

Kupiec, Paul H.; Lee, Yan; Rosenfeld, Claire

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AMERICAN ENTERPRISE INSTITUTE

Does bank supervision impact bank loan growth?

Paul H. Kupiec

American Enterprise Institute

Yan Lee

Federal Deposit Insurance Corporation

Claire Rosenfeld

The Mason School of Business at the College of William and Mary

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Does Bank Supervision Impact Bank Loan Growth?

by

Paul Kupiec, Yan Lee and Claire Rosenfeld¹

This Draft: May 11, 2015

ABSTRACT

We estimate the impact on individual bank loan growth caused by supervisory restrictions associated with a poor bank examination rating. We use a novel approach to control for bank loan demand variation and estimate a fixed-effect model using an unbalanced panel with over 443,000 bank-quarter observations from the period 1994-2011. Our estimates show that supervisory restrictions have a large negative impact on bank loan growth after controlling for the impact of monetary policy, bank capital and liquidity conditions and any voluntary reduction in lending triggered by weak legacy loan portfolio performance or other bank losses.

Key Words: Bank supervision, bank loan growth, bank capital, bank liquidity

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I. Introduction

Supervision is a distinct component of bank regulation that involves more than monitoring compliance with minimum capital, liquidity or other quantitative regulations. Bank examinations identify weaknesses in bank operations that lead to supervisory recommendations to improve bank safety and soundness. As Robert Litan and former Comptroller of the Currency John Hawke (2012) write,

Examiners are experts who are specially trained to look beyond the numbers, seeking to determine whether the processes that banks use to gather deposits, extend loans, manage risk, and keep track of all this information and to ensure its security, are appropriate. To carry out their jobs, examiners ask questions—of bank employees, executives and directors—all with an eye to ensuring that the bank is well managed and appropriately managing risks (p. 9).

In the U.S., bank supervisors have a continuous physical presence at the largest banks and conduct onsite examinations of every bank at least every 18 months. Supervisors assess quantitative and qualitative aspects of bank management and performance including asset quality, earnings, bank sensitivity to market and interest rate risks, as well as the adequacy of bank management control systems and management competency.² Should a financial institution fail to meet supervisory expectations, under Prompt Corrective Action guidelines, the supervisor may require a bank to take a wide range of remedial actions.³ If the institution is unable to rectify identified deficiencies, supervisors can restrict a bank's activities or require investments in new process, systems and personnel, or, in extreme cases, revoke an institution's charter or deposit insurance coverage for operating in an unsafe and unsound manner.⁴

One potential side effect of supervisory intervention is slower loan growth. When proactive examinations identify bank weaknesses that must be corrected—for example, in lax bank underwriting standards, high lending concentrations, or poor records and information systems—supervisory recommendations may restrict loan growth or other bank investment activities until a bank addresses the

² See Berger, Kyle and Scalise (2001) for a more detailed discussion of the bank examination process.

³ U.S. Prompt Corrective Action requirements were codified in 1991 as part of the Federal Deposit Insurance Corporation Improvement Act. 12 U.S. Code §16(g) allows that, should a Federal banking agency determine that an insured depository institution is in an unsafe or unsound condition or engaging in an unsafe or unsound practice, the agency may use its prompt corrective action powers to require the bank to take remedial actions.

⁴ Although our sample period predates the imposition of regulatory reforms introduced by The Dodd Frank Wall Street Reform and Consumer Protection Act (2010), this Act also gave bank supervisors the power to require bank holding companies to change their processes, organization or corporate structure to improve the chances that, should an institution become financially distressed, it could be liquidated in an orderly manner in a judicial bankruptcy process.

underlying weakness.⁵ Moreover, at various times in the past, often following recessions or high-profile bank losses or failures, the financial news includes reports claiming that bank examination practices had become overly rigid to the point that supervisors discouraged banks from lending to creditworthy borrowers.^{6,7} For example, in February 2010, before the U.S. House of Representatives Committee on Financial Services and Committee on Small Business, Federal Reserve Board Governor Duke testified,

Some banks may be overly conservative in their small business lending because of concerns that they will be subject to criticism from their examiners. While prudence is warranted in all bank lending, especially in an uncertain economic environment, some potentially profitable loans to creditworthy small businesses may have been lost because of these concerns, particularly on the part of small banks. Indeed, there may be instances in which individual examiners have criticized small business loans in an overly reflexive fashion.

