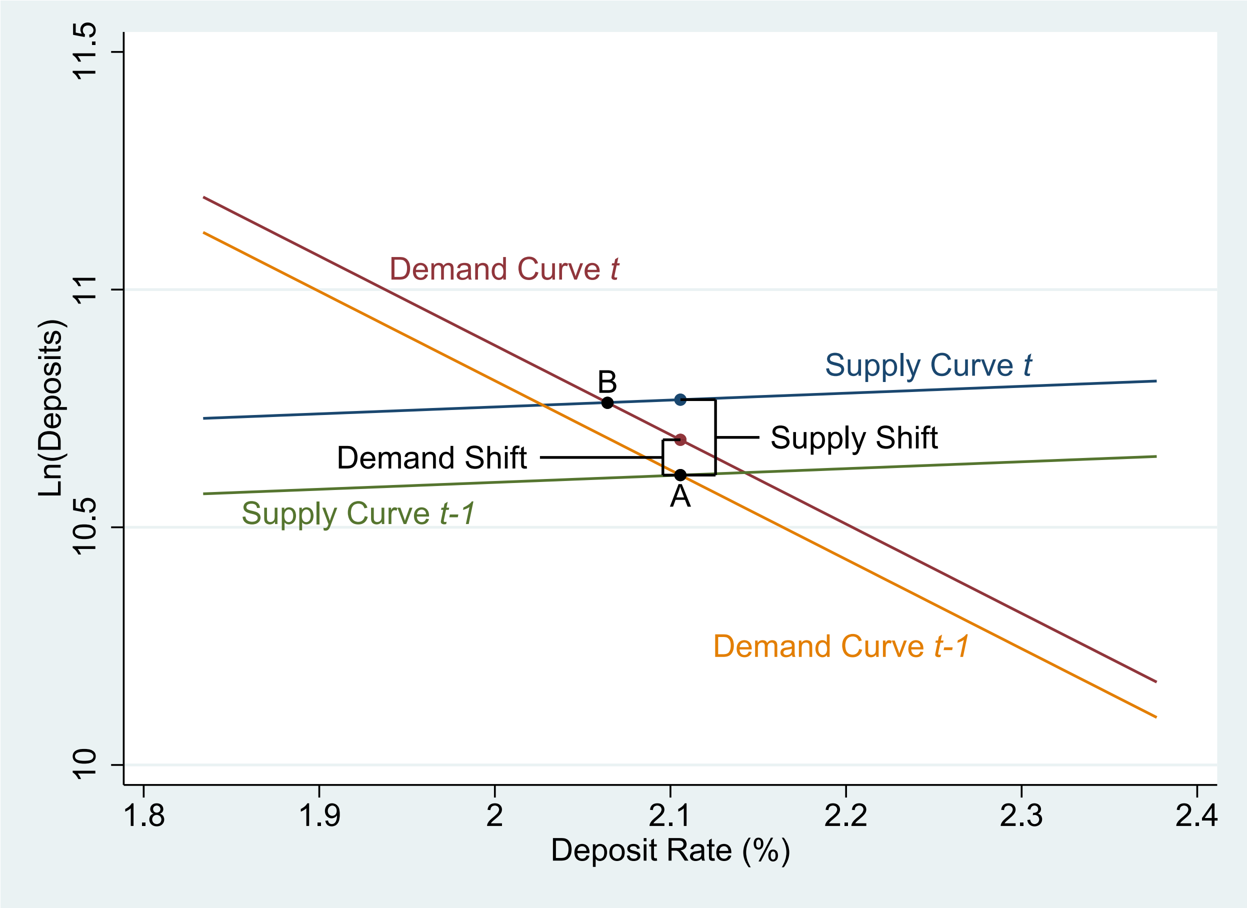

Figure 1: The figure plots the estimated supply curve from depositors and the bank's demand curve for deposits for Buffalo Prairie State Bank in 2010Q2 ($t-1$) and 2010Q3 (t). Point A is the observed log deposit amount and deposit rate (net of fees) in 2010Q2 ($t-1$). Point B is the observed log deposit amount and deposit rate (net of fees) in 2010Q3 (t). *Supply Shift* is the difference in log deposits for the $t-1$ and t supply curves, assuming the deposit rate and other bank characteristics remain fixed at their $t-1$ values. *Demand Shift* is the difference in log deposits for the $t-1$ and t demand curves, assuming the deposit rate remains fixed at its $t-1$ values.

