How Do Government Guarantees Affect Deposit Supply?

Thomas Flanagan* Edward T. Kim†

Shohini Kundu‡ Amiyatosh Purnanandam§

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Abstract

The market value of deposit insurance changes over time and across banks as the value of the underlying put option changes, but the premium banks pay for the insurance does not adjust to completely capture this variation. Consequently, their incentive to supply insured deposits changes with the change in subsidy they enjoy from deposit insurance. Factors that increase the subsidy, such as asset risk, move the supply curve outward. Consistent with this idea, we show that the supply of insured deposits increase when banks become riskier. Our findings uncover a novel channel of deposit supply, with implications for existing research on the monetary policy, deposits channel, and reaching-for-yield literature.

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*Fisher College of Business, The Ohio State University, e-mail: flanagan.224@osu.edu

†Stephen M. Ross School of Business, University of Michigan. e-mail: etkim@umich.edu

‡UCLA Anderson School of Management and CEPR. e-mail: shohini.kundu@anderson.ucla.edu

§McCombs School of Business, University of Texas at Austin. e-mail: amiyatosh@utexas.edu

1 Introduction

Bank deposits play a central role in economic growth and liquidity creation, motivating a large literature that studies the forces shaping their demand and supply and their consequences for economic outcomes. Economic shocks, policy choices, consumer preference, and banking market structure have all been shown to affect the demand and supply of deposits.[1] In this paper, we uncover a new channel that shifts the supply curve of bank deposits: variation in the effective subsidy that banks enjoy from deposit insurance. Beyond the immediate implication of our work for the theory and practice of bank funding, our results also have important implications for recent advancements in the literature, including the effect of interest rates on deposit supply and managerial incentives to reach for yield in low interest rate environments.

The classical view of deposit insurance focuses on moral hazard in asset selection. Subsidized insurance encourages banks to take excessive risks on the asset side of the balance sheet. Yet we know surprisingly little about whether banks also optimize their liability structure to extract maximum value from government guarantees. When a bank experiences financial distress and traditional funding sources become more expensive or scarce, how does it respond on the liability side? Does it actively shift toward subsidized funding through insured deposits? This paper provides the first systematic evidence that banks do precisely this – expanding their supply of insured deposits when the value of deposit insurance increases as a result of increased bank risk. While uninsured deposits leave banks as they become riskier, the increase in insured deposits allows them to protect their total deposits base.

Bank deposits are insured by regulators in almost all major economies. In the United States, the Federal Deposit Insurance Corporation (FDIC) guarantees deposits up to a certain amount in the event of a bank's failure. Banks pay a premium to the FDIC to avail of this guarantee. The FDIC's guarantee gives the insured bank a *put option* that can be exercised in the event of default. Therefore, the market value of deposit insurance varies with factors that change the value of a put option, such as the riskiness of the underlying assets. Importantly, however, the premiums

[1] Black (1975) and Fama (1985) focus on the effect of reserve requirements. Gorton and Pennacchi (1990) highlight the role of bank deposits in alleviating information frictions faced by savers. Stein (1998) teases out the role of adverse selection on the demand and supply of deposits. Kashyap and Stein (2000) focuses on the effect of policy shocks on banks' ability to raise outside funding and its impact on loan supply. Stein (2012) discusses the goals and methods of financial stability policy in an economy with privately-created money such as bank deposits. Gilje et al. (2016) relate exogenous supply shocks to bank deposits to lending markets. Drechsler et al. (2017) document the importance of bank's market power on the supply of deposits. There are numerous other valuable contributions in this field as summarized in survey articles such as Gorton and Winton (2003) and Bhattacharya and Thakor (1993).

paid by banks do not adjust fully to reflect changes in its market value for three key, not mutually exclusive, reasons: (a) banks are classified into coarse risk categories for FDIC insurance assessments, (b) premiums change infrequently, and (c) premiums typically depend on the actuarial value of insurance and not on the risk-neutral distribution of losses.[2] Figure 1 plots the average bank credit default swap (CDS) spreads, a measure of the market's assessment of bank risk, and the premium that banks pay on insured deposits. Both the level and variation in CDS spreads dwarf the assessment fees, in line with our argument that insurance premium is relatively risk-insensitive and highly subsidized. Consequently, the government guarantee in the form of deposit insurance creates variation in the effective subsidy across time and across banks.

To see why subsidy variation matters for deposit supply, consider a bank whose loan portfolio deteriorates. As credit quality declines, the bank's funding costs typically rise, bond spreads widen, equity becomes more expensive, and uninsured depositors may demand higher rates or withdraw funds entirely. Yet the FDIC premium remains essentially constant. From the bank's perspective, the relative attractiveness of insured deposits has increased: the implicit government subsidy has grown larger precisely when alternative funding sources have become more costly because their pricing is sensitive to bank risk. This creates a strong incentive to expand insured deposit supply. These incentives are economically important as well, since insured deposits form almost 77% of the total deposits of an average bank, and the subsidy on insurance premiums can be as high as 40-90 basis points (Duffie et al., 2003). We estimate that the subsidy can change a bank's return on equity by as much as 5 percentage points.

We formalize these intuitions in a standard model of insurance pricing that follows Merton (1977), where deposit insurance is priced as a put option owned by insured banks. Banks face a convex cost function in raising deposits and the subsidy obtained through the underpriced insurance premium influences their decision to supply deposits. The model shows that the deposit supply curve shifts outwards when a bank's asset risk increases. The supply curve also shifts outward in the low-interest rate regime because policy rates are often lowered in bad economic times. The negative correlation between interest rate and volatility leads to an outward shift in the supply curve when interest rates are low.

We test these implications using detailed data on the quantity and pricing of deposits for all U.S. banks covered in the Call Reports from 1986 to 2023. Our goal is to empirically establish a link

[2] While there has been a move towards risk-based pricing of deposit insurance in the recent past, it still is not fully risk-sensitive due to the above mentioned reasons. See Duffie et al. (2003); Ronn and Verma (1986); Marcus and Shaked (1984) for studies on the pricing of deposit insurance premium.

between the deposit insurance subsidy that a riskier bank enjoys and its deposit supply. In our main tests, we use the loan loss provisions (LLP) to total loans ratio as our key measure of asset risk. Since asset risk is an unobserved quantity, using the LLP ratio as a proxy for asset risk has several benefits. First, the measure is an indicator of the performance of the bank's assets, mapping directly to the model primitive. Second, it captures the riskiness of a bank's asset through the deterioration in its lending portfolio, allowing us to measure the time-varying nature of a bank's asset risk. Third, it is available for the entire sample of banks for a long period, providing us with substantial variation in macroeconomic shocks and bank risk. Finally, the measure provides us with the manager's assessment of forward-looking losses on loans they have made in the past. Therefore, we are able to tease out the effect of managerial expectations of asset risk on how they adjust their deposit supply.

Our main empirical specification estimates a panel regression using bank-quarter data over nearly four decades to identify the relationship between asset risk and deposit supply. We include bank fixed effects to absorb the effect of factors such as the bank's management style, franchise value, and geographical presence on deposit supply, as well as time fixed effects to absorb aggregate risk factors. We show that banks with a one-standard deviation higher LLP ratio have 0.50-percentage point higher insured deposits. In compositional terms, the fraction of insured deposits to total deposits increases by 0.20 percentage points for every one standard deviation increase in the LLP ratio. The increase in the fraction of insured deposits is consistent with our subsidy channel, where banks are incentivized to supply higher quantities of insured deposits, but not uninsured deposits, as risk goes up. We separately analyze the behavior of uninsured depositors and document a decrease in uninsured deposits with the LLP ratio. Collectively, these results show that as bank's risk increases, their reliance on risk-sensitive uninsured deposits decreases, whereas their reliance on subsidized insured deposit goes up. On net, total deposits do not decline despite the drop in uninsured deposits. If anything, total deposits rise modestly, implying that riskier banks ultimately attract more deposits.

Does the increase in insured deposits reflect a supply shift rather than higher depositor demand? We address this question by analyzing deposit pricing responses to changes in the value of the insurance subsidy. If banks increase insured deposit supply in response to an increase in subsidy, then we expect a decrease in price (i.e., an increase in interest rates offered), while demand side effect produces the opposite prediction. We test for these channels using data on insured deposit rates from the Call Reports. Since our analysis focuses on insured deposits, bank credit risk should not influence their pricing, which allows us to cleanly separate subsidy effects. We find that a one-standard deviation increase in the LLP ratio is associated with deposit rates that are 2.2 to 2.7 basis points higher – a 1.66% increase relative to the sample average rate of 1.63% and corresponding to around $68 in additional interest expenses on a $250,000 deposit account. An increase in the quantity of insured deposits accompanied by lower prices (higher interest rates) is consistent with an outward shift in the supply curve.

A limitation of our bank-level regressions is that we cannot separately identify the effects of local demand and banking competition from the government subsidy channel. Since local conditions play an important role in the deposit market (Drechsler et al., 2017), we additionally estimate the model using branch-level data on deposit quantities. We include branch fixed effects as well as county × quarter-year fixed effects to isolate the effect of local economic conditions, demand for deposits, and banking market competition. Our model allows us to test whether branches of banks with higher asset risk attract more deposits compared to branches of other banks in the same market. Consistent with our main results, we find that branches of banks with a one-standard deviation higher LLP ratios experience a 1.43% increase in deposits.[3]

Our results thus far show that deposit growth at high asset risk banks is not driven by demand side considerations. A remaining identification challenge is that banks receiving larger subsidies may make riskier investments, generating a positive correlation between bank risk and deposits through reverse causality. While subsidized deposit insurance is known to increase incentives for risk-taking, increases in asset risk take time to materialize in loan losses. Consequently, higher LLP ratios in a given quarter reflect riskier portfolio choices made in earlier periods. Using the LLP ratio as our risk measure therefore mitigates concerns about contemporaneous reverse causality in our regressions.

To further address any remaining endogeneity concerns, we implement an instrumental variables strategy based on a shift-share design that interacts a bank's historical portfolio composition with economy-wide default rates across asset categories. We measure default risk using the ratio of non-performing loans to total loans (NPL), which is reported by loan category and therefore permits construction of the instrument.[4] Specifically, for each bank, we fix portfolio weights across five asset classes – real estate, C&I, household and consumer, agricultural, and financial loans – at the first quarter the bank appears in the Call Reports, and combine these weights with

[3]Since we do not observe the breakdown of deposits into insured and uninsured components at the branch level, we are unable to analyze the effect of bank risk on the composition of deposits at this unit of analysis.
[4]The LLP ratio is available only at the aggregate bank level.

time-varying aggregate default rates in each category to generate predicted NPL ratios. The resulting instrument exploits cross-sectional variation in initial portfolio choices and subsequent common shocks to asset-class-specific default risk. Because portfolio allocations are fixed several years prior to the deposit supply decisions we study, and precede the realization of default shocks, the instrument is unlikely to be affected by reverse causality. These considerations form the basis of our identifying assumption. In the first-stage regression, the portfolio-weight instrument loads strongly and remains highly predictive even with bank and quarter-year fixed effects, explaining nearly 10% of the variation in realized NPL ratios across the sample. In the second stage, using the predicted NPL ratio, we find a positive and statistically significant effect on bank deposits: a one–standard deviation increase in the NPL ratio raises insured deposits by 4.7%.

We next study a setting that allows for a sharp mapping between bank risk and deposit supply by examining the deposit-taking behavior of banks that eventually fail. We track these banks from sixteen quarters before failure through the failure quarter. Because these banks are already close to failure, their riskier portfolio choices were made earlier, and increases in non-performing loans during this period primarily reflect the realization of past lending decisions rather than new risk-taking intended to exploit deposit insurance. Moreover, failing banks are typically under heightened supervisory scrutiny, making it unlikely that contemporaneous lending decisions are driven by reverse causality concerns (Correia et al., 2025). Consistent with the subsidy channel, we find that failing banks expand deposits as failure approaches: total deposits rise steadily, increasing by 35% in the quarters preceding failure. This growth is driven primarily by insured deposits, and is accompanied by rising interest rates on insured products, providing further support for our interpretation that banks respond to higher subsidy values by actively expanding the supply of insured deposits.

Our results so far exploit cross-sectional variation across banks over time. To assess whether the same patterns emerge at the aggregate level, we next examine time-series evidence for the banking sector as a whole. Figure 2 plots quarterly changes in aggregate deposits alongside the LLP measure from 1986 to 2021. The two series are positively correlated, with correlations of 32% for insured deposits and 10% for total deposits. Consistent with our channel, growth in LLP is associated with an increase in the system-wide share of insured deposits. At the same time, the deposit spread, defined as the difference between the federal funds rate and bank deposit rates, declines as the LLP ratio rises. Together, these time-series patterns indicate that periods of higher government subsidy coincide with an expansion in deposit supply, particularly insured deposits.

The value of the deposit insurance subsidy can also vary with policy rates, since rates are often lowered during periods of elevated banking-sector risk. Our mechanism therefore has implications for the relationship between interest rates and deposit supply (Drechsler et al., 2017). In Drechsler et al. (2017), this relationship is driven by bank market power, whereas in our framework it operates through changes in the value of the deposit insurance subsidy. These channels are not mutually exclusive and may reinforce one another. To assess this interaction, we replicate the core findings of the deposit pricing literature and then augment the regression with our measure of bank risk. Specifically, we estimate the branch-level deposit quantity regression including changes in the federal funds rate and the Herfindahl–Hirschman index (HHI) of local deposit market concentration, and then add the LLP ratio as an additional explanatory variable. The effect of LLP on deposit quantity remains strong, indicating that our results are not solely driven by market power. Taken together, these findings suggest that the subsidy channel provides an independent mechanism linking interest rates to deposit supply.

Our study contributes to the literature on reaching for yield in financial intermediation (Rajan, 2006; Acharya and Naqvi, 2019). This behavior is typically described as a tendency for financial institutions to invest in riskier assets in low interest rate environments in order to achieve higher returns. Existing explanations often emphasize managerial incentives to target nominal yields without fully internalizing risk. Our mechanism offers an alternative perspective: when interest rates fall, the value of the deposit insurance subsidy increases, encouraging banks to take on greater asset risk even in the absence of agency frictions. In this view, risk-taking arises from changes in government guarantees rather than from managerial behavior alone.

Our paper is also related to Billett et al. (1998), who show that deposit insurance weakens market discipline in a specific institutional setting. They find that banks substitute toward insured deposits and away from uninsured deposits following credit rating downgrades, thereby dampening depositor discipline. By contrast, our mechanism does not rely on changes in market discipline. Instead, we document an outward shift in the deposit supply curve, rather than a compositional substitution between insured and uninsured deposits. Moreover, our analysis applies to the full sample, rather than to a narrow setting driven by rating downgrades.

2 History of Deposit Insurance Premiums

Following the Great Depression, the U.S. Congress created the FDIC to guarantee deposits, offering uniform protections up to a statutory limit (currently $250,000 per depositor per bank). These protections are operationalized through the FDIC's Deposit Insurance Fund, to which each institution pays quarterly premiums (calculated as the assessment rate multiplied by the assessment base). In its early decades, the FDIC charged a flat assessment rate; every bank paid the same rate regardless of risk. After the Savings & Loan crisis in the 1980s, Congress enacted reforms that required the FDIC to hold reserves of at least 1.25% of insured deposits. The FDIC maintained a flat rate schedule to build toward that target, preserving much of its risk insensitivity.[5]

A subsequent regulation in 1991 required the FDIC to link insurance premiums to bank risk. The first risk-based assessments took effect on a transitional basis in 1993 and became permanent in 1994. Banks were categorized into three groups based on capitalization ratios and three groups based on supervisory ratings, yielding nine total categories for assessment. In practice, however, there was little variation in premiums paid: the rate ranged only from 23 to 31 basis points between the least and most risky banks.

By 1996, when the Deposit Insurance Fund had reached its 1.25% target, the vast majority of banks paid no insurance premium at all.[6] This zero-premium regime persisted from 1996 through 2006. Although the FDIC continued to classify banks in a 3 by 3 matrix based on capitalization and supervisory ratings, institutions in the top category (well capitalized and highly rated) paid no assessment fees. In terms of deposits (number of institutions), more than 96% (92%) of banks fell into this safest category, effectively rendering the system risk-insensitive (Duffie et al., 2003).

The FDIC made a renewed effort to implement risk-based pricing in 2007. Banks were now grouped into four categories based on capital ratios and supervisory ratings, with assessment rates ranging from 5 to 43 basis points. Nevertheless, the majority of banks remained in the safest category, so variation in actual payments remained limited. In 2009, following the global financial crisis, the FDIC substantially revised its assessment methodology. Premiums were now based not only on capital and supervisory ratings but also on liability composition, such as the share of unsecured or brokered deposits. The framework also distinguished between large and small banks

[5] For a more detailed historical survey, see https://www.minneapolisfed.org/article/1998/a-brief-history-of-reserves-and-premiums#1.

[6] Federal Deposit Insurance Corporation. Press Release 87-96: "Under the existing rate schedule in effect since January of 1996, institutions in the lowest risk category will continue to pay no premiums during the first half of 1997. A total of 9,538, or 94.4% of all BIF-insured institutions, are in the lowest risk category."

using a \$10 billion asset threshold. As a result, assessment rates varied more meaningfully, ranging from 7 to 77.5 basis points across institutions, and even within a given risk category depending on banks' liability structure. A subsequent 2016 reform adjusted the assessment base again, with premiums ranging from 1.5 to 40 basis points.

