Squeezed into Risk: Deposit Franchises and Bank Risk-Taking When Interest Rates Are Low*

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Abstract

This paper tests the deposit channel of bank risk-taking in the U.S. syndicated loan market during the zero lower bound period. The channel, proposed by Whited et al. (2021), operates through banks' market power over depositors. When policy rates approach zero, deposit markups are squeezed and bank profits fall. Combined with limited liability, the lost income incentivizes banks to take more risks, especially poorly capitalized banks. I measure each bank's pre-period reliance on deposit-markup income and compare banks' lending to the same firm in the same quarter, so that credit demand is held fixed. Markup-reliant banks lent more during the low-rate period. The additional lending was concentrated in thinly capitalized banks and went disproportionately to riskier firms. Importantly, banks charged no additional spread for the additional risk. The findings reveal a trade-off facing monetary policy at the effective lower bound: part of the credit stimulated by low rates is under-priced risky credit on the weakest balance sheets. Whether the markup squeeze becomes a financial-stability cost depends on bank capital.

Keywords: Deposit franchise, monetary policy, low interest rates, risk-taking channel, syndicated loans, bank capital

JEL codes: E43, E44, E52, G21

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1 Introduction

Central banks cut policy rates in response to economic downturns, and twice in the past two decades the Federal Reserve has held the federal funds rate near zero for an extended period, from 2008 to 2015, and again in 2020–2021 (Figure 1). Whether persistently low interest rates induce banks to take more risk is a first-order question for monetary policy and financial stability. A substantial empirical literature finds that low rates are associated with riskier bank lending (Jiménez et al., 2014; Ioannidou et al., 2015; Dell'Ariccia et al., 2017; Paligorova and Santos, 2017), but the relationship is theoretically ambiguous (Adrian and Shin, 2010; Dell'Ariccia et al., 2014; Martínez-Miera and Repullo, 2017), and the mechanism behind the association remains unsettled. The policy rate is an aggregate variable: every bank faces the same rate at the same time, and low-rate periods coincide with recessions, weak loan demand, unconventional policy, and regulatory change, so time-series evidence cannot easily separate one mechanism from another.

In this paper, I provide loan-level evidence on a specific mechanism proposed by Whited et al. (2021): the squeeze that low rates impose on banks' deposit-franchise income. Banks have market power over their depositors and pay deposit rates below the market rate. The markup, multiplied by the deposit base, is a major source of bank income. Because retail deposit rates cannot fall below zero, a policy rate near zero compresses the markup to approximately nothing. In the estimated structural model of Whited et al. (2021), the resulting loss of profits, combined with limited liability, raises banks' optimal risk-taking, and more so when capital is low. I refer to this mechanism as the deposit channel of bank risk-taking, and I test its central cross-sectional prediction in the U.S. syndicated loan market during 2008–2015, an extended period of low interest rates: banks that entered the low-rate period more reliant on deposit-markup income, and among them the poorly capitalized, should have expanded risky lending relative to otherwise similar banks.

For identification, I exploit two sources of variation. The first is a pre-determined measure of exposure to the squeeze. Although the compression of deposit spreads was common to all banks, its effect on profits was proportional to how much of a bank's income came from the markup beforehand. I measure each bank holding company's deposit income ratio, income from deposit markups as a share of total income, before the low-interest-rate period. The measure varies widely across banks, and for the median sample bank it is comparable in size to net income itself, so the variation captures economically large differences in the income at stake. Throughout the paper, I refer to banks with a higher pre-period deposit income ratio as markup-reliant banks. The second is the within-firm-quarter design of Khwaja and Mian (2008). Most syndicated borrowers take credit from several banks at once, the average firm in the sample borrows from more than five banks in a given quarter, so I can compare the credit supplied to the same firm in the same quarter by banks with different markup reliance, absorbing the borrower's investment opportunities, balance-sheet condition, and demand for funds in a firm-quarter fixed effect.

The empirical analysis proceeds in two steps. I first examine quantities, asking which banks expanded credit and toward which borrowers, and then prices, asking whether the additional risk was compensated; the joint pattern is what separates the deposit channel from demand-based and profit-seeking explanations. On quantities, I find that banks with greater pre-period markup reliance supplied more credit: a one-standard-deviation difference in the deposit income ratio is associated with roughly 18 percent more lending to the same firm in the same quarter. The expansion is concentrated where the deposit channel predicts. Splitting banks by pre-period Tier-1 capital, the response is significant only in the thinly capitalized banks; splitting borrowers by credit rating, I find that the effect of banks' deposit franchises on loan issuance is stronger for loans to risky firms than for loans to non-risky firms; and in the joint split, the response is significant for thinly capitalized banks and largest where they lend to risky firms. For a low-capital bank, a one-standard-deviation increase in markup reliance raises lending to risky firms by about 24 percent.

The deposit channel also operates within the structure of loans. A syndicated facility is divided into tranches: separate pieces of the same deal, each with its own amount, maturity, and contract type. Tranches differ in risk. A tranche maturing beyond one year carries the borrower's credit risk over the cycle, and a loan to a risky borrower written without a financial covenant leaves the lender holding that credit with no right to intervene as it deteriorates. Estimating the lending response at the tranche level, I find that markup-reliant banks lend more in precisely the riskier tranches, long maturities and covenant-free risky loans. The deposit channel thus shows up not only in which firms received credit but in the riskiness of the instruments through which the credit was extended.

On prices, I find that the additional risk was not compensated. Within the same firm and quarter, the loan spreads earned by markup-reliant banks on risky firms are indistinguishable from those on non-risky firms. A second price margin points the same way. Performance-pricing provisions raise the loan spread automatically when the borrower performs badly; loans without such grids are priced flat, whatever happens to the borrower (Asquith et al., 2005; Manso et al., 2010). Markup-reliant banks were more likely to write their lending flat, especially their risky lending. They expanded risky credit without charging higher spreads and without the protection that would have repriced it.

The combination of quantity and price results is what identifies risk-taking. If the lending expansion reflected stronger demand from the borrowers of markup-reliant banks, those banks should have earned higher spreads, not identical ones. If it reflected an attempt to rebuild profitability by reaching for yield, the banks should have charged more for risk, not nothing. Expanding risky credit at unchanged spreads, while giving up contractual protection against borrower deterioration, indicates a supply-driven increase in risk appetite. Under limited liability, the bank's shareholders receive the full gains when risky loans pay off, while part of the losses in default falls on creditors and the deposit insurer. A bank in this position is willing to expand risky lending without requiring higher spreads or contractual protection, because it does not bear the full downside. That this behavior appears only where markup reliance meets thin capital is precisely the interaction at the core of the deposit channel.

The results map closely onto the policy counterfactuals in Whited et al. (2021). In their model, removing deposit market power eliminates excessive risky lending at low rates, and tightening capital regulation curbs it. My estimates provide causal evidence for both margins: the risk-taking response scales with pre-determined markup reliance, which is the empirical footprint of the market-power margin; it disappears when banks' capital ratio is high, which reflects the capital margin. The findings therefore carry a concrete policy implication. Low rates compress deposit markups wherever the deposit-rate floor binds; whether that compression turns into under-priced risky credit depends on bank capital. The financial-stability cost of holding rates low is not spread evenly across the banking system. It is concentrated in institutions that combine high markup reliance with thin capital, both of which are observable to supervisors in advance.

This paper contributes to three strands of literature. First, it adds to the empirical literature on the risk-taking channel of monetary policy (Borio and Zhu, 2012; Adrian and Shin, 2010; Delis and Kouretas, 2011; Maddaloni and Peydró, 2011; Jiménez et al., 2014; Ioannidou et al., 2015; Dell'Ariccia et al., 2017; Paligorova and Santos, 2017; Aramonte et al., 2022). That literature identifies the effect of the rate environment, typically using the policy rate interacted with bank characteristics. The mechanism behind the effect is harder to pin down because the rate is common to all banks. My design holds the rate environment fixed and exploits pre-determined cross-bank variation in exposure to one specific consequence of low rates, the loss of deposit-markup income. The finding that risk-taking scales with this exposure, interacted with capital, identifies the deposit channel separately from other explanations of the same aggregate facts.

Second, the paper provides the first loan-level causal test of the deposit channel of bank risk-taking, the mechanism formalized in the structural literature on bank market power and monetary policy. Whited et al. (2021) estimate the channel in a quantitative model near the zero lower bound, Wang et al. (2022) show that the same market power weakens monetary transmission, and Abadi et al. (2023) characterize the reversal rate at which further cuts contract lending through bank net worth. These are structural models, disciplined by aggregate and model-implied moments. The within-firm-quarter elasticities estimated here supply the identifying micro moment those models lack, a credit-supply response to franchise income measured with borrower demand held fixed, and confirm the mechanism on which they rest. The same deposit franchise has been shown to shape monetary transmission (Drechsler et al., 2017), to hedge net interest margins (Drechsler et al., 2021), and to account for much of bank value (Egan et al., 2022; Drechsler et al., 2023). My results add that at the effective lower bound the franchise turns from a stabilizer into a source of income risk, because the deposit rate cannot follow the policy rate down (Claessens et al., 2018).

Third, the paper speaks to the empirical literature on how bank deposits shape risk-taking, but departs from it in measurement, setting, and outcomes. Heider et al. (2019) show that when the ECB introduced negative rates, euro-area banks with high deposit funding ratios, unable to pass negative rates to depositors, lent to riskier firms. My measure of exposure differs in a way that matters for the mechanism: it is income dependence, the markup times the deposit base, scaled by total income, rather than the share of funding from deposits, and the regressions control for the funding share directly. The setting also differs: U.S. policy rates never went negative, so the results show that the channel operates at low positive rates, where the retail deposit-rate floor already binds. Finally, the outcomes extend beyond loan volumes to spreads and contract terms, which is what permits separating risk-taking from a benign expansion of intermediation. Related work shows that deposit inflows can increase bank risk-taking (Acharya and Naqvi, 2012; Granja et al., 2022), with the effect shaped by bank capitalization (Bolton et al., 2021). The channel studied here operates through the income statement rather than through funding abundance. The capital interaction at the center of my results also connects the findings to the classic literature on franchise value and risk-shifting (Keeley, 1990; Hellmann et al., 2000; Repullo, 2004; Martínez-Miera and Repullo, 2010).