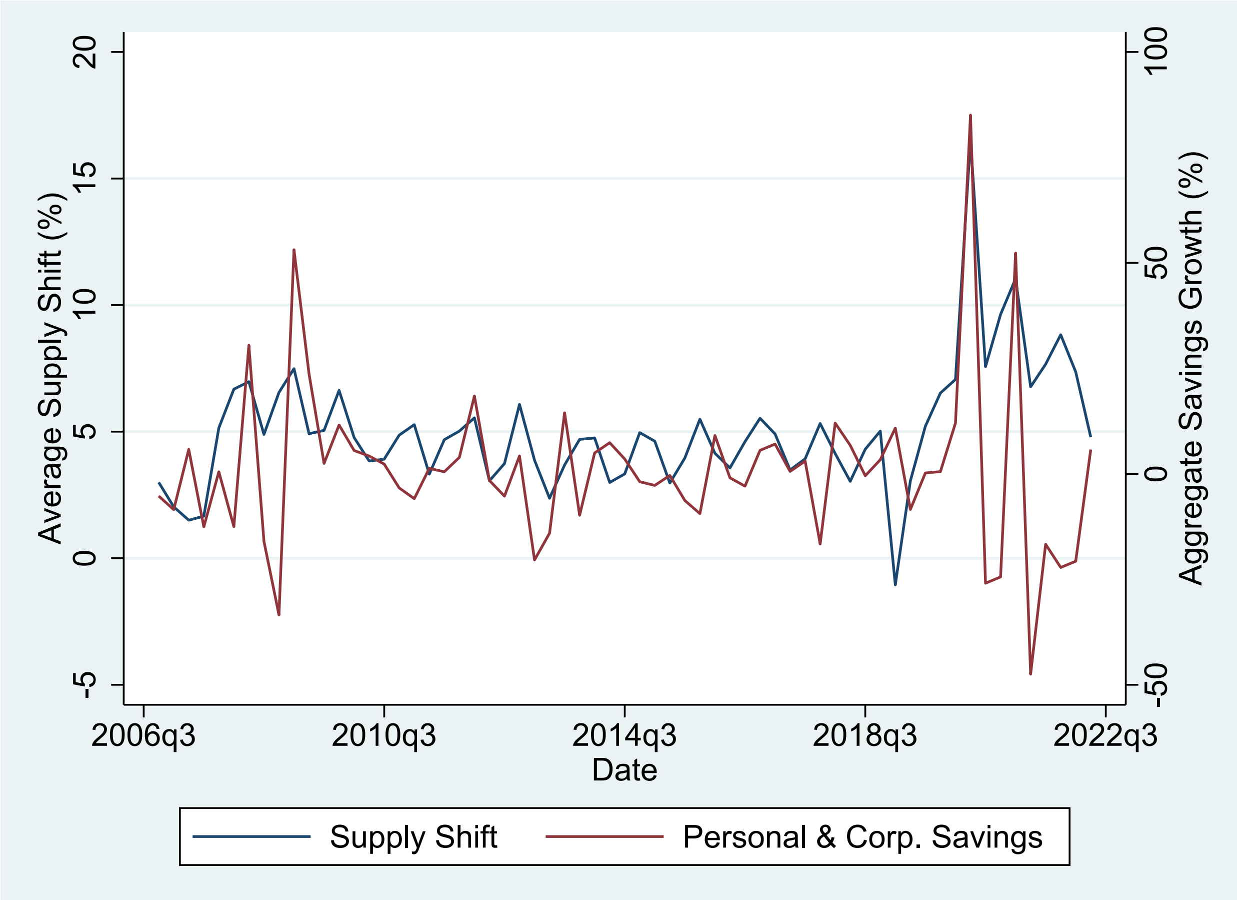

Figure 2: The figure plots the aggregate supply-driven deposit flow for all banks (left axis) and aggregate personal and corporate savings growth (right axis). Both growth rates are smoothed over the prior four quarters.

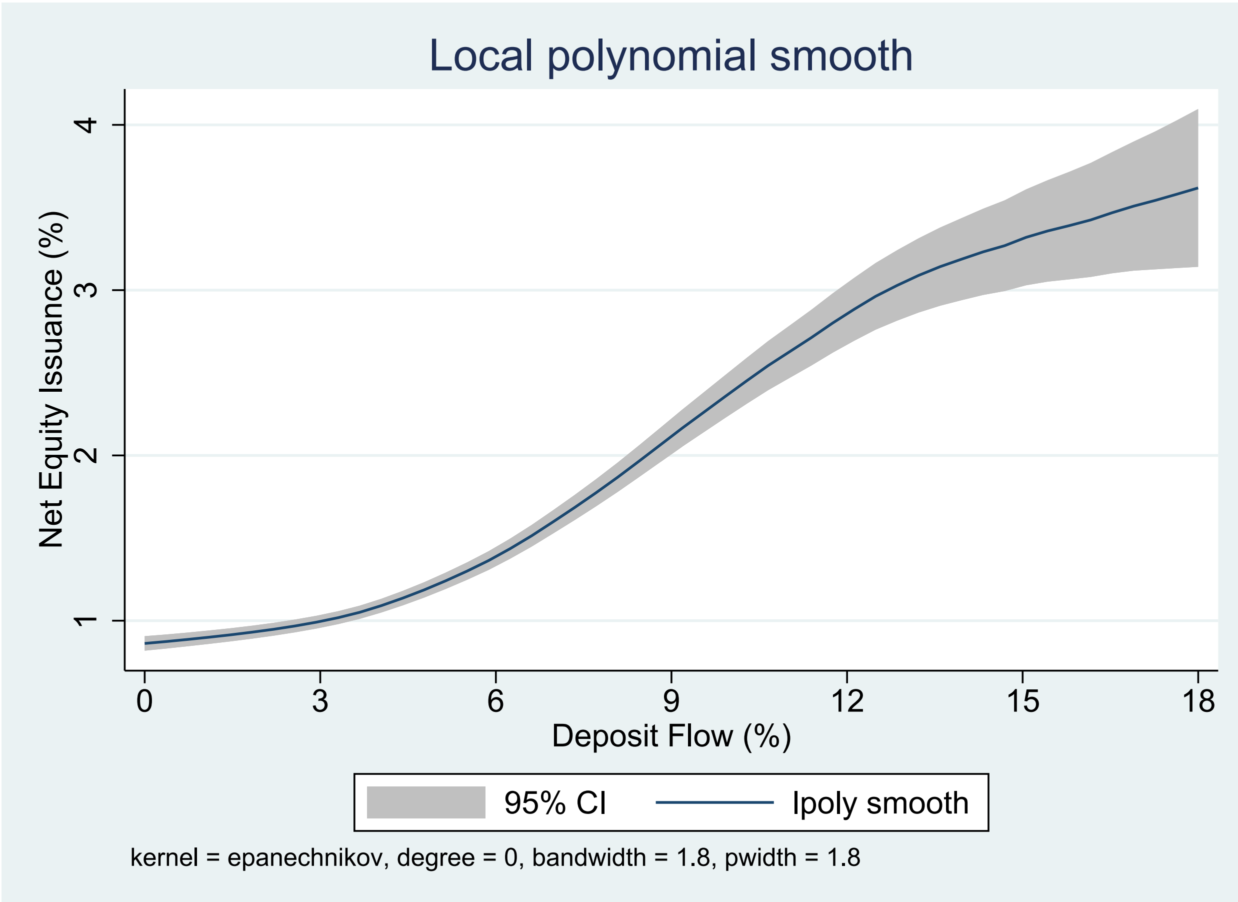

Figure 3: The figure plots the percent of equity issued as a function of the prior quarter's deposit flow.