The magnitude of the deposit insurance subsidy remains an important empirical question. While a full quantitative assessment is beyond the scope of this paper, prior studies provide useful benchmarks. Duffie et al. (2003) use a reduced-form credit risk model to estimate the fair market value of deposit insurance premiums. They show that the fair market premium equals a bank's short-maturity credit spread multiplied by the ratio of expected losses to the insurer upon failure to expected fractional loss on bank debt. Based on credit default swap (CDS) spreads and corresponding insurance premiums in 2002, they estimate that the fair market premium could be as high as 64 basis points, a significant departure from the 0 to 3 basis points most banks actually paid.

Overall, the historical evidence points to a largely flat, risk-insensitive premium structure for most of U.S. banking history. Although the system became more risk-sensitive after 2007, it remains only partially so: premiums continue to be determined by coarse supervisory categories and do not adjust continuously with market-based measures of risk. Figure 1 illustrates this stability in practice. Average assessment rates across banks remain roughly constant in the years leading up to the Great Recession, with subsequent increases largely reflecting efforts to replenish the Deposit Insurance Fund rather than changes in bank risk, which is directly reflected in the bank CDS spreads. The figure also highlights that most shifts in assessment rates coincide with regulatory changes; these are usually uniform adjustments that move the entire schedule up or down, underscoring the limited role of risk-based differentiation in the FDIC's pricing framework.

3 Data and Descriptive Statistics

We collect comprehensive data on bank balance sheet items from the quarterly Call Reports. First, we identify total domestic deposits from Schedule RC or RC-O and compute uninsured deposits that separately identify deposit amounts above the FDIC insurance threshold. Specifically, for 2001 and later, uninsured deposits are defined as the sum of RCON2710, RCONF051, and RCONF047, where RCON2710 captures deposits over \$100,000 prior to 2001, and RCONF051 and RCONF047 report deposits above \$100,000 and \$250,000, respectively, following the FDIC coverage expansion in 2008. We then define insured deposits as total domestic deposits minus estimated uninsured deposits.[7] We additionally incorporate information on bank size (total assets), leverage and capitalization (total equity capital), and total loan portfolios as control variables. We compile branch-level deposit quantities from the FDIC's Summary of Deposits. We augment our baseline dataset with quarterly bank-level information on FDIC assessment fees available in the Call Reports, as well as publicly available aggregate data from the FDIC.

To examine how government subsidies affect deposit supply, we use various measures of asset risk (Merton, 1977) as proxies for the deposit insurance subsidy. Our main measure of bank risk is the quarterly LLP ratio, which is computed as provisions for credit losses on all financial assets and off-balance-sheet credit exposures (RIADJJ33) divided by total loans. Additionally, we supplement the forward-looking LLP measure with the non-performing loan ratio, defined as the sum of nonaccruing loans and accruing loans that are 90 days or more past due divided by total loans.[8] In robustness tests, we compute additional measures of asset risk. First, we compute two market-based risk measures: the quarterly average volatility of daily stock returns of publicly traded bank holding companies, and the implied bank bond interest rate spread over a maturity-matched treasury bond. The data for stock return volatility are accessed through CRSP and the data on bond spreads are obtained from S&P Global (formerly Markit). Second, we compute a book-based measure of asset volatility as the four-quarter standard deviation of the banks' return on assets. For our instrumental variables analysis, we use each bank's historical asset holdings across the following five categories: real estate loans, C&I loans, household & consumer loans, agricultural loans, and loans to other financial firms. Specifically, we compute a measure of estimated NPL ratio weighted by historical asset composition (portfolio weight for each bank in each asset class from the year the bank was chartered).

We also construct bank-level measures of insured deposit rates following Chen et al. (2022), defined as quarterly interest expense on deposits divided by average quarterly deposit balances. We report results using two variants of this measure. First, we follow Chen et al. (2022) and define the core insured deposit rate as the interest rate paid on transaction deposits, savings deposits, and small time deposits. Second, we construct an insured time deposit rate based solely on time deposits below the insurance limit. For both measures, insured deposits are defined as deposits

[7] For years before 2001, when disaggregated reporting was not available, we use the total domestic deposit base as the insured component, consistent with FDIC definitions at the time.

[8] In the Call Reports, we define NPL using RCFD1403 and RCFD1407. When these variables are missing from the Call Reports, we construct NPL by summing the by NPL by loan subcategories as defined in the FFIEC reporting forms ffiec.gov/resources/reporting-forms/ffiec031-historic.

below \$100,000 prior to 2008 and below \$250,000 thereafter. These insured deposit rate measures are available from 1997 to 2021 in our sample. Our insured deposit measure aligns closely with aggregate FDIC statistics and captures major regulatory transitions, such as the 2009 increase in the deposit insurance limit (Appendix Figure A.1). Table 1 shows that the insured-to-total deposit ratio exhibits substantial cross-sectional dispersion across banks.

The sample period for our baseline analysis spans 1986 to 2023. Table 1 reports the descriptive statistics of key variables for the full sample period. We winsorize all variables at the 1% level to remove the effect of outliers. In the sample, the LLP ratio shows substantial variation, averaging 0.7 percent and ranging from near zero to almost 10 percent. The insured-to-total deposit ratio averages about 77 percent, indicating that most domestic deposits are protected under the FDIC guarantee. Therefore, insured deposits are economically large and an important source of bank funding. Consequently, the subsidy that banks can potentially enjoy through these deposits is economically large.

How large is the subsidy from potentially underpriced deposit insurance premiums? As Duffie et al. (2003) note, fair-market deposit insurance premia are approximately proportional to short-term credit spreads on bank debt. Using historical data, they estimate that the deposit insurance subsidy ranges from 40 to 90 basis points, depending on bank risk and assumptions about loss given default (see their Table 2). For a representative bank with an insured deposits to assets ratio of 60 percent, a 90 basis point subsidy translates into a reduction in funding costs of 0.54 percent of assets. Expressed in terms of return on equity, this implies an increase of more than 5 percentage points, which is economically large relative to typical bank ROEs of 10 to 20 percent. Although deposit insurance premia have become more risk sensitive over time, they remain only partially risk-based and continue to embed substantial subsidies, as shown in Figure 1. These magnitudes underscore the potential importance of deposit insurance subsidies in shaping deposit supply.

4 Deposit Insurance Subsidies and Deposit Supply

We develop a simple option-pricing model of a bank that funds a risky loan with insured deposits and equity. Because deposits are fully insured at a flat premium, the government guarantee embeds a put option on the bank's assets whose value rises with asset risk. Banks choose how much insured deposits to raise by trading off the marginal value of this guarantee against convex costs of funding (branch networks, staff, and other deposit-gathering expenses) and the insurance premium itself. The framework predicts that banks expand insured deposit supply when the value of deposit insurance subsidies increases.[9]

We test this prediction through several complementary empirical strategies. First, we exploit cross-sectional variation in bank risk using the LLP ratio as the measure of forward-looking asset volatility. Second, to address identification concerns, we employ two complementary strategies: (1) an instrumental variables strategy using shift-share variation in loan portfolio composition, and (2) an event study of banks approaching failure where reverse causality, i.e., insured deposits driving the asset riskiness, is ruled out by design. Third, we conduct robustness tests using alternative risk measures. Finally, we examine time-series patterns to assess whether the subsidy channel operates at the aggregate level.

4.1 Cross-Sectional Effects: Loan Loss Provisions

We begin our empirical analysis using the LLP ratio as our measure of bank risk. This choice reflects several economic and empirical considerations. From an economic perspective, LLP captures exactly what we aim to measure: managers' forward-looking, discretionary assessments of asset risk. When banks set aside provisions for potential future loan losses, they reveal their private information about portfolio quality and expected credit deterioration. This forward-looking dimension is important because the value of deposit insurance depends on expected future losses, not just realized past performance. The LLP ratio thus provides a direct mapping to the theoretical construct of asset volatility in our option-pricing framework.

From a practical standpoint, LLP also offers several important advantages. It is available for all banks in our sample from the Call Reports, providing comprehensive coverage across institutions and a long time series spanning nearly four decades. This extensive coverage allows us to observe how the subsidy channel operates across different monetary policy regimes, business cycles, and regulatory environments.

4.1.1 Baseline Specifications

Our baseline specification takes the form:

$$d_{b,t} = \alpha_b + \mu_t + \beta\sigma_{b,t-1} + \Sigma X_{b,t-1} + \epsilon_{b,t}. \quad (1)$$

[9] See Appendix A.1 for the complete theoretical derivation.

where $d_{b,t}$ measures the log of insured deposits for bank b in quarter t and $\sigma_{b,t-1}$ is the one-quarter lagged LLP ratio. $X_{b,t-1}$ is a vector of time-varying bank characteristics. Bank fixed effects (α_b) control for all time-invariant bank characteristics such as management quality, geographic footprint and business model choices that might independently influence both risk-taking and deposit supply. Quarter-year fixed effects (μ_t) control for aggregate shocks affecting all banks simultaneously. We also include bank size decile by time fixed effects to account for differential trends in deposit growth across size groups to soak away the effects of banking regulations that typically vary by size.

Table 2 presents the results. Column (1) shows the OLS estimate: a one standard deviation increase in the LLP ratio is associated with a 0.50% increase in insured deposits. This positive correlation is consistent with our hypothesis that banks expand insured deposit supply when the effective subsidy from deposit insurance increases. The coefficient is robust to the inclusion of controls, including the lagged equity-to-assets ratio, loans-to-assets ratio, deposits-to-assets ratio, and the share of real estate loans in the portfolio. These control variables ensure that our results are not driven by leverage, deposit dependence, or the asset mix of the bank.

Columns (4)-(6) examine the composition of deposits as the outcome variable. We find that banks with higher LLP ratios not only hold higher amounts of insured deposits but also increase the fraction of insured deposits relative to total deposits. Specifically, a one standard deviation increase in the LLP ratio is associated with a 0.20 percentage point increase in the insured deposit fraction. This compositional shift is consistent with our theoretical framework: when the marginal value of deposit insurance increases, banks should disproportionately expand their insured deposits, from which banks most directly benefit from this government guarantee.

In general, riskier banks should find it more difficult to attract deposits due to depositors' concerns about insolvency risk and panic runs. Our primary result that insured deposits increase with bank risk stand in sharp contrast to this conjecture, and establishes the importance of deposit insurance channel we propose in the paper. We directly assess the impact of increased bank risk on uninsured deposits in Table 3. In Columns (1) - (3) of the Table, we find a negative and significant effect of LLP on uninsured deposits consistent with the idea that depositors become more concerned about bank failure and withdraw their uninsured deposits.

A natural question arises: is the increase in insured deposit simply a reshuffling of old uninsured deposits to insured ones, or are banks attracting new insured deposits when they become riskier? A key institutional feature of the deposit insurance market makes it very unlikely that it is the old uninsured depositors who are converting to insured deposits in the same bank: they simply cannot do so because the insurance coverage applies to per depositor per bank basis. Therefore, uninsured depositors with large amounts of deposits in a bank with high LLP must go to other banks to obtain higher insurance. Likewise, a bank with high LLP must attract newer depositors as insured depositors.[10]

We now study the impact of LLP on total deposits and document our findings in Columns (4) - (6) of Table 3. Column (3) shows that total deposits increase at these banks, i.e., the increase in insured deposits does not get completely offset by the decrease in uninsured ones. When we add control variables to the regression model in Columns (5) and (6), the effect of LLP on total deposits disappears. Therefore, depending on the model specification, either the total deposit amount goes up and stays the same. This is an important result: even though banks are becoming riskier, they do not lose their total deposits as they increase the amount of insured deposits in their liabilities. Our evidence stands in sharp contract to the common narrative and economic intuition that banks lose deposit as they become riskier.

4.1.2 Deposit Pricing: Supply versus Demand

Our finding that riskier banks hold larger insured deposits is consistent with our subsidy hypothesis, but it does not definitively establish the mechanism. Adverse local economic conditions could increase deposit demand, as households and businesses seek safe havens for funds, while simultaneously weakening credit quality for banks operating in those regions. Distinguishing the supply versus demand effects requires examining how prices respond alongside quantities.

Since supply and demand shocks generate opposite predictions for price movements, we use the interest rates paid on deposits to separate the two channels. An increase in interest rate, i.e., lower price of deposits to the depositors, would be consistent with an outward shift in the supply curve, whereas a decrease in interest rate would support the demand shift. Price and quantity movements thus allow us to tease out the two channels. Further, our focus on insured deposit rates obviates the need to control for the default risk of the bank since bank risk does not play a role in pricing insured deposits.

We test this prediction using data on deposit rates from the Call Reports. We focus on core deposits – savings, transaction, and time deposits less than $100,000 before 2008, and less than

[10]Reciprocal deposits can be a mechanism where depositors with large sums of deposits can still get more insurance while maintaining the relationship with one bank. However, this product witnessed significant growth only after 2018, i.e., it was not an economically large share of bank deposits in much of our sample period (Kim et al., 2024).

$250,000 thereafter. We measure the interest rate paid on insured deposits following Chen et al. (2022). If our subsidy channel is correct, banks with higher LLP should offer higher rates on these products as they actively expand the supply of insured deposits.

Table 4 presents the results. A one standard deviation rise in the LLP ratio is associated with deposit rates that are 2.2 to 2.7 basis points higher – a 1.66% increase relative to the mean rate in our sample of 1.63% and corresponding to around $68 in additional interest expense on a $250,000 deposit account. We obtain quantitatively similar results when examining rates exclusively on insured certificates of deposits, shown in Columns (4)-(6). This similarity across different deposit denominations strengthens our interpretation that banks are systematically adjusting their supply behavior in response to changes in subsidy values rather than targeting specific depositor segments.

The combination of higher quantities and higher rates (lower prices) suggests an outward shift in the insured deposit supply curve, driven by changes in subsidy values, not movements along a fixed supply curve due to demand shocks. If insured deposit growth at risky banks reflected demand-side factors, such as uninformed depositors not recognizing credit deterioration, flight-to-safety flows due to implicit guarantees, or favorable local economic conditions, we would not observe these banks simultaneously paying substantial rate premia. The fact that riskier banks both gather more deposits and pay higher rates for them is inconsistent with increased demand but precisely matches the prediction of banks competing more aggressively to expand supply when subsidy values increase.

4.1.3 Branch-Level Analysis

A potential concern with bank-level regressions is that we are unable to control for local economic conditions that a bank branch faces in raising deposits. Banks with deteriorating credit quality could be disproportionately located in regions where depositors have stronger preferences for insured deposits, or local economic conditions could simultaneously drive both deposit supply and loan performance.

To address these concerns, we exploit branch-level deposit data from the FDIC's Summary of Deposits, which allows us to control for local economic conditions. One caveat is that branch-level deposits are reported in aggregate, without separating insured from uninsured balances. Since riskier banks are likely to lose uninsured deposits, analyzing aggregate deposits at the branch-level makes it harder to find our subsidy effect.

Our branch-level specification takes the form similar to equation 1:

$$d_{i,b,c,t} = \alpha_i + \mu_{c,t} + \beta\sigma_{b,t} + \Sigma X_{b,t} + \epsilon_{i,b,c,t}. \quad (2)$$

where $d_{i,c,b,t}$ represents the log of total branch deposits of branch i of bank b, operating in county c in quarter-year t. The key independent variable, $\sigma_{b,t}$, is the LLP ratio. Branch and geography by time fixed effects (α_i and $\mu_{c,t}$, respectively) control for branch-specific and time-varying county- or state-specific factors. This saturation of fixed effects ensures that we are comparing branches in the same county or state, in the same quarter, operated by banks with different risk profiles. The identifying variation comes from the fact that a given county typically has branches from multiple banks, and these banks differ in their aggregate (not local) credit quality. $X_{b,t}$ includes control variables such as capitalization ratio, number of branches, and bank size.

Table 5 presents the results. In column (1), we find that branches of banks with one standard deviation higher LLP ratios experience a 1.4% increase in deposits. The magnitudes are economically substantial and statistically significant. Adding state by quarter-year fixed effects in Column (2) leaves the estimate unchanged, while the more granular county by quarter-year fixed effects in Column (3) raise it modestly to 1.86%. Overall, it is unlikely that local demand shocks and regional economic conditions drive our results.

Importantly, the county $\times$ quarter-year fixed effects in Column (3) completely absorb the deposits channel mechanism documented by Drechsler et al. (2017). The positive and significant coefficient on LLP demonstrates that the subsidy channel operates through bank-level risk variation that is independent of: (1) monetary policy effects on deposit supply, (2) local market power and concentration, and (3) the interaction between these factors that drives the deposits channel.

Our results indicate that branches of riskier banks attract more deposits even when we compare them to branches of safer banks in the exact same location and time period. This pattern is difficult to reconcile with demand-side stories; instead, it is consistent with banks with higher subsidy values competing more aggressively for deposits by offering more attractive terms. In addition, the branch level analysis establishes that the total deposits, insured and uninsured combined together, increase in response to increased subsidy that banks receive through the deposit insurance.

5 Identification

Our results, especially the increase in quantity and interest rate at the same time, provides strong evidence supporting the supply side effects. Further the branch level regressions rule out the effect of local economic conditions from affecting our findings. A remaining concern is that of reverse causality: banks with more insured deposits may choose to take more risk, knowing they are protected by government guarantees. The timing convention used in our regression analysis makes this an unlikely channel: we use the lagged value of LLP as the measure of subsidy and relate it to the future financing decisions of the bank, making it unlikely that asset risk is responding to deposit financing.

We address the concern further using two complementary approaches: (1) an instrumental-variables strategy that exploits variation in realized loan performance driven by macroeconomic shocks to different asset classes, holding loan portfolio choices fixed; and (2) an event study of banks approaching failure, where reverse causality is implausible.