The rest of the paper proceeds as follows. Section 2 describes the deposit channel and its implications for loan-level data. Section 3 describes the data and the construction of the key variables. Section 4 presents the empirical analysis, including the identification strategy, the specifications and results for lending quantities and loan prices, a limited-liability model of the price of risk, alternative explanations, and robustness. Section 5 discusses implications, and Section 6 concludes.

2 The Deposit Channel of Bank Risk-Taking

Whited et al. (2021) propose a mechanism for excessive bank risk-taking based on the interaction between the level of interest rates and banks' market power in deposit markets. A deposit franchise, i.e. the branch network, payment services, and customer relationships through which a bank attracts and retains deposits, allows the bank to pay deposit rates below the market rate. The markup is a major source of income. Whited et al. (2021) estimate that deposit markups average 1.3 percent, and that markups are interest elastic, falling by roughly 40 basis points for every percentage point decline in interest rates. When the policy rate approaches zero, the markup is squeezed, and because narrow margins persist for as long as rates remain low, bank values can fall substantially. The decline in profits and franchise value, combined with limited liability, moves banks closer to the convex region of their payoff: the upside of a risky portfolio accrues to equity, while the downside is increasingly borne by creditors and the deposit insurer. The model's central prediction is that the relation between risk-taking and interest rates is highly nonlinear, weak at high rates but steep near zero, and that the risk-taking incentive is stronger for less-capitalized banks. In this paper, I ask whether this mechanism is visible in loan-level data.

The income at the center of the mechanism can be written as

$$\text{Franchise income}_{bt} \;=\; (f_t - r^d_{bt}) \times \text{IB deposits}_{bt} \;+\; f_t \times \text{NIB deposits}_{bt}, \tag{1}$$

where f_t is the federal funds rate, r^d_{bt} is the rate bank b pays on interest-bearing (IB) deposits, and non-interest-bearing (NIB) balances earn the bank the full market rate. Equation (1) shares the spirit of Drechsler et al. (2023), where the product of deposits and the deposit spreads is viewed as the cash flow generated by a bank's deposit franchise. We can also interpret bank income from the markup as the additional expenditure on deposits if banks do not charge the deposit spread over the deposit market. So a bank's deposit franchise is a source of its income arising from the bank's ability to pay below-risk-free rates on deposits. The income from the deposit spread increases with either a substantial volume of deposits or a wider deposit spread.

The expression makes the exposure to low rates mechanical. Pass-through from the policy rate to deposit rates is partial, so the deposit spread $f_t - r^d_{bt}$ widens when rates are high; but the spread cannot survive $f_t \to 0$, because retail deposit rates do not go meaningfully below zero. During the zero-lower-bound period, the spread was approximately zero and at times negative. Evidence from economies that pushed policy rates below zero confirms that the constraint is a deposit-rate floor rather than the zero policy rate itself: banks declined to pass negative rates to retail depositors, and the compression appeared in margins (Heider et al., 2019; Eggertsson et al., 2024; Ulate, 2021). The mechanism therefore requires only that rates be low, not negative, and each additional year at the floor extends the income loss (Claessens et al., 2018). Because the operating costs of running a franchise, including branches, staff, technology, do not fall with the level of interest rates, the loss of markup income passes through to profits roughly one for one.

The deposit channel has a cross-sectional implication, which is what makes it testable with micro data. If the channel holds, banks' risk-taking during a low-rate period should diverge. Banks that previously earned a larger share of their income from deposit markups lose more income when the markup is squeezed. And among those banks, the ones with low initial capital face the sharper increase in default probability and hence the stronger risk-taking incentive. The relevant exposure is the share of income earned from markups, not the share of funding raised from deposits. A bank can be heavily deposit-funded yet earn little from markups if it pays close to market rates. Such a bank has little franchise income to lose. Conversely, a bank with moderate deposit funding but strong pricing power over its depositors has a great deal to lose. This distinction separates the deposit channel from funding-side stories in which deposit inflows or funding stability drive lending (Acharya and Naqvi, 2012; Granja et al., 2022): the channel here operates through the income statement. This exposure through markup income is also distinct from interest-rate risk in the mark-to-market sense, the revaluation of long-duration assets when rates move: the deposit-channel loss is realized income, not a revaluation. The mark-to-market exposure has the opposite sign. A rate cut raises the value of legacy fixed-rate assets, so a bank exposed only through duration gains when rates fall. It is also temporary: Whited et al. (2021) show that the maturity-mismatch windfall disappears as assets and liabilities reprice, whereas the markup loss recurs every quarter for as long as rates remain at the floor.

The mechanism belongs to a long literature on franchise value and risk-shifting. Keeley (1990) attributed rising bank risk-taking in the 1980s to the erosion of charter values by deregulation and competition. Hellmann et al. (2000) showed that as competition erodes franchise value, banks' incentive to gamble rises, so that capital requirements alone may not restore prudent behavior. Repullo (2004) and Martínez-Miera and Repullo (2010) characterized when competition disciplines or unleashes risk. Dell'Ariccia et al. (2014) derived the effect of the real rate on risk-taking through intermediary leverage; and Martínez-Miera and Repullo (2017) showed that compressed intermediation margins generate search for yield. The contribution of Whited et al. (2021) is to quantify this logic for the zero-lower-bound period in an estimated model in which the eroding rent is specifically deposit-markup income. The episode studied in this paper is, in effect, a similar experiment the charter-value literature studied in earlier days, but administered by monetary policy rather than deregulation, applied to all banks simultaneously on a known date, and observable in loan-level data.

What should the channel look like in such data? On quantities, markup-reliant banks should expand credit supply relative to less reliant banks lending to the same firm at the same time. The expansion should be larger for riskier borrowers and should be concentrated among banks with low initial capital. Well-capitalized banks, whose distance to default keeps the limited-liability option far out of the money, have no reason to take on additional risk however much income they lose. On prices, the distinguishing implication is the absence of compensation. To lend more, a bank in this position is willing to hold risky credit without a higher risk premium. It is also willing to forgo contractual protections that a lender concerned with its downside would demand, such as performance-pricing provisions that raise the spread when the borrower deteriorates. By contrast, if markup-reliant banks expanded lending because their borrowers demanded more credit, their spreads should be higher than competitors'. The empirical analysis in Section 4 is organized around these two sets of implications.

3 Data and Measurement

I assemble a loan-level dataset covering U.S. syndicated lending from 2008Q4 through 2015Q4, matched on one side to the financial statements of the lending banks and on the other to the characteristics of the borrowing firms.

3.1 Syndicated loan data

Loan-level information comes from Refinitiv DealScan, accessed through WRDS. DealScan records syndicated loan originations, including borrower, lenders, amounts, pricing, maturity, tranche type, and contractual features, assembled from SEC filings, company statements, and direct lender submissions. Lenders report willingly because the data feed the league tables that advertise their underwriting business. Syndicated lending is the principal vehicle for large corporate credit in the United States, it spans the rating spectrum from investment-grade revolving facilities to leveraged buyout financing, and, central to the identification strategy, loans are funded by syndicates, so a single firm borrows simultaneously from many banks whose behavior can be compared.

In this market, a borrower mandates one or more lead arrangers, who structure the deal, negotiate pricing and covenants, and sell shares to participant lenders. The resulting facility is divided into tranches, including revolving credit lines, amortizing term loans typically held by banks (Term Loan A), and minimally amortizing institutional term loans (Term Loan B and beyond).

Each tranche specifies its own amount, maturity, and spread, and every member of a tranche lends on identical contractual terms in proportion. Revolvers and one-year facilities account for about 63 percent of tranche observations in my sample, Term Loan A for 13 percent, Term Loan B for 7 percent, and other types for about 16 percent.

Two construction choices deserve mention. First, the unit of credit supply is the lender's loan issuance, computed as the total amount multiplied by the lender's share of the syndicate. DealScan reports shares for only limited observations. So, following Chodorow-Reich (2014), I calculate the average lender share of the lead arrangers and participants separately for each syndicate structure, among syndicates that do not have missing lender shares. I then fill in the missing lender shares with the average lender shares calculated for the corresponding syndicate structure[1]. Second, loans are aggregated to the firm–bank–quarter level for the lending and pricing analyses, and kept at the tranche–bank–quarter level when the outcome concerns the structure of the tranche itself.

3.2 Matching lenders and borrowers

Lenders are matched to U.S. banks using the DealScan–bank link of Chakraborty et al. (2018, 2020), and lender financials come from Call Reports. Only bank lenders are retained. Borrowers are matched to Compustat using the link of Chava and Roberts (2008), and I keep firm-quarters with the S&P long-term issuer rating, which the risk classification requires. The final sample contains 51 banks lending to 2,121 distinct rated firms.