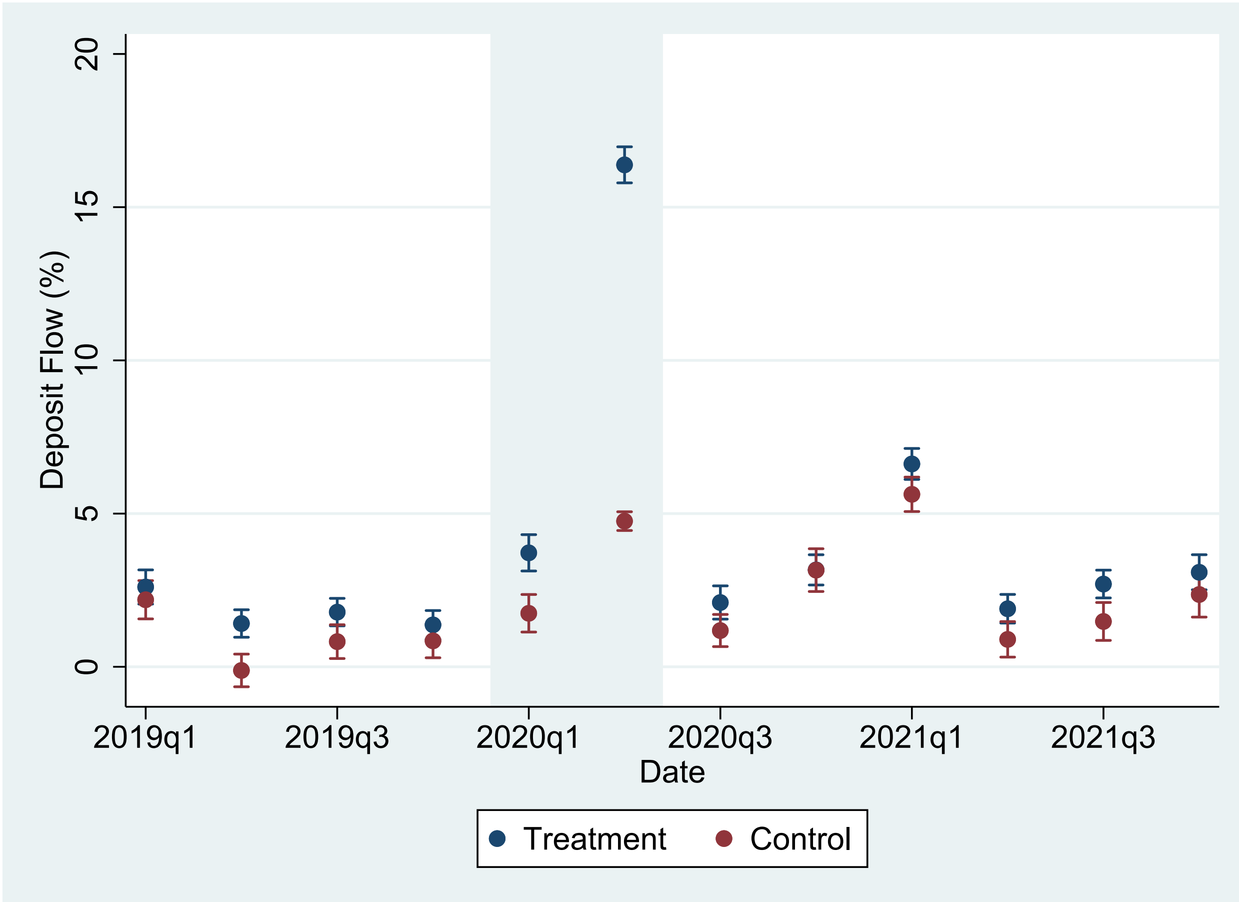

Figure 4: The figure plots the average deposit flow for treatment and control banks for each quarter from 2019Q1 to 2021Q4. The deposit inflow shock occurs in 2020Q1 and 2020Q2 (shaded region). The treatment group consists of banks with deposit inflows in the top tercile (among those banks with positive inflows) in 2020Q1 and 2020Q2, while the control banks are in the bottom tercile (among those banks with positive inflows). Treatment and control banks are matched on bank characteristics as of 2019Q4.

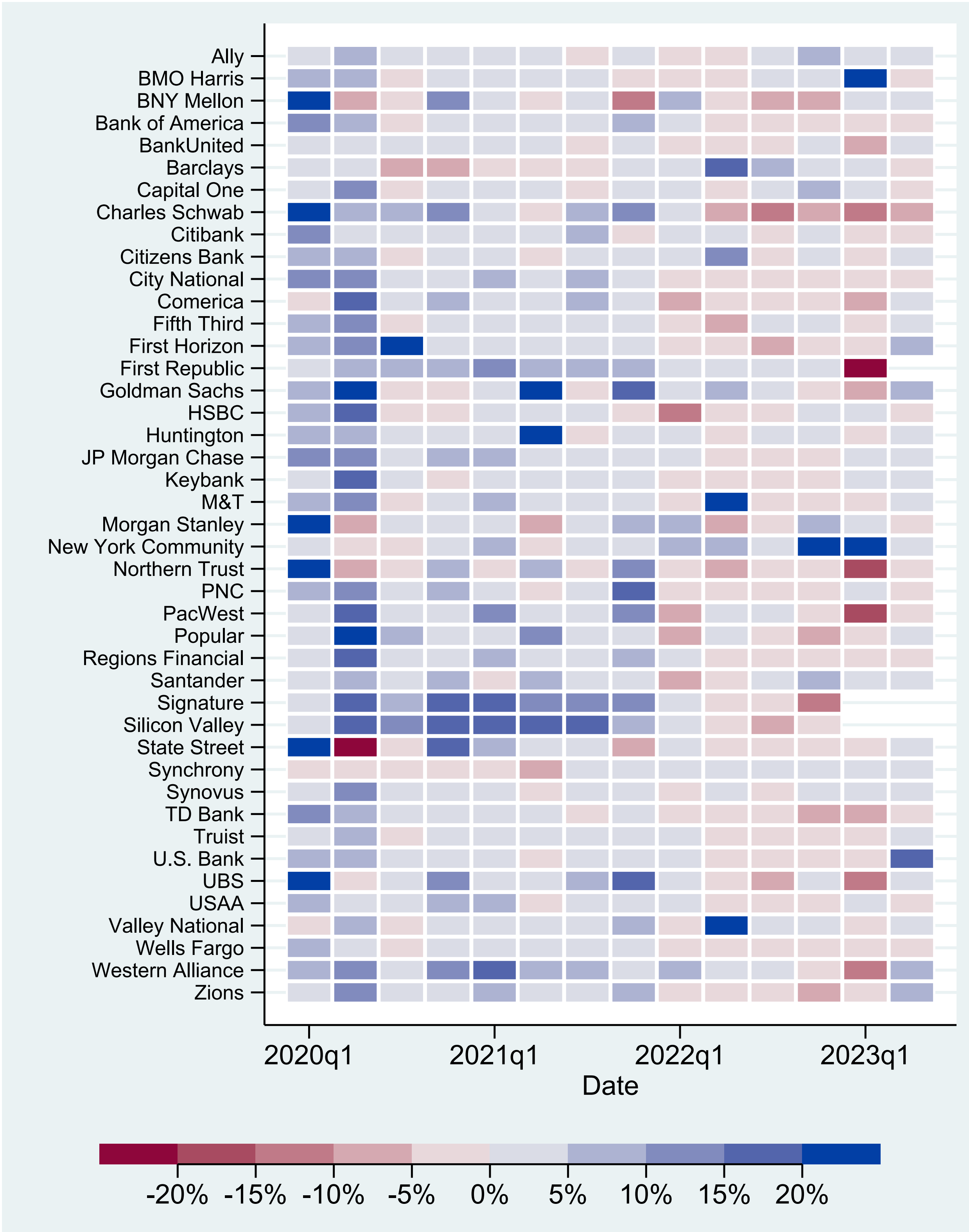

Figure 5: Quarterly deposit flows for largest banks, 2020Q1–2023Q2. Percent change in domestic deposits from Call Report data.

Table I: Summary Statistics

This table presents the summary statistics for our main variables. Our sample of U.S. banks is from 2001–2022. Variable definitions are provided in Appendix Table A.1.

