# Banks' Internal Capital Markets and Deposit Rates

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**Abstract**

A common view is that deposit rates are determined primarily by supply: depositors require higher deposit rates from risky banks and hence create market discipline. An alternative perspective is that market discipline is weak (potentially due to deposit insurance, for example) and that internal demand for funding by banks determines rates. Using branch-level deposit rate data, we find little evidence for market discipline as rates are similar across bank capitalization levels. In contrast, banks' loan growth has a causal effect on deposit rates: e.g., branches' deposit rates are correlated with loan growth in other states in which their bank has some presence.

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# 1 Introduction

Bank deposit rates are determined by the supply of deposits by households and firms and the demand for deposits by banks. The literature has emphasized the supply of deposits: ensuring that funds are deposited in safe banks is a concern of the customer, and therefore depositors bid down the deposit rates of those banks. By doing so, depositors impose market discipline on banks and force risky banks to pay higher prices. Researchers have found empirical support for this view, much of it from foreign markets and the 1980s U.S. banking crisis. Yet, it is still debatable whether deposit market discipline still is a decisive determinant of deposit rates in countries such as the United States, where deposit insurance plays such a central role and enhancements to capital regulation have led to substantially higher bank capital and therefore lower bank default risk on average.[1] Figure 1 documents that, on average, capital levels during the recent financial crisis were about 200 basis points higher than those during the 1980s banking crisis. Diamond and Rajan (2000) note that higher capital levels lead to lower bank default risk, which Berger and Bouwman (2013) and Brown and Dinc (2011) test empirically.

In addition to factors affecting deposit supply (e.g., risk-sensitive depositors), important demand-side factors could influence bank deposit rates. In particular, the internal demand for funds within the bank, which has received less attention in the literature, could help determine deposit rates. According to this channel, banks' lending and borrowing are jointly determined: for example, a decision to increase lending will lead the bank to increase deposit rates to attract new deposits. Some studies find evidence consistent with this view; however, it is difficult to

[1] E.g., Acharya and Mora (2011) find that bank-level income expense from the Call Reports (a proxy for the deposit rate) is higher for banks that are poorly capitalized. Since this analysis is at the bank level, it does not account for changes in the composition of deposit maturities and risk premia across time and across banks. Our data is at the deposit contract level, allowing examination of each maturity separately and thus providing an accurate picture on the relation between deposit rates and bank capitalization.

reach conclusions about causality. For example, Jayaratne and Morgan (2000) find that loan growth is highly correlated with deposit growth, especially for banks that are poorly capitalized. Gatev and Strahan (2006) present evidence from the syndicated loan market that the spread on commercial paper is correlated with deposit flows to banks. Discerning the channels that determine deposit rates is important in order to understand the extent to which market discipline exists and to evaluate the mechanism through which banks' internal capital markets help liquidity creation (e.g., Berger and Bouwman 2009, Bouwman 2013).

In this paper, we use branch-level deposit rates of U.S. banks (money-market deposits as well as certificate of deposit (CD) data) between 2007 and 2012 to analyze the determinants of deposit rates. We find no evidence for market discipline in deposit rates in the United States during this period. Our results suggest, however, that internal capital markets drive deposit rates and that banks' lending activity is a strong determinant of deposit rates. Hence, our results suggest that in recent years rates have been driven by banks' demand for deposits rather than by the supply of deposits.

We begin the empirical analysis by estimating the relation between deposit rates and bank risk. The view that depositors can impose market discipline on banks through deposit rates is motivated by prior research indicating that banks knowingly choose to shift risks to the Federal Deposit Insurance Corporation (FDIC) by seeking risky lending opportunities and funding them with deposits. The risk-shifting argument is illustrated by the finding of Esty (1997) that stock-owned banks exhibited higher profit variability than mutual savings and loan organizations in the mid-1980s. Keeley (1990) argues that increased competition led low-capital banks to take on more asset risk, and he documents an inverse relation between bank capital ratios and large denomination CD rates. Shoven, Smart, and Waldfogel (1992) also argue that

very high levels of competition unleashed by deregulation and evidenced by relatively high deposit rates throughout the 1980s helped to set the stage for risk-shifting by troubled banks. Another strand of the literature studies market discipline in situations where deposit insurance is not available. For example, Park and Peristiani (1998) focus on accounts larger than $100,000 that were not fully insured by the FDIC. Peria and Schmukler (2001) find evidence for market discipline in South America.

Our empirical strategy in this portion of the analysis is based on measuring the relation between deposit rates and proxies for bank risk. Following Brown and Dinc (2011) and Berger and Bouwman (2013), we select the capitalization of banks as our main proxy for bank risk. Two main forces determine the relation between deposit rates and bank risk. On the one hand, depositors require higher rates to deposit funds in riskier banks. On the other hand, while capitalization varies greatly, average capital levels are substantially higher following the Federal Deposit Insurance Corporation Improvement Act (FDICIA), which suggests reduced risk levels for deposit investors and potentially corresponding limits on market discipline.[2] In addition, deposits in the United States (up to $100k pre-2008 and $250k post-2008) are insured by the FDIC, thereby weakening the sensitivity to bank risk and failure. Depositors can limit the size of their deposits at an individual bank (and even use an intermediary to facilitate spreading out their deposits)[3] to guarantee that the deposits are fully insured if they conclude that the insurance is of significant value. In effect, insurance is available to prospective depositors by spreading out their

[2] For example, Aggrawal and Jacques (2001) document that banks increased capital ratios following FDICIA without compensating increases in risk taking.
[3] For example, Promontory Financial Group is one such intermediary.

deposits at low cost.[4] Therefore, we predict that the relation between deposit rates and bank risk is potentially weak or even nonexistent.

Indeed, we do not find a negative relation between deposit rates and bank capital shortly before or after the financial crisis, which we define as beginning in 2008/Q4, which suggests the absence of market discipline. During the period after 2008/Q4, we find a consistent positive relation between deposit rates and equity capital, suggesting better capitalized banks pay higher deposit rates. These results remain qualitatively similar across deposit horizons and deposit sizes. However, the association between higher equity capital and CD rates is strongest for smaller banks and banks with greater dependence on non-brokered deposits, suggesting that our result is driven by local and retail deposits. In robustness analyses, we verify that our results are not driven by the rate cap instituted by the FDIC in 2009, by the regulators' restrictions in earlier periods, or by a bank's participation in the Troubled Asset Relief Program (TARP). Such rate restrictions could have caused deposit rates to be uninformative about the riskiness of the banks' portfolios, leading banks to alter their investment policies (Berger, Bouwman, Kick, and Schaeck, 2012). Our results remain virtually unchanged when we remove banks that are potentially subject to these restrictions.

We test another prediction of the market discipline hypothesis - that deposit rates should predict bank failure: depositors identify banks that are in poor financial shape and therefore demand a higher premium for their deposits because these banks are more likely to fail on average. Our empirical test shows the opposite. For the four-quarter horizon, the relation between bank failure and deposit rates is negative (low deposit rates in the cross section predict

[4] Another consideration that limits the exposure of uninsured depositors is the potential ability to withdraw in advance of the collapse of the bank and the potential ability of banks to obtain liquidity in some instances (e.g., from Federal Home Loan Banks or even the Federal Reserve).

bank failure) and statistically significant; it becomes statistically insignificant for the eight-quarter horizon. Furthermore, we find the time to failure is positively correlated with deposit rates. In sum, we do not find support for market discipline in the deposit market.

These results provide preliminary support for the view that CD rates are primarily an indicator of bank demand for funds rather than an indicator of bank riskiness. Lower CD rates for weakly capitalized banks are suggestive of less aggressive deposit-seeking by the weak banks. Next, we explore the internal capital markets channel of determining deposit rates in order to directly relate bank internal loan demand to CD rates. Our hypothesis is that banks determine deposit rates based on their internal funding needs. This hypothesis is part of a larger internal capital markets mechanism, which postulates that the bank determines lending and deposit activities jointly. Previous literature suggests that internal capital markets are important to banks. Gatev, Schuermann, and Strahan (2009) find that a bank's equity return volatility increases with unused loan commitments and decreases with the level of deposits. Cetorelli and Goldberg (2012a, 2012b) provide evidence consistent with international banks shifting funds across countries to overcome liquidity shocks during the Global Financial Crisis and that, more generally, multinational banks manage liquidity on a global basis. Berger and DeYoung (2001) find mixed evidence about the efficiency of geographically spread banks.

Our focus is on the determinants of deposit rates, and thus we are interested in the causal relation between lending activity and deposit rates. Note that a causal relation in the opposite direction exists as well: an exogenous increase in the availability of deposits fosters banks' lending in remote locations. Gilje, Loutskina, and Strahan (2013) find that banks that were exposed to a shale oil (and deposit) shock in some branch locations increased their lending in other, non-shale locations, i.e., a shock to the supply of deposits generates lending activity. This

evidence is consistent with our findings in that causality can run in both directions, even for the same bank: the supply of deposits determines loan growth, and the demand for loans drives deposit rates. Whereas Gilje, Loutskina, and Strahan (2013) isolate the effects in one direction, our study isolates the effect in the opposite direction, offering complementary evidence about the functioning of internal capital markets.

We test the proposed mechanism of lending activity affecting deposit rates in several ways. Our first set of tests examines the relation among deposit rates, deposit flows, and loan growth. Despite these relationships being endogenous, they provide a baseline for the analysis. We document a strong positive correlation between deposit rates and loan growth, i.e., banks that experience a higher loan growth rate offer to pay higher deposit rates on average. The sensitivity of deposit rates to loan growth declined significantly following the financial crisis of 2008, when lending activity was relatively low. Furthermore, we find a positive correlation between deposit flows and both deposit rates and loan growth. Examining deposit flows is important because it distinguishes the market discipline and the internal capital markets hypotheses. According to the market discipline story, a bank that pays higher deposit rates is riskier and therefore should not necessarily attract more deposits than a bank that pays lower deposit rates. In contrast, the internal capital markets story suggests that banks increase deposit rates specifically to attract deposits; therefore, in equilibrium, higher deposit rates should attract deposit flows. We test this hypothesis and find that indeed deposit flows are positively correlated with deposit rates, favoring the internal capital market hypothesis. Furthermore, we replicate the main test of Jayaratne and Morgan (2000) using our more recent data, confirming that deposit growth is positively correlated with loan growth and providing further evidence for the internal capital market mechanism.

While these results support the internal capital market hypothesis, they do not isolate the direction of the effect, which is endogenous. There could be two types of endogeneity issues. First, it is possible that the relation between loan growth and deposit rates captures some unobservable bank characteristics, such as riskiness, that are observed only by depositors and not by the econometrician. Second, it is possible that the causality runs exclusively in the opposite direction and governs the correlation between loan growth and deposit rates. For example, banks are exposed to a positive deposit shock (and therefore, potentially decrease deposit rates) and as a result initiate lending activity (as in Gilje, Loutskina, and Strahan, 2013).

We tackle the endogeneity issues with several empirical approaches. First, we examine the relation between bank-level deposit rates and the common component of loan growth to which banks are exposed. The advantage of using this measure of loan growth is that it is based on market-level lending activity rather than on the bank's endogenous lending decisions. Therefore, if deposit rates are driven by loan growth, we would expect bank deposit rates to be correlated with the systematic market-wide component of loan growth. To test this prediction, we replace the bank's specific loan growth variable with state-level loan growth. We proxy state-level loan growth as the median loan growth of single-state banks. Our results are very similar to previous results: deposit rates are strongly correlated with state-level loan growth.

Second, we exploit the branching structure of banks to provide causal evidence that loan growth is an important driver of deposit rates. Our test relies on the following logic: many banks have branches in areas with different economic environments. The analysis examines whether loan growth in one state in which the bank operates (State B) affects the rates on deposits of the same bank in a different state (State A). If the bank uses deposit funding to finance loans, then high loan growth in State B potentially leads the bank to compete more aggressively for deposits

in both States A and B. Indeed, we find that branch-level deposit rates are correlated with the loan growth rates in the state in which the branches are located, as well as with loan growth in other states in which the bank operates. We show that the effect is concentrated in banks that depend on deposits as a source of financing and that this effect virtually disappeared during the financial crisis. We view this as strong evidence that loan growth is a first-order determinant of deposit rates.

In an effort to understand the economic mechanism of the demand for deposits by banks, we impose yet stronger tests to determine whether the internal capital markets of banks play a critical role in determining deposit rates. We show that the relation between state-level loan growth and deposit rates is stronger for single-state banks compared to multi-state banks. Multi-state banks can use their network of branches to seek deposits in the event of a positive loan demand shock and therefore soften the effect.[5] In contrast, single-state banks are limited in their ability to spread their demand for funding and therefore shocks to loan growth should have a stronger impact on deposit rates.