The idea that bank supervision can constrain bank lending is not novel—indeed, a core goal of bank supervision is to stop banks from making high risk loans that would have questionable value absent a government safety net subsidy. However, only a small segment of the banking literature is focused on measuring the effect of bank supervision on loan growth and none systematically examines the impact of a poor bank examination rating on subsequent bank loan growth.⁸ If bank supervisors are effective delegated monitors, then we would expect supervisory actions to have measurable effects on the lending behavior of poorly run institutions. In contrast, there is a relatively large literature that discusses the expected loan growth impact of other changes in the regulatory environment, such as a change in bank minimum capital requirements.

⁵ In response to rapid growth in Commercial Real Estate (CRE) Loan concentrations and widespread weaknesses in bank risk management practices, in December 2006, the banking agencies issued, “Joint Guidance on Concentrations in Commercial Real Estate Lending, Sound Risk Management Practices,” which codified supervisory expectations for stricter loan underwriting standards and concentration limits on CRE loans. In a subsequent joint supervisory agency study, Friend, Glenos, and Nicholas (2013) find that the 2006 interagency guidance led to substantial declines in CRE lending at targeted institutions.

⁶ See for example, Davidson (2010).

⁷ Bank loan growth was especially sluggish in the early 1990s following supervisory and regulatory changes in reaction to the S&L and banking crisis. At the time, this “credit crunch” was in part attributed to overly strict supervision. In reaction to this criticism, on March 30, 1993, the banking supervisors issued an interagency rule that exempted well- or adequately capitalized institutions from examiner criticism of loan documentation standards on small- and medium sized business loans and farms provided the loans were fully performing, under \$900,000, and in total comprised less than 20 percent of the institution’s capital.

⁸ Papers that specifically examine the effect of supervisory actions on bank loan growth include Peek and Rosengren (1995b) and Berger, Kyle and Scalise (2001).

Weaknesses in bank capital or liquidity positions may coincide with supervisory actions that require improvements in bank risk mitigation and control processes. Consequently, it is important to control for all potentially important supervision and regulatory factors concurrently when examining bank loan growth. Bank capital or liquidity studies that omit controls for bank supervision could lead to an overestimate of the importance of regulatory factors and lead policymakers to overemphasize the importance of capital and liquidity regulation when the observed effects are actually being driven by bank supervision.

In this study, we use U.S. regulatory data over the period 1994-2011 to estimate the sensitivities of banks' quarterly loan growth rates to variation in bank supervision intensity as well as variation in bank capital and liquidity conditions, while controlling for a comprehensive set of other important bank characteristics. We proxy for the intensity of bank supervision using bank supervisory CAMELS ratings as banks with poor CAMELS ratings are typically subjected to heightened scrutiny from supervisors as they are required to remedy significant safety and soundness weaknesses identified in the examination.⁹ Our controls include bank-specific characteristics as well as variables that measure the importance of traditional policy instruments such as monetary policy. We estimate the determinants of bank loan growth using an unbalanced panel regression model that includes bank fixed-effects in addition to controls for bank-level loan supply and demand factors.

Our bank fixed-effects specification allows us to measure loan growth variation attributable to specific bank-level characteristics. The regression model coefficient estimates measure the loan growth variation generated when individual bank characteristics deviate from each individual bank's long-run sample average characteristic values. The sample average values of specific bank attributes can be interpreted as an approximation for the individual bank's optimal attribute level during our sample

⁹ The purpose of this study is *not* to assess the macroeconomic impact of supervision on bank lending but rather to quantify the bank-specific impact of supervisory interventions that are typically associated with a poor supervisory examination rating. Berger, Kyle and Scalise (2001) focus on assessing whether time-variation in supervisory assessment standards can, in part, explain the large variation in aggregate bank loan growth variation over the period 1989-1998.

period.¹⁰ An innovation that changes a bank's supervisory CAMELS rating or policy changes that alter a bank's optimal capital or liquidity position will impact loan growth in a manner consistent with sample-average deviations of the CAMELS coefficients and the capital and liquidity coefficient estimates in our bank fixed-effects specification.

We control for variation in individual bank loan demand by first selecting a sample of banks that operate in a tightly-constrained geographic market. For our analysis, we only include groups of banks that operate primarily in a single county and thereby face nearly identical local market demand conditions in a given quarter.¹¹ We control for banks' local market demand conditions by including quarterly county-level measures of economic activity in our regression model.