	Mean	Std Dev	25th Pctile	Median	75th Pctile	# Obs.
Bank Asset and Risk Measures						
LT Securities Growth (%)	0.79	15.7	-5.09	-0.36	5.60	284,420
Δ LT Securities to Lag Assets (×100)	0.22	2.45	-0.84	-0.029	1.06	284,420
ST Securities Growth (%)	-0.14	105.5	-40.7	-0.42	40.7	162,855
Δ ST Securities to Lag Assets (×100)	0.0043	0.99	-0.17	0	0.16	284,420
Loan Growth (%)	1.14	5.08	-1.38	0.84	3.20	284,420
Δ Loans to Lag Assets (×100)	0.79	3.18	-0.81	0.51	2.01	284,420
Δ Gross Income to Assets (×100)	-0.015	0.15	-0.069	-0.0088	0.043	284,420
ROA (×100)	0.0020	0.0029	0.0012	0.0022	0.0032	284,420
Δ ROA (×100)	-0.0020	0.23	-0.056	0.0013	0.055	284,420
Maturity Gap (months)	55.6	30.1	33.8	50.2	72.1	284,420
Δ Maturity Gap (months)	0.52	3.93	-1.38	0.26	2.15	284,420
Risk-Weighted Assets (×100)	67.4	13.6	58.9	68.5	77.1	281,081
Δ Risk-Weighted Assets (×100)	-0.018	2.95	-1.46	0.055	1.50	280,667
Securities Losses to Lag Assets	-0.14	0.60	-0.36	-0.079	0.064	284,420
Δ NPL to Lag Assets (×100)	0.014	0.48	-0.099	0	0.091	284,420
Net Equity Issuance (%)	1.41	5.80	0	0	0.32	54,211
Bank Deposit Measures						
Total Deposit Growth (%)	1.27	5.32	-1.55	0.79	3.41	284,420
Supply Shift (%)	4.48	17.6	-3.90	4.31	12.6	284,420
Demand Shift (%)	18.0	71.3	-20.6	19.4	57.1	284,420
Alt. Supply Shift (%)	4.13	18.4	-5.01	3.97	13.1	123,282
Alt. Demand Shift (%)	6.70	1.82	5.66	6.87	7.95	123,282

Table I: Summary Statistics—*Continued*

	Mean	Std Dev	25th Pctile	Median	75th Pctile	# Obs.
Other Bank Controls						
Log Assets	12.2	1.43	11.3	12.1	12.9	284,420
NIM	0.034	0.0071	0.030	0.034	0.038	284,420
3-Year Loan Growth	0.50	0.88	0.0036	0.42	0.86	284,420
Equity to Assets	0.11	0.041	0.089	0.10	0.12	284,420
Deposits to Assets	0.83	0.074	0.81	0.85	0.88	284,420
Securities to Assets	0.22	0.15	0.11	0.20	0.31	284,420
Loans to Assets	0.63	0.16	0.53	0.65	0.75	284,420
Commitments to Assets	0.041	0.044	0.0085	0.029	0.059	284,420
Δ Commitments to Lag Assets	0.00066	0.011	-0.0028	0	0.0031	284,420
Total Deposit Rate	-0.00012	0.00045	-0.00024	-0.000062	0.000018	284,420
ROE Volatility	0.017	0.026	0.0047	0.0081	0.016	284,403
Real Estate Loans to Assets	0.43	0.19	0.31	0.45	0.57	284,420
C&I Loans to Assets	0.029	0.056	0	0	0.040	284,420
Wholesale Funding	0.20	0.10	0.12	0.18	0.26	284,420
Macroeconomic Variables						
Δ FF Rate (%)	-0.032	0.48	-0.032	0.0017	0.057	88
VW CRSP Return (%)	0.66	2.98	-0.36	1.23	2.41	88

Table II: Supply-Driven Deposit Flows and Bank Activities

The table presents the effect of deposit flows on various bank characteristics. *Supply Shift* is the quarterly growth in total domestic deposits that is driven by the change in depositors' supply curve. *Loan Growth* and *Securities Growth* are the quarterly growth in total loans and securities (LT>3 months, ST<=3 months), respectively (as a percent). Δ *Loans to Lag Assets* and Δ *Securities to Lag Assets* are the quarterly change in total loans and securities, respectively, scaled by lagged assets (×100). All continuous control variables are scaled by their sample standard deviations. Standard errors are clustered by bank.

	Loan Growth	Δ Loans to Lag Assets	LT Securities Growth	Δ LT Securities to Lag Assets	ST Securities Growth	Δ ST Securit. to Lag Assets
	(1)	(2)	(3)	(4)	(5)	(6)
Supply Shift	0.101**	0.134***	2.077***	0.402***	-0.402	0.00607
	(0.0479)	(0.0277)	(0.115)	(0.0192)	(0.583)	(0.00520)
Log Assets	-2.359***	-1.238***	12.14***	2.306***	-7.719*	-0.00662
	(0.383)	(0.227)	(0.900)	(0.148)	(4.209)	(0.0362)
NIM	-0.746***	-0.371***	0.166**	0.0503***	1.185***	0.00612**
	(0.0360)	(0.0219)	(0.0816)	(0.0119)	(0.406)	(0.00279)
3-Year Loan Growth	0.591***	0.440***	-0.249***	-0.0681***	-0.627**	0.00244
	(0.0252)	(0.0172)	(0.0578)	(0.00883)	(0.267)	(0.00188)
ROA	0.348***	0.250***	0.0861	0.0339***	0.507	0.00139
	(0.0215)	(0.0133)	(0.0569)	(0.00760)	(0.394)	(0.00261)
Equity to Assets	1.103***	0.666***	0.820***	0.168***	-0.0901	0.00685
	(0.0874)	(0.0548)	(0.140)	(0.0203)	(0.590)	(0.00495)
Deposits to Assets	0.352***	0.240***	2.343***	0.435***	-0.0583	0.00645
	(0.0495)	(0.0319)	(0.116)	(0.0190)	(0.601)	(0.00419)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	286,634	286,638	280,632	286,638	160,787	286,638
R^2	0.170	0.192	0.053	0.063	0.022	0.011

Standard errors in parentheses. * p<.10, ** p<.05, *** p<.01

Table III: Supply-Driven Deposits and Bank Risk

The table presents the effect of supply shifts in deposits on measures of bank income and risk. *Supply Shift* is the quarterly growth in total domestic deposits that is driven by the change in depositors' supply curve. Δ *Gross Income to Assets* is the change in the bank's quarterly gross income divided by assets, scaled by 100. Δ *ROA* is the change in the bank's quarterly net income divided by assets, scaled as a percent. Δ *Maturity Gap* is the bank's quarterly change in the average difference between asset maturity and liability maturity in months following English, Van den Heuvel, and Zakrajšek (2018). Δ *Risk-Weighted Assets* is the quarterly change in the ratio of risk-weighted assets to total assets, scaled by 100. All continuous control variables are scaled by their sample standard deviations. Variable definitions are provided in Appendix Table A.1.