We summarize our data in Section 2. Our analysis in Section 3 suggests that deposit rates are not driven by market discipline during our sample period of 2007–2012, as these rates are not negatively related to bank equity and do not predict bank failure. Instead, we exploit the branching structure of the banks in Section 4 and provide strong evidence that deposit rates are driven by internal capital markets. We offer concluding comments in Section 5. Collectively, our findings show that deposit rates are determined by the demand of banks rather than by the supply of depositors.

[5] It is possible that multi-state banks also have additional flexibility.

## 2 Data and Variable Construction

### 2.1 Data

Our analysis makes use of several sources of data. We employ the bank Reports of Condition and Income, often referred to as Call Reports, to identify banks with low capital (equity to assets), as well as bank-related variables and controls such as loan growth and asset size. The Call Reports data comprise all of the mandatory filings by banks at a quarterly frequency. These data are available starting in 1984.

We use a panel dataset of deposit rate quotes provided by RateWatch at the branch level. RateWatch collects deposit rates and sells its data to industry participants. Clients of the firm are banks interested in knowing the published rates of their competitors. RateWatch collects deposit rate information from banks via telephone, fax, and email and by scraping banks' websites. The data are available on a weekly frequency since 2001; however, they are adjusted for bank mergers only since 2007. We compare RateWatch's bank list to the list of banks in the Call Reports and estimate that its dataset covers about 75%–85% of the market, depending on the year.

To merge bank financial data with deposit rate data, we consolidate the branch level quotes at the bank level. The final dataset covers the period of 2007/Q1 to 2012/Q3. We have deposit rates for accounts of \$10k, \$100k, \$250k, \$500k, and \$1m[6] for different maturities: money market rate and Certificate of Deposit (CD) rates for 6, 12, 24, 36, 48, and 60 months. In Tables 1 and 2, we split the analysis by account size and maturity. In the later part of the analysis, we focus on the most commonly available rates: the 12-month CD rate for \$10k accounts. The Call Reports dataset indicates that only a relatively small fraction of bank deposits

[6] Rates for accounts larger than \$100k are available only for the later part of the sample, starting from 2011/Q1.

are of a longer maturity than 12 months. Thus, shorter term deposit rates—such as 12-month CDs—are more likely to reflect aggregate deposit investor sentiment vis-à-vis bank risk. In our Call Reports sample, about 80% of bank deposits have less than one year in maturity remaining and about 97% of bank deposits have less than three years of maturity remaining. For robustness, we also estimate our tests using 6- and 24-month deposit rates; the core results are unchanged.

To provide a robust measure of banks' rates, we average the weekly deposit rate observations for each quarter. Because our Call Reports sample is at the bank level (as opposed to the branch level), we average the branch-level observations to the bank level, and hence our final database is at the bank-quarter level. Our final dataset consists of an unbalanced panel with 6,582 banks between 2007/Q1 and 2012/Q3 with 120,650 bank-quarter observations of 12-month CD rates. In Table 6, we use a subset of interstate banks for which we generate a bank-state-quarter dataset: one observation for each bank's operation within a state-quarter. This dataset contains 25,284 bank-state-quarter observations from 524 unique banks.

We plot the time series of deposit rates in Figure 2 for three different maturities for $10k accounts (money market rates and 12-month and 24-month rates) as well as 12-month rates for larger accounts: $100k and $500k. Each plot shows the median deposit rate in each calendar quarter as well as the $5^{th}$ and $95^{th}$ percentiles. The figure shows that in our sample period, money market rates are significantly lower than rates of longer maturities. Furthermore, there is little difference between the rates for $10k and $100k accounts. Because the data for $500k accounts is populated only since 2011/Q1, it is hard to make inferences about the magnitude of deposit rates for very large accounts.

## 2.2 Variables

Our primary variables of interest, besides deposit rates, are bank capital, bank failure, deposit growth, and loan growth. Variable definitions are provided in Appendix A. Bank capital measures the risk of bank failure. In line with the literature (e.g., Berger and Bouwman (2013) and Brown and Dinc (2011)), we measure bank capital as the equity-to-asset ratio defined as total bank equity divided by total bank assets. Figure 1 presents a time series of the ratio of equity-to-assets. The figure shows that since 1987 banks have improved their capitalization. In the robustness analysis in Appendix B, we use alternative measures of bank capital: Tier-1-capital-to-assets and Tier-1-capital-to-risk-weighted assets.

Our analysis uses additional variables of interest. Bank failure is defined according to the FDIC failure list,[7] which includes all failures and assistance transactions (purchase and assumptions, re-privatizations, etc.). Deposit growth is calculated as a one-quarter change in a bank's total deposits. In a parallel fashion, loan growth is computed as the one-quarter change in total outstanding loans. Unfortunately, the Call Reports do not provide a breakdown for new deposits, deposits reinvested, and deposits matured, or for loans originated, loans renewed, and loans terminated. The amount of total outstanding loans is net of nonperforming loans and of loans for which there is a reasonable concern that they will become nonperforming. Because our loan growth measure is derived from changes in the stock of loans, as opposed to flows of new loans, we cannot directly differentiate between loan growth declines emanating from reducing new lending and from writing-off losses from existing loans. To remedy this concern, we include in all our specifications a measure of charge-offs, thus controlling for the effect of loan write-offs on lending growth.

[7] http://www.fdic.gov/bank/individual/failed/banklist.html

In addition, we include a large set of controls in our specifications. These include several proxies related to other aspects of financial health aside from capital: asset quality (ratio of performing loans to total loans), the deposits-to-liabilities ratio, the charge-off ratio, and the loans-to-assets ratio.[8] In addition, we control for the ratio of time deposits to total deposits, the ratio of large deposits (i.e., deposits of $100k or more) to total deposits, and the ratio of brokered to total deposits. Organizational controls include bank size (proxied by logged assets), branch network size (proxied by the logged number of bank branches), a multi-bank holding company affiliation dummy, and a new bank dummy (an indicator denoting that the bank was established within the previous five years). Finally, we include measures of the asset composition: the ratio of real estate–related loans to total assets and the fraction of commercial and industrial loans to total assets.

Other variables of interest are the large deposit rate ratios (from the Call Reports), which measure the dollar amount of large deposits (i.e., deposits larger than $100k or $250k) as a fraction of the total dollar amount of deposits within a bank. We present the time series for these variables in Figure 3. The Call Reports provide information on deposits larger than $100k for the entire sample period. The Reports only include information for deposits greater than $250k starting with the first quarter of 2010. Figure 3 shows that the percentage of deposits larger than $100k increases almost monotonically over the sample period, particularly during the peak of the financial crisis (around 2008/Q4–2009/Q1). Interestingly, these larger deposits make up a substantial portion of total bank deposits: nearly 40% before the financial crisis, and over 45% at

[8] The loans-to-assets ratio measures the fraction of dollar loans on the bank's asset side divided by total assets. This is a proxy for bank illiquidity. In unreported results, we consider alternative measures such as liquid assets–to–total assets, where liquid assets include cash, federal funds sold and reverse repos, and non-MBS (Mortgage-Backed Securities). The core results are robust to such alternative definitions of liquidity.

the end of the sample period.[9] These magnitudes are surprising, especially prior to the October 2008, when the FDIC insured only deposits of up to $100k. The ratio of deposits larger than $250k to total deposits appears to remain stable from 2011/Q1 until the end of the sample period.

# 3 Tests of Market Discipline

## 3.1 The Correlation between Deposit Rates and Capital Ratios

We begin the empirical analysis by testing the correlation between deposit rates and the capital ratio (equity-to-assets). In Table 2, we provide several specifications for regressions of rates on the equity-to-asset ratio (interacted with indicators for pre-crisis or during crisis):

$$Deposit\ rate_{i,q} = \alpha + \beta_1 E/A_{i,q-1} \times I(q < 2008/Q4) + \beta_2 E/A_{i,q-1} \times I(q \geq 2008/Q4) + \gamma B_{i,q-1} + \delta T_q + \varepsilon_{i,q,} \quad (1)$$

where $Deposit\ rate_{i,q}$ is the deposit rate of bank $i$ at quarter $q$. $E/A_{i,q-1}$ is the lagged equity-to-assets ratio. $I(q < 2008/Q4)$ and $I(q \geq 2008/Q4)$ are indicators of whether quarter $q$ precedes 2008/Q4 or not, respectively. $B_{i,q-1}$ is a set of bank-quarter controls. $T_q$ is a set of time (quarter) fixed effects. All specifications are estimated with robust standard errors clustered by bank.

In Panel A, we regress deposit rates for different maturities (money market, and 6, 12, 24, 48, and 60 month CDs) on the equity-to-assets ratio. If market discipline is an important force, then deposit rates should be higher for poorly capitalized banks, i.e., the coefficient on equity-to-assets should be negative. In contrast, the panel shows that all but one coefficient is positive and most are statistically significant; the coefficients for money market, 6-month CD, and 12-month

[9] These represent the fraction of deposits that are partially uninsured (the uninsured deposits are only those above the FDIC threshold).

CD are significant at the 1% level. This result tells us that deposit rates are actually *lower* on average for poorly capitalized banks.

The relation between deposit rate and bank capital is plotted in Figure 4. For the purpose of this plot, we split bank-quarters into 10 equity-to-assets bins (within quarter). Then, we regress the deposit rates (12-month CD rates for $10k accounts) on the equity-to-assets decile indicators, bank-level controls, and calendar fixed effects. We perform the analysis for two subsamples: pre-2008/Q4 and 2008/Q4 onward. Prior to the crisis, CD rates exhibit a U-shape with respect to the capital ratio. Following the crisis, CD rates increase with capital. In any case, the magnitude of the effect is low: rates in the bottom of the U-shape are 0.07% lower, on average, than rates for banks that have very low or very high capital. From 2008/Q4 onward, CD rates of well-capitalized banks are about 0.05% higher than those of poorly capitalized banks.

Another means of identifying poorly capitalized banks is to examine past returns. We sort the subset of publicly traded banks on their past returns in the previous quarter into quintiles. Then, we regress 12-month CD rates on quintile indicators in addition to the usual controls. We plot the coefficients in Figure 5, which illustrates that there is no meaningful variation across bank capitalization. Banks in the lowest quintile of past returns have statistically the same CD rates as banks in quintiles 3, 4, and 5.

In Panels B, C, and D of Table 2, we provide additional robustness analyses for our results about the no/weak relation between deposit rates and the capital ratio. In Panel B, we use the deposit rate for the 12-month maturity as the dependent variable. We examine CD rates for different account sizes. The panel shows that prior to 2008/Q4 there is no relation between CD rates and equity-to-assets. From 2008/Q4 onward, the relation is positive for all account sizes. Again, this coefficient is the opposite of what we would expect if market discipline were in

effect. In Panel C, we break the sample by the ratio of large deposits to total deposits. Large deposits are defined as greater than $100k (Columns (1) and (2)) or $250k (Columns (3) and (4)).[10] None of the subsamples shows a statistically significant negative relation between CD rates and capital ratio. In Panel D, we break the sample by the ratio of deposits-to-liabilities (Columns (1) and (2)) and whether or not the bank holds brokered deposits (Columns (3) and (4)). As before, none of the subsets exhibits a negative relationship between CD rates and bank capital. The positive relation between capital and CD rates appears to be stronger for banks with a high deposit to liability ratio and for banks relying on nonbrokered deposit funding.

We next explore how the correlation between CD rates and bank capitalization varies with bank size. We split the sample into three bank size brackets (up to $500m, between $500m and $10bn, and above $10bn). The results show that the positive correlation between CD rates and bank capitalization exists primarily for small banks and that the correlation for mid-size and large banks is largely zero. Again, we do not observe the significant negative coefficients predicted by the market discipline hypothesis.

In the analysis so far, we do not find any association between deposit rates and capital ratio that would suggest that market discipline is in force.

### 3.2 Bank Capital and Deposit Rates: Robustness

To ensure that our counterintuitive results are not driven by government intervention in the market during the crisis, we conduct several robustness tests. First, regulators could have compelled capital-constrained banks to restrict lending activity and increase capital. Thus, our

[10] In October 2008, the FDIC increased the limit for insured deposits to $250,000; however, banks started reporting the deposit amount above $250,000 only in early 2010.

results could reflect bank strategy or regulatory pressure. To address this concern, we re-run the tests for the 12-month CD rates but exclude banks that are not well-capitalized by PCA (Prompt Corrective Action) levels; these levels are 10% total risk-based capital, 6% tier-1 risk based capital, and 5% tier-1 leverage. We find that only about 3% of banks are not well-capitalized over our sample period according to PCA levels. Excluding these few banks from the sample does not change the direction or statistical significance of the relation between CD rates and capital ratio (Table 2, Panel F, Column (1)). Therefore, while banks facing regulatory scrutiny for having very low capitalization might indeed have different incentives for lending and demand for deposits, our tests suggest that regulatory factors do not drive our results.