5.1 Instrumental Variables: Non-Performing Loans and Portfolio Composition

For our instrumental variables approach, we use non-performing loans (NPL) as our measure of bank risk. The NPL ratio, defined as the sum of nonaccrual loans and loans past due by more than 90 days divided by total loans, captures the realized deterioration of a bank's loan portfolio. Unlike LLP, which reflects managerial discretion and forward-looking assessments, NPL represents actual credit events that have already occurred. A key advantage of using NPL for identification is that it mitigates the moral hazard concern: if a bank increases its asset risk by making riskier loans, it will take several quarters – typically 2-4 years – for those loans to become non-performing. Hence, the use of NPL as a measure of asset risk ameliorates the concern that current deposit supply decisions cause future risk-taking, because higher levels of NPL in a given quarter reflect riskier portfolio choices made by banks in the past.[11]

Our instrument exploits two sources of variation: each bank's historical loan portfolio composition across different asset classes, and subsequent economy-wide shocks to credit quality within those classes. The construction follows a shift-share design. For each bank, we take its loan portfolio composition from the first quarter in which it appears in the Call Reports. Specifically, we measure the initial loan share, $w_{b,i}$, across five major categories i: real estate loans, com-

[11] In addition, LLP is not disaggregated by loan type in the Call Reports. Thus, we cannot exploit the within-bank variation in LLP across different asset classes.

mercial and industrial (C&I) loans, household and consumer loans, agricultural loans, and loans to financial institutions.[12] We then fix these portfolio weights and compute a predicted NPL ratio (*PortfolioWeightIV*) for each subsequent quarter by multiplying $w_{b,i}$ by time-varying aggregate NPL rates in each asset class ($s_{i,t}$):

$$\text{PortfolioWeightIV}_{b,t} = \sum_i w_{b,i} * s_{i,t}. \tag{3}$$

The intuition is straightforward. Banks make initial portfolio allocation decisions based on their expertise and local market conditions. These allocation decisions exhibit substantial persistence due to fixed costs, relationship banking, and the gradual nature of portfolio rebalancing. When macroeconomic conditions subsequently deteriorate for particular asset classes (e.g., commercial real estate downturn), banks with greater historical exposure experience larger increases in non-performing loans independent of their current portfolio decisions. This variation is plausibly exogenous because banks could not have anticipated the specific pattern of future credit shocks when making these initial allocation decisions. By including bank and time fixed effects in our regressions, we additionally absorb both permanent cross-bank differences and common macroeconomic shocks.

The first-stage results in Column (1) of Table 6 demonstrate that our instrument strongly predicts realized NPL ratios. A one standard deviation increase in *PortfolioWeightIV* is associated with a 0.50 percentage point increase in the realized NPL ratio. The instrument is highly significant, and the first-stage F-statistic exceeds 500. Even after absorbing variation through bank and time fixed effects, the instrument explains approximately 39% of the variation in NPL ratios.

Columns (2)-(4) examine log insured deposits as the outcome. Column (2) presents the OLS relationship: a one standard deviation increase in NPL is associated with a 0.8% increase in insured deposits, mirroring our earlier findings using the LLP ratio as the measure of bank risk. In the second stage, we find that a one standard deviation increase in the NPL ratio causes a 4.7% increase in insured deposits and that this finding is not driven by differential effects by bank size.

The IV estimate of 4.7% exceeds the OLS estimate of 0.8% for two main reasons. First, measurement error in LLP (e.g., managerial discretion, smoothing incentives) and in NPL (e.g., classification practices and charge-off timing) attenuates OLS toward zero, and our Bartik instrument corrects this by isolating plausibly exogenous macro-driven variation. Second,the instrument cap-

[12]Since the data on agriculture loans became available after 1991, the regression model with the IV design is estimated on a slightly shorter time period from 1991 to 2023.

tures systematic credit shocks since we compute it using aggregate default rates on different asset categories. Therefore, variation caused by the instrument captures the systematic component of loan losses, which matters most for deposit insurance value because of its effect on risk-premia.

Columns (5)-(7) examine the insured deposit fraction as the outcome variable. The OLS estimate in column (5) shows that a one standard deviation increase in the NPL ratio is associated with a 1.25 percentage point increase in the insured-to-total deposit ratio. The 2SLS estimate in columns (6) and (7) increases to 5.4 and 6.4 percentage points. This compositional result reinforces our interpretation that banks specifically expand the insured part of their liabilities where the government guarantee provides the most value. For a bank with an initial insured share of 77% (the sample mean reported in Table 1), a 5.4 percentage point increase corresponds to a 7% relative rise in the insured fraction.

5.2 Event Study: Deposit Dynamics of Failed Banks

In our second test, we examine banks approaching failure – a setting in which risk clearly rises over time and the bank's funding decision is primarily driven by their desire to exploit the value of insurance. Banks that ultimately fail experience deteriorating credit quality as their loans gradually sour. Importantly, by the time a bank is within a few quarters of failure, management typically operates under intense regulatory scrutiny and has little ability or incentive to expand risky lending.[13] Any increase in non-performing loans during this period primarily reflects the realization of past lending decisions during better times rather than the effect of concurrent financing decisions on new risks (Correia et al., 2025). If we observe deposit expansion during this period, accompanied by rising deposit rates and a shift toward insured products, it would strongly support our interpretation that banks respond to increasing subsidy values by actively expanding their supply of insured deposits, even when their ability to manipulate asset risk is severely constrained.

We estimate the following event-study specification for the 568 banks that failed between 2000Q4 and 2023Q4:

$$y_{b,t} = \mu_t + \sum_{k=-21}^{0} \beta_k \mathbb{1}[\text{Quarters to Failure} = k] + \epsilon_{b,t}. \tag{4}$$

[13]For instance, supervisory intervention such as consent orders, growth restrictions, and enhanced monitoring constrains new originations. Management can additionally face heightened personal liability and reputational loss.

where $y_{b,t}$ represents various deposit and asset quality measures for bank b in quarter t. The coefficients β_k trace the evolution of these measures as banks approach failure, with quarter zero representing the last quarter before failure. We include time fixed effects (μ_t) to control for aggregate trends. We examine behavior over the 21 quarters (approximately five years) preceding failure.

Figure 3 presents the results across six dimensions, while Table 7 reports selected coefficients at key event-time periods (-16, -12, -8, -4, and 0 quarters before failure). We find that the NPL ratio increases nearly monotonically from close to zero at 16 quarters before failure to approximately 10% in the quarter immediately preceding failure. The steady, gradual nature of this deterioration is important as it reflects the cumulative realization of credit losses rather than discrete strategic risk-taking episodes. LLP ratios (also shown in Panel (a), red line, and Column 7 of the table) follow a similar but slightly more volatile pattern, rising from near zero to about 1.2% by the quarter before failure. The correlation between NPL and LLP dynamics validates both as measures of asset quality deterioration, though the smoother trajectory of NPL as a realized stock variable (rather than a discretionary flow measure) makes it particularly suitable for this event study analysis.

The deposit composition dynamics, shown in Panel (b), are striking. The fraction of time deposits under $100,000 relative to total domestic deposits rises by 6.8% in the final quarter before failure. This dramatic shift toward smaller insured deposits indicates that failing banks strategically target the deposit segment where government guarantees provide the most value. The pattern is not confined to the final few quarters but emerges gradually over the entire pre-failure period, accelerating as bankruptcy approaches. Panel (c) confirms this compositional shift from a different angle: the ratio of insured to total domestic deposits increases by 3 percentage points, with the increase concentrated in the final 12 quarters.

Critically, we find that total deposits increase substantially as subsidy values rise. Panel (d) shows that log insured deposits increase by approximately 35% from 16 quarters before failure to the final quarter, while Panel (e) shows that log total deposits increase by approximately 33%. These are large economic magnitudes: failed banks increase their total deposits by about one-third in the five years before failure, even as their credit quality systematically deteriorates. This finding is crucial for interpreting our mechanism. Despite facing severe financial distress and rising NPL ratios, these banks do not experience deposit outflows; instead, they actively expand their deposit base. The slightly faster growth of insured deposits relative to total deposits confirms that banks strategically emphasize the insured segment where the subsidy is most valuable, but the key result is that total deposits grow substantially rather than contract. This expansion occurs precisely when subsidy values are increasing most rapidly, providing strong evidence that banks respond to higher subsidies by competing aggressively for deposits rather than passively accepting deposit flight.

The fact that total deposits expand (rather than contract) during the pre-failure period rules out several alternative interpretations. If our results simply reflected uninsured depositors fleeing risky banks (a pure demand-side story), we would observe declining total deposits even as the insured fraction mechanically increased. Instead, the growth in total deposits indicates that banks actively supply more deposits by offering attractive terms, and this supply expansion more than offsets any flight by uninsured depositors. The deposit expansion occurs even as asset quality systematically deteriorates, ruling out the interpretation that deposit growth simply reflects bank health or business expansion.

The pricing evidence in Panel (f) further supports a supply-side interpretation of deposit growth. Banks approaching failure offer substantially higher rates to attract deposits, with the 12-month CD rate rising from 11 basis points above baseline at 16 quarters before failure to 27–38 basis points in quarters 8 through 4. This increase is steepest in the middle period (quarters 12 through 4), coinciding with the fastest growth in total deposits and the largest shifts in deposit composition. Such rising rate premia are difficult to reconcile with demand-driven explanations, under which banks experiencing stronger deposit demand could maintain or lower rates. Instead, the joint increase in quantities and rates indicates an outward shift in deposit supply, consistent with banks actively expanding insured deposit supply as subsidy values increase.

Several features of these dynamics merit emphasis. First, the patterns emerge gradually over multiple years, not suddenly in the final quarters. The NPL ratio begins rising 16-20 quarters before failure, total deposit expansion accelerates steadily, and rate premia grow from 11 to 38 basis points between quarters -16 and -8. This gradual evolution rules out alternative explanations based on last-minute revelation of information or sudden panic by depositors. If depositors were reacting to discrete information events, we would see discontinuous jumps in deposit flows and rates; instead, the smooth trajectories suggest a systematic supply-side response by banks as subsidy values gradually increase. Second, the strong positive relationship between NPL ratios and deposit quantities as well as rates matches our subsidy channeland the supply-side interpretation. Third, the disproportionate growth of insured relative to total deposits confirms that banks prioritize the insured segment where the government guarantee is most valuable.

While it is true that our event study sample of failed banks is not necessarily representative, it is important to note that we are not attempting to estimate the magnitude of the subsidy effect for the average bank. Rather, we use it as a well-identified setting where reverse causality is ruled out. The fact that we observe the predicted patterns validates our interpretation of the cross-sectional results in Tables 2-6.

5.3 Aggregate Effects and Time-Series Evidence

In this section, we examine whether aggregate banking sector risk influences total deposit supply through the subsidy channel. If the subsidy channel operates at the system level rather than just across individual banks, it has clear implications for monetary-policy transmission and financial stability.

Panels (a) and (b) of Figure 2 plots the time series of year-over-year changes in total banking sector deposits against changes in the aggregate LLP ratio.Using year-over-year changes ensures that our deposit supply measure is not affected by seasonal variation in banks' accounting practices. Panel (a) shows a positive correlation of 10% between aggregate LLP growth and total deposit growth. Appendix Figure A.2a shows even stronger correlations with other measures of bank risk: 19% for bond credit spreads and 34% for implied volatility of bank returns. The correlation between the LLP ratio and *insured* deposit growth is substantially higher at 32% (panel (b)). The stronger relationship for insured deposits in Panel (b) – precisely the segment most directly benefiting from government guarantees – provides strong support for our subsidy channel. It also suggests that the aggregate relationship primarily operates through compositional shifts: when banking sector risk rises, banks reallocate deposits toward insured products where the subsidy is most valuable. In panel (c) of Figure 2, the rate spread of insured deposit rates over the federal funds rate exhibit a negative correlation of -0.09 with the LLP ratio. This pricing pattern at the aggregate level mirrors our findings from Table 2, confirming that when insurance subsidies increase, banks compete more aggressively for deposits and reduce spreads.

Appendix Table A.1 formalizes these relationships using time-series regressions, with the caveat that such a time-series regression is unlikely to detect a causal link since several other forces are likely to be at play in the time-series, including the effect of money-market-mutual-funds on banking sector deposits and the aggregate banking sector policies. We include the independent effect of changes in Fed Funds rate as well as the the changes in the Fed's balance sheet size to separate out the direct effect of deposit channel and the reserves channel from affecting our analysis (Drechsler et al., 2017; Acharya and Rajan, 2024), however it is impractical to soak away the effect of all possible sources of variation in such a regression. Our panel data regression remains the key empirical specification of the paper.

We do not find any meaningful relationship between total deposit growth and the LLP ratio in the aggregate: the loss of uninsured deposit and the gain of insured deposits seems to cancel each other out in the aggregate. Consistent with the subsidy channel, Column (2) documents a strong positive relationship between LLP ratio and the insured deposit growth. Column (3) shows the pricing effect: banks pay higher interest rate on insured deposits when aggregate loan losses are high. These results confirm that the subsidy channel operates at the aggregate level in addition to across banks. We discuss the macroeconomic and financial stability implications further in Section 6.

5.4 Robustness

5.4.1 High-Frequency Measures of Bank Risk

Our main results use LLP and NPL as measures of bank asset risk. While these accounting-based measures have important advantages, they also have limitations: LLP reflects managerial discretion and may be subject to earnings management or smoothing, while NPL depends on classification decisions and charge-off timing. To address these concerns, we study the subsidy channel using alternative measures of bank risk. First, we use implied volatility from one-year at-the-money equity options, which reflects market expectations of future equity volatility for publicly traded bank holding companies. Second, we use banks' bond spreads over maturity-matched Treasury securities, which capture credit risk as perceived by debt investors. Third, we compute a book-based measure of asset volatility: the four-quarter rolling standard deviation of return on assets (ROA).

Table 8 presents the results. Column (1) indicates that banks with one standard deviation higher implied equity volatility hold 1.9% more insured deposits. To the extent that market-based risk measures can be confounded by leverage, asset composition, bank size, and funding structure, we control for these variables in Column (2). The coefficient remains statistically and economically significant. Columns (3) and (4) use bond spreads as the bank risk measure: a one standard deviation higher spread is associated with 12.9% or 10.3% more insured deposits. The larger magnitude likely reflects that bond spreads more directly capture default risk – the core determinant of deposit insurance value – whereas equity volatility also reflects upside uncertainty. The results remain significant despite the small samples of banks with actively traded bonds or options. Figure 4 displays the relationship between aggregate insured deposit growth and our alternative risk measures. Insured deposit growth and bank bond spreads (implied volatility) exhibits a strong positive correlation of approximately 41% (60%).[14] Overall, we confirm that insured deposits increase during high-risk periods when insurance subsidies are most valuable.

Appendix Figure A.2a provides additional evidence that the deposit-risk relationship operates through our proposed subsidy channel. Panel (a) examines total deposit growth, showing correlations of 19% with bank bond spreads and 34% with implied volatility. These weaker relationships for total deposits compared to insured deposits reinforce our earlier finding that the subsidy channel operates primarily through compositional shifts toward insured products rather than through overall deposit expansion. Panel (b) examines deposit spreads, showing strong negative correlations with both risk measures (-55% for bank bond spreads and implied volatility). This pricing pattern at the aggregate level, shown in Appendix Figure A.2b, mirrors our cross-sectional results in Table 2 and confirms that the subsidy mechanism operates consistently across both individual banks and the banking system as a whole.

These robustness results have two important implications. First, they demonstrate that our findings are not an artifact of accounting measurement or managerial discretion. Second, the consistency across different risk measures strengthens our interpretation that we are capturing variation in true economic risk (the underlying volatility of bank assets) rather than noise or idiosyncratic features of particular accounting treatments. The fact that implied volatility, bond spreads, and accounting based measures all predict similar deposit responses provides confidence that our mechanism is robust.

It is worth noting the limitations of these alternative measures. They are available only for publicly traded bank holding companies (a small fraction of our sample) and for limited time periods, restricting statistical power. They also mechanically incorporate leverage, as higher deposits raise leverage and thereby increase both equity volatility and bond spreads. We address this concern by controlling for the equity-to-assets ratio in all specifications, but some mechanical correlation may remain. Despite these caveats, the alignment between accounting and market-based measures indicates that our findings reflect genuine economic forces rather than measurement artifacts.

[14] Appendix Figure A.3 examines the relation with CDS spreads, finding a correlation of 31%.

5.4.2 Excluding Headquarters Branches: Approximating Insured Deposits

Our branch-level analysis in Table 5 uses total branch deposits as the outcome variable, combining both insured and uninsured components. While we would ideally examine insured deposits at the branch level, the Summary of Deposits data does not disaggregate deposits by insurance status at the branch level. However, we can construct an approximation by exploiting differences in deposit composition between headquarters and non-headquarters branches.

According to the Summary of Deposits reporting instructions, deposits should generally be assigned to the office in closest proximity to the account holder's address. However, the instructions recognize that "certain classes of deposits and deposits of certain types of customers may be assigned to a single office for reasons of convenience or efficiency." In practice, this means that brokered deposits, internet deposits, and other large wholesale deposits, which are more likely to exceed FDIC insurance limits, are often assigned to the headquarters branch regardless of where the depositor is located. Consequently, headquarters branches tend to have disproportionately large average deposit balances and higher concentrations of uninsured deposits, while non-headquarters branches serve primarily retail customers with smaller, fully-insured deposits (see Kundu et al. (2021) for details on the geographic concentration of deposits).

By excluding headquarters branches, we effectively isolate branches that predominantly gather retail deposits, most of which fall below the FDIC insurance threshold. This provides an indirect test of whether our results are driven by insured deposits, specifically. If the subsidy channel operates primarily through insured deposits, as our theory predicts, we should observe similar effects when we exclude headquarters branches and focus on predominantly-insured retail deposits. Appendix Table A.2 presents the results. The similarity of results when focusing on retail-oriented branches provides additional evidence that the subsidy channel operates through insured deposits.