3.3 The deposit income ratio

The key explanatory variable measures a bank's pre-period reliance on deposit-markup income, referred as "deposit income ratio" in this paper,

$$\mathrm{DIR}_b \;=\; \frac{(f - r_b^d) \times \text{IB deposits}_b + f \times \text{NIB deposits}_b}{\text{Total income}_b}, \tag{2}$$

expressed in percent, where the deposit rate is interest expense on interest-bearing deposits divided by interest-bearing deposit balances and total income is interest plus non-interest income. The second term values non-interest-bearing deposits at the full policy rate, since the rate paid on them is zero. Non-interest-bearing deposits are sticky funds that a bank obtains at no interest cost by providing payment and liquidity services, and the spread it earns by holding them while the policy rate is positive is exactly the rent its franchise generates. In a competitive deposit market the bank would have to pay the policy rate on these balances, so the fact that it pays nothing is itself the franchise. Omitting this term would understate franchise income for precisely the banks

[1] For example, in deals with one lead arranger and one participant, on average the lead arranger retains the certain share of the loan and the participant the rest, so I use these numbers weights in all deals with one lead arranger and one participant. This method is widely used in the literature using the Dealscan database, e.g. Dagostino et al. (2023) and Donaldson et al. (2024)

whose deposit market power is strongest. Because the ratio is fixed in the pre-period, it does not move with the policy rate during the sample. I compute the average over the eight quarters before the low-interest rate period, 2006Q4–2008Q3, which smooths idiosyncratic quarters and, more important, fixes the measure before the low-rate period, so that it cannot reflect choices made in response to the squeeze. Deposit franchises are built on branch networks and customer relationships that change slowly, which is why pre-period reliance is a good measure of exposure to a squeeze that was not anticipated over that window.

Panel A of Table 1 and Figure 2 describe the cross-sectional variation. Across the 51 sample banks, the deposit income ratio averages 11.9 percent of total income, with a standard deviation of 4.7 percentage points, and a range of 2.7 to 24.6 percent. These magnitudes are large relative to profitability. Net income for the sample banks is about 13 percent of total income, and the bank-by-bank ratio of pre-period markup income to net income has a median of 0.89. For the typical sample bank, the income at stake in the squeeze was therefore comparable to its entire net income.

One property of the deposit income ratio matters for identification. Deposit income ratio is not weak capitalization in disguise. Across the sample banks the deposit income ratio and the pre-period Tier-1 ratio are essentially uncorrelated, with a cross-sectional correlation of -0.07 that is not significantly different from zero, and if anything thinly capitalized banks carry somewhat weaker franchises. Mean DIR is 10.9 percent among banks below the sample-median pre-period Tier-1 ratio and 13.0 percent among banks above it. The two conditions the channel requires, thin capital and a large deposit franchise, are thus not systematically related in the cross-section, so the capital interactions below are identified from genuine joint variation rather than from a mechanical association between the two characteristics, and they compare meaningfully different markup reliance within each capital group.

One may also concern that deposit income ratio could be correlated with other features of a bank's business model. In the sample it rises with the share of funding drawn from deposits and with profitability, the natural counterparts of deposit-franchise income, without being closely tied to any single characteristic. Such characteristics could in principle affect lending and risk-taking on their own, and two considerations address that possibility. First, bank size, loan portfolio composition, funding structure, and risk-weighted assets all enter the regressions as pre-period controls, so the deposit-income-ratio effect is measured holding them fixed. Second, the channel operates through the interaction with capital, and Section 4.6 shows that interacting each of these characteristics with bank capital, and separately with borrower risk, leaves the deposit-income-ratio interaction unchanged.

3.4 Risk classifications and outcomes

A firm-quarter is classified as risky if the firm's S&P long-term rating is below BBB$-$ in that quarter. Sub-investment-grade status is the classification the market prices, the one regulation uses, and one the lending bank cannot influence. Of the 2,121 borrowers, 1,051 are sub-investment-grade at some point in the window. Risky cells are 40 percent of observations and carry \$2.4

trillion, 37 percent, of the sample's total loan issuance. A bank is classified as Low Capital if its pre-period Tier-1 capital ratio falls below the sample median.

The outcomes fall into two groups. The quantity outcome is the log of the bank's loan to a firm in a quarter; at the tranche level, the same outcome is studied across tranche characteristics, including an indicator for maturity beyond twelve months and an indicator for covenant-free risky lending, a tranche to a sub-investment-grade borrower that carries no financial covenant, both of which suggest the riskiness of the lending. The price outcomes are, first, the all-in spread drawn, which is the contractual spread over LIBOR plus the facility fee (Berg et al., 2016); and second, the use of flat pricing, lending written without a performance-pricing grid. Performance-pricing provisions tie the spread to the borrower's debt-to-EBITDA ratio or credit rating, raising it automatically if the borrower deteriorates; they are a standard contractual protection for lenders (Asquith et al., 2005). A loan written flat leaves the lender holding deteriorating credit at a stale spread, so flat pricing measures the price protection a bank chose to forgo.

3.5 The estimation sample

Table 1 shows the summary statistics of the estimation sample. The full sample covers 51 banks and 2,121 firms over 2008Q4 to 2015Q4. The preferred specification uses 17,437 firm–bank–quarter cells, organized into 3,188 firm-quarters with at least two lenders each, 5.5 lenders on average, with an interquartile range of three to seven. The average cell is a $321 million commitment, with a median of $111 million, and aggregate commitments are $6.4 trillion. The average all-in spread drawn is 195 basis points, with 150 for investment-grade and 255 for sub-investment-grade cells, so the average price of crossing the rating boundary is roughly 105 basis points, a useful benchmark for the pricing results. Sixty-one percent of loan volume carries flat pricing, and the share is bimodal. A quarter of cells are entirely grid-protected and more than a quarter entirely flat. At the tranche level, the median facility matures in 56 months.

The sample is small in number but not in economic weight. Syndicated lending is concentrated among large banks, and although the 51 sample banks are a small fraction of the roughly 4,000 bank holding companies that filed call reports in the pre-period, they held more than 70 percent of total banking-industry assets and are concentrated at the top of the size distribution. The results therefore characterize the banks that intermediate the bulk of credit and conduct essentially all syndicated lending, not the many small community banks that do not participate in this market. Whether the same deposit channel operates among small lenders, whose deposit franchises and borrower pools differ, is a question the syndicated market cannot answer, and the findings should be read as applying to the large, syndication-active banks that dominate the asset side of the banking system.

The sample covers large U.S. banks and rated borrowers in the syndicated loan market, the natural setting for this question. The syndicated market is where the credit conditions of large U.S. corporations are set. It is also the segment in which bank–firm pairs are observed together with the contract terms, spreads, performance pricing, and tranche structure, that separate risk-taking from a benign expansion of credit. The deposit channel does not require these banks to have unusually high market power. It requires only that they differ in how much of their income comes from deposit markups, and that reliance, which I measure directly with the deposit income ratio, varies widely across the sample. This variation, together with the cross-bank variation in capital, is what identifies the channel.

4 Empirical Analysis

This section presents the empirical analysis. I begin with the identification strategy, then examine the effect of deposit franchises on lending quantities, laying out the regression specifications at the firm–bank–quarter and tranche levels and presenting the results, before turning to loan prices in the same framework. Quantities reveal which banks expanded credit and to which borrowers, and prices reveal whether the additional risk was compensated, so the two together separate the deposit channel from demand-based and profit-seeking explanations. A simple limited-liability model then interprets the central finding, that markup-reliant banks lend more to risky borrowers without charging more for the risk. The section closes by weighing alternative explanations and confirming the result's robustness.

4.1 Identification strategy

The identification problem is that banks with different deposit income ratios may face different borrowers with different credit demand. To determine whether the deposit channel encourages risk-taking, one must disentangle the impact of loan demand faced by banks while accounting for the influence of other bank variables. I address it by comparing banks within the same firm-quarter. All specifications below include firm$\times$quarter fixed effects, so the coefficients are identified from firms that borrow from at least two sample banks in the same quarter. The fixed effect absorbs the firm's total borrowing, its investment opportunities, its riskiness, and the macroeconomic environment, all of which are common across the firm's lenders at that moment. What remains as identifying variation is the allocation of a given firm's borrowing across its lenders as a function of those lenders' pre-determined markup reliance, averaged across 3,188 multi-lender firm-quarters. The design follows Khwaja and Mian (2008) and its applications to lender health and monetary policy (Chodorow-Reich, 2014; Jiménez et al., 2014). The innovation is the treatment, a pre-determined, theoretically motivated exposure to the policy-rate floor. Because identification is within firm-quarter, cells in which a firm borrows from a single sample bank drop out. Specifications with only firm fixed effects retain the singletons and show that their exclusion does not generate the results. Standard errors are three-way clustered at the firm–bank–quarter level. The treatment varies at the bank level.

The identifying assumption is that, conditional on the controls, a firm's demand for credit in a quarter does not vary across its lenders in a way correlated with those lenders' pre-period deposit income ratios. The assumption permits firms to differ arbitrarily, demand to move arbitrarily over time, and firms to match non-randomly to banks in levels. What the assumption rules out is a within-firm shift in borrowing toward markup-reliant lenders unrelated to supply.

Three threats deserve discussion. The first is relationship intensity. A firm may draw more from its long-standing lead bank than from peripheral participants. The controls include the bank's pre-period asset mix and profitability, which absorb broad clientele differences. Lead banks in the deal also do not have systematically higher or lower deposit income ratios. The second is that the deposit income ratio could proxy for other exposures to the rate environment. The control set is chosen against this. Deposits over liabilities fixes the funding share, which is also the margin emphasized by Heider et al. (2019), and the income, asset-composition, and profitability controls fix the scale and mix of the income statement. The third is crisis damage. Low pre-period capital partly reflects business models the crisis subsequently impaired. The comparison that delivers the key results, however, runs across markup reliance within the low-capital group, where crisis exposure is held comparatively fixed.

One measurement issue warrants note. Imputed syndicate shares introduce noise in the dependent variable rather than bias, unless markup reliance correlates with within-syndicate-structure share deviations, which the imputation cannot generate because imputed shares vary only with syndicate structure and role.

4.2 The effect of deposit franchises on lending quantities

Specifications. I begin with the quantity of credit at the firm–bank–quarter level. The baseline specification is

$$\log(\text{Loans}_{bft}) \;=\; \alpha_{ft} \;+\; \beta\,\text{DIR}_b \;+\; \gamma' X_b \;+\; \varepsilon_{bft}, \tag{3}$$

where Loans_{bft} is bank b's loan issuance to firm f in quarter t, summed across deals. α_{ft} is a firm×quarter fixed effect. DIR_b is the pre-period deposit income ratio defined in equation (2), and X_b collects the pre-period bank controls, including log assets, deposits over liabilities, the Tier-1 capital ratio, risk-weighted assets over total assets, net income over assets, loans over assets, and total income over assets, all eight-quarter pre-period averages. Under the deposit channel, banks that relied more heavily on markup income expand credit supply when the markup is squeezed, so I expect $\beta > 0$ if the channel exists.