Another potential concern is that the positive correlation we find between CD rates and banks' capital during the Global Financial Crisis stems from rates being capped by regulators (e.g., the FDIC) or from bank strategies directed by regulators. Berger and Bouwman (2013) and Berger and Turk-Ariss (2012) have raised such concerns. Hence, we exclude from the analysis subsets of banks that were likely to be affected by government intervention.

We explore two distinct relevant interventions. First, during the Global Financial Crisis, the FDIC intervened in the deposit market. The FDIC was concerned that certain distressed banks raised CD rates in order to attract deposits. To prevent such behavior, the FDIC proposed capping the allowed rates in May 2009 and started to enforce these in January 2010. To ensure that our results are not driven by the FDIC ruling, we re-run regressions akin to those in Table 2, Panel A, excluding the banks with "potentially" binding caps, i.e., banks with CD rates above the capped level. The rates caps are set separately for each CD maturity level and also by account size (less or equal to $100k or greater than $100k). We use the non-jumbo (less or equal to $100k) rate caps for 12-month CD rates, which range from a low of 1.02% in the 3$^{rd}$ quarter of

2012 to a high of 1.98% in the 2nd quarter of 2009.[11] The results are presented in Table 2, Panel F, Column (2). The correlation of CD rates with the equity-to-asset ratio remains positive and statistically significant for the post-2008/Q4 period. Hence, our results are not driven by the rate caps imposed by regulators.

Second, the Troubled Asset Relief program (TARP) could have affected banks' operating strategies (see Duchin and Sosyura (2013)). The program was launched in 2008 to counter the effects of subprime lending and allowed for the U.S. government to purchase from banks "troubled" assets that were deemed illiquid or difficult to value. The goal was largely to increase banks' financial flexibility and increase the potential for greater lending growth. To the extent that banks receiving TARP were under regulatory scrutiny and faced capital discipline, both bank capitalization and the relation between capitalization and demand for loans (i.e., CD rates) might be different for TARP banks. To explore whether TARP banks influenced our findings, we conduct additional tests in which we remove from the sample all banks receiving initial TARP funding within the prior two years. We find that 620 banks in our sample received TARP funding or were subsidiaries of bank holding companies receiving initial TARP funding between 2008/Q4 and 2009/Q4. About 3.8% of bank observations are from banks receiving TARP funding in the previous two years (4,530 bank-quarter observations). When we remove these bank-observations from our analyses, our core results remain consistent (Table 2, Panel F, Column (3)).

[11] The FDIC sets rate caps for jumbo and non-jumbo CDs at 75 basis points above the national rate, which is the simple average of CD rates for commercial banks using RateWatch data. The caps for jumbo and non-jumbo CDs are almost identical in both quarters, and non-reported robustness tests confirm that our results are not sensitive to which one is used.

In Column (4) of Table 2, Panel F, we exclude all potentially affected banks. Our results remain positive and statistically significant, meaning that well-capitalized banks pay higher CD rates.

### 3.3 Bank Capital and Deposit Rates: Alternative Bank Capital Measures

The previous regressions used equity-to-assets as a measure of bank capital. In Appendix B, we provide additional analyses with alternative capital measures. We replace the equity-to-assets variable with Tier 1 capital–to–total assets (Appendix B, Panels A and B), and Tier 1 capital–to–risk-weighted assets (Appendix B, Panels C and D). In almost all specifications, the coefficients conform to the results using equity-to-assets as a measure of bank capitalization. The coefficients are either statistically indistinguishable from zero or statistically greater than zero.

### 3.4 Bank Failure and Deposit Rates

We conduct an additional test for the market discipline hypothesis. Specifically, this theory suggests that deposit rates should be reflective of bank default risk; therefore, ex post bank failure likelihood should be positively associated with higher ex ante deposit rates. We follow the FDIC definition of failure and flag bank-quarters as failures according to the FDIC's publicly available list. We run the following logit regression:

$$Failure\ within\ Q\ quarters_{i,q} = \alpha + \beta_1 Deposit\ rate_{i,q-1} + \gamma B_{i,q-1} + \delta T_q + \varepsilon_{i,q}, \quad (2)$$

where $Failure\ within\ Q\ quarters_{i,q}$ is an indicator of whether the bank failed within $Q$ quarters from quarter $q$. We estimate these specifications for two different horizons, $Q = 4$ and $Q = 8$, using robust standard errors clustered by bank. $Deposit\ rate_{i,q-1}$ is the deposit rate of

bank $i$ at quarter $q-1$. $B_{i,q-1}$ is a set of bank-quarter controls. $T_q$ is a set of time (quarter) fixed effects.

The regression results in Table 3, Columns (1) and (2) show that the relation is negative for both horizons and statistically significant for the four-quarter horizon. This result contradicts the prediction that the relation between the variables should be positive.

Next, we limit the sample to banks that failed ex post, and ask whether the time-to-failure is correlated with the current deposit rates:

$$Time-to-failure_{i,q} = \alpha + \beta_1 Deposit\ rate_{i,q-1} + \gamma B_{i,q-1} + \delta T_q + \varepsilon_{i,q}, \quad (3)$$

where $Time-to-failure_{i,q}$ is measured in years. The results are estimated using OLS regressions with robust standard errors clustered at the bank level. We find that time-to-failure is positively correlated with deposit rates (Table 3, Column (3)), again contradicting the prediction of the market discipline hypothesis.

In sum, we do not find any evidence indicating that the market discipline hypothesis describes deposit rate data in the United States for the years 2007 to 2012.

## 4 Internal Capital Markets and Deposit Rates

### 4.1 Deposit Flows

Our main hypothesis is that banks use time deposits (CDs) to fund lending activity; we, therefore, expect to find a correlation between deposit growth (i.e., flows) and both loan growth and deposit rates. When loan growth is high, banks seek deposits, increasing their rates in order

to attract them. Based on this mechanism, we expect that the flow of deposits is positively correlated with loan growth and that banks that offer higher deposit rates attract more deposits.

These predictions differentiate the market discipline hypothesis from the internal capital market hypothesis. The market discipline story suggests that deposit rates reflect risk: banks that are riskier offer higher deposit rates. Depositors should not necessarily favor banks that offer high deposit rates because of the differences in risk. In addition, deposit flows should not necessarily be positively correlated with loan growth. In contrast, the internal capital market hypothesis suggests that flows of deposits increase with deposit rates and that flows are positively correlated with loan growth.

We test these predictions in Table 4, Panel A. The OLS regressions are estimated with robust standard errors clustered by bank and take the following form:

$$\begin{aligned} Deposit\ growth_{i,q} &= \alpha + \beta_1 Loan\ growth_{i,q-1} + \beta_2 Loan\ growth_{i,q-1} \times I(q \geq 2008/Q4) \\ &+ \beta_3 Deposit\ rate_{i,q-1} + \beta_4 Deposit\ rate_{i,q-1} \times I(q \geq 2008/Q4) \\ &+ \gamma B_{i,q-1} + \delta T_q + \varepsilon_{i,q,} \end{aligned} \quad (4)$$

where $Deposit\ growth_{i,q}$ is defined as the quarter-on-quarter net growth in total deposits for the bank. In Table 4, Panel A, Column (1), we include loan growth on the right-hand side but exclude the deposit rate. The results show that deposit growth is very strongly correlated with loan growth and that the correlation declines during the financial crisis. This result is qualitatively similar to the finding of Jayaratne and Morgan (2000) that banks' loan growth is strongly correlated with insured deposit growth. Our results show that prior to the financial

crisis, a one standard deviation change in loan growth is associated with a change of 8.8% in the same direction in deposit growth (Column (1)).[12]

We examine the relation between deposit growth and deposit rates in Column (2) for the entire sample, and in Columns (3) and (4) we split the sample by capitalization level. Low-capital banks are defined as the bottom 10% of capitalization within each quarter. The results show that deposit flows are correlated with deposit rates and that this correlation increased following the financial crisis. In addition, we find that the correlations are strong for both weakly and strongly capitalized banks, suggesting that having lower capital does not qualitatively alter the relations between loan growth and deposit growth or CD rates and deposit growth.

These findings can be explained by the changing economic environment following the financial crisis. The financial crisis was characterized by a freeze in lending activity, which created an imbalance in the amount of lending and deposits. This imbalance is plotted in Figure 6. Prior to 2008/Q4, the aggregate deposit amount surpassed the aggregate loan amount by less than $1 trillion. Following the financial crisis, however, the gap widens, and the difference between aggregate deposits and aggregate loans is more than $2.5 trillion dollars in 2012.

The fact that more funds were deposited in banks than banks were willing to lend created two effects. First, internal capital markets were not critical for growth, since banks were flush with cash. Hence, the association between deposit growth and loan growth declined significantly. Second, because more deposits were available in a low-interest-rate environment, deposits were more sensitive to deposit rates. Therefore, the coefficient on the interaction of deposit rates and the crisis indicator in Columns (2) to (4) is positive, meaning deposit flows were more sensitive to deposit rates during the financial crisis. Prior to the financial crisis, a one standard deviation

[12] $0.131 \times 0.047 / 0.070 = 0.088$.

change in deposit rates is associated with a 0.050 standard deviation change in deposit flows in the same direction; following the crisis, the effect grows to 0.128 standard deviations (Column (2)).[13]

Note that for the economic significance calculations, we use the standard deviation of the mean-adjusted 12-month CD rates ($10k accounts) rather than the raw rates. Raw rates vary across quarters for macroeconomic reasons unrelated to the factors we explore and could affect our outcomes. In our analysis, we are interested in the within-quarter variation in CD rates.

To test whether these results vary across bank size, we split the sample into three groups based on bank asset size and repeat the core analysis. The results are presented in Table 4, Panel B. The table shows that prior to the Global Financial Crisis, the sensitivity of deposits to the deposit rates offered was especially high for small banks but was nonexistent for large banks. Interestingly, following the crisis, the sensitivity of deposits to deposit rates increased for all bank sizes, particularly for large banks. This finding suggests that depositors sought safety in large banks as opposed to small banks.

### 4.2 Deposit Rates and Growth of Banks' Loan Portfolios

Next, we assess the relation between deposit rates and loan growth. The internal capital markets mechanism suggests that loan growth determines deposit rates. We begin by examining the endogenous relation between deposit rates and loan growth by regressing the 12-month deposit rate (for $10k accounts) on lagged loan growth, controlling for bank characteristics and fixed effects. As before, our models are estimated with robust standard errors clustered by bank:

[13] 0.009 × 0.389 / 0.070 = 0.050; (0.009 + 0.014) × 0.389 / 0.070 = 0.128.

$$Deposit\ rate_{i,q}$$

$$= \alpha + \beta_1 Loan\ growth_{i,q-1} + \beta_2 Loan\ growth_{i,q-1} \times I(q \geq 2008/Q4) \quad (5)$$

$$+ \gamma B_{i,q-1} + \delta T_q + \varepsilon_{i,q}.$$

The internal capital market hypothesis predicts that deposit rates are positively correlated with loan growth. We use the lagged loan growth of the bank as the independent variable of interest and present out results in Table 5, Panel A, Columns (1)–(4). Lagged loan growth has a positive and significant coefficient, meaning that CD rates move in the same direction as loan growth. The sensitivity of CD rates to loan growth is significantly higher in the pre-crisis period and almost completely muted in the post-2008/Q4 period. To demonstrate the economic magnitude, consider the coefficient on lagged loan growth in Column (2), which measures the sensitivity of deposit rates to lagged loan growth in the pre-crisis period. A one standard deviation shift in lagged loan growth is associated with a shift in the same direction of about 3.6% of a standard deviation.[14] In Figure 7, we present the coefficients from a similar regression, based on a lagged loan growth decile indicator (instead of the continuous lagged loan growth variable).

The relation between deposit rates and loan growth is, however, endogenous. A positive relation could result from high loan growth causing an increase in deposit rates or from high deposit rates leading to high loan growth, or a third factor that we have not controlled for could be driving up both variables. To discern the drivers of the correlation and test the causal relation between loan growth and deposit rates, we employ two empirical methodologies. First, we replace banks' loan growth rate with the loan growth rate of other banks within the same state. Second, we exploit the branching structure of banks and examine the internal capital market

[14] 0.317 × 0.047 / 0.389 = 0.038.

across states. In addition, we test another prediction of the internal capital markets mechanism—that correlations between banks that operate within a single state should be stronger than those that operate in multiple states.