	Δ Gross Income to Assets (1)	Δ ROA (2)	Δ Maturity Gap (3)	Δ Risk-Weighted Assets (4)
Supply Shift	0.00572***	0.0144***	0.150***	0.159***
	(0.00125)	(0.00147)	(0.0220)	(0.0253)
Log Assets	0.0539***	0.0851***	0.947***	2.053***
	(0.00956)	(0.0122)	(0.162)	(0.204)
NIM	-0.0194***	0.0433***	0.0255	-0.611***
	(0.000809)	(0.00152)	(0.0193)	(0.0186)
3-Year Loan Growth	0.00175***	0.0137***	-0.112***	-0.108***
	(0.000558)	(0.00122)	(0.0157)	(0.0129)
ROA	-0.0427***	-0.175***	-0.0484***	0.115***
	(0.000917)	(0.00136)	(0.0127)	(0.0114)
Equity to Assets	-0.00367***	-0.00111	0.161***	0.0451
	(0.00123)	(0.00258)	(0.0359)	(0.0418)
Deposits to Assets	0.00118	0.00766***	0.295***	0.224***
	(0.00106)	(0.00164)	(0.0248)	(0.0298)
Bank Fixed Effects	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes
Observations	280,623	280,623	280,623	280,623
R^2	0.113	0.388	0.063	0.072

Standard errors in parentheses. * p<.10, ** p<.05, *** p<.01

Table IV: Supply Shifts, Model Robustness

The table presents robustness exercises from the results in Table III. Panel A includes *Demand Shift* as an additional control. Panel B uses an alternative model to estimate *Supply Shift* and *Demand Shift*. *Supply Shift* is the quarterly growth in total domestic deposits that is driven by the change in depositors' supply curve. *Demand Shift* is the quarterly growth in total domestic deposits that is driven by the change in the bank's demand curve for deposits. *Additional Controls* include the same control variables as in Tables II and III. All continuous control variables are scaled by their sample standard deviations. Variable definitions are provided in Appendix Table A.1. Standard errors are clustered by bank.

	Panel A: Incorporating Demand Shifts			
	Δ Gross Income to Assets (1)	Δ ROA (2)	Δ Maturity Gap (3)	Δ Risk-Weighted Assets (4)
Supply Shift	0.0118***	0.0205***	0.187***	0.263***
	(0.00150)	(0.00163)	(0.0235)	(0.0310)
Demand Shift	0.0128***	0.0127***	0.0774***	0.218***
	(0.000483)	(0.000792)	(0.0111)	(0.0106)
Additional Controls	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes
Observations	280,623	280,623	280,623	280,623
R^2	0.117	0.390	0.063	0.074

	Panel B: Alternative IO Model			
	Δ Gross Income to Assets (1)	Δ ROA (2)	Δ Maturity Gap (3)	Δ Risk-Weighted Assets (4)
Supply Shift	0.0173***	0.0141***	0.141***	0.325***
	(0.00220)	(0.00199)	(0.0380)	(0.0472)
Demand Shift	0.0102***	0.00361***	0.00964	0.226***
	(0.000887)	(0.00114)	(0.0232)	(0.0204)
Additional Controls	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes
Observations	121,433	121,433	121,433	121,433
R^2	0.150	0.438	0.106	0.104

Standard errors in parentheses. * p<.10, ** p<.05, *** p<.01

Table V: Deposit Flows and Bank Risk, Bartik Instruments

The table presents the effect of instrumented deposit flows on bank income and risk. Each row presents a different specification of *Deposit Flow* on different bank outcome variables, using Bartik-type instruments. Column 1 presents the associated first-stage regression, and Columns 2–5 present the instrumented second-stage regressions. *Deposit Flow* is the lagged quarterly growth in total domestic deposits. *Bank-Level Instrument* constructs the instrument at the bank-level by calculating the bank's deposit share from five years prior in its size quintile and quarterly deposit flow (excluding the current bank). *County-Based Instrument* constructs the instrument by using the bank's share of its overall deposits in each county from five years prior and annual deposit flow in its size quintile (excluding the current bank's and county's deposit flows). *State-Based Instrument* constructs the instrument by using the bank's share of its overall deposits in each state from five years prior and annual deposit flow in its size quintile (excluding the current bank's and state's deposit flows). *Observations* apply to Columns 1–5 within each specification. *Additional Controls* include the same control variables as in Tables II and III. All continuous control variables are scaled by their sample standard deviations. Variable definitions are provided in Appendix Table A.1. Standard errors are clustered by bank.

	First Stage	Second Stage				Observations
	Deposit Flow	Δ Gross Income to Assets	Δ ROA	Δ Maturity Gap	Δ Risk-Weighted Assets	
	(1)	(2)	(3)	(4)	(5)	(6)
Bank-Level Instrument	0.218***	0.0145***	0.0118***	0.136***	0.373***	361,943
	(0.00353)	(0.00178)	(0.00158)	(0.0353)	(0.0353)	
County-Based Instrument	0.108***	0.0284***	0.0515***	0.250**	0.509***	109,229
	(0.00428)	(0.00507)	(0.00589)	(0.122)	(0.116)	
State-Based Instrument	0.109***	0.0272***	0.0509***	0.254**	0.476***	109,229
	(0.00432)	(0.00503)	(0.00587)	(0.121)	(0.115)	
Additional Controls	Yes	Yes	Yes	Yes	Yes	
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	
Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	

* p<.10, ** p<.05, *** p<.01

Table VI: Supply Shifts and Bank Risk, Alternative Explanations

The table presents the effect of deposit flows on bank income and risk using alternative measures. Each row presents a different specification of *Supply Shift* on different bank outcome variables. *Using Matched Sample* runs the baseline specification on a restricted sample that results from nearest-neighbor matching. *Include Deposit HHI* adds the bank's deposit market HHI as an additional control. *Include Loans and Commitments* is run over the full sample but adds the following control variables: lagged *Commitments to Assets*, lagged *Loans to Assets*, contemporaneous Δ *Commitments to Lag Assets*, and contemporaneous Δ *Loans to Lag Assets*. *Observations* apply to Columns 1–3 within each specification. *Additional Controls* include the same control variables as in Table IV Panel A. All continuous control variables are scaled by their sample standard deviations. Variable definitions are provided in Appendix Table A.1. Standard errors are clustered by bank.