The channel's sharper predictions concern who expands and toward whom. To test them, I interact the deposit income ratio with the borrower-risk and bank-capital indicators:

$$\log(\text{Loans}_{bft}) \;=\; \alpha_{ft} + \sum_{j,k} \beta_{jk}\,\text{DIR}_b \times \mathbf{1}\{\text{FirmRisk}_{ft} = j\} \times \mathbf{1}\{\text{LowCap}_b = k\} + \delta' Z_{bft} + \gamma' X_b + \varepsilon_{bft}, \tag{4}$$

where FirmRisk_{ft} equals one if firm f's S&P rating is below BBB− in quarter t, LowCap_b equals one if bank b's pre-period Tier-1 ratio is below the sample median, and Z_{bft} absorbs the uninteracted group indicators. I also estimate the pairwise versions that interact DIR_b with each indicator separately. Each β_{jk} measures the slope of credit supply with respect to markup reliance within the indicated group, holding the firm-quarter fixed. The deposit channel predicts the ordering $\beta_{11} > \beta_{01} > 0$ for low-capital banks, which means that the expansion exists and is larger for risky firms, and no comparable response for well-capitalized banks (β_{10} close to zero).

The firm–bank–quarter cell aggregates across loan instruments, so it cannot reveal which kinds of loans the expansion ran through. I therefore estimate a third specification at the tranche level, where the unit of observation is bank b's loan issuance to tranche τ of firm f in quarter t:

$$\log(\text{Loans}_{b\tau ft}) \;=\; \alpha_{ft} + \sum_{j,k} \beta_{jk}\, \text{DIR}_b \times \mathbf{1}\{D_\tau = j\} \times \mathbf{1}\{\text{LowCap}_b = k\} + \delta' Z_{b\tau t} + \gamma' X_b + \varepsilon_{b\tau ft}, \quad (5)$$

where D_τ is a tranche characteristic, either LongMaturity$_\tau$, which equals one if the tranche matures in more than twelve months, or CovLiteRisky$_\tau$, which equals one if the tranche finances a sub-investment-grade borrower and carries no financial covenant. A covenant gives the lender the right to act as the borrower deteriorates, so a risky borrower without one leaves the lender holding the credit unprotected, and both indicators order tranches by the credit risk a lender absorbs. The firm×quarter fixed effect is retained, so the comparison remains within borrower-quarter, now across both banks and instruments. I also estimate the pairwise versions without the capital interaction. Under the deposit channel, the lending response of markup-reliant banks should be larger in the riskier tranches ($\beta_{1k} > \beta_{0k}$) and, as in equation (4), should be concentrated among low-capital banks.

Results. Table 2 reports estimates of equation (3) under progressively stricter fixed effects, moving from firm only, to firm and quarter, to the preferred firm×quarter. The coefficient on the deposit income ratio is positive and statistically significant throughout and grows as demand is absorbed more completely. It is 0.03 with firm fixed effects, 0.03 adding quarter effects, and 0.04 within firm-quarter. Banks that entered the low-rate period more reliant on deposit-markup income lent more during it. The progression across columns is itself informative. If unobserved demand were generating the correlation, absorbing demand more completely should shrink the coefficient toward zero. Instead it rises. The estimates are economically meaningful. A one-standard-deviation difference in markup reliance (4.7 percentage points) corresponds to roughly 0.17 log points, about 18 percent more credit to the same firm in the same quarter. Among the controls, the deposit funding share has no explanatory power, deposits over liabilities enters at 0.01 with an equal-sized standard error, so it is the income from deposit pricing power, not reliance on deposit funding, that predicts the expansion. This distinguishes the result within-sample from the funding-share margin of Heider et al. (2019).

Table 3 reports estimates of equation (4) and its pairwise components. Columns (1) and (2) interact the deposit income ratio with the Low Capital indicator. Within firm-quarter, the slope is 0.04 and statistically significant for low-capital banks, and 0.05 but insignificant for well-capitalized ones. Columns (3) and (4) interact with borrower risk. The slope is 0.04 for sub-investment-grade borrowers and 0.03 for investment-grade borrowers, both significant. Columns (5) and (6) report the full interaction. The results are mostly shown among low capital banks. Among these banks, the response is significant for lending to safe firms and larger still for lending to risky firms, which is the ordering the deposit channel predicts. The expansion of risky lending is concentrated where markup reliance meets thin capital, and well-capitalized banks show no comparable expansion in risky lending however markup-reliant they are. Table 7 tests these comparisons formally. The risky–safe difference in slopes is statistically significant in the pairwise specification and within low-capital banks, while the pairwise difference along the capital dimension is not. Among well-capitalized banks the risky-lending slope in Table 3 is itself insignificant, so the risk tilt is confined to thinly capitalized lenders. A one-standard-deviation increase in markup reliance raises a low-capital bank's lending to risky firms by about 24 percent.

Because these are within-firm-quarter comparisons, the pattern cannot be generated by markup-reliant banks serving riskier firms. The same risky firm, borrowing in the same quarter, obtained more credit from its markup-reliant, thinly capitalized lenders than from its other banks. The syndicates of risky firms therefore shifted toward fragile banks, which matters for financial stability independently of any aggregate effect, since the cost of a risky loan depends on the loss-absorbing capacity of the bank that holds it. The capital interaction also aligns with Jiménez et al. (2014), who finds that lower overnight rates induce less capitalized banks to lend more to ex ante riskier firms. That design identifies the effect of the rate, with capital as a modifier. Here the rate environment is common to all banks, and the risk-taking is located by pre-determined markup reliance interacted with capital.

Table 4 reports estimates of equation (5), which further tests the deposit channel through the characteristics of tranches. The riskiness of a loan depends on both the borrower and the contract. Columns (1) and (2) split tranches by maturity. A multi-year commitment exposes the lender to the borrower's credit over the cycle, while a 364-day facility reprices or expires. Markup-reliant banks lend more in tranches maturing beyond one year and not in shorter facilities. The maturity differences are statistically significant (Table 7), and the long-maturity response is concentrated in low-capital banks.

Columns (3) and (4) of Table 4 turn to covenant protection. Financial covenants give a lender the right to intervene as a borrower's condition deteriorates, so their absence matters most where deterioration is likely. Covenant absence is not itself a mark of risk. Investment-grade borrowers routinely borrow without maintenance covenants, and covenants are written into weaker loans precisely because the borrower is weaker, so the exposed combination is a sub-investment-grade borrower whose loan also carries no covenant. I define such a tranche as covenant-free risky tranche, referred to as "cov-lite risky" tranche. Markup-reliant banks lend more in covenant-free risky tranches than in the rest, a difference that is statistically significant (Table 7), and the response is again confined to low-capital banks. A one-standard-deviation more reliant low-capital bank committed about 20 percent more volume to covenant-free risky loans, while well-capitalized banks show no such tilt. The reading is the same as in Table 3. Where the instrument itself carries more credit risk, whether through duration or the loss of covenant protection, the lending of markup-reliant, thinly capitalized banks expands most. These estimates tie the micro evidence to the defining market development of the period. The institutional leveraged-loan market expanded rapidly, covenant protections loosened, and supervisors issued leveraged-lending guidance in 2013 amid concern about credit-market overheating (Stein, 2013). The results here add a bank-side supply term, concentrated in the least capitalized banks and traceable to the deposit-franchise squeeze.

4.3 The effect of deposit franchises on loan prices

Specifications. Now I explore the effects on price, asking whether the additional risk was compensated. I examine two price margins with the same structure as equation (4):

$$y_{bft} \;=\; \alpha_{ft} + \sum_{j,k} \beta_{jk}\, \mathrm{DIR}_b \times \mathbf{1}\{\mathrm{FirmRisk}_{ft} = j\} \times \mathbf{1}\{\mathrm{LowCap}_b = k\} + \delta' Z_{bft} + \gamma' X_b + \varepsilon_{bft}, \qquad (6)$$

where I examine two dependent variables y_{bft}. One dependent variable is the loan spread charged by bank b to firm f in quarter t, measured as weighted average of the all-in spread drawn, in basis points, weighted by loan volume supplied by bank b to firm f in quarter t. The other dependent variable is a flat-pricing indicator, equal to one if at least half of the bank's lending is written without a performance-pricing grid. I also estimate the level effect of DIR_b and the pairwise interactions. All specifications retain the firm$\times$quarter fixed effects, the bank controls, and the three-way clustered standard errors.

Two features of the spread outcome bear on interpretation. First, because every member of a tranche earns the same contractual spread, within-firm-quarter pricing differences across banks reflect which of the firm's deals and tranches each bank participated in and the pricing of deals it arranged. The regression therefore measures the price of the exposure a bank chose to hold against a given borrower at a given time. Second, the all-in spread drawn omits arrangement and undrawn fees, which accrue disproportionately to arrangers. If markup-reliant banks arranged more of the risky deals they funded, measured spreads would if anything overstate their compensation, so the estimates below are conservative (Berg et al., 2016).

The deposit channel makes signed predictions for these coefficients. If markup-reliant banks expanded risky lending because franchise losses lowered their private cost of default, they should , to some extent, give up premia on risky credit. In other words, β_{11} in the spread regression should be approximately zero or negative. They should also write more risky credit without performance protection, so the corresponding coefficient in the flat-pricing regression should be positive. If instead the quantity expansion reflected borrower demand or an effort to rebuild profitability, the spread coefficients should be positive precisely where the quantity response is largest.