### 4.3 Deposit Rates and State-Level Loan Growth

As a first attempt towards unlocking the endogenous relation between bank loan growth and deposit rates, we replace bank loan growth with the loan growth of the median bank in the state. Arguably, this variable reflects the common component of loan growth across banks within the state, but does not reflect idiosyncratic variation at the bank level that could induce endogeneity. We calculate the state-level loan growth as follows: we limit the sample to banks that operate in one state only. For each state-quarter, we compute the median loan growth of the single-state banks that operate in this state. Then, for each bank in the sample, we compute the average state-level loan growth across all the states in which the bank operates. The state-level loan growth variable essentially measures the state-level common component in loan growth, independent of the bank's idiosyncratic loan growth. We replace the bank-level loan growth variable with the state-level loan growth variable and run the following regression:

$$\begin{aligned} Deposit\ rate_{i,q} &= \alpha + \beta_1 State - level\ loan\ growth_{i,q-1} \\ &+ \beta_2 State - level\ loan\ growth_{i,q-1} \times I(q \geq 2008/Q4) + \gamma B_{i,q-1} + \delta T_q \\ &+ \varepsilon_{i,q}. \end{aligned} \tag{6}$$

The results, presented in Table 5, Panel A, Columns (5)–(8), are estimated using OLS regressions with robust standard errors clustered at the bank level. The coefficients reflect a

strong correlation between loan growth and deposit rates. Pre-crisis, the coefficient is 1.176 (Column (6)) and the standard deviation of the market loan growth is 0.014; thus, a one standard deviation in market loan growth is associated with a 4.2% change in the standard deviations of the mean-adjusted 12-month CD rate.[15] We also interact loan growth with a crisis dummy (2008/Q4 onwards). The interaction shows that the association between CD rates and loan growth does not change significantly during the crisis (Columns (6) and (8)).

We also provide analysis by bank size bracket in Table 5, Panels B and C (without and with bank fixed effects, respectively). The results broadly show that the sensitivity of CD rates to loan growth is higher for small banks, as anticipated. These banks have limited access to financial markets and must rely more on deposit funding to finance their loan growth. The regressions show a decline in the sensitivity of CD rates to loan growth following the financial crisis, potentially because lending activity froze at many banks.

Overall, these results show that loan growth and CD rates are correlated in the pre-crisis period and have a weaker or no correlation once the crisis begins.

### 4.4 Exploiting the Branching Structure

Another way to pin down the causal relationship between loan growth and deposit rates is to exploit the branching structure of banks. In particular, in the absence of internal capital markets, deposit rates in one branch would be independent of the loan growth that other, geographically distant branches experience. Because our data include deposit rate information at the branch level, we can exploit the branching structure to show that loan growth actually drives

[15] $1.176 \times 0.014 / 0.389 = 0.042$.

deposit rates and thereby provide a stronger test of causality. To understand how the branching structure can be useful for testing causality, consider the following thought experiment. Suppose a bank has branches in locations that have low loan growth (State A) and other branches in locations that have relatively high loan growth (State B). Given that the bank is interested in fulfilling the high demand for loans in State B, the bank may use its State A branches to raise deposit funding. Thus, we should observe that the deposit rates in the State A branches are correlated with the loan growth experienced by the State B branches. Hence, our test measures the correlation between the deposit rate in a particular location and loan growth experienced in a different location in which the bank has some presence.

For this test, we transform our data into a bank-state-quarter level dataset and limit the sample to banks that have a presence in more than one state. For each bank-state-quarter, we calculate the average deposit rates across all branches within the state. Also, for each state-quarter we compute the state-level growth rate as the median loan growth of all single-state banks. Our final dataset contains 25,284 bank-state-quarter observations (524 unique banks).

Our empirical test seeks to compute the sensitivity of deposit rates to out-of-state loan growth, while controlling for in-state loan growth. Therefore, for each bank-state-quarter, we compute two variables: *out-of-state loan growth* and *in-state loan growth*. *Out-of-state loan growth* is the average state-level loan growth of all states in which the bank-quarter has presence, excluding the specific state-quarter. The complementary variable is *in-state loan-growth*, which is calculated as simply the state-level loan growth for the state of the bank-state-quarter. We run the following regression:

$$Deposit\ rate_{i,s,q} \tag{7}$$
$$= \alpha + \beta_1 Out-of-state\ loan\ growth_{i,s,q-1} + \beta_2 Out-of$$
$$- state\ loan\ growth \times I(q \geq 2008/Q4)$$
$$+ \beta_3 In-state\ loan\ growth_{i,s,q-1} + \beta_4 In-state\ loan\ growth$$
$$\times I(q \geq 2008/Q4) + \gamma B_{i,q-1} + \delta T_q + \varepsilon_{i,q,}$$

where the index *isq* relates to a bank-state-quarter observation, and *out-of-state loan growth* and *in-state loan growth* are both lagged by one quarter. As before, we include bank-quarter controls and time dummies. The coefficients are estimated using OLS regressions with robust standard errors clustered at the bank-state level.

The results of the analysis are presented in Table 6. Panel A shows the results for the entire universe of bank-state-quarters. The panel indicates that both out-of-state and in-state loan growth variables determine CD rates. The effect is weaker in the post-2008/Q4 period. During the pre-2008/Q4 period, the economic magnitude of the effect can be estimated as follows (Column (2)): a one standard deviation increase in other states' loan growth (0.014) increases CD rates by 0.052% (13.3% standard deviations).[16]

To sharpen the test, we perform two splits of the sample by dependence of the bank on deposit funding. In Table 6, Panel B, Columns (1) and (2), we split the sample by the deposits-to-liabilities ratio and repeat the regressions from Panel A. The results show that before the crisis banks with high deposits-to-liabilities exhibit a stronger correlation between CD rates and out-of-state loan growth. Following the crisis, the correlation is indistinguishable from zero for both low and high deposit-to-liabilities ratios.

[16] 3.702 × 0.014 / 0.389 = 0.133.

The second sample split is by brokered deposits. Prior to the crisis, banks with no brokered deposits—which are likely to depend more on local deposits as opposed to deposits from the national market—exhibit a positive correlation between CD rates and out-of-state loan growth.

Overall, these results are consistent with the existence of an internal capital market and with the idea that the internal demand for funds is an important factor driving deposit rates.

### 4.5 Single versus Multi-State Banks

Another test that aims to identify the causal effect of loan growth on deposit rates relates to the geographic spread of banks' presence. The prediction is that banks that operate in different geographic environments (proxied by multi-state operations) have lower sensitivity to local loan growth, because they can smooth the shocks to internal demand for deposit funding over a greater network of branches.

To test this prediction, we return to the bank-quarter sample, in which both deposit rates and state-level loan growth variables are averaged across branches and states of presence, respectively. We create two sub-samples using banks that have a presence in more than one state (7,859 bank-quarter observations and 518 unique banks) and banks that have a presence only in one state (111,706 bank-quarter observations and 6,145 unique banks).[17] We regress the 12-month CD rate for $10k accounts at the bank-quarter level on state-level loan growth. The results, presented in Table 7, show that, consistent with the hypothesis, single-state banks exhibit

[17] For the multi-state subsample, we require that banks operate in more than one state and that we have CD rate data for more than one state. For the single-state subsample, we require that each bank operate in one state and therefore implicitly exclude banks that have CD rate data for only one state but operate in more than one state. As a result, the total number of observations in the two subsamples does not exactly equal the number of observations in the full sample.

a high correlation between CD rates and lagged state-level loan growth. In contrast, in multi-state banks, the sensitivity of CD rates to lagged state-level loan growth is statistically indistinguishable from zero.

In summary, our causality test shows that loan growth has a first-order economic effect on CD rates in the pre-crisis period but virtually zero effect afterwards. The effect is particularly strong for banks that rely on deposit funding to finance their loan portfolio growth.

## 5 Conclusion

The study presents new evidence in a novel setting showing that deposit rates in the United States for the 2007–2012 period were determined by internal capital markets rather than by market discipline. Our first set of tests finds no evidence for the effects of market discipline. Specifically, deposit rates are not negatively correlated with banks' equity, contradicting the expectations of the market discipline theory. Furthermore, deposit rates do not predict bank failure.

In contrast, we find strong evidence that deposit rates are determined by internal capital markets. Consistent with a significant role of internal capital markets, we show that deposit flows are correlated with lagged deposit rates and with loan growth. In addition, we exploit the branching structure of banks to find evidence of a causal relationship between loan growth and deposit rates: deposit rates in one state are associated with loan growth in other states in which the bank operates. Furthermore, this relation is stronger for banks that rely heavily on deposits from the states in which the bank operates (as opposed to deposits from the national market). Also, the relation between deposit rates and loan growth is stronger for banks that have a smaller

geographic spread. For these banks, the internal capital market is small; hence, demand shocks for loans translate to stronger effects on deposit rates.

One message to policymakers emerging from our paper is that during the Financial Crisis, market discipline was not a tool that could be relied upon to assess bank riskiness. Deposit rates are not indicative of the quality of the bank but rather reflect bank loan growth and frictions in the access to funding and potential reliance upon bank deposit insurance.

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## Appendix A. Variable Definitions

| Variable | Definition | Data Source |
|---|---|---|
| Deposit rate for x-month horizon and $Y account | The average of X-month deposit rate for $Y account, averaged across the branches of the bank | RateWatch |
| Asset quality | Total performing loans & leases / Total assets | Call Reports |
| State Level Loan Growth | The average of state-level loan growth in other states in which the bank operates | Call Reports |
| Charge-off ratio | Total charge offs / Total loans | Call Reports |
| Commercial and industrial loans-to-assets | Total commercial and industrial loans / Total assets | Call Reports |
| Deposit growth (1-qtr change) | log (total deposits(t)) – log(total deposits (t-1)) | Call Reports |
| Deposits-to-liabilities ratio | Total deposits / Liabilities | Call Reports |
| Equity-to-assets | Equity / Total assets | Call Reports |
| Failure within Q quarters | An indicator to whether the bank failed according to the FDIC (http://www.fdic.gov/bank/individual/failed/banklist.html) | FDIC |
| Large deposits ratio | Total deposits of $100k or more / Total deposits | Call Reports |
| Loan growth (1-qtr change) | log (total loans(t)) – log(total loans(t-1)) | Call Reports |
| Loan growth in other states | The average state-level loan growth of the states in which the bank has a presence, excluding the state to which the bank-state relates | Call Reports |
| Loan growth in own state | State-level loan growth of the bank-state's own state | Call Reports |
| Loans-to-assets | Total loans / Total assets | Call Reports |
| Log # offices | log (# branches) | Call Reports |
| Log assets ($ Thousands) | log (total assets ($ Thousands)) | Call Reports |
| Mean-adjusted deposit rate for x-month horizon and $Y account | The average of X-month deposit rate for $Y account, averaged across the branches of the bank, minus the average deposit rate for the same quarter | RateWatch |
| Multi-bank holding company indicator | Indicator of whether the bank is affiliated with a multi-bank-holding company (MBHC) | Call Reports |
| New bank indicator | Indicator of whether the bank was chartered in previous five years | Call Reports |
| Non-brokered deposits–to–total liabilities | Non-brokered deposit liabilities / Total liabilities | Call Reports |
| Tier-1-capital | Sum of total equity capital less unrealized gain (loss) on securities less accumulated net gains (losses) on cash flow hedges less nonqualifying perpetual preferred stock plus qualifying minority interests in consolidated subsidiaries less disallowed goodwill and other disallowed intangible assets | Call Reports |
| Tier-1-capital-to-assets | Tier-1-capital / Total assets | Call Reports |
| Tier-1-capital–to–risk-weighted assets | Tier-1-capital / Risk-weighted assets | Call Reports |

## Appendix B. Robustness Tables

The table presents regressions of 12-month CD rates on lagged measures of bank capitalization interacted with a period dummy. In Panels A and B, bank capitalization is measured as tier-1-capital–to–total assets. In Panels C and D, bank capitalization is measured as tier-1-capital–to–risk-weighted assets. Control variables include loan growth, deposits-to-liabilities, logged assets, the log # offices, the large deposit ratio, time deposits–to–total deposits, loans-to-assets, brokered deposits–to–total deposits, a multi-bank holding company indicator, a new bank indicator, the charge-off ratio, and asset quality. All control variables are lagged by one quarter. All regressions are OLS regressions. Variable definitions are in Appendix A. *t*-statistics are presented in parentheses. ***, **, * represent statistical significance at the 1%, 5%, or 10% levels, respectively.