	Δ Gross Income to Assets (1)	Δ ROA (2)	Δ Maturity Gap (3)	Δ Risk-Weighted Assets (4)	Observations (5)
Supply Shift					
Using Matched Sample	0.00994***	0.0188***	0.174***	0.294***	253,754
	(0.00155)	(0.00178)	(0.0246)	(0.0316)	
Include Deposit HHI	0.0117***	0.0201***	0.170***	0.256***	286,609
	(0.00143)	(0.00174)	(0.0229)	(0.0302)	
Include Loans and Commitments	0.0110***	0.0187***	0.192***	0.204***	286,631
	(0.00143)	(0.00173)	(0.0233)	(0.0295)	
Additional Controls	Yes	Yes	Yes	Yes	
Bank Fixed Effects	Yes	Yes	Yes	Yes	
Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes	

Standard errors in parentheses. * p<.10, ** p<.05, *** p<.01

Table VII: Supply Shifts and Bank Risk, Equity Issuance Concerns

The table presents the effect of deposit flows on bank income and risk. *Supply Shift* is the quarterly growth in total domestic deposits that is driven by the change in depositors' supply curve. In Panel A, *Low Equity* (*High Equity*) is the sample of firms in the lowest tercile (highest tercile) by equity to assets. In Panel B, the difference-in-differences specifications are from 2018–2021 around the introduction of the community banking leverage ratio framework. Treated banks are community banks that qualify for the new framework, while control banks are similarly matched banks that are just above the size threshold for the regulation. *Post* is an indicator for 2020–2021, when the framework came into effect. *Additional Controls* include the same control variables as in Table IV Panel A. All continuous control variables are scaled by their sample standard deviations. Variable definitions are provided in Appendix Table A.1. Standard errors are clustered by bank.

Panel A: Subsamples by Equity Ratios

	Δ Gross Income to Assets		Δ ROA		Δ Maturity Gap		Δ Risk-Weighted Assets	
	Low Equity Ratio	High Equity Ratio	Low Equity Ratio	High Equity Ratio	Low Equity Ratio	High Equity Ratio	Low Equity Ratio	High Equity Ratio
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Supply Shift	0.0180***	0.00760***	0.0288***	0.0108***	0.250***	0.190***	0.375***	0.138***
	(0.00297)	(0.00253)	(0.00289)	(0.00269)	(0.0393)	(0.0412)	(0.0611)	(0.0448)
Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	93,743	91,670	93,743	91,670	93,743	91,670	93,743	91,670
R^2	0.136	0.141	0.443	0.404	0.089	0.093	0.119	0.082

Panel B: Change in Community Banking Regulatory Ratios

	Δ Gross Income to Assets		Δ ROA		Δ Maturity Gap		Δ Risk-Weighted Assets	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treated × Post × Deposit Flow	-0.0121	-0.0232*	-0.0323***	-0.0429***	-0.480**	-0.531**	-0.318*	-0.282
	(0.0135)	(0.0132)	(0.0121)	(0.0130)	(0.207)	(0.240)	(0.181)	(0.188)
Additional Controls × Post	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Matched Sample	No	Yes	No	Yes	No	Yes	No	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	34,619	33,649	34,619	33,649	34,619	33,649	27,402	26,599
R^2	0.076	0.077	0.060	0.060	0.177	0.180	0.181	0.185

Standard errors in parentheses. * p<.10, ** p<.05, *** p<.01

Table VIII: Deposit Flows and Bank Performance

The table presents the effect of uninsured deposit flows and changes in the Fed funds rate on different bank outcomes. *Securities Losses to Lag Assets* is the quarterly total realized and unrealized securities losses on securities scaled by the prior quarter's assets (scaled by 100). *Δ NPL to Assets* is the quarterly change in the level of non-performing loans scaled by the prior quarter's assets (scaled by 100). *Total Deposit Growth* is the quarterly growth in total domestic deposits. All continuous control variables are scaled by their sample standard deviations. Standard errors are clustered by bank.

	Securities Losses to Lag Assets (1)	Δ NPL to Lag Assets (2)	Total Deposit Growth (3)
Supply Shift	-0.0190***	0.000386	-0.230***
	(0.00475)	(0.00246)	(0.0626)
Supply Shift × Δ FF Rate	0.0131***	0.0137***	-0.0945**
	(0.00404)	(0.00295)	(0.0438)
Additional Controls	Yes	Yes	Yes
Additional Controls × Δ FF Rate	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes
Year-Quarter Fixed Effects	Yes	Yes	Yes
Observations	284,382	284,382	284,382
R^2	0.573	0.054	0.172

Standard errors in parentheses. * p<.10, ** p<.05, *** p<.01

Table IX: Bank Risk Following 2020 Deposit Shock

The table presents the effect of supply-driven deposit flows on bank income and risk from 2019Q1–2021Q4. *Treated* is an indicator that equals one if *Deposit Flow* is in the top tercile in 2020Q1–2020Q2 (among banks with positive deposit flows), or zero if it is in the bottom tercile (among banks with positive deposit flows). *Post (2020–2021)* is an indicator that equals one for 2020Q3–2021Q4. *Post (2022)* is an indicator that equals one for 2022Q1–2022Q4. *Additional Controls* × *Post* are the control variables as in Tables II and III, fixed at their 2019Q4 values and interacted with the *Post (2020–2021)* or *Post (2022)* indicator. Treated and control samples are constructed using nearest neighbor matching. Variable definitions are provided in Appendix Table A.1. Standard errors are clustered by bank.

	Δ Gross Income to Assets	Δ ROA	Δ Maturity Gap	Δ Risk-Weighted Assets	Total Deposit Growth
	(1)	(2)	(3)	(4)	(5)
Treated × Post (2020–2021)	0.00808**	-0.00450	0.678***	1.303***	
	(0.00348)	(0.00359)	(0.124)	(0.109)	
Treated × Post (2022)					-2.497***
					(0.184)
Additional Controls × Post	Yes	Yes	Yes	Yes	Yes
Matched Sample	Yes	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	26,239	26,239	26,239	20,412	25,641
R^2	0.065	0.047	0.170	0.257	0.339

Standard errors in parentheses. * p<.10, ** p<.05, *** p<.01

Appendix

A. Additional Robustness

Besides the concerns addressed in Section IV, the results presented in Section III afford other alternative explanations. One concern is that deposits tend to be sticky, with retail depositors not frequently switching banks. Here, the bank-county level analysis in Table VI of Section IV is helpful. Because the analysis is at the annual level, supply-driven deposit flows include only bank-quarters in which the bank does not increase the deposit rates in the preceding four quarters. While our main measure assumes no rise in the deposit rate in the current and the previous quarter, this analysis allows us to estimate the effects of longer periods without an increase in deposit rates. This verifies that we do not solely capture the effect of depositors' slow reaction to past changes in the deposit rate. This stricter requirement provides higher confidence that stickiness of deposits is not a meaningful threat to our main measure.

Another concern regarding the expansion of the bank's balance sheet following supply-driven deposit inflows is that differences in investment opportunities among some of the banks drive the observed effect. To this end, as a robustness test we match banks based on their physical footprint in the analysis of the recent U.S. banking turmoil episode in Section VII. Thus, if there is a specific investment opportunity that coincides with supply-driven deposits in an area where only some banks operate, it would be accounted for in our setting. This allows us to compare two similarly situated banks, with only one experiencing significant supply-driven deposit inflows. Appendix Table A.4 presents the evidence that the results are not explained by differences in investment opportunities.

Another set of concerns relates to our results being driven by specific time periods. Low interest-rate environments may drive banks' reaching for yield behavior and correlate with supply-driven deposit flows. Other factors include the effect of QE on bank reserves (Acharya and Naqvi, 2012; Diamond, Jiang, and Ma, 2024; Acharya, Chauhan, Rajan, and Steffen, 2023), the results being driven by the COVID period, or by the implementation of the Temporary Liquidity Guarantee Program (TLGP) following the global financial crisis.