Results. Table 5 reports the spread regressions. The level effect in column (1) is economically negligible, about 0.9 basis points per standard deviation against a 195 basis point mean spread, so the lending response operates through quantities, not prices. Columns (2) and (3) split the sample by capital and by borrower risk. Neither capital group prices markup reliance significantly, and the pricing response that does appear falls on investment-grade rather than risky credit. Column

(4) reports the full interaction and isolates the group that matters for the channel, low-capital banks lending to risky firms, the group with the largest quantity response. Their spread coefficient is close to zero and slightly negative. These banks supplied markedly more credit to risky borrowers as markup reliance rose, yet did not raise the price they charged for it. Against the 105 basis point average gap in spreads between risky and safe borrowers, the additional risk they took on went essentially uncompensated.

The pricing of risky loans is best read against the pricing of safe loans by the same banks. Table 7 makes this comparison. Within low-capital banks, the spread slope on risky borrowers is no higher than the slope on safe borrowers. The difference is negative, about -0.34 basis points per percentage point of the deposit income ratio. Low-capital banks that relied heavily on deposit markups thus lend more to risky firms but do not charge them more than they charge safe firms. They take on the extra default risk without extra compensation.

Read together with Table 3, the spread results carry the central inference of the paper. Low-capital, markup-reliant banks supplied roughly a quarter more credit to risky borrowers and charged nothing additional for it. A demand explanation implies the opposite price movement. A bank favored by borrower demand earns more on the marginal loan, not the same. A profit-restoration explanation also implies higher spreads, since the point of reaching for yield is to rebuild income. Quantities up with spreads unchanged, and price premia appearing only among well-capitalized banks and on safe credit, is what under-priced, supply-driven risk-taking looks like in loan data. It is also the cross-sectional counterpart of the time-series finding that loan risk premia compress when monetary policy is easy (Paligorova and Santos, 2017; Ioannidou et al., 2015). In this sample, that compression is produced by the specific banks whose franchise income the low-rate environment had squeezed.

Table 6 reports the flat-pricing regressions. Because the flat-pricing share is bimodal, the outcome is an indicator for whether the bank writes the majority of its lending in the cell without a performance-pricing grid, estimated as a linear probability model. The level effect in column (1) is positive but imprecise. The effect is concentrated on risky borrowers in column (2), where the slope is significant for risky borrowers and not for safe ones, with the gap between them significant at the 5 percent level. Splitting by capital in column (3) leaves both groups insignificant, but the full interaction in column (4) locates the effect: the only significant coefficient belongs to low-capital banks lending to risky firms. A one-standard-deviation increase in markup reliance raises the probability that a low-capital bank's risky lending is majority flat by about 2 percentage points. As with spreads, the sharpest comparison is risky against safe lending by the same banks. Table 7 shows that, within low-capital banks, this probability rises more for risky borrowers than for safe ones, a difference statistically significant. These banks write less performance protection, not more, exactly when the borrower is more likely to default. A grid is most valuable exactly where deterioration is likely. A bank that expands risky lending while writing it flat takes on more exposure and less protection at once. The under-pricing of risk thus extends beyond the spread to the state-contingent terms of the contract, where risk can build without showing up in measured prices or volumes.

4.4 The price of risk under limited liability

The evidence so far describes a supply-driven expansion in risk-taking, and the pattern is sharpest in one cell of the data. Markup-reliant banks lent more, lent more to risky borrowers, and yet charged no extra spread for the added risk, precisely where markup reliance met thin capital. This invites a sharp question. Why would a profit-maximizing bank forgo compensation for risk in order to lend more? A bank that bore the full cost of default would never do so, because extending risky credit below its actuarial price destroys value, so the behavior cannot be rationalized within a fully-liable benchmark. Limited liability could be the answer. Because shareholders value a loan only in states where the bank survives, the bank's reservation spread falls below the actuarial price, and it falls most where markup reliance meets thin capital, exactly the corner of the data where I find risk priced at no premium.

Consider a bank deciding whether to commit one dollar to a risky loan at spread s. The borrower defaults with probability p, in which case the lender loses L. The bank itself fails in some states. Let q denote the probability that the borrower defaults and the bank survives to bear the loss, so that $q \leq p$. Because equity is worthless when the bank fails, shareholders value the loan only in states where the bank survives. The marginal loan is worth

$$\Delta V \;=\; (1-p)\,s \;-\; q\,L, \tag{7}$$

the spread earned when the borrower does not default minus the loss borne only in states where the bank is still standing. The bank is willing to lend when $\Delta V \geq 0$, so the lowest spread it requires is

$$\bar{s} \;=\; \frac{q\,L}{1-p}. \tag{8}$$

The wedge between q and p is the whole story. A bank fails alongside its borrower when their defaults coincide, and corporate defaults cluster in bad aggregate times, exactly when a thinly capitalized, franchise-squeezed bank is itself close to failure. So for such a bank q falls well below p, and its reservation spread $\bar{s}$ falls below the market spread. The gap $(p-q)L$ is the share of the expected loss that lands on creditors and the deposit insurer rather than on shareholders. A simple example fixes ideas. Suppose a risky borrower defaults with probability $p = 0.10$. A well-capitalized bank survives all ten default states out of a hundred, so $q = 0.10$ and it prices the full loss. A thin-capital bank that fails in seven of those ten states has $q = 0.03$, internalizes less than a third of the loss, and requires a far lower spread.

Two implications follow, and both match the evidence. First, the discount falls on risky loans, not safe ones. For a safe borrower p is small and the bank survives the rare default, so $q \approx p$ and $\bar{s}$ stays near the actuarial price whatever the bank's capital. The wedge $(p-q)L$ grows with p, so it bites precisely where default risk is high. Second, the discount falls on thin-capital banks, not well-capitalized ones. A well-capitalized bank survives almost every borrower default, so $q \approx p$

and $\bar{s}$ is unmoved. Underpricing therefore appears only at the intersection of risky borrower and thin capital, the same cell where the quantity expansion concentrates.

The deposit channel works through q. Bank survival depends on the equity and franchise value a bank carries into bad states, and the markup squeeze erodes franchise value in proportion to markup reliance. For a well-capitalized bank survival stays near certain, so $\bar{s}$ does not move. For a thin-capital bank, lost franchise income lowers survival in the very states where risky loans default, which lowers q and $\bar{s}$. Once $\bar{s}$ sits below the market spread, each risky loan earns a positive surplus for shareholders, so the bank wants to expand quantity and can win it by pricing at or just below the market. This is the pattern the data show. Quantities rise and prices stay flat, but only where markup reliance meets thin capital.

4.5 Alternative explanations

Several explanations could in principle generate more lending by markup-reliant banks without any change in risk appetite. None reproduces the full pattern of quantities, prices, and capital that the deposit channel predicts. The most direct is borrower demand. A firm may draw more credit from its lead bank than from peripheral participants, and lead banks could differ from participants in ways correlated with deposit reliance. The within-firm-quarter design already absorbs any demand the firm directs at all of its lenders, so this story requires a within-firm shift toward markup-reliant lenders unrelated to supply. It also makes the wrong price prediction, because a bank favored by borrower demand earns a higher spread on the marginal loan, yet the spreads of markup-reliant banks on risky credit are flat and the tilt toward risky borrowers appears only below the median capital ratio, which demand gives no reason to produce. A funding-side version of the story replaces demand with deposit abundance. A bank flush with stable deposits might expand credit mechanically (Acharya and Naqvi, 2012; Granja et al., 2022), but the deposit funding share enters the regressions directly and carries no explanatory power, the exposure that predicts the expansion is markup income rather than deposit volume, and funding abundance attaches no special role to capital and no reason to forgo covenants or performance grids.

A second group of explanations grants a change in behavior but locates it in profit-seeking rather than risk-shifting. Under reaching for yield, squeezed banks rebuild income by moving into higher-yielding credit, a motive that predicts higher spreads on risky loans, since the premium is the whole point. The markup-reliant banks here charged no such premium and more often wrote their risky lending without performance protection, and uncompensated expansion is the signature the profit-restoration account cannot reproduce. Crisis damage and evergreening sit closer to the data, since thinly capitalized banks were often the crisis-damaged ones, but the capital and profitability controls absorb the level of damage, and the comparison that delivers the result runs across markup reliance within the low-capital group, where crisis exposure is held roughly fixed. Evergreening further predicts concessions on existing distressed borrowers rather than the new origination of covenant-free credit to rated sub-investment-grade firms that the tranche results show. The remaining stories fail on the capital interaction. Superior information would let some banks lend more to safe-looking risky firms at no premium, but information advantages do not switch off above the median capital ratio, and a better-informed lender wants more contractual protection, not less. Implicit guarantees give protected banks their own risk-shifting incentive, but that incentive reinforces the limited-liability logic rather than replacing it, and it would scale with the value of the guarantee rather than with pre-period markup reliance.

4.6 Robustness

The central interaction is robust to allowing other bank characteristics to act through capital. A concern, raised in Section 4.1, is that the deposit income ratio stands in for a correlated characteristic whose effect on risk-taking itself depends on capital. Table 8 re-estimates the triple-interaction specification in column (6) of Table 3 while interacting each pre-period control, the log of assets, the deposit funding share, risk-weighted assets, net income, loans, and total income, with the Low Capital indicator, with the Firm Risk indicator, and with both, and finally in a fully saturated specification that gives every control its own risk-by-capital interaction. The coefficient on the deposit income ratio for low-capital banks lending to risky firms is 0.05 in the baseline and lies between 0.04 and 0.06 throughout, significant at the 1 percent level in every column, including the saturated one. No other characteristic, allowed to interact with capital and risk, displaces it.

A placebo confirms that the deposit income ratio is special among these characteristics. Table 9 puts each pre-period characteristic, standardized, into the triple interaction in place of the deposit income ratio, and only the deposit income ratio generates a significant low-capital risk-taking interaction. Funding structure, loan composition, risk weighting, and profitability produce no such pattern. Bank size is left out of this comparison because it mechanically scales loan volume rather than measuring a funding or franchise characteristic. The expansion of risky lending is attributable to deposit-market power specifically, not to a correlated dimension of portfolio or funding operating through capital.