### Panel A: Deposit Rates and Bank Tier-1-Capital–to–Total Assets, No Bank Fixed Effects

| Dependent variable: | Deposit rate, $10k accounts (%) of … | | | | | |
|---|---|---|---|---|---|---|
| | Money market | 6-month CD | 12-month CD | 24-month CD | 48-month CD | 60-month CD |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Tier-1-capital to total assets (q-1) × I(pre-2008/Q4) | 1.3967*** | 0.3474* | 0.4812*** | 0.3902** | 0.4725*** | 0.4731*** |
| | (4.81) | (1.75) | (2.77) | (2.30) | (2.82) | (2.75) |
| Tier-1-capital to total assets (q-1) × I(2008/Q4 onward) | 0.5144*** | 0.4682*** | 0.5202*** | 0.2488** | 0.1431 | 0.0089 |
| | (4.13) | (4.45) | (5.04) | (2.32) | (0.94) | (0.05) |
| Bank characteristics | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank FE | No | No | No | No | No | No |
| Calendar quarter FE | Yes | Yes | Yes | Yes | Yes | Yes |
| State FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Obs | 116535 | 121076 | 121331 | 115326 | 92027 | 92417 |
| Adj $R^2$ | 0.541 | 0.906 | 0.920 | 0.911 | 0.874 | 0.850 |

### Panel B: Deposit Rates and Bank Tier-1-Capital–to–Total Assets, With Bank Fixed Effects

| Dependent variable: | Deposit rate, $10k accounts (%) of … | | | | | |
|---|---|---|---|---|---|---|
| | Money market | 6-month CD | 12-month CD | 24-month CD | 48-month CD | 60-month CD |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Tier-1-capital to total assets (q-1) × I(pre-2008/Q4) | 1.1306*** | 0.2049 | 0.4341** | 0.3519* | 0.4118** | 0.4361** |
| | (3.73) | (0.91) | (2.21) | (1.91) | (2.12) | (2.11) |
| Tier-1-capital to total assets (q-1) × I(2008/Q4 onward) | 0.7947*** | 0.9317*** | 1.0473*** | 0.7012*** | 0.5383*** | 0.4805** |
| | (3.27) | (5.17) | (6.43) | (4.64) | (3.00) | (2.57) |
| Bank characteristics | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Calendar quarter FE | Yes | Yes | Yes | Yes | Yes | Yes |
| State FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Obs | 116535 | 121076 | 121331 | 115326 | 92027 | 92417 |
| Adj $R^2$ | 0.663 | 0.938 | 0.950 | 0.945 | 0.926 | 0.909 |

# Appendix B. Robustness Tables (Cont.)

## Panel C: Deposit Rates and Bank Tier-1-Capital–to–Risk-Weighted Assets, No Bank Fixed Effects

| Dependent variable: | Deposit rate, $10k accounts (%) of … | | | | | |
|---|---|---|---|---|---|---|
| | Money market | 6-month CD | 12-month CD | 24-month CD | 48-month CD | 60-month CD |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Tier-1-capital-to-risk weighted assets (q-1) × I(pre-2008/Q4) | 0.0727 | -0.1951** | -0.0054 | 0.0202 | -0.0007 | 0.0599 |
| | (0.56) | (-2.11) | (-0.07) | (0.25) | (-0.01) | (0.65) |
| Tier-1-capital-to-risk weighted assets (q-1) × I(2008/Q4 onward) | 0.5075*** | 0.3046*** | 0.2786*** | 0.0587 | -0.0240 | -0.1634* |
| | (6.39) | (4.68) | (4.46) | (0.88) | (-0.26) | (-1.67) |
| Bank characteristics | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank FE | No | No | No | No | No | No |
| Calendar quarter FE | Yes | Yes | Yes | Yes | Yes | Yes |
| State FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Obs | 116534 | 121075 | 121330 | 115325 | 92026 | 92416 |
| Adj $R^2$ | 0.540 | 0.906 | 0.920 | 0.911 | 0.874 | 0.850 |

## Panel D: Deposit Rates and Bank Tier-1-Capital–to–Risk-Weighted Assets, With Bank Fixed Effects

| Dependent variable: | Deposit rate, $10k accounts (%) of … | | | | | |
|---|---|---|---|---|---|---|
| | Money market | 6-month CD | 12-month CD | 24-month CD | 48-month CD | 60-month CD |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Tier-1-capital-to-risk weighted assets (q-1) × I(pre-2008/Q4) | 0.0980 | -0.1328* | 0.0044 | -0.0176 | -0.0639 | -0.0461 |
| | (0.96) | (-1.75) | (0.07) | (-0.29) | (-0.93) | (-0.64) |
| Tier-1-capital-to-risk weighted assets (q-1) × I(2008/Q4 onward) | 0.6777*** | 0.5578*** | 0.4762*** | 0.2385*** | 0.1175 | 0.0107 |
| | (5.35) | (6.12) | (5.90) | (3.12) | (1.37) | (0.12) |
| Bank characteristics | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Calendar quarter FE | Yes | Yes | Yes | Yes | Yes | Yes |
| State FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Obs | 116534 | 121075 | 121330 | 115325 | 92026 | 92416 |
| Adj $R^2$ | 0.664 | 0.938 | 0.950 | 0.945 | 0.926 | 0.909 |

## Table 1. Summary Statistics

The table presents summary statistics for the variables used in the analysis. The sample period is 2007/Q1 to 2012/Q3. Panel A shows summary statistics for the analysis for the main sample, based on 12-month deposit rates for $10k accounts. Panel B shows summary statistics for the sample that includes deposit rates for a variety of maturities and account sizes. Panel C presents summary statistics for the sample used for the bank branching analysis. Variable definitions are in Appendix A.

### Panel A: Summary Statistics of Main Sample (unit of observation: bank-quarter)

| | N | Mean | Std Dev | p5 | p25 | p50 | p75 | p95 |
|---|---|---|---|---|---|---|---|---|
| Asset quality | 122,388 | 0.985 | 0.021 | 0.95 | 0.98 | 0.99 | 1.00 | 1.00 |
| Brokered Deposit Ratio | 122,388 | 0.040 | 0.082 | 0.00 | 0.00 | 0.00 | 0.04 | 0.20 |
| Charge-off ratio | 122,388 | 0.004 | 0.009 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 |
| Commercial and industrial loans-to-assets | 122,385 | 0.146 | 0.093 | 0.03 | 0.08 | 0.13 | 0.19 | 0.32 |
| CD Deposit growth (1-qtr change) | 122,388 | 0.002 | 0.071 | -0.10 | -0.03 | 0.00 | 0.03 | 0.12 |
| Deposits-to-liabilities ratio | 122,388 | 0.933 | 0.069 | 0.80 | 0.90 | 0.95 | 0.99 | 1.00 |
| Equity-to-assets | 122,387 | 0.106 | 0.033 | 0.07 | 0.09 | 0.10 | 0.12 | 0.17 |
| Failure within 4 quarters | 122,388 | 0.009 | 0.096 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Failure within 8 quarters | 122,388 | 0.019 | 0.136 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Large deposits ratio ($100k) | 122,388 | 0.422 | 0.157 | 0.19 | 0.31 | 0.41 | 0.52 | 0.71 |
| Large deposits ratio ($250k) | 57,773 | 0.134 | 0.112 | 0.01 | 0.06 | 0.11 | 0.18 | 0.36 |
| Loan growth (1-qtr change) | 122,388 | 0.008 | 0.047 | -0.06 | -0.02 | 0.00 | 0.03 | 0.08 |
| Loans-to-assets | 122,388 | 0.645 | 0.145 | 0.37 | 0.56 | 0.67 | 0.75 | 0.85 |
| Log # offices | 122,388 | 1.367 | 1.075 | 0.00 | 0.69 | 1.39 | 1.95 | 3.18 |
| Log assets ($ Thousands) | 122,388 | 12.071 | 1.264 | 10.33 | 11.26 | 11.94 | 12.70 | 14.23 |
| Multi-bank holding company | 122,388 | 0.190 | 0.392 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 |
| New bank indicator | 122,388 | 0.056 | 0.230 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 |
| Real-estate loans-to-assets | 121,602 | 0.702 | 0.173 | 0.36 | 0.60 | 0.74 | 0.83 | 0.93 |
| State-level loan growth | 122,342 | 0.006 | 0.014 | -0.02 | 0.00 | 0.01 | 0.01 | 0.03 |
| Time deposits-to-total deposits ratio | 122,388 | 0.435 | 0.139 | 0.21 | 0.34 | 0.44 | 0.53 | 0.66 |
| Time to failure (years) | 3,947 | 1.883 | 1.254 | 0.25 | 0.85 | 1.69 | 2.67 | 4.32 |

### Panel B: Summary Statistics of Deposit Rates (unit of observation: bank-quarter)

| Rate | N | Mean | Std Dev | p5 | p25 | p50 | p75 | p95 |
|---|---|---|---|---|---|---|---|---|
| Money market, $10k accounts | 117,307 | 0.754 | 0.706 | 0.10 | 0.25 | 0.50 | 1.00 | 2.23 |
| 12-month CD rate, $10k accounts | 122,113 | 1.890 | 1.333 | 0.39 | 0.80 | 1.49 | 2.73 | 4.56 |
| 24-month CD rate, $10k accounts | 116,090 | 2.146 | 1.236 | 0.60 | 1.14 | 1.85 | 2.96 | 4.53 |
| 48-month CD rate, $10k accounts | 92,625 | 2.551 | 1.119 | 1.00 | 1.66 | 2.38 | 3.30 | 4.64 |
| 60-month CD rate, $10k accounts | 93,116 | 2.754 | 1.083 | 1.23 | 1.92 | 2.60 | 3.49 | 4.75 |
| 12-month CD rate, $100k accounts | 78,051 | 1.320 | 1.009 | 0.35 | 0.66 | 1.00 | 1.57 | 3.88 |
| 12-month CD rate, $250k accounts | 34,939 | 0.676 | 0.265 | 0.25 | 0.50 | 0.65 | 0.85 | 1.14 |
| 12-month CD rate, $500k accounts | 35,003 | 0.689 | 0.332 | 0.25 | 0.50 | 0.65 | 0.85 | 1.15 |
| 12-month CD rate, $1m accounts | 34,611 | 0.676 | 0.268 | 0.25 | 0.50 | 0.65 | 0.85 | 1.13 |
| Adjusted 12-month CD rate, $10k accounts | 122,113 | 0.000 | 0.389 | -0.67 | -0.22 | 0.01 | 0.24 | 0.63 |

## Table 1. Summary Statistics (Cont.)

### Panel C: Summary Statistics of Branching Structure Analysis (unit of observation: bank-state-quarter)

| | N | Mean | Std Dev | p5 | p25 | p50 | p75 | p95 |
|---|---|---|---|---|---|---|---|---|
| 12-month CD rate ($10k) (%) | 24,863 | 1.469 | 1.276 | 0.15 | 0.47 | 1.00 | 2.21 | 4.19 |
| Adjusted 12-month CD rate ($10k) (%) | 24,863 | 0.125 | 0.424 | -0.56 | -0.16 | 0.11 | 0.40 | 0.86 |
| Asset quality | 24,863 | 0.979 | 0.022 | 0.94 | 0.97 | 0.99 | 0.99 | 1.00 |
| Brokered Deposit Ratio | 24,863 | 0.045 | 0.066 | 0.00 | 0.00 | 0.02 | 0.06 | 0.19 |
| Charge-off ratio | 24,863 | 0.008 | 0.012 | 0.00 | 0.00 | 0.00 | 0.01 | 0.03 |
| Commercial and industrial loans-to-assets | 24,863 | 0.169 | 0.089 | 0.05 | 0.10 | 0.16 | 0.21 | 0.32 |
| Deposits-to-liabilities | 24,863 | 0.866 | 0.092 | 0.68 | 0.81 | 0.88 | 0.94 | 0.99 |
| Equity-to-assets | 24,863 | 0.105 | 0.031 | 0.07 | 0.09 | 0.10 | 0.12 | 0.16 |
| In-state loan growth | 24,863 | 0.006 | 0.016 | -0.02 | 0.00 | 0.00 | 0.01 | 0.03 |
| Large deposit ratio | 24,863 | 0.447 | 0.141 | 0.24 | 0.35 | 0.43 | 0.53 | 0.72 |
| Loans-to-assets | 24,863 | 0.651 | 0.121 | 0.41 | 0.59 | 0.67 | 0.73 | 0.83 |
| Log # offices | 24,863 | 4.338 | 2.202 | 1.61 | 2.56 | 3.78 | 6.12 | 8.58 |
| Log assets ($ Thousands) | 24,863 | 15.452 | 2.687 | 12.16 | 13.31 | 14.66 | 17.78 | 20.91 |
| Multi-bank holding company | 24,863 | 0.433 | 0.496 | 0.00 | 0.00 | 0.00 | 1.00 | 1.00 |
| New bank indicator | 24,863 | 0.019 | 0.136 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Out-of-state loan growth | 24,863 | 0.006 | 0.014 | -0.01 | 0.00 | 0.00 | 0.01 | 0.03 |
| Real-estate loans-to-assets | 24,863 | 0.701 | 0.146 | 0.44 | 0.60 | 0.72 | 0.81 | 0.92 |
| Time deposits-to-total deposits ratio | 24,863 | 0.317 | 0.156 | 0.09 | 0.19 | 0.31 | 0.43 | 0.58 |

## Table 2. Deposit Rates and Bank Capitalization

The table presents regressions of 12-month CD rates on lagged equity-to-assets interacted with a period dummy. Control variables include loan growth, deposits-to-liabilities, logged assets, the log # offices, the large deposit ratio, time deposits–to–total deposits, loans-to-assets, brokered deposits–to–total deposits, a multi-bank holding company indicator, a new bank indicator, the charge-off ratio, and asset quality. All control variables are lagged by one quarter. All regressions are OLS regressions. Variable definitions are in Appendix A. *t*-statistics are presented in parentheses. ***, **, * represent statistical significance at the 1%, 5%, or 10% levels, respectively.