6 Interest Rate Sensitivity and Monetary Policy Transmission

Our findings have important implications for understanding how monetary policy transmits through the banking sector. There is a large literature on the effect of monetary policy changes on economic outcomes, including traditional channels that emphasize the direct effect of interest rates on spending and investments, the credit channel that focuses on the role of banks, and the collateral channel that focuses on effect of interest rates on asset valuation. Developed more recently, the deposits channel emphasize the importance of bank market power in the transmission of monetary policy shocks. Banks decrease their deposit supply and increase the spreads in high interest rate regime due to the market power they enjoy especially in a high interest rate regime (Drechsler et al., 2017). Our subsidy channel provides an independent mechanism through which monetary policy affects deposit supply. In our model, the connection between interest rates and deposit insurance value operates through two channels, as detailed in Appendix A.1. First, policy rates and bank risk are negatively correlated: the Federal Reserve typically lowers rates during economic downturns when credit risk is elevated. We confirm this pattern in Appendix Figure A.4, which plots the Fed Funds rate against the aggregate LLP ratio from 1986 to 2021. The negative correlation of approximately -53% is visually apparent and economically intuitive. During the 2001 recession, 2008-09 financial crisis, and 2020 pandemic, the Fed aggressively cut rates precisely when banking sector provisions spiked. This negative correlation implies that periods of low interest rates coincide with high deposit insurance subsidies through the risk channel.

Second, interest rates can affect the value of the deposit insurance put option in an economy where deposits provide liquidity services to the consumers. In periods of scarce liquidity in the aggregate financial system, the value of liquidity provided by the deposit contracts is likely to be relatively higher compared to periods with abundant liquidity. Periods of low liquidity are characterized in our model as periods of high interest rates. For example, in an economy with limited reserves in the banking system, aggregate liquidity is expected to be low and the interest rates high. Therefore, depositors are willing to pay more for liquidity services, i.e., accept relatively lower interest rate, in periods of high interest rate. As a result, the value of the default option of the bank goes down when interest rates are high. Consequently, the value of deposit insurance premium decreases when interest rates are high, i.e., the subsidy comes down in high interest rate regime. As a result, banks are less willing to supply deposits in high interest regime.

Both these forces imply that the deposit supply curve shifts outward when interest rates fall, operating independently of banks' market power in local deposit markets.

6.1 Distinguishing the Subsidy Channel from the Deposits Channel

To establish that our subsidy channel is distinct from the deposits channel, we study both mechanisms in a single regression specification. The deposits channel operates through the interaction of Federal Funds rate changes (ΔFF) and local market concentration (HHI): when the Fed lowers rates, banks in concentrated markets increase the supply of deposits by paying relatively higher interest rates (as a deviation from the Fed Funds rate as in Drechsler et al. (2017)). Since both the Fed Funds rate and local market structure vary at the county-time level, the inclusion of county × quarter-year fixed effects in our earlier regressions completely absorb this interaction ($\Delta FF_t \times HHI_{c,t}$), absorbing the deposits channel mechanism.

In this section, we drop the county × quarter-year fixed effects, and directly include ($\Delta FF_t \times HHI_{c,t}$) as an additional regressor in the model. Table 9 presents the results using branch-level deposit growth as the outcome variable. Column (1) reproduces the deposits channel result: the coefficient on ΔFF × HHI is negative and significant (-0.91), indicating that when the Federal Reserve lowers rates (negative ΔFF), banks in concentrated markets (high HHI) experience larger deposit inflows. This confirms the market power mechanism. Column (2) adds the change in the LLP ratio (ΔLLP) to the specification. The deposits channel coefficient becomes stronger (-1.25), while ΔLLP enters with a positive and significant coefficient (0.010): branches affiliated with banks experiencing larger provision increases also experience higher deposit growth, even controlling for interest rate movements and HHI. The fact that both variables remain significant indicates they capture distinct mechanisms.

The key test comes in Columns (5) and (6), which include county × quarter-year fixed effects. These fixed effects completely absorb the ΔFF × HHI interaction, eliminating the deposits channel by construction – we can no longer include these variables in the regression because they are perfectly collinear with the fixed effects. Yet ΔLLP remains positive, significant, and economically meaningful (coefficient of 0.011 in Column 6). This result demonstrates that our subsidy channel operates through bank-level risk variation that is orthogonal to local market power and monetary policy effects.

Moreover, our most conservative specifications in the cross-sectional analysis (Tables 2, 5, and 6) include quarter-year fixed effects that absorb the level of the federal funds rate and other aggregate time-varying factors. The fact that LLP and NPL ratios remain significant predictors of deposit supply in these specifications further confirms that the subsidy channel operates through bank-specific variation in risk rather than merely reflecting the aggregate correlation between interest rates and banking sector risk.

6.2 Implications for Bank Risk-Taking and Reaching-for-Yield

Our findings also have implications for understanding bank risk-taking behavior, particularly the "reaching-for-yield" phenomenon (Rajan, 2006; Acharya et al., 2013). This literature shows that banks invest in riskier assets during low interest rate environments to achieve higher yields. The typical explanation invokes agency frictions: managers have nominal return targets and increase risk to meet these targets when safe asset returns are low.

Our subsidy channel provides a complementary, and in some ways more fundamental, explanation that operates through rational optimization rather than agency conflicts. When banks become riskier, whether through deliberate portfolio choices or exogenous shocks to credit quality, the value of deposit insurance increases. This creates a direct incentive to expand insured deposit supply, as we document throughout our analysis. Importantly, this mechanism operates even without agency problems: a bank maximizing shareholder value will rationally choose to increase risk-taking when the subsidy from deposit insurance rises, because the government guarantee effectively lowers the bank's cost of capital for risky investments by capping downside losses.

The connection to reaching-for-yield behavior is straightforward but nuanced. During low interest rate periods, banking sector risk is typically elevated (Appendix Figure A.4). Higher risk increases deposit insurance subsidies, which in turn increases banks' willingness to expand insured deposits. As banks expand deposits, they need to deploy these funds in loans and investments. The increased subsidy makes riskier assets more attractive on a risk-adjusted basis because the deposit insurance put option limits losses. Thus, low interest rates encourage risk-taking not just because managers are reaching for nominal yields (the traditional explanation), but because the economic value of government guarantees has increased, making risky strategies genuinely more profitable from the bank's perspective after accounting for the implicit subsidy.

This interpretation suggests that reaching-for-yield may be partially a rational response to changing subsidy values rather than purely a behavioral or agency-driven phenomenon. Banks are not simply taking excessive risk due to misaligned incentives; they are optimizing their portfolios given that the government has effectively reduced their cost of capital for risky investments through deposit insurance. Of course, both channels – agency frictions and subsidy incentives – can coexist in practice, and our results do not rule out the importance of managerial agency problems. Rather, we identify an independent mechanism that operates even with perfect alignment between managers and shareholders.

6.3 Broader Implications

Despite extensive research on deposit insurance dating back to Merton (1977), surprisingly little is known about how changes in subsidy values affect banks' incentives to supply deposits.

The existing literature focuses almost exclusively on the asset side: how deposit insurance encourages excessive risk-taking in loan portfolios and investment decisions (Keeley, 1990). Our results demonstrate that banks also optimize their liability structure in response to subsidy variation, actively expanding insured deposit supply when subsidies increase. This liability-side response has several important implications.

First, it affects the fiscal cost of deposit insurance. When aggregate banking sector risk rises, not only does the expected payout from the insurance fund increase (because failures become more likely), but banks simultaneously expand their insured deposits (as shown in our time-series results in Figure 2). This expansion of the insured deposit base amplifies the fiscal burden during crises. Policymakers evaluating the cost of deposit insurance should account for this endogenous liability response, not just the mechanical increase in expected losses on a fixed deposit base.

Second, our findings have implications for financial stability. During periods of stress, when banks face funding pressures, the deposit insurance subsidy provides a mechanism for distressed banks to continue attracting deposits by offering higher rates. While this may appear stabilizing in the short run by preventing sudden deposit runs, it can delay the recognition of insolvency and enable weak banks to continue operating and potentially taking excessive risks. The failed bank event study illustrates this dynamic: banks approaching failure expanded deposits substantially in the years before collapse, suggesting the subsidy may have prolonged their operations.

Third, our results inform debates about deposit insurance design and pricing. Current FDIC premiums adjust for bank risk, but as documented in Section 2, this adjustment is coarse and incomplete. Our findings show that even imperfect risk-based pricing generates substantial variation in effective subsidies, and banks respond to this variation by adjusting deposit supply. Charging premiums that fully reflect the market value of the insurance guarantee could dampen these supply responses and reduce the extent to which the insurance system distorts banks' liability choices.

7 Conclusion

This paper identifies a novel mechanism through which government guarantees influence deposit supply: the deposit insurance subsidy. By modeling deposit insurance as a put option, we demonstrate that the value of the subsidy varies with bank risk and macroeconomic conditions, particularly changes the aggregate risk of the banking sector. Since FDIC insurance premiums do not fully adjust to reflect shifts in the market value of deposit insurance, the effective subsidy that a bank enjoys changes with parameters that change the market value of the FDIC insurance guarantee. Using detailed data on U.S. banks from 1986 to 2023, we provide robust empirical evidence that banks expand deposit supply in response to increases in subsidy value.

The subsidy channel also has implications for financial stability. By incentivizing banks to expand deposit supply in response to higher asset risk, the effective cost of deposit insurance to the FDIC can be substantially higher than a model that ignores this effect. These findings suggest that policymakers should carefully consider the impact of additional deposits that a high risk bank raises to exploit the subsidy value. Our paper presents a novel challenge to the models of deposit insurance pricing since the amount of underlying asset that the FDIC insures changes with the increasing volatility of the asset. Practically all existing models of deposit insurance pricing ignores this effect in their estimation and calibration.

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Figures

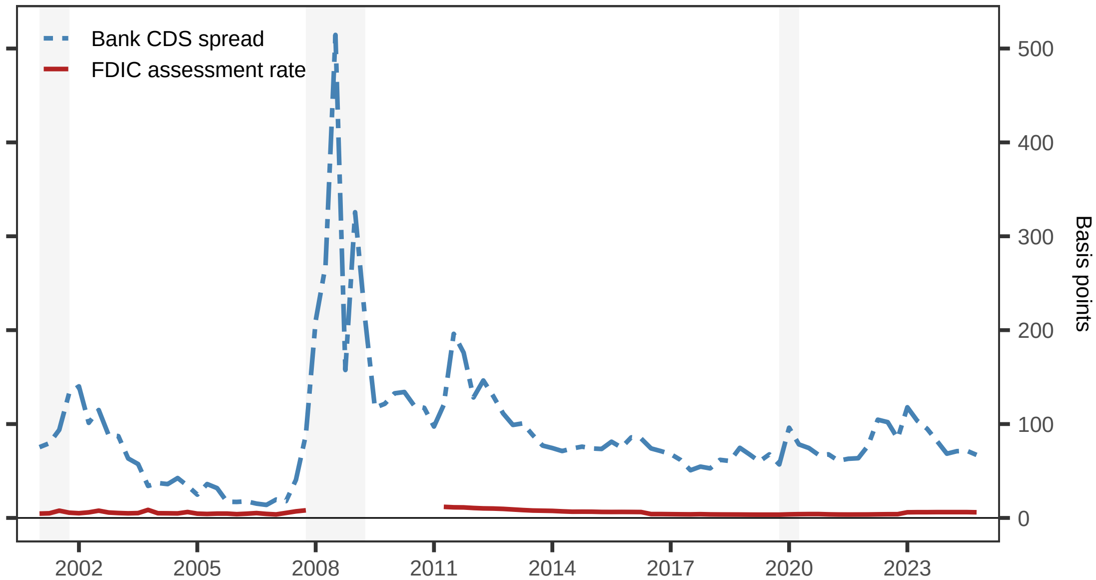
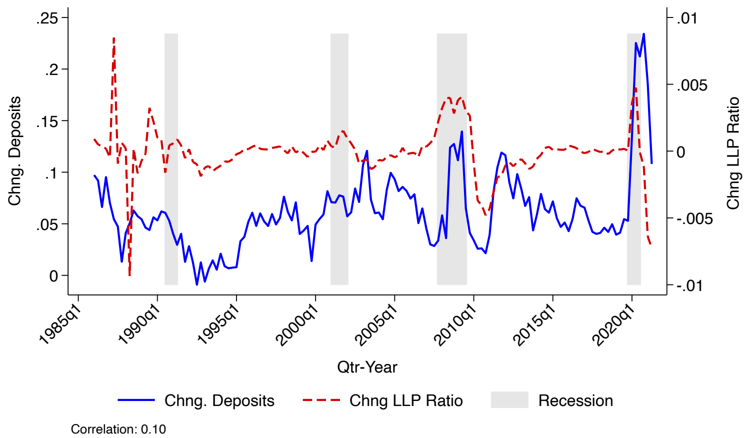
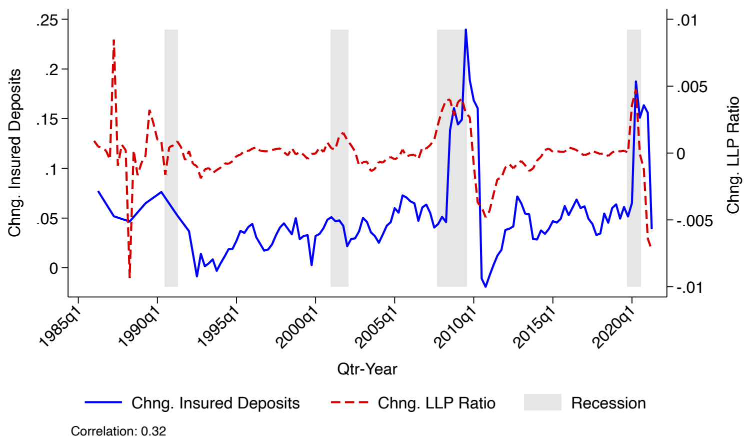


Figure 1: FDIC Assessment Rates and Bank Risk

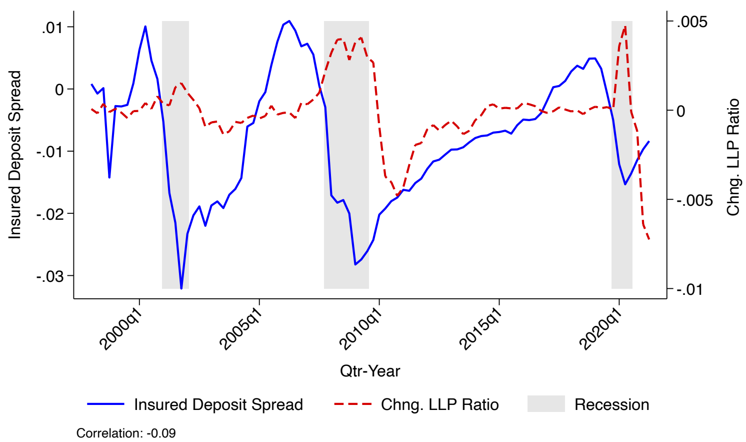
Notes: This figure plots the relationship between the annualized FDIC deposit insurance assessment rates levied on commercial banks and the bank CDS spread between 2001Q1 and 2024Q4. The grey shaded region denotes recessions.
Source: Call Reports, FDIC, Markit.



(a) Total deposits and LLP Ratio



(b) Insured deposits and LLP Ratio

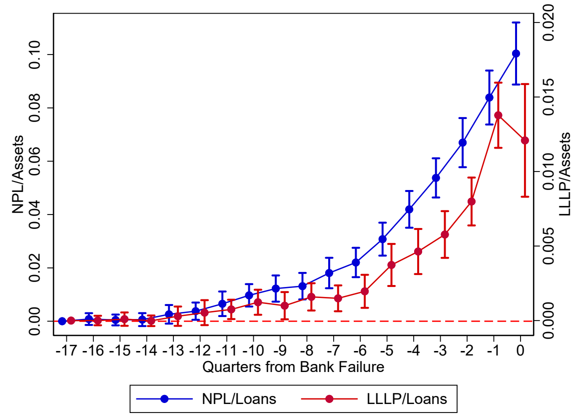


(c) Insured Deposit Rate Spread and LLP Ratio

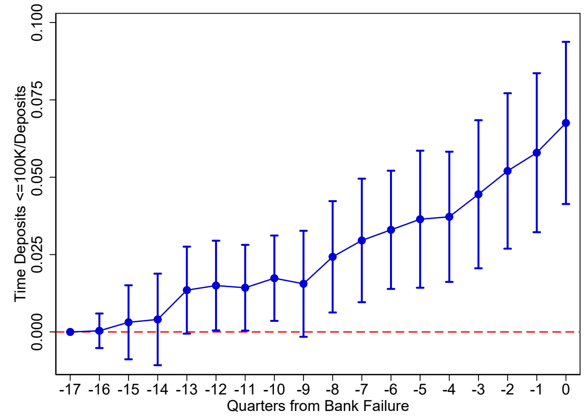
Figure 2: Deposit Growth and Loan Loss Provisions

Notes: This figure plots the relation between year-over-year quarterly deposit growth rates and the year-over-year quarterly changes in LLP Ratio. Panel (a) plots the growth of total deposits, Panel (b) plots the growth of insured deposits, and Panel (c) panel plots the average insured deposit rate spread over the fed funds rate.
Source: Call Reports.