In addition to controlling for individual bank supervision intensity and capital and liquidity positions, our methodology controls for cross-section and time-series variation in a comprehensive set of bank attributes that the literature has shown to be important determinants of a bank's loan supply. These controls include a bank's average cost of liabilities, a bank's past profitability, its past loan portfolio performance, and measures of the degree of competition in the bank's local market. Our estimates show that most of these factors are statistically significant, but, economically, some factors are more important than others. By comparing the economic importance of policy-related factors, we can assess the potential importance of supervision activities for individual bank loan growth relative to capital and liquidity regulations and traditional monetary policy instruments.

Our results show that the factor that generates the greatest impact on a bank's loan growth is the intensity of the bank's supervisory monitoring as measured by its regulatory CAMELS rating. Our

¹⁰ The CAMEL(S) supervisory rating system was in place the entire period. The rating system was modified slightly in 1995 to explicitly include 'S', a sensitivity rating for a bank's market and interest rate risk. Prior to 1995, the 'S' component was implicit in a bank's composite supervisory CAMEL rating. Beginning in 1998, banks with more than \$1 billion in trading book assets became subject to new market risk capital requirements. Our sample does not include any banks that were required to meet market risk capital requirements.

¹¹ Though some may argue that eliminating very large institutions from the sample by way of imposing the concentration of deposits requirement on our sample banks would diminish the relevance of our study, this is the mechanism we use for identification. Moreover, our analysis is focused on bank loan growth rates and not on the level of a bank's outstanding loans. Historically, very few large institutions have ever received a CAMELS 3 or CAMELS 4-5 supervisory rating, so excluding large institutions does not create any obvious biases in our estimates of the effect of a CAMELS rating downgrade on an individual bank's subsequent loan growth rate.

estimates suggest that, other things equal, a CAMELS 3-rated bank reduces its quarterly loan growth by more than 1.36 percentage points on average while a bank with a CAMELS rating of 4 or 5 reduces quarterly loan growth by more than 2.07 percentage points, on average.¹² While the importance of supervisor monitoring intensity is exceptionally large at the individual bank level, prior to the financial crisis, relatively few banks were rated CAMELS 3, 4, or 5 and so the supervisory channel has only a localized effect on bank loan growth over most of our sample period.¹³

After supervisory monitoring, a bank's average cost of liabilities is economically the most important factor affecting loan growth.¹⁴ We allow a bank to react differently to changes in the average cost of liabilities in the local bank market and changes in the bank's own average cost of liabilities. We use lagged values of individual bank average cost of liabilities and county average bank cost of liabilities as instruments. We find reductions in loan growth when the average cost of bank liabilities in the local market increases as well as when a bank faces an idiosyncratic increase in its own funding cost. Holding other things constant, we find that when the average cost of liabilities in the local banking market increases by 1 percentage point, banks reduce quarterly loan growth by about 77 bps. By comparison, should the bank's own average cost of liabilities increase by 1 percentage point, the bank will reduce its quarterly loan growth by 99 bps on average.

Controlling for other factors, we find that a bank's leverage-capital ratio has a small positive effect on a bank's subsequent lending growth. Our estimates suggest that 1 percentage point increase in a bank's leverage capital ratio will, on average, be associated with about 4 bps of additional loan growth the

¹² The coefficient estimates we report in this overview section are the estimates from Table 3, which uses sample banks that meet a 50 percent deposit threshold within one county. Estimates from our more restrictive 75 and 100 percent deposit threshold samples are very similar and are reported in the paper.

¹³ Only about 5 percent of our sample bank-quarter observations prior to 2009 are rated CAMELS 3 and about 1 percent had CAMELS 4 or 5 rating. In addition, the banks in our sample are relatively small institutions. The macroeconomic importance of this supervision effect is likely to be much larger in 2009-2011 when the share of CAMELS 4 and 5 rated banks was closer to 12 percent, and over 25 percent of banks were rated CAMELS 3. As mentioned earlier, very few, if any, of the largest institutions have ever received a CAMELS 4 or 5 rating so this channel has not been important for the largest institutions.