5 Implications

The findings suggest a trade-off facing monetary policy at the effective lower bound. Holding rates low supports aggregate credit, but part of the marginal credit documented here is risky lending by fragile banks at spreads that do not reflect the risk, lending that transfers expected losses to creditors and the deposit insurer rather than creating surplus. The deposit franchise is central to monetary transmission and to bank stability in normal times (Drechsler et al., 2017, 2021). At the effective lower bound it becomes a source of income risk, because deposit rates cannot follow the policy rate down. The mechanism concerns duration at the floor rather than the rate cut itself. Franchise income is a flow, so the squeeze and the associated incentive accumulate with every quarter the markup remains compressed, including the quarters added by forward guidance. This complements the literature on the reversal rate and on weakened transmission at low rates (Abadi et al., 2023; Wang et al., 2022; Eggertsson et al., 2024): well before accommodation becomes contractionary through bank net worth, it can become risk-creating through bank incentives, and a measure of transmission that counts loan volumes without conditioning on who originates them, and at what price relative to risk, will overstate the benefit of staying low.

For prudential policy, the operative fact is that the response is entirely concentrated below the median pre-period Tier-1 ratio. Well-capitalized banks experienced the same income squeeze. They did not expand lending to riskier borrowers or riskier tranches, did not write more flat-priced risky credit, and charged for the expansion they undertook. Capital performed its disciplining role: where franchise rents no longer make prudence privately optimal, equity at stake does (Repullo, 2004). This is the reduced-form counterpart of the counterfactual in Whited et al. (2021), in which capital regulation curbs the risk-taking incentive created by low rates, and it suggests a practical supervisory screen: during low-rate periods, scrutiny should increase with the product of a bank's markup reliance and its capital shortfall, both observable from regulatory filings. The results also indicate that supervisory stress scenarios, which have historically emphasized rising rates, should include a low-for-long scenario in which the relevant risk is not mark-to-market losses but the gradual buildup of under-priced credit exposure, visible in contract terms such as performance pricing as much as in volumes.

The mechanism is not specific to 2008–2015. Policy rates returned to the floor in 2020; the euro area and Japan operated at or below zero for most of a decade, with documented effects of deposit-rate floors on bank margins and lending (Heider et al., 2019; Eggertsson et al., 2024). A related fragility surfaced at the other end of the rate cycle in the 2023 U.S. regional bank stress, where the deposit franchise failed as an interest-rate hedge once uninsured depositors ran (Drechsler et al., 2023). That episode ran through deposit flight and asset duration rather than the income squeeze studied here, so it is a complementary fragility rather than another instance of the same mechanism. What the cases share is a structural fact. The deposit franchise ties both bank profitability and bank stability to the level of interest rates, and regulation has priced that exposure only partially.

6 Conclusion

This paper tests the deposit channel of bank risk-taking proposed by Whited et al. (2021) using loan-level data from the U.S. syndicated loan market during the 2008–2015 low-rate period. The channel predicts that banks whose income depended most on deposit markups, and whose capital was thin, should have responded to the markup squeeze by taking more credit risk. Comparing banks lending to the same firm in the same quarter, I find that pattern on both quantities and prices. Banks one standard deviation more reliant on markup income lent about 18 percent more. The expansion was concentrated in thinly capitalized banks, went disproportionately to sub-investment-grade borrowers, and was largest in the riskier long-maturity and covenant-free tranches. The additional risk was not compensated. Spreads on risky credit did not move, while their risky lending was more often written without performance-pricing protection. The behavior appears only where markup reliance meets low capital, which is the interaction the theory predicts, and it provides reduced-form support for the model's policy counterfactuals. The risk-taking incentive operates through deposit market power and is shut off by capital.

The findings carry two main messages. For the study of monetary transmission, they provide identified micro evidence for a mechanism that has so far rested on structural estimation, and the within-firm-quarter elasticities reported here are moments to which models of bank market power and low rates can be matched. For policy, they locate the margin that converts an income squeeze into a risk problem: low rates compress deposit markups wherever the deposit-rate floor binds, and whether the compression produces under-priced risky credit depends on bank capital.

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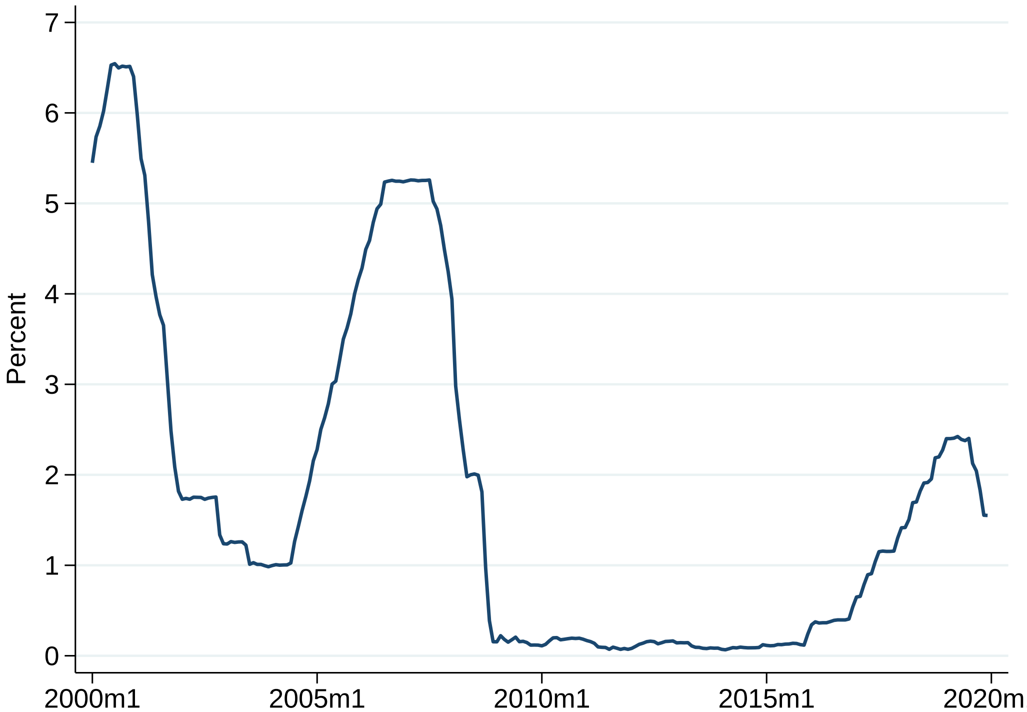
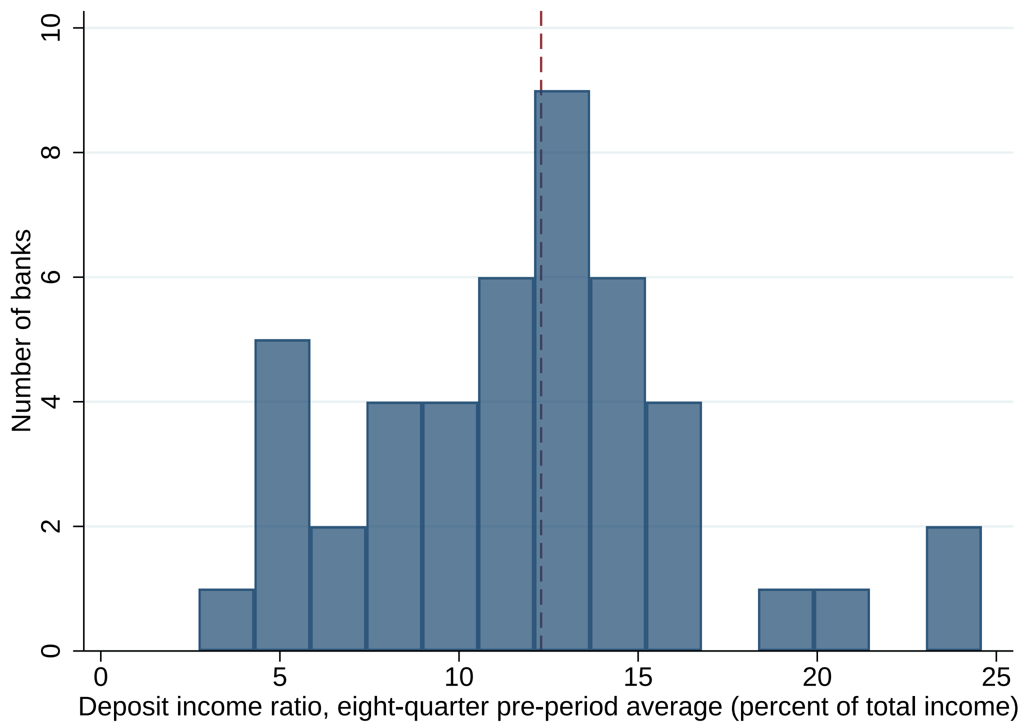
Figure 1: The Federal Funds Rate



Notes. The figure plots the effective federal funds rate, as a monthly average of daily observations from FRED, between 2000 and 2019. From late 2008 to late 2015 the rate stayed near zero, averaging about 13 basis points over 2009 to 2015. At that level there is almost no room between the market rate and the floor on retail deposit rates, the markup that generates deposit-franchise income.

Figure 2: Deposit Income Ratios across Sample Banks



Notes. The figure shows the distribution of the deposit income ratio across the 51 bank holding companies in the sample. The deposit income ratio is income from deposit markups as a percentage of total income, averaged over the eight quarters before 2008Q4, as defined in equation (2). The dashed line marks the median, 12.3 percent. The cross-sectional standard deviation is 4.7 percentage points and the interquartile range runs from 8.7 to 14.5 percent. This pre-determined variation in exposure to the markup squeeze identifies the deposit channel.