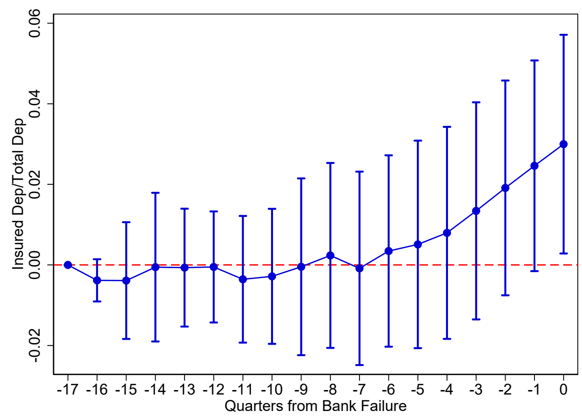
Figure 3: Event Study: Dynamics of Bank Deposits for a Sample of Failed Banks



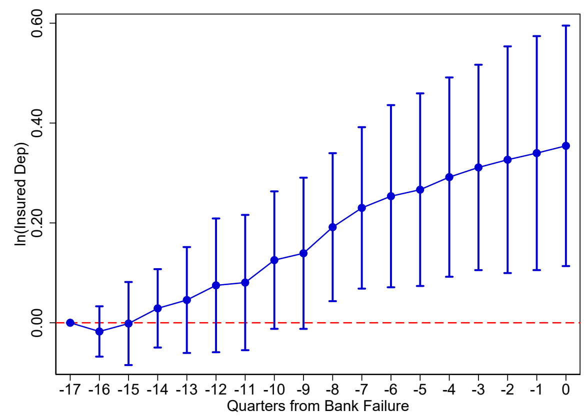
(a) NPL and Loan Lease Loss Provisions



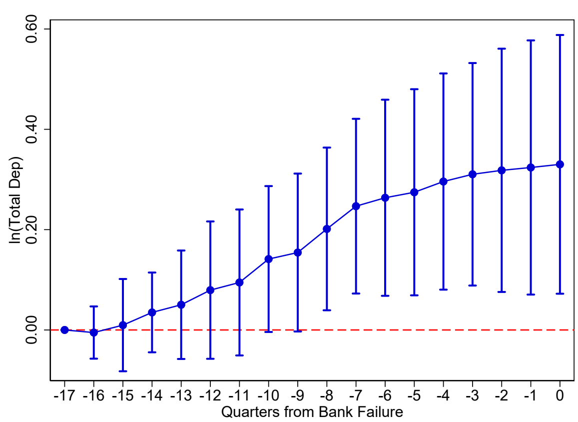
(b) Time Deposits ≤\$100k / Deposits



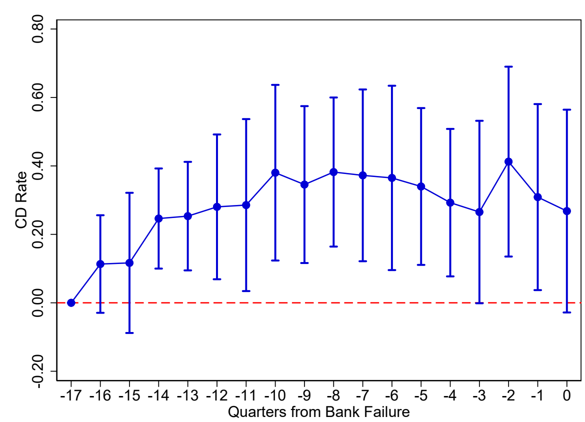
(c) Insured Deposit Fraction



(d) ln(Insured Deposits)



(e) ln(Deposits)



(f) CD Deposit Rate

Notes: This figure presents estimates from event-study regressions examining the dynamics of deposit and asset quality measures for failed banks in the 17 quarters preceding failure. Each panel plots coefficients from a separate regression of the form $y_{it} = \sum_{k=-17}^{0} \beta_k \mathbb{1}[\text{Quarters to Failure} = k] + \gamma_t + \varepsilon_{it}$, where γ_t represents calendar quarter fixed effects. The x-axis shows quarters relative to bank failure (quarter 0 is the last quarter before failure). Panel (a) shows the ratio of non-performing loans to total loans (blue) and the ratio of loan, lease, loss provisions to total loans (red). Panel (b) shows the fraction of time deposits under \$100,000 relative to total domestic deposits. Panel (c) shows the ratio of total insured deposits to total domestic deposits. Panel (d) displays the natural logarithm of total insured deposits. Panel (e) displays the natural logarithm of total domestic deposits. Panel (f) presents the bank's 12-month CD rate. Error bars areas represent 90% confidence intervals. Standard errors are two-way clustered by bank and quarter-year to account for serial correlation within banks and common shocks across banks in the same time period. There are a total of 568 failed banks from 2000Q4 through 2023Q4.

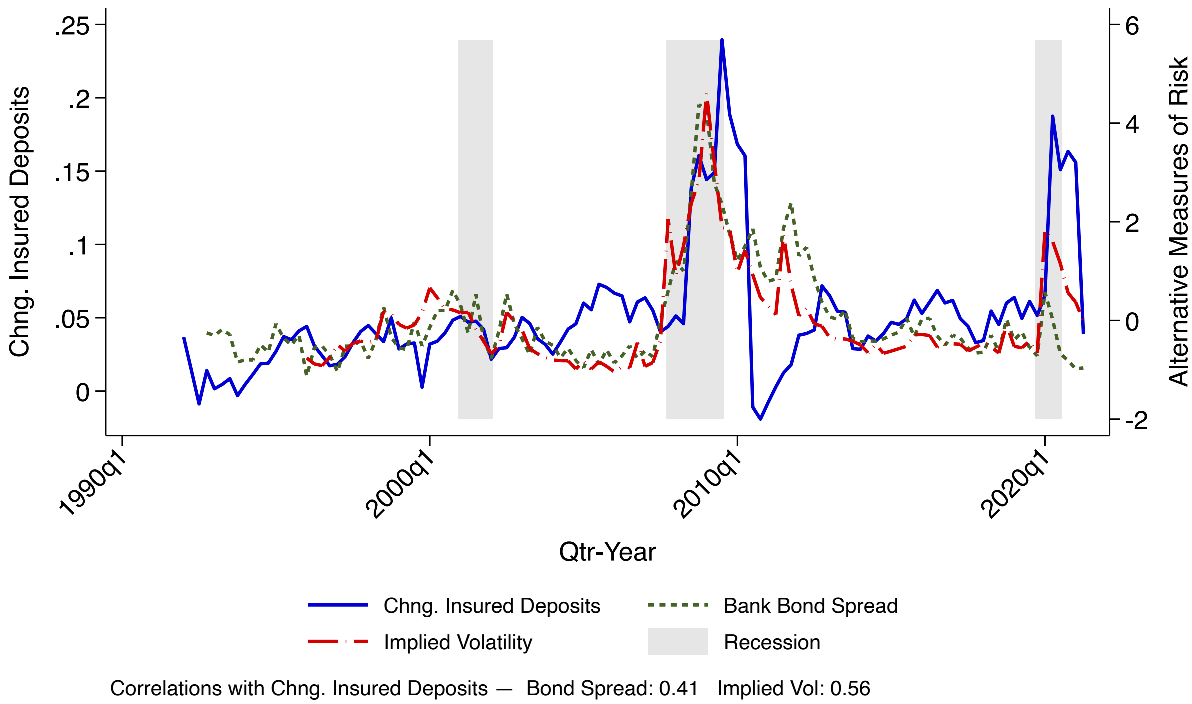


Figure 4: Insured Deposits Growth and Alternative Measures of Bank Risk

Notes: This figure plots the relation between the year-over-year quarterly insured deposit growth rates and alternative measures of bank risk. The alternative measures of bank risk include the bank bond interest rate spread over a maturity-matched treasury bond, the implied volatility from options on the banks' equity.
Source: Call Reports.

Tables

Table 1: Summary Statistics

	Mean	SD	Min	P25	P50	P75	Max	N
LLP Ratio	0.612	1.36	-0.717	0.000	0.221	0.568	9.817	1168382
Insured Deposits to Total Deposits	83.372	13.38	0.000	78.172	86.512	92.420	99.930	976777
Core Deposit Rate	1.632	1.20	0.100	0.599	1.372	2.422	4.863	496109
Insured Deposit Rate	3.020	1.78	0.287	1.373	2.809	4.673	6.489	602302
Implied σ	0.337	0.21	0.026	0.235	0.282	0.367	7.258	25353
$PortfolioWeightIV$	1.754	1.09	0.614	1.042	1.290	2.230	5.854	902936
$NPLRatio$	1.660	2.21	0.000	0.284	0.894	2.097	12.412	1170998
Book Equity to Book Assets	10.234	3.93	4.088	7.874	9.375	11.477	29.766	1175102
Loans to Assets	57.499	15.93	14.075	47.476	59.329	69.148	86.592	1175102
$\sigma(ROA)$	0.001	0.00	0.000	0.000	0.001	0.002	0.017	1164135
Bank Bond Spread	0.012	0.01	0.000	0.006	0.008	0.013	0.145	7653

Notes: LLP Ratio is the annualized quarterly loan loss provision over total loans. Core deposit rate is the annualized two-quarter average of interest expense on transaction, savings, and insured time deposits over the quantity of these amounts. Insured deposit rate is the annualized two-quarter average of interest expense on insured time deposits over the quantity of these amounts. Implied σ is the rolling one-year implied volatility of sample banks' equity returns using Optionsmetric. PortfolioWeightIV is the shift-share instrument constructed by multiplying a bank's earliest available lagged portfolio weights across five asset classes by the aggregate NPL levels in those asset classes. NPL ratio is defined as the sum of nonaccrual loans and accruing loans that are past due by more than 90 days divided by total net loans. $\sigma(ROA)$ is the standard deviation of the banks' lagged four quarters of return on assets. Bank Bond Spread is the banks' average bond yield minus maturity-matched treasury bonds.
Source: OptionMetrics, Call Reports, TRACE, FISD.

Table 2: Bank Risk and Insured Deposits

	Log(Ins. Dep.)			Insured Fraction		
	(1)	(2)	(3)	(4)	(5)	(6)
L.LLP Ratio	0.005***	0.004***	0.003***	0.185***	0.212***	0.158***
	(2.68)	(3.97)	(3.18)	(7.48)	(8.33)	(6.26)
L.Book Equity to Book Assets		0.018***	0.016***		-0.529***	-0.562***
		(6.02)	(5.77)		(-7.70)	(-7.92)
L.Loans to Assets		0.020***	0.019***		0.203***	0.192**
		(6.19)	(5.76)		(2.60)	(2.49)
L.Deposits to Assets		1.326***	1.306***		2.427**	2.131**
		(19.21)	(20.01)		(2.50)	(2.20)
L.Real Estate Loans		0.077***	0.086***		3.782***	4.098***
		(3.57)	(3.74)		(6.45)	(7.06)
L.Log(Assets)		1.335***	1.337***		-4.842***	-3.070***
		(233.20)	(88.80)		(-25.33)	(-7.29)
Time FE	✓	✓	✓	✓	✓	✓
Bank FE	✓	✓	✓	✓	✓	✓
Bank Size Decile × Time FE			✓			✓
Observations	967,991	967,991	967,991	967,961	967,961	967,961
R^2	0.91	0.98	0.98	0.76	0.77	0.77

t statistics in parentheses

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

Notes: This table documents the relation between the LLP Ratio of a bank and the bank's insured deposits. The outcome variable in Columns (1) - (3) is the log of total insured deposits. The outcome variable in Columns (4) - (6) is the fraction of insured deposits as a percentage of total deposits. When indicated, specifications include year-quarter, bank, and bank size decile by year-quarter fixed effects. All explanatory variables are standardized, and standard errors are clustered by bank holding company.
Source: Call Reports.

Table 3: Bank Risk and Uninsured Deposits

	Log(Unins. Dep.)			Log(Deposits)		
	(1)	(2)	(3)	(4)	(5)	(6)
L.LLP Ratio	-0.010***	-0.014***	-0.014***	0.009***	0.000	0.000
	(-4.29)	(-7.77)	(-7.79)	(6.59)	(0.11)	(0.30)
L.Book Equity to Book Assets		0.055***	0.065***		0.028***	0.026***
		(11.17)	(13.05)		(8.92)	(9.03)
L.Loans to Assets		0.039***	0.028***		0.013***	0.013***
		(7.21)	(5.10)		(5.39)	(5.06)
L.Deposits to Assets		1.200***	1.027***		1.337***	1.329***
		(17.31)	(15.39)		(21.21)	(22.46)
L.Real Estate Loans		-0.312***	-0.303***		0.025	0.031
		(-7.60)	(-7.51)		(1.38)	(1.55)
L.Log(Assets)		1.639***	1.569***		1.416***	1.399***
		(129.27)	(61.93)		(304.05)	(100.72)
Time FE	✓	✓	✓	✓	✓	✓
Bank FE	✓	✓	✓	✓	✓	✓
Bank Size Decile × Time FE			✓			✓
Observations	962,370	962,370	962,370	1,149,991	1,149,991	1,149,991
R^2	0.87	0.92	0.92	0.91	0.99	0.99

t statistics in parentheses

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

Notes: This table documents the relation between the LLP Ratio of a bank and the bank's uninsured deposits in Columns (1) - (3) and total deposits in Columns (4) - (6). The outcome variable in Columns (1) - (3) is the log of total uninsured deposits. The outcome variable in Columns (4) - (6) is the log of total deposits. When indicated, specifications include year-quarter, bank, and bank size decile by year-quarter fixed effects. All explanatory variables are standardized, and standard errors are clustered by bank holding company.
Source: Call Reports.

Table 4: Bank Risk and Insured Deposit Rates

	Core Deposit Rate			Insured CD Rate		
	(1)	(2)	(3)	(4)	(5)	(6)
L.LLP Ratio	0.022***	0.023***	0.027***	0.011***	0.014***	0.018***
	(11.64)	(12.62)	(15.11)	(6.47)	(8.73)	(10.98)
L.Book Equity to Book Assets		0.009**	0.007		-0.021***	-0.014***
		(2.02)	(1.48)		(-5.83)	(-3.66)
L.Loans to Assets		0.038***	0.038***		0.061***	0.062***
		(6.22)	(6.07)		(11.11)	(11.29)
L.Deposits to Assets		0.121**	0.052		-0.023	0.003
		(1.99)	(0.88)		(-0.48)	(0.06)
L.Real Estate Loans		0.099**	0.093**		-0.023	-0.042
		(2.18)	(2.03)		(-0.59)	(-1.09)
L.Log(Assets)		0.211***	0.187***		0.152***	0.161***
		(16.16)	(9.35)		(14.65)	(8.92)
Time FE	✓	✓	✓	✓	✓	✓
Bank FE	✓	✓	✓	✓	✓	✓
Bank Size Decile × Time FE			✓			✓
Observations	494,982	494,982	494,982	601,471	601,471	601,471
R^2	0.92	0.92	0.92	0.94	0.94	0.94

t statistics in parentheses

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

Notes: This table documents the relation between the LLP Ratio of a bank and the bank's deposit rates. Deposit rates are constructed following Chen et al. (2022) as the annualized two-quarter average interest expense over deposits. Core deposit rate is the rate on transactions, and savings, and insured time deposits. Insured CD rate is the rate on insured time deposits. When indicated, specifications include year-quarter, bank, and bank size decile by year-quarter fixed effects. All explanatory variables are standardized, and standard errors are clustered by bank holding company.
Source: Call Reports

Table 5: Deposit Supply Effects Controlling for Local Conditions

	Log(Branch Deposits)		
	(1)	(2)	(3)
L.LLP Ratio	0.014***	0.016***	0.019***
	(3.08)	(4.06)	(4.59)
L.Book Equity to Book Assets	-0.045***	-0.044***	-0.043***
	(-5.93)	(-7.40)	(-7.29)
L.Loans to Assets	0.025**	0.028***	0.027***
	(2.50)	(2.89)	(2.86)
L. No. Branches	-0.041**	-0.046***	-0.046***
	(-2.02)	(-2.89)	(-3.04)
L.Log(Assets)	0.041**	0.036**	0.029*
	(2.11)	(2.15)	(1.73)
L.Real Estate Loans	0.104	0.036	0.084
	(1.32)	(0.48)	(1.14)
L.Deposits to Assets	0.167**	0.227***	0.224***
	(2.25)	(4.17)	(4.19)
Branch FE	✓	✓	✓
Bank Size Decile × Time FE	✓	✓	✓
State × Time FE		✓	
County × Time FE			✓
Observations	1,683,012	1,682,984	1,677,099
R^2	0.8950	0.8975	0.9053

t statistics in parentheses

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

Notes: This table documents the relation between a bank's LLP Ratio and branch-level deposit quantities, measured as log total deposits. When indicated, specifications include year-quarter, bank, bank size decile by year-quarter fixed effects, branch state by year-quarter fixed effects, and branch county by year-quarter fixed effects.. All explanatory variables are standardized, and standard errors are clustered by bank holding company. *Source:* Call Reports, Summary of Deposits.