### Panel A: Deposit Rates and Bank Capitalization, by Maturity

| Dependent variable: | Deposit rate, $10k accounts (%) of … | | | | | |
|---|---|---|---|---|---|---|
| | Money market | 6-month CD | 12-month CD | 24-month CD | 48-month CD | 60-month CD |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Equity-to-Assets (q-1) × I(pre-2008/Q4) | 1.3185*** | 0.2825 | 0.3575** | 0.1501 | 0.3120* | 0.2040 |
| | (4.89) | (1.52) | (2.17) | (0.94) | (1.91) | (1.24) |
| Equity-to-Assets (q-1) × I(2008/Q4 onward) | 0.4170*** | 0.4966*** | 0.5255*** | 0.2559** | 0.1737 | -0.0023 |
| | (3.78) | (5.23) | (5.61) | (2.58) | (1.24) | (-0.02) |
| Bank characteristics | Yes | Yes | Yes | Yes | Yes | Yes |
| Calendar quarter FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Obs | 116534 | 121075 | 121330 | 115325 | 92026 | 92416 |
| Adj $R^2$ | 0.541 | 0.906 | 0.920 | 0.911 | 0.874 | 0.850 |

### Panel B: Deposit Rates and Bank Capitalization, by Account Size

| Dependent variable: | 12-month CD rate (%) of … | | | | |
|---|---|---|---|---|---|
| | $10k accounts | $100k accounts | $250k accounts | $500k accounts | $1m accounts |
| | (1) | (2) | (3) | (4) | (5) |
| Equity-to-Assets (q-1) × I(pre-2008/Q4) | 0.3575** | -0.1890 | 1.2028 | | |
| | (2.17) | (-0.55) | (0.87) | | |
| Equity-to-Assets (q-1) × I(2008/Q4 onward) | 0.5255*** | 0.5443*** | 0.4044*** | 0.4450*** | 0.4227*** |
| | (5.61) | (5.82) | (4.83) | (4.69) | (4.77) |
| Bank characteristics | Yes | Yes | Yes | Yes | Yes |
| Calendar quarter FE | Yes | Yes | Yes | Yes | Yes |
| Obs | 121330 | 77532 | 34747 | 34806 | 34424 |
| Adj $R^2$ | 0.920 | 0.902 | 0.463 | 0.574 | 0.456 |

## Table 2. CD Rates of Low-Capital Banks during Crisis (Cont.)

### Panel C: Deposit Rates and Bank Capitalization, by Fraction of Large Deposits

| Dependent variable: | 12-month CD rate, $10k accounts (%) | | | |
|---|---|---|---|---|
| Sample broken by: | Fraction of Deposits >$100k | | Fraction of Deposits >$250k | |
| | Low | High | Low | High |
| | (1) | (2) | (3) | (4) |
| Equity-to-Assets (q-1) × I(pre-2008/Q4) | 0.1934 | 0.4908** | | |
| | (0.75) | (2.45) | | |
| Equity-to-Assets (q-1) × I(2008/Q4 onward) | 0.8995*** | 0.2188** | 0.6685*** | 0.1829* |
| | (5.96) | (1.96) | (5.68) | (1.75) |
| Bank characteristics | Yes | Yes | Yes | |
| Calendar quarter FE | Yes | Yes | Yes | |
| Obs | 48856 | 72474 | 22947 | 34340 |
| Adj $R^2$ | 0.921 | 0.919 | 0.923 | 0.927 |

### Panel D: Deposit Rates and Bank Capitalization, by Deposits/Liabilities and by Non-Brokered Deposits

| Dependent variable: | 12-month CD rate, $10k accounts (%) | | | |
|---|---|---|---|---|
| Sample broken by: | Deposits / Liabilities | | Brokered deposits | |
| | Low | High | >0 | None |
| | (1) | (2) | (3) | (4) |
| Equity-to-Assets (q-1) × I(pre-2008/Q4) | 0.1478 | 0.4472** | 0.5847** | 0.4477** |
| | (0.50) | (2.45) | (2.09) | (2.30) |
| Equity-to-Assets (q-1) × I(2008/Q4 onward) | 0.3917*** | 0.6796*** | 0.2758** | 0.6577*** |
| | (3.07) | (5.41) | (2.06) | (5.57) |
| Bank characteristics | Yes | Yes | Yes | Yes |
| Calendar quarter FE | Yes | Yes | Yes | Yes |
| Obs | 63066 | 58264 | 54959 | 66371 |
| Adj $R^2$ | 0.913 | 0.927 | 0.915 | 0.925 |

## Table 2. CD Rates of Low-Capital Banks during Crisis (Cont.)

### Panel E: Deposit Rates and Bank Capitalization, by Bank Size

| Dependent variable: | 12-month CD rate, $10k accounts (%) | | | | | |
|---|---|---|---|---|---|---|
| Sample broken by: | Bank assets | | | Bank assets | | |
| | <$500m | [$500m,$10bn] | >$10bn | <$500m | [$500m,$10bn] | >$10bn |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Equity-to-Assets (q-1) × I(pre-2008/Q4) | 0.5178*** | -0.5593 | -1.0294 | 0.6693*** | -0.2082 | -1.5191 |
| | (3.11) | (-0.82) | (-0.48) | (3.63) | (-0.33) | (-0.86) |
| Equity-to-Assets (q-1) × I(2008/Q4 onward) | 0.6865*** | -0.3896 | 0.9193 | 1.2795*** | 0.7472* | -1.0898 |
| | (6.65) | (-1.60) | (0.98) | (8.16) | (1.77) | (-0.81) |
| Bank characteristics | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank FE | No | No | No | Yes | Yes | Yes |
| Calendar quarter FE | Yes | Yes | Yes | Yes | Yes | Yes |
| State FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Obs | 101365 | 18677 | 1288 | 101365 | 18677 | 1288 |
| Adj $R^2$ | 0.924 | 0.901 | 0.908 | 0.952 | 0.936 | 0.936 |

### Panel F: Deposit Rates and Bank Capitalization, Robustness

| Dependent variable: | 12-month CD rate (%) | | | |
|---|---|---|---|---|
| Sample: | Exclude poorly-capitalized banks | Exclude rates above rate-cap ceiling | Exclude banks receiving TARP | Exclude all (1)-(3) |
| | (1) | (2) | (3) | (4) |
| Equity-to-Assets (q-1) × I(pre-2008/Q4) | 0.3985** | 0.4066** | 0.3684** | 0.4590*** |
| | (2.48) | (2.46) | (2.23) | (2.86) |
| Equity-to-Assets (q-1) × I(2008/Q4 onward) | 0.5386*** | 0.4154*** | 0.5653*** | 0.4260*** |
| | (5.42) | (4.95) | (5.77) | (4.68) |
| Bank characteristics | Yes | Yes | Yes | Yes |
| Calendar quarter FE | Yes | Yes | Yes | Yes |
| Obs | 111430 | 114534 | 114357 | 99505 |
| Adj $R^2$ | 0.919 | 0.925 | 0.921 | 0.926 |

## Table 3. Bank Failure and CD Rates

The table presents regressions of failure indicators (Columns (1) and (2)) and time-to-fail (Column (3)). A bank is considered to have failed if it is included in the FDIC failed bank list. The sample in Column (3) is limited to banks that actually failed. The regressions in Columns (1) and (2) are logit regressions in which the marginal effect for the average bank-quarter is presented. The regression in Column (3) is an OLS regression. Control variables include change in deposits-to-liabilities, logged assets, the log # offices, the large deposit ratio, time deposits–to–total deposits, loans-to-assets, brokered deposits–to–total deposits, an interbank holding company indicator, a new bank indicator, the charge-off ratio, and asset quality. All control variables are lagged by one quarter. Variable definitions are in Appendix A. *t*-statistics are presented in parentheses. ***, **, * represent statistical significance at the 1%, 5%, or 10% levels, respectively.

| Dependent variable: | Failure within… | | |
|---|---|---|---|
| Sample: | 4 quarters | 8 quarters | Time to fail |
| | (1) | (2) | (3) |
| 12-month CD rate, $10k accounts (%) | -0.3490** | -0.0021 | 0.2228*** |
| | (-2.46) | (-0.02) | (2.66) |
| Bank characteristics | Yes | Yes | Yes |
| Calendar quarter FE | Yes | Yes | Yes |
| Obs | 98912 | 98912 | 2708 |
| Pseudo $R^2$ (Adj $R^2$) | 0.522 | 0.457 | 0.408 |

## Table 4. Deposit Growth, CD Rates, and Loan Growth

The table presents regressions of deposit quarter-on-quarter growth on lagged loan growth and 12-month CD rate and lagged loan growth. In Panel A, Columns (1) and (2) use the entire sample of bank-quarters. Columns (3) and (4) split the sample based on the equity-to-assets ratio, with Column (3) using the bottom decile and Column (4) using the top nine deciles. Panel B splits the sample by bank asset size. Control variables include the change in deposits-to-liabilities, logged assets, the log # offices, the large deposit ratio, time deposits–to–total deposits, loans-to-assets, brokered deposits–to–total deposits, an interbank holding company indicator, a new bank indicator, the charge-off ratio, and asset quality. All control variables are lagged by one quarter. All regressions are OLS regressions. Variable definitions are in Appendix A. *t*-statistics are presented in parentheses. ***, **, * represent statistical significance at the 1%, 5%, or 10% levels, respectively.

### Panel A: Deposit Growth and Deposit Rates

| Dependent variable: | Deposit growth | | | |
|---|---|---|---|---|
| Sample: | All | All | Low capital | High capital |
| | (1) | (2) | (3) | (4) |
| 12-month CD rate, $10k accounts (%) (q-1) | | 0.0089*** | 0.0107*** | 0.0084*** |
| | | (11.31) | (4.48) | (10.46) |
| × I(2008/Q4 onward) | | 0.0143*** | 0.0098*** | 0.0148*** |
| | | (11.87) | (2.67) | (11.80) |
| Loan growth (q-1) | 0.1314*** | 0.1689*** | 0.1864*** | 0.1646*** |
| | (6.18) | (11.89) | (4.62) | (11.14) |
| × I(2008/Q4 onward) | -0.0494** | -0.0888*** | -0.0661 | -0.0912*** |
| | (-2.25) | (-5.72) | (-1.34) | (-5.65) |
| Bank characteristics | Yes | Yes | Yes | Yes |
| Calendar quarter FE | Yes | Yes | Yes | Yes |
| Obs | 121598 | 114709 | 11590 | 103119 |
| Adj $R^2$ | 0.106 | 0.112 | 0.143 | 0.108 |

## Table 4. Deposit Growth, CD Rates, and Loan Growth (Cont.)

### Panel B: Deposit Growth and Deposit Rates, by Bank Size

| Dependent variable: | Deposit growth | | | | | |
|---|---|---|---|---|---|---|
| Sample broken by: | Bank assets | | | Bank assets | | |
| | <$500m | [$500m,$10bn] | >$10bn | <$500m | [$500m,$10bn] | >$10bn |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| 12-month CD rate, $10k accounts (%) (q-1) | 0.0093*** | 0.0052*** | -0.0058 | 0.0099*** | 0.0076*** | 0.0112 |
| | (12.27) | (2.81) | (-0.65) | (9.92) | (3.09) | (1.49) |
| × I(2008/Q4 onward) | 0.0142*** | 0.0092*** | 0.0376*** | 0.0185*** | 0.0075** | 0.0223 |
| | (11.51) | (3.11) | (2.90) | (13.09) | (2.25) | (1.59) |
| Loan growth (q-1) | 0.1519*** | 0.0402** | 0.0213 | 0.0696*** | 0.0135 | -0.0077 |
| | (5.06) | (2.38) | (0.68) | (4.51) | (1.01) | (-0.28) |
| × I(2008/Q4 onward) | -0.0552* | 0.0001 | -0.0343 | -0.0208 | 0.0061 | 0.0187 |
| | (-1.82) | (0.01) | (-0.81) | (-1.28) | (0.28) | (0.42) |
| Bank characteristics | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank FE | No | No | No | Yes | Yes | Yes |
| Calendar quarter FE | Yes | Yes | Yes | Yes | Yes | Yes |
| State FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Obs | 100309 | 18351 | 1255 | 100309 | 18351 | 1255 |
| Adj $R^2$ | 0.118 | 0.127 | 0.125 | 0.164 | 0.185 | 0.178 |

## Table 5. Deposit Rates and Loan Growth

The table presents regressions of the 12-month CD rates on measures of loan growth. Columns (1) and (2) use lagged bank loan growth as a proxy for current loan growth. Columns (3) and (4) use the lagged market loan growth as a proxy for current loan growth. Control variables include the change in deposits-to-liabilities, logged assets, the log # offices, a large deposit ratio, time deposits–to–total deposits, loans-to-assets, brokered deposits–to–total deposits, an interbank holding company indicator, a new bank indicator, the charge-off ratio, and asset quality. All control variables are lagged by one quarter. All regressions are OLS regressions. Variable definitions are in Appendix A. *t*-statistics are presented in parentheses. ***, **, * represent statistical significance at the 1%, 5%, or 10% levels, respectively.