Table 1: Summary Statistics

	Mean	SD	p25	p50	p75	*N*
Panel A: Lender characteristics, eight-quarter pre-period averages (one observation per BHC)						
Deposit income ratio (%)	11.90	4.74	8.66	12.29	14.47	51
Tier-1 capital ratio (%)	10.19	4.02	8.36	9.13	10.29	51
log(Assets)	17.34	1.80	16.07	17.47	18.67	51
Total assets ($ billion)	159.2	375.2	9.5	38.7	129.0	51
Deposits/liabilities (%)	67.30	8.95	60.06	66.42	72.52	51
Risk-weighted assets/assets (%)	79.87	9.85	73.15	79.11	85.94	51
Net income/assets (%)	0.24	0.13	0.14	0.25	0.32	51
Loans/assets (%)	63.83	11.40	57.72	67.44	71.21	51
Total income/assets (%)	1.87	0.24	1.73	1.83	1.96	51
Panel B: Firm–bank–quarter cells, 2008Q4–2015Q4						
Loan amount ($ million)	321.1	774.0	50.0	111.0	298.5	20,023
log(Loans)	4.83	1.30	3.91	4.71	5.70	20,023
Firm Risk (rated below BBB−)	0.40	0.49	0	0	1	20,023
Low Capital lender	0.72	0.45	0	1	1	20,023
All-in spread drawn (bps)	196.9	107.1	125.0	170.0	249.3	18,111
Flat-pricing share (%)	61.10	43.60	0.00	82.90	100.00	20,023
Panel C: Tranche–bank–quarter observations, 2008Q4–2015Q4						
Maturity (months)	49.2	18.5	37	56.0	60	29,082
Long Maturity (> 12 months)	0.90	0.30	1	1	1	29,082
No covenant	0.47	0.50	0	0	1	29,303
Cov-lite Risky	0.22	0.42	0	0	0	29,303
log(Loans)	4.24	1.46	3.29	4.21	5.22	29,303

Notes. Panel A reports pre-period characteristics of the 51 bank holding companies in the sample, measured as averages over the eight quarters before 2008Q4 from FR Y-9C filings. The deposit income ratio is income from deposit markups divided by total income, where total income is interest plus non-interest income. Markup income is computed as (fed funds rate − deposit rate) × interest-bearing deposits + fed funds rate × non-interest-bearing deposits. Panel B describes the firm–bank–quarter cells underlying Tables 2, 3, 5, and 6. The sample contains 2,121 Compustat-rated borrowers and $6.4 trillion in total commitments. The preferred specification uses 17,437 cells in 3,188 firm–quarters with at least two lenders, 5.5 lenders on average. The loan amount is the lender's commitment, equal to the tranche amount times the lender's (imputed) share, summed across tranches within the cell. The all-in spread drawn is the loan-volume-weighted spread over LIBOR plus facility fee, winsorized at the 1st and 99th percentiles. Its sample is smaller because DealScan does not report pricing for all tranches. The flat-pricing share is the percentage of the cell's loan volume in tranches without a performance-pricing grid. Panel C describes the tranche–bank–quarter sample underlying Table 4, which contains 6,167 distinct tranches. Maturity is available for 29,082 observations. No covenant equals one if the tranche carries no financial covenant, and Cov-lite Risky equals one if such a tranche also finances a sub-investment-grade borrower.

Table 2: The Effect of Deposit Franchises on Lending

	log(Loans)		
	(1)	(2)	(3)
Deposit Income Ratio$_{pre}$	0.03**	0.03**	0.04**
	(0.012)	(0.013)	(0.013)
$\log(Assets)_{pre}$	0.34***	0.34***	0.35***
	(0.020)	(0.022)	(0.023)
Deposit Ratio$_{pre}$	0.01	0.01	0.01
	(0.010)	(0.010)	(0.010)
Capital Ratio$_{pre}$	-0.05	-0.05	-0.05
	(0.029)	(0.030)	(0.032)
RWA$_{pre}$	-0.01	-0.01	-0.01
	(0.004)	(0.004)	(0.004)
Net Income Ratio$_{pre}$	-0.90*	-0.95*	-0.99*
	(0.456)	(0.480)	(0.496)
Loan Ratio$_{pre}$	-0.00	-0.00	-0.00
	(0.003)	(0.003)	(0.003)
Income Ratio$_{pre}$	0.16	0.18	0.23
	(0.210)	(0.222)	(0.238)
Time Fixed Effects	No	Yes	No
Firm Fixed Effects	Yes	Yes	No
Firm-Time Fixed Effects	No	No	Yes
Observations	17,871	17,871	17,437
Within R squared	0.16	0.18	0.27

Notes. This table reports estimates of equation (3). The unit of observation is a firm–bank–quarter cell in the U.S. syndicated loan market, 2008Q4–2015Q4. The dependent variable is the log of the lender's loan commitments to the firm in the quarter (tranche amount times lender share, summed across tranches). Deposit Income Ratio$_{pre}$ is the bank holding company's income from deposit markups as a percentage of its total income, averaged over the eight quarters before 2008Q4; a unit increase is one percentage point. Bank controls, all measured as eight-quarter pre-period averages, are the log of total assets, deposits over liabilities, the Tier-1 capital ratio, risk-weighted assets over assets, net income over assets, loans over assets, and total income over assets. Column (1) includes firm fixed effects; column (2) adds quarter fixed effects; column (3), the preferred specification, includes firm$\times$quarter fixed effects, so that the coefficient is identified from firms borrowing from at least two banks in the same quarter. Standard errors, in parentheses, are clustered three ways, by firm, bank holding company, and quarter. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3: Lending by Borrower Risk and Bank Capital

	log(Loans)					
	(1)	(2)	(3)	(4)	(5)	(6)
Deposit Income Ratio$_{pre}$						
$\times$ Low Capital $= 0$	0.05	0.05				
	(0.035)	(0.036)				
$\times$ Low Capital $= 1$	0.03**	0.04***				
	(0.013)	(0.013)				
$\times$ Firm Risk $= 0$			0.03**	0.03**		
			(0.012)	(0.013)		
$\times$ Firm Risk $= 1$			0.04***	0.04***		
			(0.014)	(0.014)		
$\times$ Firm Risk $= 0 \times$ Low Capital $= 0$					0.06*	0.07*
					(0.036)	(0.037)
$\times$ Firm Risk $= 0 \times$ Low Capital $= 1$					0.03**	0.04***
					(0.012)	(0.012)
$\times$ Firm Risk $= 1 \times$ Low Capital $= 0$					0.04	0.04
					(0.036)	(0.037)
$\times$ Firm Risk $= 1 \times$ Low Capital $= 1$					0.04***	0.05***
					(0.014)	(0.015)
Time Fixed Effects	Yes	No	Yes	No	Yes	No
Firm Fixed Effects	Yes	No	Yes	No	Yes	No
Firm-Time Fixed Effects	No	Yes	No	Yes	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17,871	17,437	17,871	17,437	17,871	17,437
Within R squared	0.18	0.27	0.18	0.27	0.18	0.27

Notes. This table reports estimates of equation (4) and its pairwise components. The unit of observation is a firm–bank–quarter cell, 2008Q4–2015Q4; the dependent variable is the log of the lender's loan commitments to the firm in the quarter. Deposit Income Ratio$_{pre}$ is the bank's income from deposit markups as a percentage of total income, averaged over the eight quarters before 2008Q4. Low Capital equals one if the bank's pre-period Tier-1 capital ratio is below the sample median. Firm Risk equals one if the borrower's S&P long-term rating in the quarter is below BBB−. Columns (1)–(2) interact the deposit income ratio with bank capital, columns (3)–(4) with borrower risk, and columns (5)–(6) with both; each interaction reports the slope of credit supply with respect to the deposit income ratio within the indicated group. Uninteracted group indicators and the full set of pre-period bank controls from Table 2 are included throughout. Odd columns include firm and quarter fixed effects; even columns include firm$\times$quarter fixed effects. Standard errors, in parentheses, are clustered by firm, bank holding company, and quarter. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: Loan Composition: Maturity and Covenant Protection

	log(Loans)			
	(1)	(2)	(3)	(4)
Deposit Income Ratio$_{pre}$				
$\times$ Long Maturity = 0	0.01			
	(0.010)			
$\times$ Long Maturity = 1	0.03**			
	(0.011)			
$\times$ Long Maturity = 0 $\times$ Low Capital = 0		0.10**		
		(0.038)		
$\times$ Long Maturity = 0 $\times$ Low Capital = 1		0.01		
		(0.011)		
$\times$ Long Maturity = 1 $\times$ Low Capital = 0		0.03		
		(0.034)		
$\times$ Long Maturity = 1 $\times$ Low Capital = 1		0.03**		
		(0.012)		
$\times$ Cov-lite Risky = 0			0.02**	
			(0.011)	
$\times$ Cov-lite Risky = 1			0.04***	
			(0.011)	
$\times$ Cov-lite Risky = 0 $\times$ Low Capital = 0				0.04
				(0.033)
$\times$ Cov-lite Risky = 0 $\times$ Low Capital = 1				0.03**
				(0.012)
$\times$ Cov-lite Risky = 1 $\times$ Low Capital = 0				0.03
				(0.038)
$\times$ Cov-lite Risky = 1 $\times$ Low Capital = 1				0.04***
				(0.011)
Firm-Time Fixed Effects	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	29,078	29,078	29,303	29,303
Within R squared	0.14	0.14	0.14	0.14