Table 6: Instrumental Variables: NPL and Deposit Supply

	NPL Ratio	Log(Ins. Dep.)			Insured Fraction		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
L.Portfolio Weight IV	0.521***	0.011***			1.253***		
	(24.00)	(6.11)			(15.65)		
L. $\widehat{NPL}$			0.047***	0.054***		5.356***	6.366***
			(6.29)	(5.83)		(15.42)	(14.74)
L.Book Equity to Book Assets	-0.152***	0.018***	0.022***	0.021***	-0.556***	-0.184***	-0.015
	(-12.38)	(5.91)	(6.97)	(6.82)	(-8.44)	(-2.72)	(-0.20)
L.Loans to Assets	-0.271***	0.020***	0.026***	0.026***	0.204**	0.831***	0.904***
	(-16.01)	(5.14)	(7.52)	(7.36)	(2.53)	(9.03)	(9.19)
L.Log(Assets)	0.103***	1.317***	1.321***	1.320***	-4.796***	-5.076***	-3.162***
	(3.69)	(213.70)	(234.52)	(88.94)	(-26.30)	(-27.46)	(-8.29)
L.Deposits to Assets	1.156***	1.262***	1.225***	1.205***	2.407***	-0.611	-1.196
	(8.76)	(18.40)	(18.10)	(19.10)	(2.70)	(-0.68)	(-1.30)
L.Real Estate Loans	1.456***	0.086***	0.042*	0.049**	4.373***	0.631	0.390
	(11.79)	(3.51)	(1.89)	(2.06)	(7.13)	(0.93)	(0.55)
Time FE	✓	✓	✓	✓	✓	✓	✓
Bank FE	✓	✓	✓	✓	✓	✓	✓
Bank Size Decile × Time FE				✓			✓
Observations	886,762	887,762	886,762	886,762	887,731	886,730	886,730
Instrument F Stat	576.12						
R^2	0.39	0.98	0.82	0.48	0.77	-0.18	-0.34

t statistics in parentheses

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

Notes: This table documents the relation between the NPL Ratio of a bank and the bank's insured deposits. PortfolioWeightIV is the shift-share instrument constructed by multiplying a bank's earliest available lagged portfolio weights across five asset classes by the aggregate NPL levels in those asset classes. The first stage is presented in column (1). $\widehat{NPLRatio}$ is the NPL Ratio instrumented by the lagged portfolio weights shift-share instrument. The outcome variable in Columns (2) - (4) is the log of total insured deposits. The outcome variable in Columns (5) - (7) is the fraction of insured deposits as a percentage of total deposits. When indicated, specifications include year-quarter, bank, and bank size decile by year-quarter fixed effects. All explanatory variables are standardized, and standard errors are clustered by bank holding company.
Source: Call Reports.

Table 7: Event Study: Deposit Dynamics of Failed Banks

Quarters to Failure	Outcome Variable						
	Time Dep. <$100k/Dep.	12-Month CD Rate	Insured Fraction	Log(Insured Deposits)	Log(Total Deposits)	NPL Ratio	LLP Ratio
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
-16	0.0004	0.1133	-0.0038	-0.0175	-0.0052	0.0008	0.0000
	(0.11)	(1.33)	(-1.21)	(-0.57)	(-0.17)	(0.61)	(0.01)
-12	0.0150*	0.2804**	-0.0005	0.0750	0.0794	0.0038*	0.0005
	(1.72)	(2.21)	(-0.06)	(0.93)	(0.96)	(1.93)	(1.06)
-8	0.0243**	0.3821***	0.0024	0.1915**	0.2014**	0.0131***	0.0016***
	(2.24)	(2.93)	(0.17)	(2.14)	(2.06)	(4.40)	(2.89)
-4	0.0372***	0.2926**	0.0080	0.2917**	0.2959**	0.0419***	0.0046***
	(2.94)	(2.27)	(0.50)	(2.43)	(2.28)	(10.11)	(5.09)
0	0.0675***	0.2680	0.0300*	0.3544**	0.3301**	0.1004***	0.0121***
	(4.28)	(1.51)	(1.83)	(2.44)	(2.13)	(14.33)	(5.31)
Time FE	✓	✓	✓	✓	✓	✓	✓
Observations	8,463	804	8,463	8,463	8,464	8,461	8,443
R^2	0.18	0.93	0.35	0.11	0.12	0.49	0.20

t-statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents coefficients from event-study regressions examining the dynamics of deposit composition, quantities, pricing, and asset quality for 568 banks that failed between 2000Q4 and 2023Q4. Each column reports coefficients from a separate regression of the form $y_{b,t} = \sum_{k=-17}^{0} \beta_k \mathbb{1}[\text{Quarters to Failure} = k] + \gamma_t + \varepsilon_{b,t}$, where γ_t represents calendar quarter-year fixed effects. The table reports coefficients for selected event-time periods: -16, -12, -8, -4, and 0 quarters before failure (quarter 0 is the last quarter before failure). Time Dep. <$100k/Dep. is the fraction of time deposits under $100,000 relative to total domestic deposits (corresponds to Panel (b) of Figure 3). 12-Month CD Rate is the bank's offered rate on 12-month certificates of deposit (Panel (f)). Insured Fraction is the ratio of insured to total domestic deposits (Panel (c)). Log(Insured Deposits) is the natural logarithm of total insured deposits (Panel (d)). Log(Total Deposits) is the natural logarithm of total domestic deposits (Panel (e)). NPL Ratio is non-performing loans divided by total loans (Panel (a), blue line). LLP Ratio is loan loss provisions divided by total loans (Panel (a), red line). Standard errors are two-way clustered by bank and quarter-year to account for serial correlation within banks and common shocks across banks in the same time period.
Source: Call Reports.

Table 8: Alternative Measures of Bank Risk

	Log(Ins. Deposits)			
	(1)	(2)	(3)	(4)
L. Implied σ	0.019**	0.013*		
	(2.45)	(1.77)		
L. Bank Bond Spread			0.129*	0.103*
			(1.81)	(1.83)
L.Book Equity to Book Assets		0.042		0.093
		(1.39)		(1.30)
L.Loans to Assets		-0.113*		-0.142**
		(-1.96)		(-2.54)
L.Log(Assets)	1.221***	1.311***	1.236***	1.311***
	(13.07)	(19.43)	(7.96)	(9.53)
L.Deposits to Assets		2.982***		5.392***
		(3.53)		(2.75)
L.Real Estate Loans		1.425***		2.117***
		(2.69)		(4.84)
Time FE	✓	✓	✓	✓
Bank FE	✓	✓	✓	✓
Bank Size Decile × Time FE	✓	✓	✓	✓
Observations	23,361	23,361	6,614	6,614
R^2	0.95	0.96	0.94	0.94

t statistics in parentheses

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

Notes: This table documents the relation between the bank's insured deposits and alternative measures of bank asset risk. Implied σ is the rolling two-year implied volatility of sample banks' equity returns using Optionsmetric. Bank Bond Spread is the banks' average bond yield minus maturity-matched treasury bonds. When indicated, specifications include year-quarter, bank, and bank size decile by year-quarter fixed effects. All explanatory variables are standardized, and standard errors are clustered by bank holding company.
Source: Call Reports.

Table 9: Branch-Level Comparison with the Deposits Channel

	Deposit Growth					
	(1)	(2)	(3)	(4)	(5)	(6)
Δ FF × HHI	-0.914**	-1.251***	-1.146***	-1.350***		
	(-2.43)	(-3.78)	(-3.82)	(-4.62)		
HHI	0.066***	0.055***	0.051**	0.040**		
	(2.73)	(2.74)	(2.49)	(2.39)		
Δ LLP		0.010***		0.010***		0.011***
		(6.92)		(7.09)		(6.94)
L.Log(Assets)	-0.010***	-0.009**	-0.009**	-0.008**	-0.008*	-0.007*
	(-2.65)	(-2.53)	(-2.29)	(-2.17)	(-1.85)	(-1.69)
Time FE	✓	✓				
Branch FE	✓	✓	✓	✓	✓	✓
State × Time FE			✓	✓		
County × Time FE					✓	✓
Observations	1,588,409	1,586,236	1,588,383	1,586,210	1,583,310	1,581,135
R^2	0.1600	0.1605	0.1668	0.1674	0.1996	0.2002

t statistics in parentheses

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

Notes: This table documents the relation between the change in bank's LLP Ratio, Federal Funds rate changes, and branch-level deposit quantities. The outcome variable is the log of total branch deposits. Δ FF is the year-over-year change in the Federal Funds rate. HHI is the Herfindahl-Hirschman Index, measuring local deposit market concentration at the county level. Δ LLP is the year-over-year change in the loan loss provision ratio. Column (1) replicates the deposits channel specification from Drechsler et al. (2017). Column (2) adds the change in the bank's LLP Ratio. Column (3) adds bank size controls and the HHI interaction term. Columns (4)-(6) progressively add more stringent fixed effects: Column (4) includes time and bank size decile × time fixed effects; Column (5) adds state × time fixed effects; Column (6) adds county × time fixed effects. All specifications include branch fixed effects. All explanatory variables are standardized, and standard errors are clustered by bank holding company.
Source: Call Reports, Summary of Deposits.

A Appendix

A.1 Model

We formalize our intuition in a model similar to Merton (1977) in this section. We consider a bank that issues D dollars of insured deposit and funds a loan of value D+E where E is the equity value. Banks fund a fraction of their loans with equity such that $L = \frac{D}{w}$ so that $E = \frac{D}{w} - D$. w is the leverage ratio. We assume that there are no uninsured deposits in the bank's liability mix. In the baseline specification, deposits provide no liquidity or convenience service and therefore they simply earn the risk-free rate because they are insured: $r_d = r$, where r is the risk-free rate. We assume a maturity date of T for both loans and deposits to keep our analysis focused on our channel.

The loan market is assumed to be perfectly competitive, so banks simply maximize the value of the put option of deposit insurance net of any deposit insurance premium and the convex cost of raising deposits. Raising deposits incurs costs such as branch network operations, ATM network, maintenance cost, and staff cost; together, they are convex in the amount of deposits raised. Deposit insurance premium is paid today at a flat rate of $\bar{p}$ per unit of deposit. Although the deposit insurance premium is flat and constant over time, factors that move its market value such the volatility of bank assets, σ, or r are not. They change with macroeconomic conditions, policy choices, as well as bank-specific factors.

Banks' optimization problem is the following:

$$\max_{\{D\}} P[L, K, \sigma, r, T] - \frac{1}{2}cD^2 - \bar{p}D \tag{A.1}$$

where, $P[L, K, \sigma, r, T]$ denotes the value of a European put option on the underlying asset L with strike price K, the face value of deposits. Therefore,

$$\begin{aligned} P[L, K, \sigma, r, T] &= Ke^{-rT}\Phi(-d_2) - L\Phi(-d_1) \\ d_1 &= \frac{ln(\frac{L}{K}) + (r + \frac{\sigma^2}{2})T}{\sigma\sqrt{T}}; \\ d_2 &= d_1 - \sigma\sqrt{T}; \\ K &= D \cdot e^{rT}; \\ \frac{L}{K} &= \frac{D}{wD \cdot e^{rT}} = \frac{1}{w \cdot e^{rT}}. \end{aligned} \tag{A.2}$$

Simplification of the above expressions lead to the following:

$$\begin{aligned} P[L, K, \sigma, r, T] &= D\Phi(-d_2) - \frac{D}{w}\Phi(-d_1); \\ d_1 &= \frac{-ln(w)}{\sigma\sqrt{T}} + \frac{\sigma\sqrt{T}}{2}; \\ d_2 &= d_1 - \sigma\sqrt{T} \end{aligned} \tag{A.3}$$

The first order condition of the bank's optimization problem in Equation A.1 can be written as follows:

$$\frac{\partial P[L,K,\sigma,r,T]}{\partial D} = cD + \bar{p} \tag{A.4}$$

Simplifying further:

$$\begin{aligned}
\frac{\partial P[L,K,\sigma,r,T]}{\partial D} &= \Phi(-d_2) + D.\frac{\partial\Phi(-d_2)}{\partial D} - \frac{\Phi(-d_1)}{w} - \frac{D}{w}\frac{\partial\Phi(-d_1)}{\partial D} \\
&= \Phi(-d_2) - D\phi(-d_2)\frac{\partial d_2}{\partial D} - \frac{\Phi(-d_1)}{w} + \frac{D}{w}\phi(-d_1)\frac{\partial d_1}{\partial D} \\
&= \Phi(-d_2) - \frac{\Phi(-d_1)}{w}
\end{aligned}$$

Therefore, the optimal quantity of deposits is given by the following equation:

$$\Phi(-d_2) - \frac{\Phi(-d_1)}{w} = cD + \bar{p}$$

$$D^* = \frac{1}{c}\{\Phi(-d_2) - \frac{\Phi(-d_1)}{w} - \bar{p}\} \tag{A.5}$$

Optimal supply of deposits decreases when marginal cost c is higher; and when deposit insurance premium paid, $\bar{p}$ is higher. It increases when the default option has a higher value.

Optimal supply as volatility changes: Now, using the envelope theorem, we find the sensitivity of optimal quantity of deposits with respect to asset volatility σ:

$$\begin{aligned}
\frac{\partial D^*}{\partial\sigma} &= \frac{1}{c}\frac{\partial}{\partial\sigma}\{\Phi(-d_2) - \frac{\Phi(-d_1)}{w}\} \\
&= \frac{1}{c}\{-\phi(-d_2).\frac{\partial d_2}{\partial\sigma} + \frac{1}{w}\phi(-d_1).\frac{\partial d_1}{\partial\sigma}\}
\end{aligned}$$

Note:

$$\phi(-d_2) = \frac{1}{w}\phi(d_1) \tag{A.6}$$

Therefore,

$$\begin{aligned}
\frac{\partial D^*}{\partial\sigma} &= \frac{1}{c}\{-\frac{1}{w}\phi(d_1).\frac{\partial d_2}{\partial\sigma} + \frac{1}{w}\phi(-d_1).\frac{\partial d_1}{\partial\sigma}\} \\
&= \frac{\phi(d_1)}{cw}\{-\frac{\partial d_2}{\partial\sigma} + \frac{\partial d_1}{\partial\sigma}\} \\
&= \frac{\phi(d_1)}{cw}\sqrt{T} > 0
\end{aligned} \tag{A.7}$$

Therefore, banks supply more deposits when volatility goes up. Periods with higher macroeconomic volatility or bank-specific losses are likely to be associated with a higher supply of deposits.

A.1.1 Optimal supply as r changes:

Interest rates can affect deposit insurance value through two potential channels. First, policy rates are often lowered in bad economic times, producing a negative correlation between r and σ. Second, interest rates can affect the price of liquidity and therefore the premium depositors are willing to pay for liquidity benefits of deposits. We first present a model where r and σ are negatively correlated. Then we generalize the model to a setting with liquidity benefits.

A.1.2 Policy Rates

Interest rates in the economy follow a negative relation with the observed volatility of the banking sector. This is consistent with the idea that policy interventions often happen during bad economic times, when rates are lowered. We capture that intuition with a simple linear relation between volatility and interest rate as follows:

$$\sigma = \hat{b} - \hat{a} * r \tag{A.8}$$

It follows that (Proof in the Appendix):

$$\begin{aligned} \frac{\partial D^*}{\partial r} &= \frac{1}{c}\frac{\partial}{\partial r}\{\Phi(-d_2) - \frac{\Phi(-d_1)}{w}\} \\ &= -\phi(d_1)\{\frac{\hat{a}\sqrt{T}}{cw}\} < 0 \end{aligned} \tag{A.9}$$

Therefore, when interest rates go up, optimal deposit financing comes down. The sensitivity of optimal deposit supply to interest rate is high when a is high, i.e., when asset volatility is more sensitive to r. If we set this parameter to zero, we obtain Merton (1977) that the value of deposit insurance put option is insensitive to interest rates.

A.1.3 Liquidity Benefits of Deposits

So far, in our model, deposits are priced at the risk-free rate. We now extend our model to include the liquidity benefits of deposits that the consumers enjoy. On average, deposits pay lower interest rates than the risk-free rate because they come with liquidity benefits. In periods of scarce liquidity in the aggregate financial system, the value of liquidity provided by the deposit contracts is likely to be relatively higher compared to periods with abundant liquidity. Periods of low liquidity are characterized in our model as periods of high interest rates. Therefore, we now assume that the interest rate on deposits (r_d) is given by the following schedule that accounts for higher liquidity premium in high interest rate regime:

$$r_d = r(1 - \alpha) - \beta, \tag{A.10}$$

where $0 < \alpha < 1$ and β are positive numbers. As shown in Appendix A.2.3:

$$\frac{\partial P[.]}{\partial r} = -\alpha D T e^{-(\alpha r + \beta)T}\Phi(-d_2) < 0 \tag{A.11}$$

Therefore, the value of the put option decreases when interest rates are high. Consequently, the supply of deposits decreases in a high interest rate regime. As shown in Appendix A.2.3, we get the following relation between optimal deposit quantity supplied by the banks and interest rates:

$$c\frac{\partial D^*}{\partial r} = -\alpha T e^{-(\alpha r+\beta)T}\Phi(-d_2) < 0. \tag{A.12}$$

Therefore, the optimal quantity of deposits decreases when interest rates go up. The effect is stronger when parameter c is smaller, i.e., for banks that are likely to face a lower marginal cost of raising deposits. Similarly, the effects are stronger for banks that have depositors who value liquidity more (the α parameter).