### Panel A: Deposit Rates and Loan Growth

| Dependent variable: | 12-month CD rate, $10k accounts (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Loan growth (q-1) | 0.2314*** | 0.3174*** | 0.1045*** | 0.1252*** | | | | |
| | (8.59) | (4.54) | (5.44) | (2.88) | | | | |
| × I(2008/Q4 onward) | | -0.1281* | | -0.0316 | | | | |
| | | (-1.76) | | (-0.69) | | | | |
| State-level loan growth (q-1) | | | | | 1.0765*** | 1.1760*** | 1.6104*** | 1.2909*** |
| | | | | | (5.98) | (3.92) | (7.55) | (3.56) |
| × I(2008/Q4 onward) | | | | | | -0.1741 | | 0.5694 |
| | | | | | | (-0.56) | | (1.44) |
| Bank characteristics | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Calendar quarter FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank FE | No | No | Yes | Yes | No | No | Yes | Yes |
| Obs | 121330 | 121330 | 121330 | 121330 | 121284 | 121284 | 121284 | 121284 |
| Adj $R^2$ | 0.920 | 0.920 | 0.950 | 0.950 | 0.950 | 0.950 | 0.920 | 0.920 |

## Table 5. Deposit Rates and Loan Growth (Cont.)

### Panel B: Deposit Rates and Loan Growth, by Bank Size, no Bank Fixed Effects

| Dependent variable: | 12-month CD rate, $10k accounts (%) | | | | | |
|---|---|---|---|---|---|---|
| Sample broken by: | Bank assets | | | Bank assets | | |
| | <$500m | [$500m,$10bn] | >$10bn | <$500m | [$500m,$10bn] | >$10bn |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Loan growth (q-1) | 0.3763*** | 0.0827 | 0.2510 | | | |
| | (4.09) | (0.73) | (1.16) | | | |
| × I(2008/Q4 onward) | -0.1412 | -0.0148 | -0.2548 | | | |
| | (-1.50) | (-0.12) | (-1.06) | | | |
| State-level loan growth (q-1) | | | | 2.2841*** | -3.6041*** | 6.2229 |
| | | | | (6.58) | (-2.70) | (1.28) |
| × I(2008/Q4 onward) | | | | -0.4452 | 5.7263*** | -3.8283 |
| | | | | (-1.26) | (3.56) | (-0.72) |
| Bank characteristics | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank FE | No | No | No | No | No | No |
| Calendar quarter FE | Yes | Yes | Yes | Yes | Yes | Yes |
| State FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Obs | 101365 | 18677 | 1288 | 101319 | 18677 | 1288 |
| Adj $R^2$ | 0.924 | 0.901 | 0.908 | 0.924 | 0.901 | 0.908 |

### Panel C: Deposit Rates and Loan Growth, by Bank Size, with Bank Fixed Effects

| Dependent variable: | 12-month CD rate, $10k accounts (%) | | | | | |
|---|---|---|---|---|---|---|
| Sample broken by: | Bank assets | | | Bank assets | | |
| | <$500m | [$500m,$10bn] | >$10bn | <$500m | [$500m,$10bn] | >$10bn |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Loan growth (q-1) | 0.1599*** | -0.0497 | 0.0257 | | | |
| | (2.90) | (-0.55) | (0.08) | | | |
| × I(2008/Q4 onward) | -0.0316 | 0.0804 | 0.0681 | | | |
| | (-0.55) | (0.85) | (0.20) | | | |
| State-level loan growth (q-1) | | | | 1.6659*** | -1.6060* | -3.1636 |
| | | | | (5.46) | (-1.70) | (-0.93) |
| × I(2008/Q4 onward) | | | | -0.6281** | 2.0799** | 4.2592 |
| | | | | (-1.99) | (2.04) | (1.14) |
| Bank characteristics | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Calendar quarter FE | Yes | Yes | Yes | Yes | Yes | Yes |
| State FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Obs | 101365 | 18677 | 1288 | 101319 | 18677 | 1288 |
| Adj $R^2$ | 0.952 | 0.936 | 0.936 | 0.952 | 0.936 | 0.936 |

## Table 6. Local CD Rates and Loan Growth in Other States

The table presents our analysis of CD rates. Panels A and B show a regression of the 12-month CD rates on measures of loan growth. Panel A uses a sample of all interstate bank-quarters. In Panel B, Columns (1) to (4), we restrict the sample to interstate banks that rely on local deposits. In Panel B, Columns (5) to (8), we restrict the sample to low capital interstate banks. These banks have a below-median ratio of brokered deposits–to–total deposits. Control variables include the change in deposits-to-liabilities, logged assets, the log # offices, the large deposit ratio, time deposits–to–total deposits, loans-to-assets, brokered deposits–to–total deposits, a multi-bank holding company indicator, a new bank indicator, the charge-off ratio, and asset quality. All control variables are lagged by one quarter. All regressions are OLS regressions. Variable definitions are in Appendix A. *t*-statistics are presented in parentheses. ***, **, * represent statistical significance at the 1%, 5%, or 10% levels, respectively.

### Panel A: All Interstate Banks

| Dependent variable: | 12-month CD rate (%) | | | |
|---|---|---|---|---|
| Sample: | All inter-state bank-quarters | | | |
| | (1) | (2) | (3) | (4) |
| Out-of-state loan growth (q-1) | 2.5713*** | 3.7024*** | 1.2991** | 1.3030 |
| | (3.82) | (2.71) | (2.40) | (1.31) |
| × I(2008/Q4 onward) | | -1.7430 | | 0.0071 |
| | | (-1.24) | | (0.01) |
| In-state loan growth (q-1) | 1.1871*** | 0.6226 | 0.5361 | 0.2238 |
| | (2.74) | (1.00) | (1.62) | (0.41) |
| × I(2008/Q4 onward) | | 0.8640 | | 0.5221 |
| | | (1.22) | | (0.88) |
| Bank characteristics | Yes | Yes | Yes | Yes |
| Calendar quarter FE | Yes | Yes | No | No |
| State × Quarter FE | No | No | Yes | Yes |
| Obs | 24863 | 24863 | 24863 | 24863 |
| Adj $R^2$ | 0.923 | 0.923 | 0.944 | 0.944 |

## Table 6. Local CD Rates and Loan Growth in Other States (Cont.)

### Panel B: Interstate Banks, by Dependence on Deposits

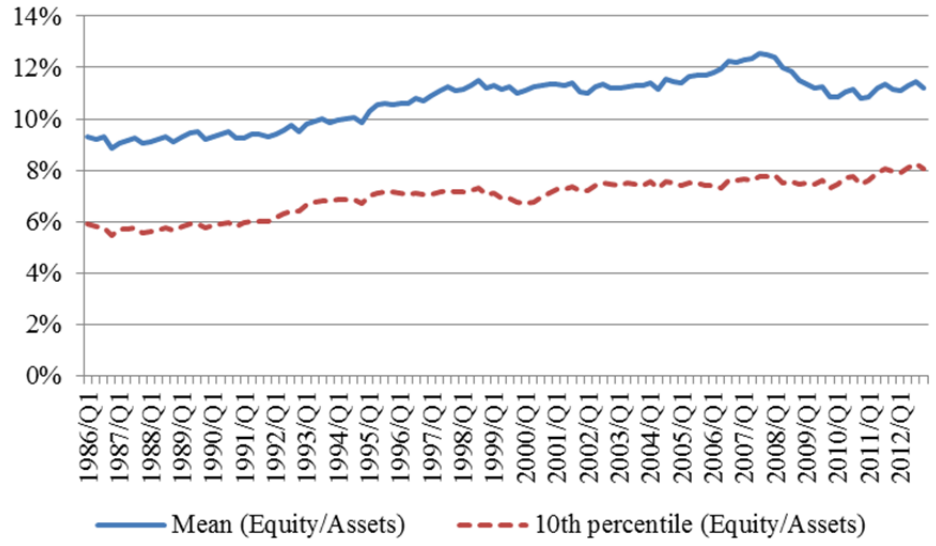
| Dependent variable: | 12-month CD rate, $10k accounts (%) | | | |
|---|---|---|---|---|
| Sample broken by: | Deposits / Liabilities | | Brokered deposits | |
| | Low | High | >0 | None |
| | (1) | (2) | (3) | (4) |
| Out-of-state loan growth (q-1) | 2.4799* | 7.8046*** | 1.6351 | 6.6445** |
| | (1.82) | (2.64) | (1.19) | (2.47) |
| × I(2008/Q4 onward) | -0.6690 | -7.0235** | 0.3115 | -4.7168 |
| | (-0.46) | (-2.31) | (0.21) | (-1.59) |
| In-state loan growth (q-1) | 0.1454 | 3.5654*** | -0.0140 | 2.2113 |
| | (0.23) | (2.78) | (-0.02) | (1.59) |
| × I(2008/Q4 onward) | 1.1782 | -1.9850 | 1.2311* | -0.4274 |
| | (1.64) | (-1.25) | (1.72) | (-0.24) |
| Bank characteristics | Yes | Yes | Yes | Yes |
| Calendar quarter FE | Yes | Yes | Yes | Yes |
| Obs | 20987 | 3876 | 19515 | 5348 |
| Adj $R^2$ | 0.926 | 0.923 | 0.928 | 0.916 |

## Table 7. CD Rates and Loan Growth: Single- versus Multi-State Banks

The table presents regressions of the 12-month CD rates on measures of loan growth. Columns (1) and (2) use lagged bank loan growth as a proxy for current loan growth. Columns (3) and (4) use the lagged market loan growth as a proxy for current loan growth. Control variables include the change in deposits-to-liabilities, logged assets, the log # offices, the large deposit ratio, time deposits–to–total deposits, loans-to-assets, brokered deposits–to–total deposits, an interbank holding company indicator, a new bank indicator, the charge-off ratio, and asset quality. All control variables are lagged by one quarter. All regressions are OLS regressions. Variable definitions are in Appendix A. *t*-statistics are presented in parentheses. ***, **, * represent statistical significance at the 1%, 5%, or 10% levels, respectively.