Notes. This table reports the effect of pre-period deposit income ratios on lending across tranche maturities and across covenant protection. The unit of observation is a tranche–bank–quarter observation (the lender's commitment to a single tranche), 2008Q4–2015Q4; the dependent variable is the log of the lender's commitment. Long Maturity equals one if the tranche matures in more than twelve months. Cov-lite Risky equals one if the tranche finances a sub-investment-grade borrower and carries no financial covenant, the combination that leaves the lender holding a weak credit while waiving the covenant rights that would let it intervene as the borrower deteriorates. Covenant data are from DealScan, matched at the tranche level. Deposit Income Ratio$_{pre}$ is the bank's income from deposit markups as a percentage of total income, averaged over the eight quarters before 2008Q4. Low Capital equals one if the bank's pre-period Tier-1 ratio is below the sample median. Uninteracted group indicators and the full set of pre-period bank controls from Table 2 are included. All columns include firm$\times$quarter fixed effects. Standard errors, in parentheses, are clustered by firm, bank holding company, and quarter. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: The Effect of Deposit Franchises on Loan Spreads

	Loans Spread			
	(1)	(2)	(3)	(4)
Deposit Income Ratio$_{pre}$	0.19			
	(0.115)			
$\times$ Low Capital $=0$		0.39		
		(0.251)		
$\times$ Low Capital $=1$		0.14		
		(0.142)		
$\times$ Firm Risk $=0$			0.28**	
			(0.111)	
$\times$ Firm Risk $=1$			0.05	
			(0.199)	
$\times$ Firm Risk $=0$ $\times$ Low Capital $=0$				0.06
				(0.465)
$\times$ Firm Risk $=0$ $\times$ Low Capital $=1$				0.29**
				(0.127)
$\times$ Firm Risk $=1$ $\times$ Low Capital $=0$				0.75
				(0.677)
$\times$ Firm Risk $=1$ $\times$ Low Capital $=1$				-0.05
				(0.232)
Firm-Time Fixed Effects	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	15,995	15,995	15,995	15,995
Within R squared	0.00	0.00	0.00	0.00

Notes. This table reports the effect of pre-period deposit income ratios on loan spreads. The unit of observation is a firm–bank–quarter cell, 2008Q4–2015Q4. The dependent variable is the all-in spread drawn, in basis points over LIBOR, weighted by loan volume across the cell's tranches and winsorized at the 1st and 99th percentiles (sample mean 195 bps, 150 bps for investment-grade and 255 bps for sub-investment-grade borrowers). Deposit Income Ratio$_{pre}$ is the bank's income from deposit markups as a percentage of total income, averaged over the eight quarters before 2008Q4, so coefficients are in basis points per percentage point. Low Capital equals one if the bank's pre-period Tier-1 ratio is below the sample median; Firm Risk equals one if the borrower is rated below BBB$-$. Uninteracted group indicators and the full set of pre-period bank controls from Table 2 are included. All columns include firm$\times$quarter fixed effects, so pricing differences are measured across banks lending to the same firm in the same quarter. Standard errors, in parentheses, are clustered by firm, bank holding company, and quarter. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: The Effect of Deposit Franchises on Flat Pricing

	Majority Flat Pricing			
	(1)	(2)	(3)	(4)
Deposit Income Ratio$_{pre}$	0.003			
	(0.002)			
$\times$ Firm Risk = 0		0.001		
		(0.002)		
$\times$ Firm Risk = 1		0.004**		
		(0.002)		
$\times$ Low Capital = 0			0.006	
			(0.004)	
$\times$ Low Capital = 1			0.003	
			(0.002)	
$\times$ Low Capital = 0 $\times$ Firm Risk = 0				0.006
				(0.004)
$\times$ Low Capital = 0 $\times$ Firm Risk = 1				0.006
				(0.005)
$\times$ Low Capital = 1 $\times$ Firm Risk = 0				0.001
				(0.002)
$\times$ Low Capital = 1 $\times$ Firm Risk = 1				0.004**
				(0.002)
Firm-Time Fixed Effects	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	17,437	17,437	17,437	17,437
Within R squared	0.02	0.02	0.02	0.02

Notes. This table reports the effect of pre-period deposit income ratios on whether a bank writes lending without performance-pricing provisions. The unit of observation is a firm–bank–quarter cell, 2008Q4–2015Q4. The dependent variable is an indicator equal to one if at least half of the cell's loan volume is in tranches that carry no performance-pricing grid, i.e., whose spread does not ratchet up automatically when the borrower's credit quality deteriorates, so that the cell is majority flat-priced; it equals one for 64 percent of cells. The flat-pricing share is bimodal, so the binary indicator is a cleaner outcome than the continuous share. Estimates are from a linear probability model, so coefficients give the change in the probability per percentage point of the deposit income ratio. Deposit Income Ratio$_{pre}$ is the bank's income from deposit markups as a percentage of total income, averaged over the eight quarters before 2008Q4. Low Capital equals one if the bank's pre-period Tier-1 ratio is below the sample median; Firm Risk equals one if the borrower is rated below BBB−. Uninteracted group indicators and the full set of pre-period bank controls from Table 2 are included. All columns include firm$\times$quarter fixed effects. Standard errors, in parentheses, are clustered by firm, bank holding company, and quarter. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 7: Tests of Differences between Interaction Coefficients, Tables 3–6

Contrast	Difference	SE	p-value
Table 3: Lending, $\log(\textit{Loans})$			
Low Capital $= 1 -$ Low Capital $= 0$ (col. 2)	-0.014	(0.033)	[0.668]
Firm Risk $= 1 -$ Firm Risk $= 0$ (col. 4)	0.012**	(0.005)	[0.014]
[LC $= 1$, FR $= 1$] $-$ [LC $= 1$, FR $= 0$] (col. 6)	0.011**	(0.005)	[0.042]
Table 4: Lending, $\log(\textit{Loans})$, *tranche level*			
Long Maturity $= 1 -$ Long Maturity $= 0$ (col. 1)	0.015***	(0.004)	[0.001]
[LC $= 1$, LM $= 1$] $-$ [LC $= 1$, LM $= 0$] (col. 2)	0.016***	(0.003)	[0.000]
Cov-lite Risky $= 1 -$ Cov-lite Risky $= 0$ (col. 3)	0.012***	(0.004)	[0.007]
[LC $= 1$, CL $= 1$] $-$ [LC $= 1$, CL $= 0$] (col. 4)	0.012***	(0.004)	[0.008]
Table 5: Loan spread (bps)			
Low Capital $= 1 -$ Low Capital $= 0$ (col. 2)	-0.249	(0.247)	[0.322]
Firm Risk $= 1 -$ Firm Risk $= 0$ (col. 3)	-0.222	(0.193)	[0.261]
[LC $= 1$, FR $= 1$] $-$ [LC $= 1$, FR $= 0$] (col. 4)	-0.340	(0.211)	[0.118]
Table 6: Majority flat pricing (LPM)			
Firm Risk $= 1 -$ Firm Risk $= 0$ (col. 2)	0.003**	(0.001)	[0.044]
Low Capital $= 1 -$ Low Capital $= 0$ (col. 3)	-0.003	(0.004)	[0.367]
[LC $= 1$, FR $= 1$] $-$ [LC $= 1$, FR $= 0$] (col. 4)	0.003*	(0.001)	[0.066]

Notes. Each row reports a `lincom` test of the difference between two interaction coefficients on the pre-period deposit income ratio, from the indicated column of the indicated paper table. All underlying regressions are the published firm×quarter fixed-effects specifications with the full set of pre-period bank controls; samples, outcomes, and variable definitions are identical to the published tables. LC denotes Low Capital, FR Firm Risk, LM Long Maturity, and CL Cov-lite Risky. For specifications with a single interacted dummy, the test is the difference between the two group slopes; for triple interactions, the focal cell [LC $= 1$, dummy $= 1$] is tested against the adjacent same-capital cell [LC $= 1$, dummy $= 0$]. Standard errors, in parentheses, are clustered by firm, bank holding company, and quarter; p-values in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 8: Robustness: Bank Controls Interacted with Capital and Risk

	log(Loans)				
	(1)	(2)	(3)	(4)	(5)
Deposit Income Ratio$_{pre}$					
$\times$ Firm Risk $= 1 \times$ Low Capital $= 1$	0.05***	0.06***	0.04***	0.06***	0.06***
	(0.015)	(0.014)	(0.016)	(0.015)	(0.016)
Controls $\times$ Low Capital	No	Yes	No	Yes	Yes
Controls $\times$ Firm Risk	No	No	Yes	Yes	Yes
Controls $\times$ Low Capital $\times$ Firm Risk	No	No	No	No	Yes
Firm-Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Observations	17,437	17,437	17,437	17,437	17,437
Within R squared	0.27	0.29	0.27	0.29	0.29

Notes. This table re-estimates the triple-interaction specification in column (6) of Table 3 and reports the coefficient on the deposit income ratio for low-capital banks lending to risky firms. Column (1) is the baseline. Columns (2) through (4) add each pre-period bank control, the log of assets, the deposit funding share, risk-weighted assets, net income, loans, and total income, interacted with the Low Capital indicator, with the Firm Risk indicator, and with both. Column (5) is fully saturated, giving each control its own Firm Risk by Low Capital interaction. All columns include firm$\times$quarter fixed effects and the full set of pre-period controls from Table 2. Standard errors, in parentheses, are clustered by firm, bank holding company, and quarter. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 9: Placebo: Alternative Pre-Period Characteristics in the Interaction

	Characteristic $\times$ Firm Risk $\times$ Low Capital				
	Deposit income ratio	Deposit funding ratio	Loan ratio	Risk-weighted asset ratio	Net income ratio
log(Loans), per SD	0.22***	0.10	-0.04	0.06	0.03
	(0.069)	(0.082)	(0.050)	(0.082)	(0.049)

Notes. Each column reports a separate regression that replaces the deposit income ratio in the column-(6) triple interaction of Table 3 with the indicated pre-period characteristic, standardized to unit standard deviation, and reports the coefficient for low-capital banks lending to risky firms; the dependent variable is the log of the lender's loan commitments. Only the deposit income ratio enters significantly; funding structure, loan composition, risk weighting, and profitability produce no such pattern. All regressions include firm$\times$quarter fixed effects and the full set of pre-period controls from Table 2. Standard errors, in parentheses, are clustered by firm, bank holding company, and quarter. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.