A.2 Derivations

A.2.1 Sensitivity of Market Value of Deposit Insurance to r

$$\begin{aligned} P[L,K,\sigma,r,T] &= Ke^{-rT}\Phi(-d_2) - L\Phi(-d_1) \\ d_1 &= \frac{ln(\frac{L}{K}) + (r+\frac{\sigma^2}{2})T}{\sigma\sqrt{T}}; \\ d_2 &= d_1 - \sigma\sqrt{T}; \\ K &= D\cdot e^{rT}; \\ \frac{L}{K} &= \frac{D}{wD\cdot e^{rT}} = \frac{1}{w\cdot e^{rT}}. \\ \sigma &= \hat{b} - \hat{a} * r \end{aligned} \tag{A.13}$$

$$\begin{aligned} P[L,K,\sigma,r,T] &= D\Phi(-d_2) - \frac{D}{w}\Phi(-d_1) \\ d_1 &= \frac{-ln(w\cdot e^{rT}) + (r+\frac{(\hat{b}-\hat{a}*r)^2}{2})T}{(\hat{b}-\hat{a}*r)\sqrt{T}} \\ d_1 &= \frac{-ln(w) - rT + (r+\frac{(\hat{b}-\hat{a}*r)^2}{2})T}{(\hat{b}-\hat{a}*r)\sqrt{T}} \\ d_1 &= \frac{-ln(w) + (\frac{(\hat{b}-\hat{a}*r)^2}{2})T}{(\hat{b}-\hat{a}*r)\sqrt{T}} \\ d_1 &= \frac{-ln(w)}{(\hat{b}-\hat{a}*r)\sqrt{T}} + \frac{(\hat{b}-\hat{a}*r)\sqrt{T}}{2} \\ d_2 &= d_1 - (\hat{b}-\hat{a}*r)\sqrt{T} \end{aligned} \tag{A.14}$$

It follows that:

$$\frac{1}{D}\frac{\partial P[L,K,\sigma,r,T]}{\partial r} = \frac{\partial\Phi(-d_2)}{\partial r} - \frac{1}{w}\frac{\partial\Phi(-d_1)}{\partial r} \tag{A.15}$$

$$\begin{aligned}
\frac{\partial \Phi(-d_1)}{\partial r} &= \frac{\partial \Phi(-d_1)}{\partial d_1}\frac{\partial d_1}{\partial r} \\
&= -\phi(-d_1).\frac{\partial}{\partial r}\{\frac{-ln(w)}{(\hat{b}-\hat{a}*r)\sqrt{T}} + \frac{(\hat{b}-\hat{a}*r)\sqrt{T}}{2}\} \\
&= -\phi(-d_1)\{\frac{-\hat{a}.ln(w)}{(\hat{b}-\hat{a}*r)^2\sqrt{T}} - \frac{\hat{a}\sqrt{T}}{2}\} \\
&= \phi(-d_1)\{\frac{\hat{a}.ln(w)}{(\hat{b}-\hat{a}*r)^2\sqrt{T}} + \frac{\hat{a}\sqrt{T}}{2}\} \qquad \text{(A.16)}
\end{aligned}$$

Now,

$$\begin{aligned}
\phi(-d_2) &= \phi(d_2) = \frac{1}{\sqrt{2\pi}}e^{-\frac{d_2^2}{2}} = \frac{1}{\sqrt{2\pi}}e^{-\frac{(d_1-\sigma\sqrt{T})^2}{2}} = \frac{1}{\sqrt{2\pi}}e^{-\frac{(d_1^2-2d_1\sigma\sqrt{T}+\sigma^2T)}{2}} \\
&= \phi(d_1)e^{-\frac{(-2d_1\sigma\sqrt{T}+\sigma^2T)}{2}} = \phi(d_1)e^{-\frac{(-2(ln\frac{L}{K}+(r+\frac{\sigma^2}{2})T)+\sigma^2T)}{2}} \\
&= \phi(d_1)e^{ln(\frac{L}{K})+rT} = \phi(d_1)e^{ln(\frac{1}{w.e^{rT}})+rT} \\
&= \phi(d_1)e^{-ln(w)} = \frac{1}{w}\phi(d_1) \qquad \text{(A.17)}
\end{aligned}$$

Therefore,

$$\begin{aligned}
\frac{\partial \Phi(-d_2)}{\partial r} &= -\phi(-d_2)\frac{\partial d_2}{\partial r} \\
&= -\phi(-d_2)\{\frac{\partial d_1}{\partial r} + \hat{a}\sqrt{T}\} \\
&= -\frac{1}{w}\phi(d_1)\{\frac{-\hat{a}.ln(w)}{(\hat{b}-\hat{a}*r)^2\sqrt{T}} + \frac{\hat{a}\sqrt{T}}{2}\} \qquad \text{(A.18)}
\end{aligned}$$

Combining with equation 14 above:

$$\begin{aligned}
\frac{1}{D}\frac{\partial P[L,K,\sigma,r,T]}{\partial r} &= \frac{\partial \Phi(-d_2)}{\partial r} - \frac{1}{w}\frac{\partial \Phi(-d_1)}{\partial r} \\
&= -\frac{1}{w}\phi(d_1)\{\frac{-\hat{a}.ln(w)}{(\hat{b}-\hat{a}*r)^2\sqrt{T}} + \frac{\hat{a}\sqrt{T}}{2}\} - \frac{1}{w}\phi(-d_1)\{\frac{\hat{a}.ln(w)}{(\hat{b}-\hat{a}*r)^2\sqrt{T}} + \frac{\hat{a}\sqrt{T}}{2}\} \\
&= (\frac{1}{w} - \frac{1}{w})\phi(d_1)\{\frac{\hat{a}.ln(w)}{(\hat{b}-\hat{a}*r)^2\sqrt{T}}\} + \phi(d_1)(-\frac{1}{w} - \frac{1}{w})\{\frac{\hat{a}\sqrt{T}}{2}\} \\
&= \phi(d_1)(-\frac{2}{w})\{\frac{\hat{a}\sqrt{T}}{2}\} = -\phi(d_1)\{\frac{\hat{a}\sqrt{T}}{w}\} \qquad \text{(A.19)}
\end{aligned}$$

Since $w > 0$, the above value is negative for all parameter values.

A.2.2 Bank's Optimization Problem

$$\max_{\{D\}} P[L,K,\sigma,r,T] - \frac{1}{2}cD^2 - \bar{p}D$$

FOC:

$$\frac{\partial P[L,K,\sigma,r,T]}{\partial D} = cD + \bar{p}$$

Note:

$$\begin{aligned} P[L,K,\sigma,r,T] &= D\Phi(-d_2) - \frac{D}{w}\Phi(-d_1) \quad \text{(A.20)} \\ d_1 &= \frac{-ln(w)}{(\hat{b} - \hat{a} * r)\sqrt{T}} + \frac{(\hat{b} - \hat{a} * r)\sqrt{T}}{2} \\ d_2 &= d_1 - (\hat{b} - \hat{a} * r)\sqrt{T} \end{aligned}$$

$$\begin{aligned} \frac{\partial P[L,K,\sigma,r,T]}{\partial D} &= \Phi(-d_2) + D.\frac{\Phi(-d_2)}{\partial D} - \frac{\Phi(-d_1)}{w} - \frac{D}{w}\frac{\partial\Phi(-d_1)}{\partial D} \\ &= \Phi(-d_2) - D\phi(-d_2)\frac{\partial d_2}{\partial D} - \frac{\Phi(-d_1)}{w} + \frac{D}{w}\phi(-d_1)\frac{\partial d_1}{\partial D} \\ &= \Phi(-d_2) - \frac{\Phi(-d_1)}{w} \end{aligned} \quad \text{(A.21)}$$

Therefore, optimal quantity of deposits is given by the following equation:

$$\Phi(-d_2) - \frac{\Phi(-d_1)}{w} = cD + \bar{p}$$

$$D^* = \frac{1}{c}\{\Phi(-d_2) - \frac{\Phi(-d_1)}{w} - \bar{p}\} \quad \text{(A.22)}$$

Optimal supply of deposits decreases when marginal cost c is higher; and when deposit insurance premium paid, $\bar{p}$ is higher. It increases when the default option has higher value.

Now using the envelope theorem, let's find the sensitivity of optimal D w.r.t. 'r'

$$\begin{aligned} \frac{\partial D^*}{\partial r} &= \frac{1}{c}\frac{\partial}{\partial r}\{\Phi(-d_2) - \frac{\Phi(-d_1)}{w}\} \\ &= -\phi(d_1)\{\frac{\hat{a}\sqrt{T}}{cw}\} \end{aligned} \quad \text{(A.23)}$$

Therefore, when interest rate goes up, optimal deposit financing comes down.

A.2.3 Model with Liquidity Benefits of Deposits

Suppose a bank makes a loan of value L with a maturity of T_L at an interest rate r_L. Risk-free rate is r and $r_L > r$. Loan is funded with insured deposit D and equity capital of E. For simplicity assume that the deposits are issued as zero coupon bond with maturity T and a promised rate of return of r_D. Therefore, deposit has a face value of $D.e^{r_d T} \equiv K$. Rate of return on deposits is below the market rate of return r, specifically, $r_d = r.(1-\alpha) - \beta$, where $0 < \alpha < 1$, and $\beta > 0$. This is a flexible parametrization that captures both a fixed amount and a variable amount of liquidity premium a depositor is willing to pay.

Deposits are insured by the FDIC at a fixed rate of c per unit of the market value of a deposit. The market value of the deposit insurance, P, can be obtained by a standard put option formula on the asset value of the bank with the face value of a deposit as the strike price.

$$
\begin{aligned}
P[L,K,\sigma,r,T] &= Ke^{-rT}\Phi(-d_2) - L\Phi(-d_1) \qquad \text{(A.24)}\\
d_1 &= \frac{ln(\frac{L}{K}) + (r+\frac{\sigma^2}{2})T}{\sigma\sqrt{T}}\\
d_2 &= d_1 - \sigma\sqrt{T}
\end{aligned}
$$

The amount of subsidy that a bank enjoys on its insured deposit is the difference between the market value of deposit insurance and the premium paid. The subsidy changes as interest rates change because the fair market valuation of deposit insurance changes with interest rate. When interest rates are high, market value comes down and therefore the subsidy enjoyed by banks comes down. Proof below:

$$
\begin{aligned}
\frac{\partial P[L,K,\sigma,r,T]}{\partial r} &= \frac{\partial Ke^{-rT}\Phi(-d_2)}{\partial r} - \frac{\partial L\Phi(-d_1)}{\partial r} \qquad \text{(A.25)}\\
&= \frac{\partial De^{r_d T}e^{-rT}\Phi(-d_2)}{\partial r} - \frac{\partial L\Phi(-d_1)}{\partial r}\\
&= \frac{\partial De^{(-\alpha r-\beta)T}\Phi(-d_2)}{\partial r} - \frac{\partial L\Phi(-d_1)}{\partial r}\\
&= \{-\alpha TDe^{-(\alpha r+\beta)T}\Phi(-d2)\} + \frac{De^{-(\alpha r+\beta)T}\partial\Phi(-d_2)}{\partial r} - \frac{\partial L\Phi(-d_1)}{\partial r} \qquad \text{(A.26)}
\end{aligned}
$$

$$
\begin{aligned}
\frac{\partial\Phi(-d_1)}{\partial r} &= \frac{\partial\Phi(-d_1)}{\partial d_1}\frac{\partial d_1}{\partial r}\\
&= -\phi(-d_1).\frac{\partial}{\partial r}\frac{ln(\frac{L}{K}) + (r+\frac{\sigma^2}{2})T}{\sigma\sqrt{T}}\\
&= -\phi(-d_1).\frac{1}{\sigma\sqrt{T}}\{\frac{\partial}{\partial r}(-lnK) + T\}\\
&= -\phi(-d_1).\frac{1}{\sigma\sqrt{T}}\{\frac{\partial}{\partial r}(-ln(De^{r_d T})) + T\}\\
&= -\phi(-d_1).\frac{1}{\sigma\sqrt{T}}\{\frac{\partial}{\partial r}(-r_d T) + T\}\\
&= -\phi(-d_1).\frac{1}{\sigma\sqrt{T}}\{(-(1-\alpha)T) + T\}
\end{aligned}
\qquad \text{(A.27)}
$$

$$
\begin{aligned}
&= -\phi(-d_1).\frac{1}{\sigma\sqrt{T}}\alpha T \\
\frac{\partial\Phi(-d_2)}{\partial r} &= -\phi(-d_2)\frac{\partial d_2}{\partial r} = -\phi(-d_2)\frac{\partial d_1}{\partial r} = -\phi(-d_2)\frac{1}{\sigma\sqrt{T}}\alpha T \\
\frac{\partial P[.]}{\partial r} &= \{-\alpha T D e^{(-\alpha r-\beta)T}\Phi(-d2)\} \\
&\quad -De^{-\alpha r T}\phi(-d_2).\frac{1}{\sigma\sqrt{T}}\alpha T + L\phi(-d_1).\frac{1}{\sigma\sqrt{T}}\alpha T
\end{aligned} \tag{A.28}
$$

$$
\begin{aligned}
\phi(-d_2) &= \phi(d_2) = \frac{1}{\sqrt{2\pi}}e^{-\frac{d_2^2}{2}} = \frac{1}{\sqrt{2\pi}}e^{-\frac{(d_1-\sigma\sqrt{T})^2}{2}} = \frac{1}{\sqrt{2\pi}}e^{-\frac{(d_1^2-2d_1\sigma\sqrt{T}+\sigma^2 T)}{2}} \\
&= \phi(d_1)\frac{1}{\sqrt{2\pi}}e^{-\frac{(-2d_1\sigma\sqrt{T}+\sigma^2 T)}{2}} \\
&= \phi(d_1)e^{ln(\frac{L}{K})+rT} = \phi(d_1)e^{ln(\frac{L}{D.e^{r_d T}})+rT} \\
&= \phi(d_1)e^{rT}\frac{L}{D.e^{r_d T}} = \phi(d_1)e^{(\alpha r+\beta)T}\frac{L}{D}
\end{aligned}
$$

$$
\begin{aligned}
\frac{\partial P[.]}{\partial r} &= \{-\alpha T D e^{-(\alpha r+\beta)T}\Phi(-d2)\} && \text{(A.29)} \\
&\quad -De^{-(\alpha r+\beta)T}\phi(d_2).\frac{1}{\sigma\sqrt{T}}\alpha T + L\phi(d_1).\frac{1}{\sigma\sqrt{T}}\alpha T \\
&= \{-\alpha T D e^{-(\alpha r+\beta)T}\Phi(-d2)\} && \text{(A.30)} \\
&\quad -De^{-(\alpha r+\beta)T}\phi(d_1)e^{(\alpha r+\beta)T}\frac{L}{D}.\frac{1}{\sigma\sqrt{T}}\alpha T + L\phi(d_1).\frac{1}{\sigma\sqrt{T}}\alpha T \\
&= -\alpha D T e^{-(\alpha r+\beta)T}\Phi(-d2) < 0 && \text{(A.31)}
\end{aligned}
$$

Note from the first order condition:

$$
\frac{\partial P[L,K,\sigma,r,T]}{\partial D} = cD + \bar{p} \tag{A.32}
$$

$$
\begin{aligned}
\frac{\partial P[L,K,\sigma,r,T]}{\partial D} &= \frac{\partial K e^{-rT}\Phi(-d_2)}{\partial D} - \frac{\partial L\Phi(-d_1)}{\partial D} && \text{(A.33)} \\
&= \frac{\partial D e^{r_d T}e^{-rT}\Phi(-d_2)}{\partial D} - \frac{\partial D\Phi(-d_1)}{w\partial D} \\
&= \frac{\partial D e^{(-\alpha r-\beta)T}\Phi(-d_2)}{\partial D} - \frac{\partial D\Phi(-d_1)}{w\partial D} \\
&= e^{-(\alpha r+\beta)T}\Phi(-d2) + \frac{De^{-(\alpha r+\beta)T}\partial\Phi(-d_2)}{\partial D} - \frac{\Phi(-d_1)}{w} - \frac{D\partial\Phi(-d_1)}{w\partial D} \\
&= e^{-(\alpha r+\beta)T}\Phi(-d2) - De^{-(\alpha r+\beta)T}\phi(-d_2)\frac{\partial d_2}{\partial D} - \frac{\Phi(-d_1)}{w} + \frac{D}{w}\phi(-d_1)\frac{\partial d_1}{\partial D} \\
&= e^{-(\alpha r+\beta)T}\Phi(-d_2) - \frac{\Phi(-d_1)}{w} && \text{(A.34)}
\end{aligned}
$$

Optimal deposit quantity is given by:

$$\begin{aligned} e^{-(\alpha r+\beta)T}\Phi(-d_2) - \frac{\Phi(-d_1)}{w} &= cD^* + \bar{p} \\ D^* &= \frac{1}{c}\{e^{-(\alpha r+\beta)T}\Phi(-d_2) - \frac{\Phi(-d_1)}{w} - \bar{p}\} \end{aligned}$$

Therefore, the sensitivity of deposit supply to interest rate is given by the following:

$$\begin{aligned} c\frac{\partial D^*}{\partial r} &= -\alpha T e^{-(\alpha r+\beta)T}\Phi(-d_2) + e^{-(\alpha r+\beta)T}\frac{\partial \Phi(-d_2)}{\partial r} - \frac{1}{w}\frac{\partial \Phi(-d_1)}{\partial r} \\ &= -\alpha T e^{-(\alpha r+\beta)T}\Phi(-d_2) - e^{-(\alpha r+\beta)T}\phi(-d_2)\frac{\partial d_2}{\partial r} + \frac{1}{w}\phi(-d_1)\frac{\partial d_1}{\partial r} \\ &= -\alpha T e^{-(\alpha r+\beta)T}\Phi(-d_2) - e^{-(\alpha r+\beta)T}\phi(-d_2)\frac{\alpha T}{\sigma\sqrt{T}} + \frac{1}{w}\phi(-d_1)\frac{\alpha T}{\sigma\sqrt{T}} \\ &= -\alpha T e^{-(\alpha r+\beta)T}\Phi(-d_2) - e^{-(\alpha r+\beta)T}.e^{(\alpha r+\beta)T}\frac{1}{w}\phi(d_1)\frac{\alpha T}{\sigma\sqrt{T}} + \frac{1}{w}\phi(d_1)\frac{\alpha T}{\sigma\sqrt{T}} \\ &= -\alpha T e^{-(\alpha r+\beta)T}\Phi(-d_2) < 0. \end{aligned} \tag{A.35}$$