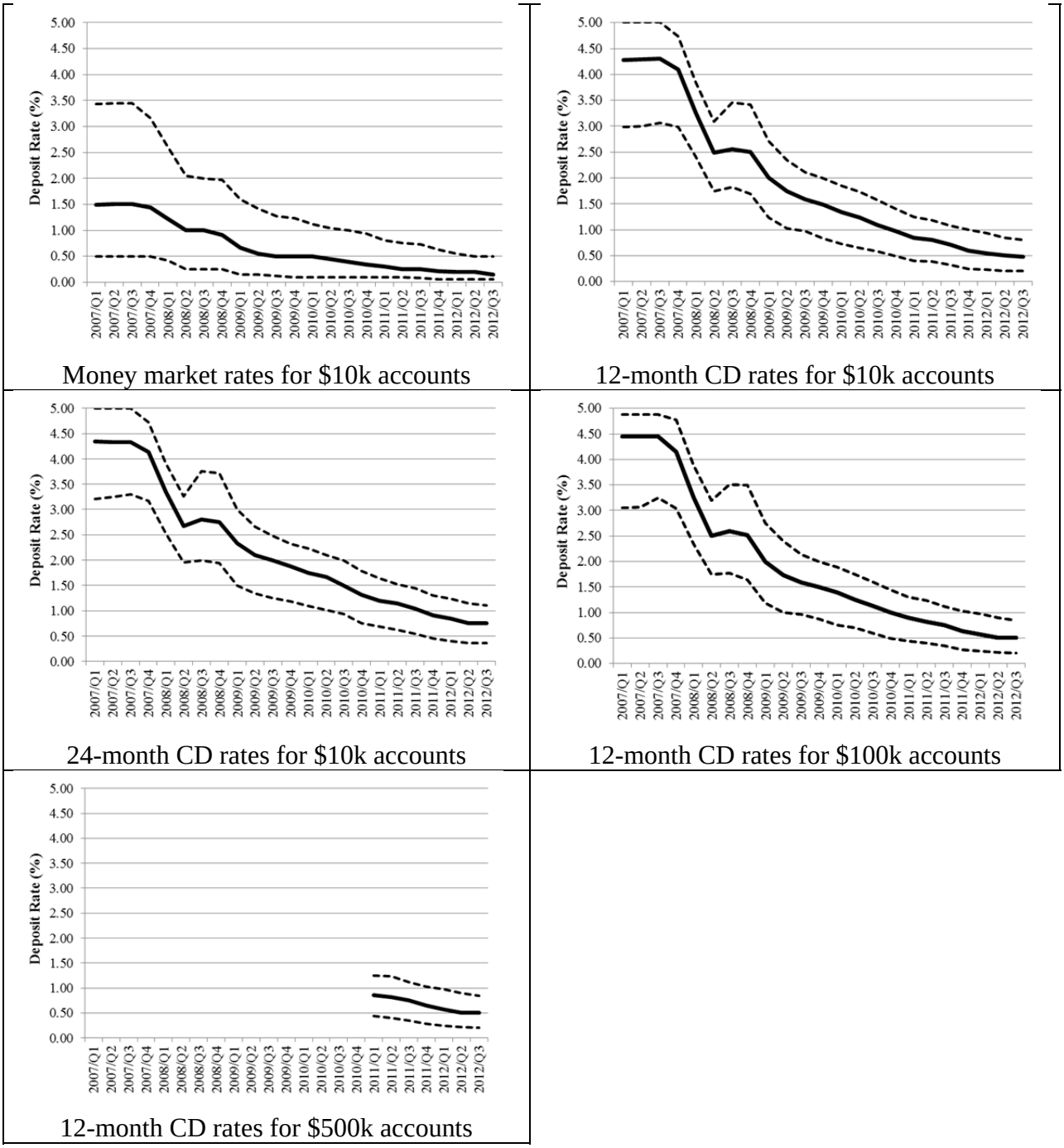
| Dependent variable: | 12-month CD rate, $10k accounts (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sample: | Multi-state banks | | | | Single-state banks | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| State-level loan growth (q-1) | 0.9286 | 0.0226 | 0.3102 | -0.7572 | 1.8538*** | 1.9488*** | 1.2058*** | 1.5744*** |
| | (1.08) | (0.01) | (0.39) | (-0.54) | (8.91) | (5.88) | (6.75) | (5.32) |
| × I(2008/Q4 onward) | | 1.4855 | | 1.7695 | | -0.1702 | | -0.6457** |
| | | (0.88) | | (1.34) | | (-0.50) | | (-2.07) |
| Bank characteristics | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Calendar quarter FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank FE | No | No | Yes | Yes | No | No | Yes | Yes |
| Obs | 7859 | 7859 | 7859 | 7859 | 111706 | 111706 | 111706 | 111706 |
| Adj $R^2$ | 0.913 | 0.913 | 0.938 | 0.938 | 0.925 | 0.925 | 0.953 | 0.953 |

**Figure 1. Equity Capital to Assets 1987–2012**



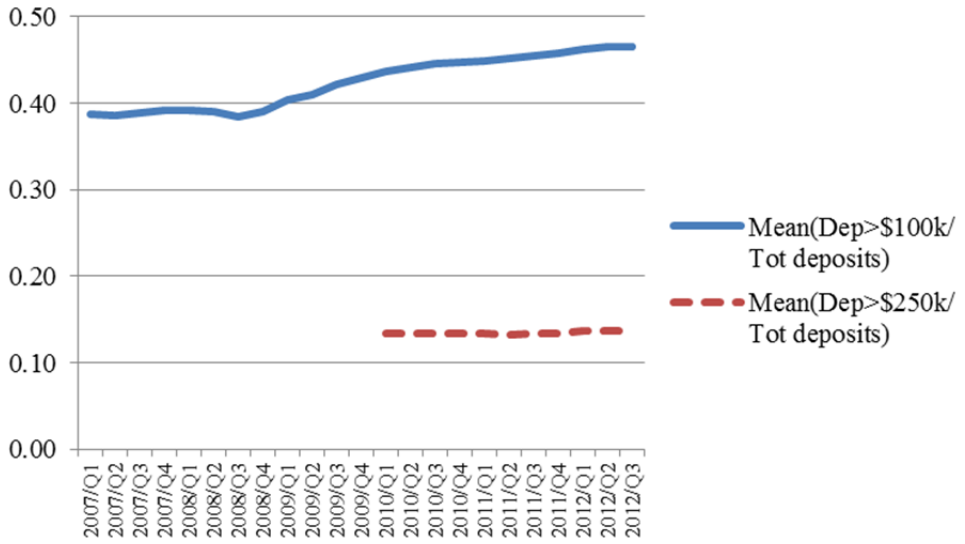

The figure shows the average equity-to-assets ratio and the 10th percentile of the distribution of equity-to-assets. Source: Call Reports.

**Figure 2. Time Series of Deposit Rates, by Maturity and Account Size**



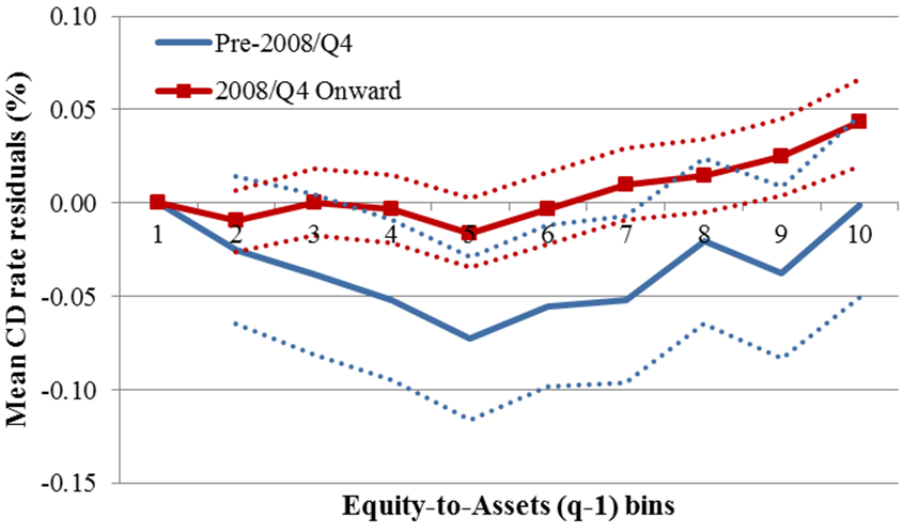

The figure presents time series of deposits for money market accounts and 12-month accounts for different account sizes: $10k, $100k, and $500k accounts. The figure plots the 5th, 50th and 95th percentiles. Source: RateWatch.

**Figure 3. Time Series of Large Deposit Ratios**



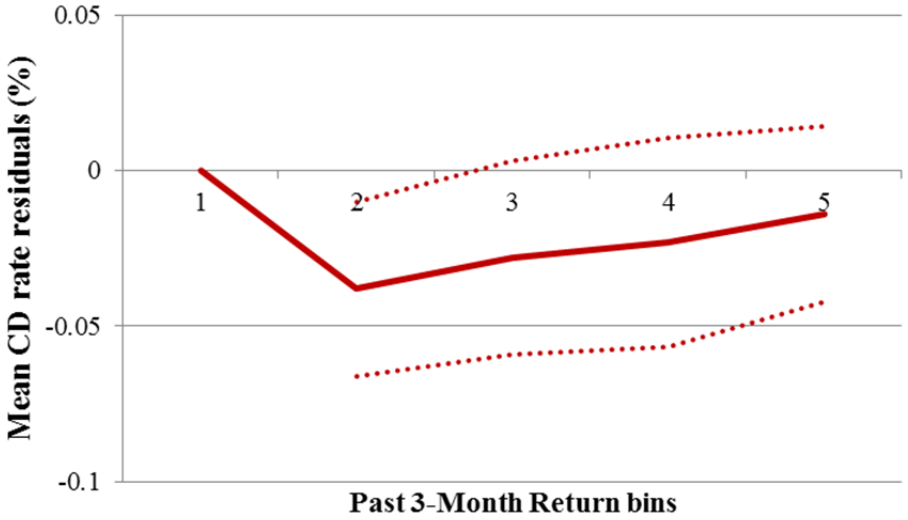

The figure shows the evolution of the average large deposit ratios over time. These variables measure the percentage of the dollar amount of large deposits (i.e., deposits larger than $100k or $250k) as a fraction of the total dollar amount of deposits within a bank. Source: Call Reports.

**Figure 4. CD Rates and Equity-to-Assets**



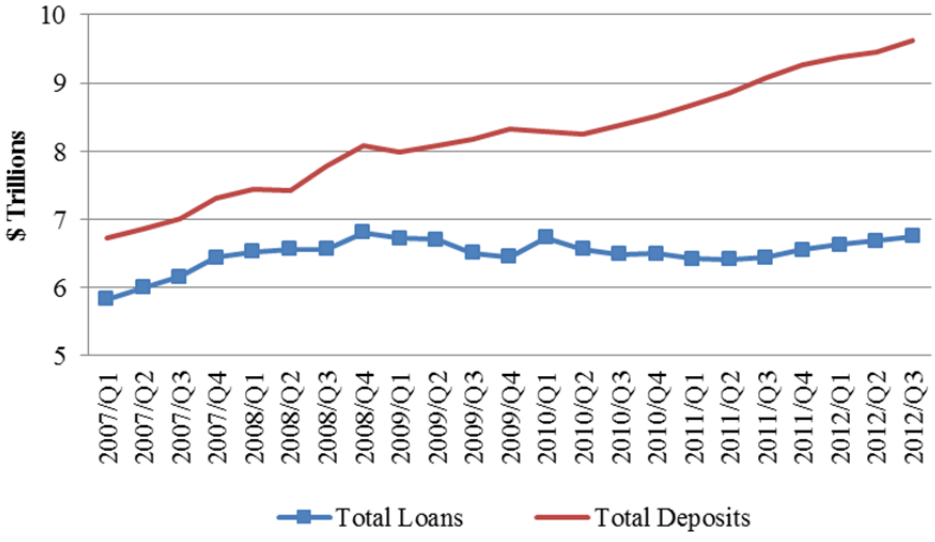

The figure shows the relation between deposit rates and lagged equity-to-assets. It presents the coefficients from regressions of CD rates (12-month duration for $10k accounts) on lagged equity-to-assets decile indicators, bank controls, and calendar fixed effects. The sample is split into two: pre-2008/Q4 and 2008/Q4 onward. The solid lines represent the point estimates of the coefficients. The dotted lines represent two standard errors around the point estimates of the coefficients. Sources: RateWatch and Call Reports.

**Figure 5. CD Rates and Past 3-Month Returns**



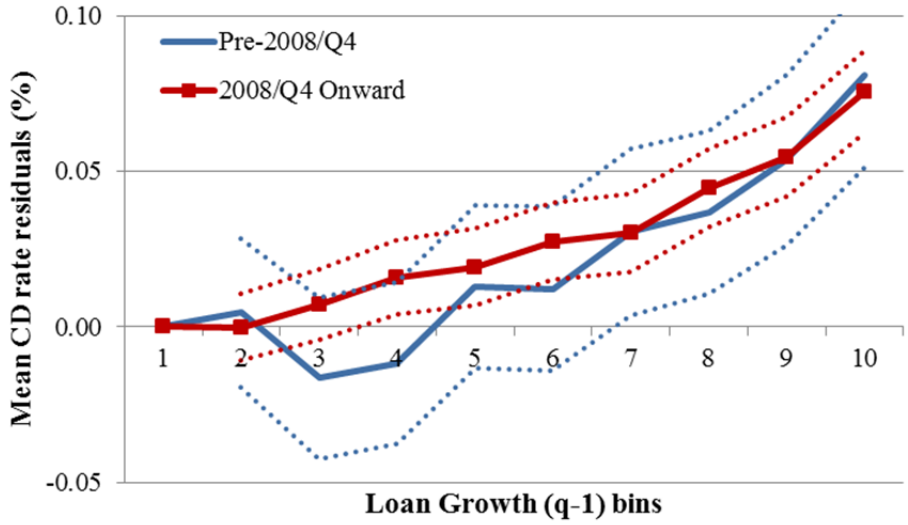

The figure shows the relation between deposit rates and lagged 3-month returns. It presents the coefficients from regressions of CD rates (12-month duration for $10k accounts) on lagged 3-month return quintile indicators, bank controls, and calendar fixed effects. The solid line represents the point estimate of the coefficients. The dotted lines represent two standard errors around the point estimate of the coefficients. Sources: RateWatch and Call Reports.

**Figure 6. Aggregate Deposits and Loans**




The figure shows the quarterly aggregate deposits and loans. Source: Call Reports.

**Figure 7. CD Rates and Equity-to-Assets**




The figure shows the relation between deposit rates and lagged loan growth. It presents the coefficients from regressions of CD rates (12-month duration for $10k accounts) on lagged loan growth decile indicators, bank controls, and calendar fixed effects. The sample is split into two: pre-2008/Q4 and 2008/Q4 onward. The solid lines represent the point estimate of the coefficients. The dotted lines represent two standard errors around the point estimate of the coefficients. Sources: RateWatch and Call Reports.