In Appendix Table A.5, we perform different subsamples related to these concerns. First, we rerun the baseline specification in Equation (7) excluding all quarters in our sample that have effective Fed funds rates below 0.25%. Second, we exclude QE periods from the specifications.[22] Third, we exclude the TLGP period of 2008–2010, which is when the FDIC fully guaranteed noninterest-bearing transaction accounts held at participating banks and thrifts. Fourth, we exclude the COVID period (i.e., 2020 onwards) to confirm that the results are not only driven by this period. Across these subsamples, the results remain similar in terms of economic magnitude and are all statistically significant at the 5% level or higher.

[22]These periods are 2008Q4–2010Q2, 2010Q4–2011Q2, 2012Q3–2014Q4, and 2020Q1–2021Q4.

Table A.1: Variable Definitions

This table presents the data sources and the definitions of the variables used in our analysis.

	Definition	Data Sources
Bank Asset and Risk Measures		
LT Securities Growth	Quarterly log difference in securities holdings, excluding government securities that are three months or less in maturity (RCFD1772+RCFD1773-RCFDA549). Scaled as a percent.	Call Report
Δ LT Securities to Lag Assets	Quarterly difference in government securities holdings that are three months or less in maturity (RCFD1772+RCFD1773-RCFDA549). Divided by lagged assets (RCFD2170). Scaled by 100.	Call Report
ST Securities Growth	Quarterly log difference in government securities holdings that are three months or less in maturity (RCFDA549). Scaled as a percent.	Call Report
Δ ST Securities to Lag Assets	Quarterly difference in securities holdings, excluding government securities that are three months or less in maturity (RCFDA549). Divided by lagged assets (RCFD2170). Scaled by 100.	Call Report
Loan Growth	Quarterly log difference in loans (RCFD5369+RCFDB528). Scaled as a percent.	Call Report
Δ Loans to Lag Assets	Quarterly difference in loans (RCFD5369+RCFDB528). Divided by lagged assets (RCFD2170). Scaled by 100.	Call Report
Δ Gross Income to Assets	Quarterly gross income (RIAD4107+RIAD4079+RIAD3521+RIAD3196). Divided by assets (RCFD2170). Scaled by 100.	Call Report
ROA	Quarterly net income (RIAD4340) divided by assets (RCFD2170). Scaled as a percent.	Call Report
Δ ROA	Quarterly difference in ROA. Scaled as a percent.	Call Report
Maturity Gap	Following English, Van den Heuvel, and Zakrajšek (2018), difference between estimated maturity of assets and estimated maturity of liabilities, in months.	Call Report
Δ Maturity Gap	Quarterly difference in maturity gap, in months.	Call Report
Risk-Weighted Assets	Risk-weighted assets (RCFDA223) divided by assets (RCFD2170). Scaled by 100.	Call Report
Δ Risk-Weighted Assets	Quarterly difference in risk-weighted assets. Scaled by 100.	Call Report
Securities Losses to Lag Assets	Realized losses on HTM and AFS securities -(RIAD3521+RIAD3196) plus unrealized losses on HTM securities (RCFD1754-RCFD1771) plus unrealized losses on AFS securities (RCFD1772-RCFD1773). Divided by lagged assets (RCFD2170). Scaled by 100.	Call Report
Δ NPL to Lag Assets	Quarterly difference in nonperforming loans (NPL defined as sum of items in Schedule RC-N Column B (Past due 90 days or more and still accruing) and Column C (Nonaccrual)). Divided by lagged assets (RCFD2170). Scaled by 100.	Call Report
Net Equity Issuance	Dollar amount of perpetual preferred and common stock issued by the bank's BHC, net of retirements, divided by lagged equity capital (BHCK3577+BHCK3578+BHCK3579+BHCK3580)/BHCK3210. Scaled as a percent.	Y-9C

Table A.1: Variable Definitions—*Continued*

	Definition	Data Sources
Bank Deposit Measures		
Total Deposit Growth	Quarterly log difference in total domestic deposits (RCON2200). Scaled as a percent.	Call Report
Supply Shift	Quarterly log difference in estimated deposits driven by a change in depositors' supply as defined in Section I.A. Scaled as a percent.	Call Report
Demand Shift	Quarterly log difference in estimated deposits driven by a change in banks' demand as defined in Section I.B. Scaled as a percent.	Call Report
Other Bank Controls		
Log Assets	Log total assets (RCFD2170).	Call Report
NIM	Sum of net income (RIAD4074) over last four quarters divided by total assets (RCFD2170).	Call Report
3-Year Loan Growth	Log difference in loans (RCFD5369+RCFDB528) between current quarter and 12 quarters prior.	Call Report
Equity to Assets	Ratio of equity (RCFD3210) to assets (RCFD2170).	Call Report
Deposits to Assets	Ratio of total deposits (RCON2200+RCFN2200) to assets (RCFD2170).	Call Report
Securities to Assets	Ratio of total securities (RCFD1754+RCFD1773) to assets (RCFD2170).	Call Report
Loans to Assets	Ratio of loans (RCFD5369+RCFDB528) to assets (RCFD2170).	Call Report
Commitments to Assets	Ratio of unused commitments (Item 1, Schedule RC-L) to assets (RCFD2170).	Call Report
Δ Commitments to Lag Assets	Unused commitments (Item 1, Schedule RC-L) divided by lagged assets (RCFD2170).	Call Report
Total Deposit Rate	Interest expense on domestic deposits (Pre-2017: RIAD4508+ RIAD0093+RIADA517+RIADA518; 2017 on: RIAD4508+ RIAD0093+RIADHK03+RIADHK04) divided by total domestic deposits.	Call Report
ROE Volatility	Standard deviation of quarterly ROE (net income to equity) over the past three years.	Call Report
Real Estate Loans to Assets	Real estate loans (RCFD1410) divided by assets (RCFD2170).	Call Report
C&I Loans to Assets	Commercial and industrial loans (RCFD1763+RCFD1764) divided by assets (RCFD2170).	Call Report
Wholesale Funding	Wholesale funding (Pre-2002: RCON2604+RCFN2200+RCFD2800 +RCFD3190; 2002-2009: RCON2604+RCFN2200+RCFD3200 +RCONB993+RCFDB995+RCFD3190; 2010 on: RCONJ473 +RCONJ474+RCFN2200+RCFD3200+RCONB993+RCFDB995 +RCFD3190) divided by assets (RCFD2170).	Call Report
Macroeconomic Variables		
Δ FF Rate	Quarterly difference in the effective fed funds rate. Scaled as a percent.	FRED
VW CRSP Return	Quarterly return of the value-weighted CRSP index. Scaled as a percent.	CRSP

Table A.2: Deposit Market Share Regressions

The table presents the estimates for Equations (3) and (6). *Net Deposit Rate* is the bank's quarterly deposit rate, net of fees. *No. of Branches* is the number of branches. *Employees per Branch* is the number of bank employees divided by the number of branches. *Advertising* is the quarterly advertising expense divided by the number of branches. *Fixed Assets* is the quarterly expenses on premises and fixed assets divided by total assets. *IV-1* includes as instruments the bank-specific estimated pass-through of the three-month interbank rate and averages and squared averages of competitor's *No. of Branches*, *Employees per Branch*, and *Advertising*. *IV-2* includes as instruments the bank-level Bartik instrument and its most recent lag. All continuous control variables are scaled by their sample standard deviations. Variable definitions are provided in Appendix Table A.1. Standard errors are clustered by bank.