A.3 Other Tables & Results

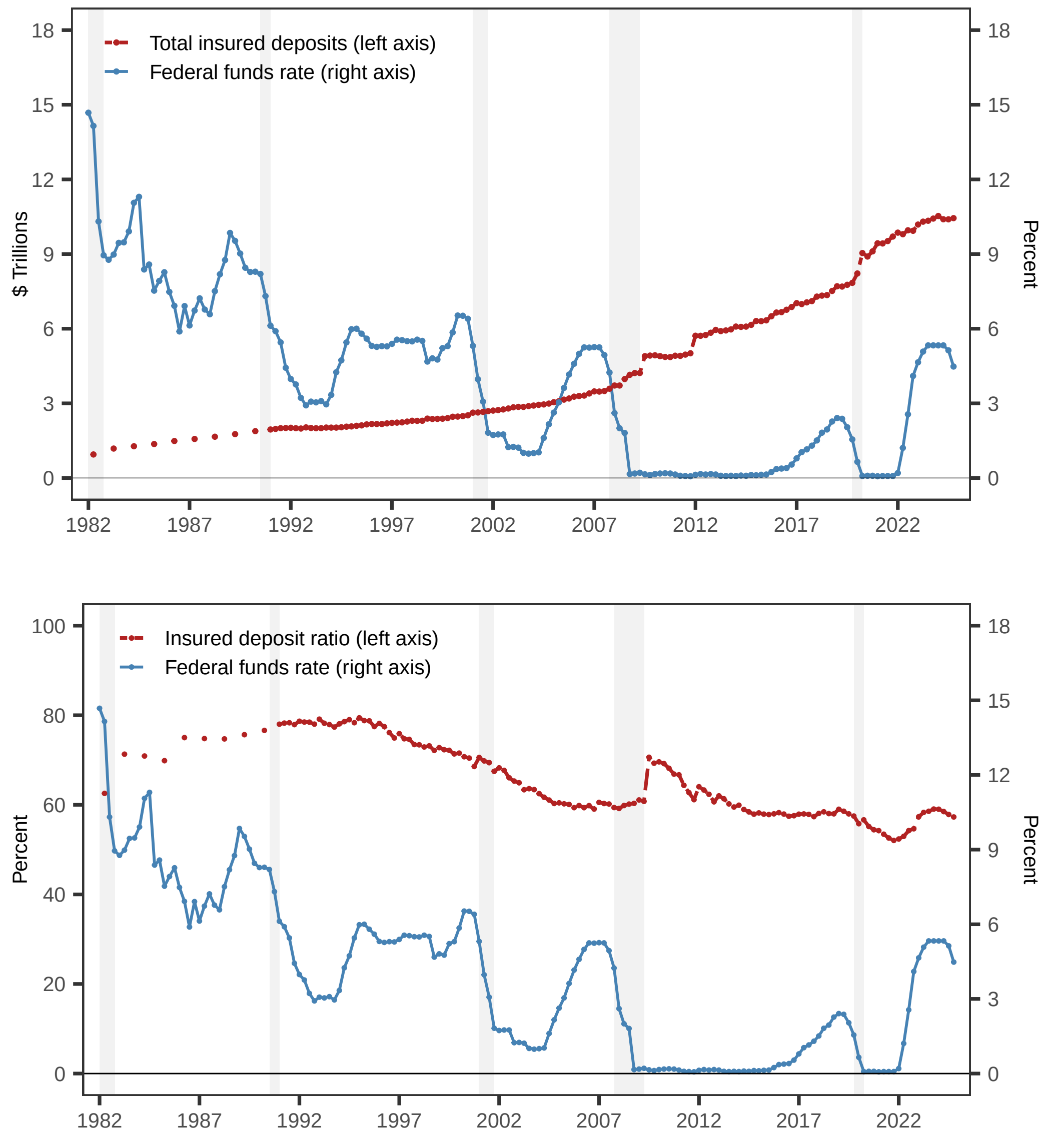
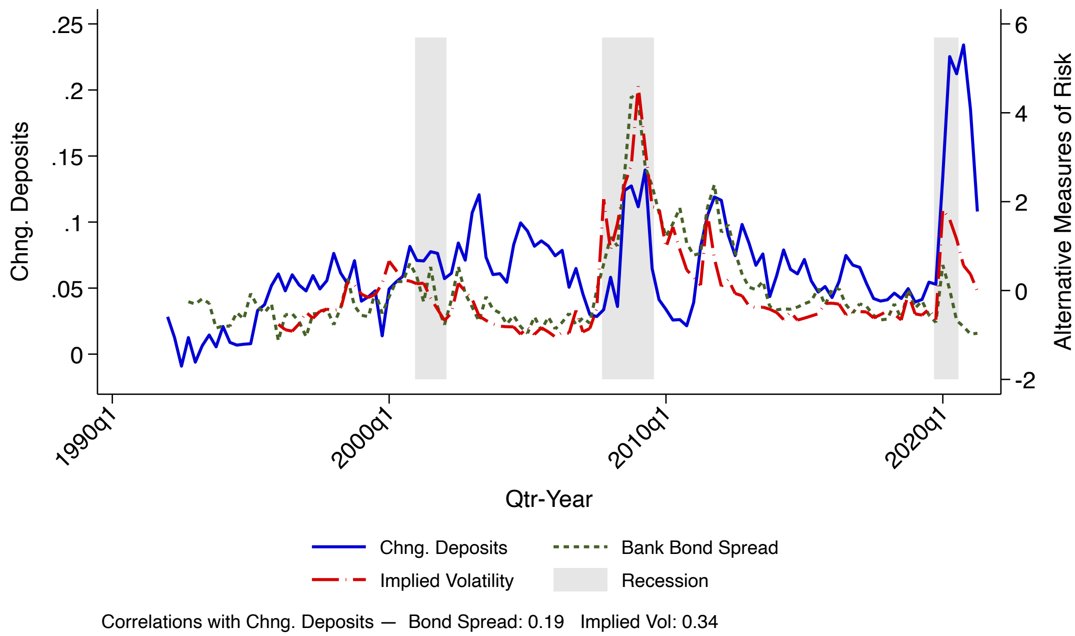


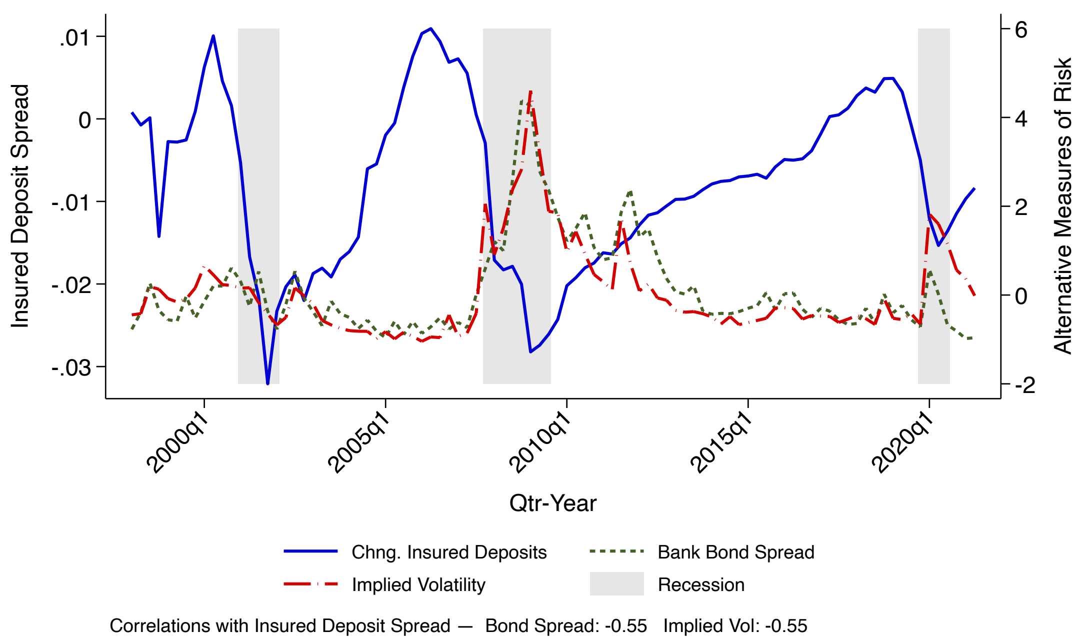
Figure A.1: Evolution of Insured Deposits

Notes: This figure plots the total amount of insured deposits (top panel) and the ratio of insured to total deposits (bottom panel) from 1982Q1 to 2024Q4. Both series are plotted against the effective federal funds rate.
Source: Call Reports, Federal Reserve Board (H.15 Release).

Figure A.2: Total Deposits Growth and Spread and LLP Ratio



(a) Total deposits and LLP Ratio



(b) Insured Deposit Rate Spread and LLP Ratio

Notes: This figure plots the relation between aggregate banking sector LLP growth and deposit outcomes. Panel (a) plots year-over-year total deposit growth against the LLP ratio. Panel (b) plots the insured deposit rate spread (fed funds rate minus average insured deposit rate) against the LLP ratio. The sample period is 1986-2021.
Source: Call Reports.

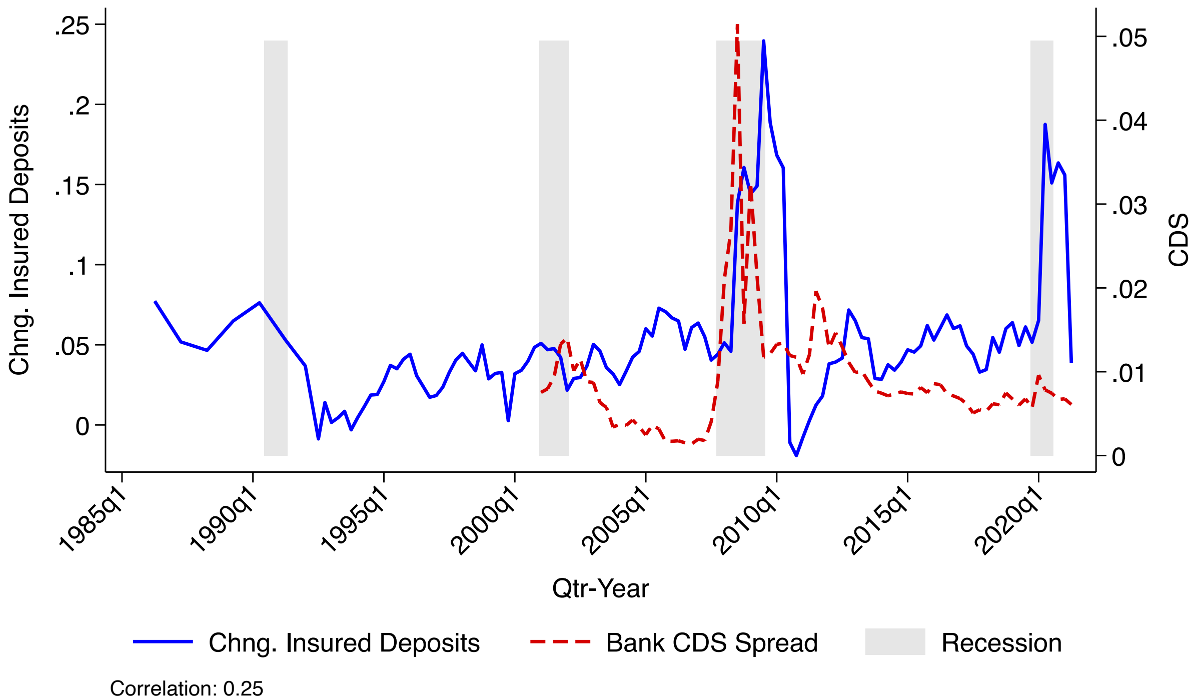


Figure A.3: Deposits and CDS spread

Notes: This figure plots the relation between quarterly deposit growth and alternative measures of bank risk. Panel (a) uses the CDS spread, panel (b) the bank bond credit spread, and panel (c) the implied volatility of bank equity. *Source:* Call Reports, Bloomberg.

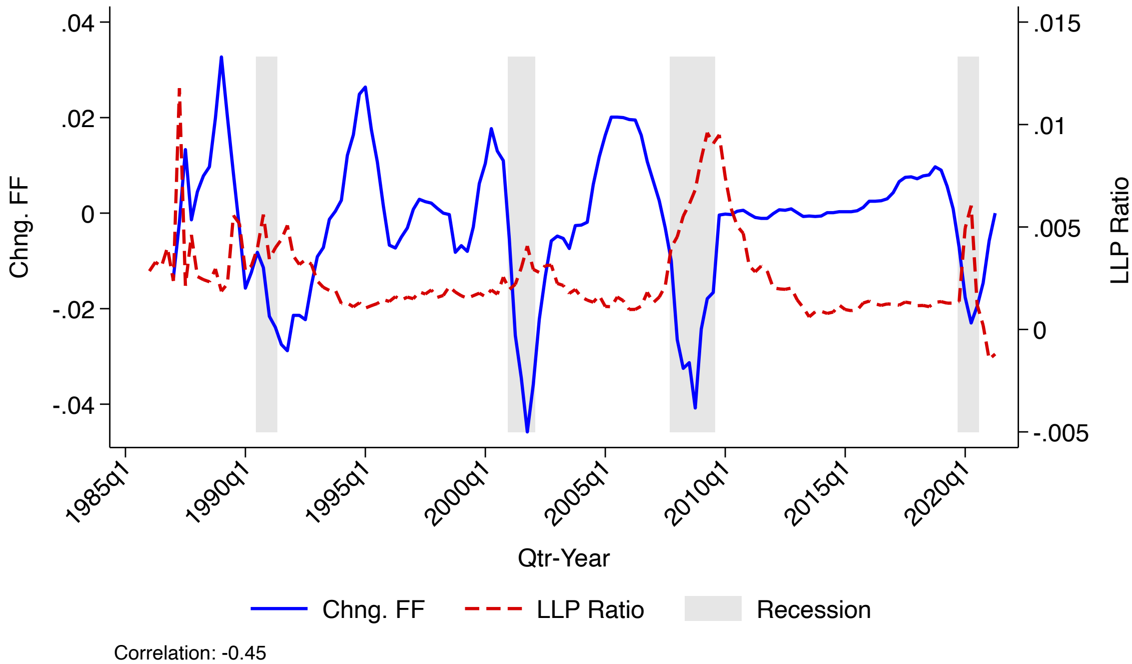


Figure A.4: Fed Funds and LLP Ratio

Notes: This figure plots the relation between year-over-year quarterly Fed Funds growth rates and the LLP Ratio.
Source: Call Reports.

Table A.1: Aggregate Bank Risk and Deposits

	Dep. Growth	Insured. Dep Growth	Insured Dep. Spread
	(1)	(2)	(3)
LLP Ratio	-5.185	9.416**	-1.626***
	(-1.58)	(2.17)	(-5.62)
Change in Fed Funds	-1.709**	-0.508	0.436***
	(-2.08)	(-0.64)	(5.83)
Fed Balance Sheet Growth	0.045	0.038	0.010***
	(0.93)	(1.26)	(3.32)
Observations	71	71	71
R^2	0.2330	0.3333	0.6550

t statistics in parentheses

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

Notes: This table presents time-series regressions examining the relation between aggregate banking sector LLP growth and deposit outcomes. The sample consists of quarterly observations from 1986 to 2021. LLP Ratio is the year-over-year growth rate in aggregate loan loss provisions for all banks in the banking system. The dependent variable in Column (1) is the year-over-year quarterly growth rate in total deposits. The dependent variable in Column (2) is the year-over-year quarterly growth rate in insured deposits. The dependent variable in Column (3) is the aggregate insured deposit spread, defined as the fed funds rate minus the average rate offered on insured deposits. All variables are computed as log changes relative to the same quarter one year earlier to remove seasonal effects.
Source: Call Reports

Table A.2: Robustness: Branch Level Deposit Supply without Headquarters

	Log(Branch Deposits)			
	(1)	(2)	(3)	(4)
L.LLP Ratio	0.014***	0.014***	0.016***	0.018***
	(3.08)	(2.66)	(3.55)	(3.98)
L.Book Equity to Book Assets	-0.045***	-0.038***	-0.036***	-0.036***
	(-5.93)	(-4.55)	(-5.61)	(-5.58)
L.Loans to Assets	0.025**	0.025**	0.027***	0.026***
	(2.50)	(2.29)	(2.63)	(2.61)
L. No. Branches	-0.041**	-0.041**	-0.046***	-0.047***
	(-2.02)	(-1.99)	(-2.82)	(-3.06)
L.Log(Assets)	0.041**	0.041*	0.036**	0.030*
	(2.11)	(1.92)	(1.96)	(1.69)
L.Real Estate Loans	0.104	0.094	0.029	0.084
	(1.32)	(1.11)	(0.36)	(1.08)
L.Deposits to Assets	0.167**	0.133*	0.196***	0.188***
	(2.25)	(1.74)	(3.39)	(3.32)
Branch FE		✓	✓	✓
Bank Size Decile × Time FE		✓	✓	✓
State × Time FE			✓	
County × Time FE				✓
Observations	1,683,012	1,578,534	1,578,506	1,570,903
R^2	0.8950	0.8929	0.8952	0.9032

t statistics in parentheses

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

Notes: This table documents the relation between a bank's LLP Ratio and branch-level deposit quantities, measured as log total deposits. When indicated, specifications include year-quarter, bank, bank size decile by year-quarter fixed effects, branch state by year-quarter fixed effects, and branch county by year-quarter fixed effects.. All explanatory variables are standardized, and standard errors are clustered by bank holding company. *Source:* Call Reports, Summary of Deposits.