	Log Market Share	
	Depositor Supply (1)	Bank Demand (2)
Net Deposit Rate	0.131***	-1.702***
	(0.0152)	(0.336)
No. of Branches	0.128***	0.115***
	(0.0391)	(0.0394)
Employees per Branch	0.0798***	0.0841***
	(0.0224)	(0.0271)
Advertising	0.000889	
	(0.00212)	
Fixed Assets		-0.204***
		(0.0305)
3-Year Loan Growth		0.242***
		(0.0301)
Deposits to Assets		0.313***
		(0.0400)
Bank Fixed Effects	Yes	Yes
Year-Quarter Fixed Effects	Yes	Yes
IV-1	Yes	No
IV-2	No	Yes
Observations	309,328	309,328

Standard errors in parentheses. * p<.10, ** p<.05, *** p<.01

Table A.3: Nearest Neighbor Match

The table presents the Probit specification used to generate the nearest neighbor matched sample in Table VI. *Outward Supply Shift* is an indicator variable that the bank had an outward shift in deposit supply in a given quarter. All bank-level control variables are from the prior quarter. All continuous control variables are scaled by their sample standard deviations. Variable definitions are provided in Appendix Table A.1. Standard errors are clustered by bank.

	Outward Supply Shift (1)
Total Deposit Rate	-0.120***
	(0.00760)
ROE Volatility	-0.0168***
	(0.00588)
Real Estate Loans to Assets	0.106***
	(0.00601)
C&I Loans to Assets	0.00631
	(0.00751)
Wholesale Funding	-0.0740***
	(0.00742)
Log Assets	-0.136***
	(0.00899)
NIM	-0.0419***
	(0.00711)
3-Year Loan Growth	-0.197***
	(0.00736)
ROA	0.0256***
	(0.00532)
Equity to Assets	-0.0217*
	(0.0123)
Deposits to Assets	-0.143***
	(0.00907)
Δ FF Rate$_{t-1}$	-0.0361***
	(0.00335)
Δ FF Rate$_{t-2}$	-0.0294***
	(0.00333)
VW CRSP Return$_{t-1}$	0.0116***
	(0.00194)
VW CRSP Return$_{t-2}$	-0.00908***
	(0.00204)
Observations	286,676
Pseudo R^2	0.035

Standard errors in parentheses. * p<.10, ** p<.05, *** p<.01

Table A.4: Bank Risk, Controlling for Investment Opportunities

The table presents the effect of supply-driven deposit flows on bank income and risk from 2019Q1–2021Q4. The specifications are the same as in Table IX Panel A, except the nearest neighbor match between treated and control banks includes a geographic similarity measure to match banks on investment opportunities. Variable definitions are provided in Appendix Table A.1. Standard errors are clustered by bank.

	Δ Gross Income to Assets		Δ Maturity Gap		Δ Risk-Weighted Assets	
	(1)	(2)	(3)	(4)	(5)	(6)
Treated × Post	0.0158***	0.0101**	0.596***	0.625***	1.125***	1.073***
	(0.00424)	(0.00420)	(0.142)	(0.148)	(0.154)	(0.154)
Additional Controls	No	Yes	No	Yes	No	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	20,526	20,526	20,526	20,526	16,295	16,295
R^2	0.066	0.069	0.175	0.177	0.275	0.277

Standard errors in parentheses. * p<.10, ** p<.05, *** p<.01

Table A.5: Supply-Driven Deposits and Bank Risk, Additional Robustness

The table presents the effect of deposit flows on bank income and risk for different robustness tests. Each row presents a different specification of *Supply-Driven Deposit Flow* on different bank outcome variables. *Exclude Low Interest Rate Periods* drops all quarters with an effective fed funds rate below 0.25%. *Exclude QE Periods* drops quarters with quantitative easing activity. *Exclude TLGP Period* drops 2008–2010 when the FDIC's Temporary Loan Guarantee Program was active. *Exclude Post 2019* drops 2020–2022 which coincides with the COVID shock and subsequent stimulus activity. *Observations* apply to Columns 1–3 within each specification. *Additional Controls* include the same control variables as in Tables II and III. All continuous control variables are scaled by their sample standard deviations. Variable definitions are provided in Appendix Table A.1. Standard errors are clustered by bank.

	Δ Gross Income to Assets (1)	Δ Maturity Gap (2)	Δ Risk-Weighted Assets (3)	Observations (4)
Supply-Driven Deposit Flow				
Exclude Low Interest Rate Periods	0.0155***	0.0305**	0.235***	233,479
	(0.000603)	(0.0131)	(0.0144)	
Exclude QE Periods	0.0139***	0.0396***	0.235***	281,366
	(0.000550)	(0.0116)	(0.0123)	
Exclude TLGP Period	0.0121***	0.0482***	0.230***	321,312
	(0.000477)	(0.0102)	(0.0115)	
Exclude Post 2019	0.0131***	0.0482***	0.227***	396,946
	(0.000442)	(0.00910)	(0.00971)	
Additional Controls	Yes	Yes	Yes	
Bank Fixed Effects	Yes	Yes	Yes	
Year-Quarter Fixed Effects	Yes	Yes	Yes	

Standard errors in parentheses. * p<.10, ** p<.05, *** p<.01

Table A.6: Total Deposits and Bank Risk, Recent Issuance

The table presents the effect of deposit flows on measures of bank income and risk. *Total Deposit Growth* is the lagged quarterly growth in total domestic deposits. *Supply Shift* is the quarterly growth in total domestic deposits that is driven by the change in depositors' supply curve. *Net Equity Issuance* is the percent of equity issued (net of retirements) in a quarter, scaled by total equity. All continuous control variables are scaled by their sample standard deviations. Standard errors are clustered by bank.

	Net Equity Issuance (%)	
	(1)	(2)
Total Deposit Growth	0.188***	
	(0.0300)	
Supply Shift		0.202***
		(0.0756)
Additional Controls	Yes	Yes
Bank Fixed Effects	Yes	Yes
Year-Quarter Fixed Effects	Yes	Yes
Observations	53,473	53,473
R^2	0.207	0.206

Standard errors in parentheses. * p<.10, ** p<.05, *** p<.01