¹⁴ Under normal (positive interest rate) market conditions, monetary policy operates through this channel.

following quarter. When we measure a bank's capital position using the bank's regulatory tier 1 or total risk-based capital ratios, we find smaller positive effects.¹⁵

In terms of banks' liquidity conditions, our evidence suggests that a 1 percentage point increase in a bank's liquid asset ratio will, on average, be associated with 3 bps additional loan growth the subsequent quarter. Holding constant a bank's average cost of liabilities and other factors, we find that banks that make greater use of core deposit funding have slightly lower quarterly loan growth on average (about 1 bps). Again, holding constant average cost of liabilities, banks that make greater use of brokered deposits and other sources of so-called "hot money" also experience slightly lower quarterly loan growth on average (about 2 bps).

Overall, our interpretation is that the increase in intensity of bank supervision following a poor examination rating has a very pronounced direct impact on a bank's loan growth. In contrast, variation in bank capital and liquidity positions have only minor impacts on loan growth.¹⁶ Our analysis also clearly shows that when banks suffer losses—from their existing loan portfolios or otherwise—they react by curtailing their lending regardless of supervision intensity or their capital and liquidity positions. The tendency for banks to reduce lending in the face of losses is compounded tremendously if bank losses generate additional supervisory scrutiny.

The remainder of our paper is organized as follows: Section II discusses related literature. Section III discusses the methodology and data that we use to assess the importance of these alternative determinants of bank lending growth. Section IV presents our estimation results and extensive analysis that supports the robustness of our findings. Section V concludes the paper. An Appendix includes a supplemental review of related literature.

¹⁵ Our 4 bps estimate of the leverage ratio effect on quarterly loan growth is consistent with estimates produced by Carlson, Shan, and Warusawitharana (2013) (CSW) [13 bps annually] who use U.S. bank data and a broadly similar identification strategy.

¹⁶ Even annualizing the effects of the control variables on loan growth, we do not find economically important effects for bank capital and liquidity ratios.

II. Literature¹⁷

A. *The Supervisor Monitoring Channel*

A number of studies focus on systematic variation in the intensity of bank supervisor monitoring.¹⁸ Overall, there is some evidence that the criteria used by supervisors to qualify an institution as high- or low-quality (from a safety and soundness perspective) vary over time. When bank profits are cyclically high and nonperforming assets are low, supervisors seemingly lower the standards needed to achieve a favorable safety and soundness regulatory rating. Banks respond to weaker supervisory standards by weakening their own underwriting standards and increasing loan growth. In contrast, when bank profits are cyclically weak and nonperforming assets are large, supervisors strengthen the criteria needed to achieve a favorable safety and soundness rating, requiring banks to tighten underwriting standards and reduce loan growth.¹⁹

Two studies, Peek and Rosengren (1995b) (PR), and Berger, Kyle, and Scalise (2001) are the most closely related to our work. PR analyze the effect of supervisory interventions for 68 large New England banks over the period 1989-1992. They find that banks under supervisory enforcement actions significantly decreased lending the following quarter compared to banks without any formal supervisory actions. PR's model includes an interaction between supervisory actions and bank capitalization rates. Higher bank capital ratios tend to mitigate the negative growth effects associated with enforcement actions. PR estimate that, for a bank with a leverage ratio of 4 percent, a supervisory enforcement action will reduce bank loans by about 1.4 percentage points the subsequent quarter. PR discount the hypothesis that bank capital shortages caused the 1989-1992 "credit crunch" in the New England region in favor of a causal role for bank supervisory enforcement actions.

Berger, Kyle and Scalise (2001) (BKS) re-examine explanations for the bank loan growth deficit during the credit crunch period. BKS attempt to assess whether the rigor of supervisory examination

¹⁷ An appendix includes an additional, more detailed review of related literature.

¹⁸ See for example, Peek and Rosengren (1995b), Berger, Kyle and Scalise (2001), Curry, Fissel and Hanweck (2008) and Krainer and Lopez (2009).

¹⁹ Rajan (1994) provides an alternative explanation for time variation in bank underwriting standards which is not driven by supervision.

standards varied systematically over the 1989-1998 period and whether this could, in part, explain the slowdown in bank lending growth during the 1989-1992 credit crunch and the acceleration in bank lending growth over the period 1993-1998. BKS do not find evidence of harsher supervisory standards during the credit crunch, and while they find big improvements in banks supervisory ratings over the 1993-1998 period, they attribute this, at least in part, to higher frequency examinations over this period changing the sample composition in favor of better run institutions. Overall, BKS find some evidence of a moderation in supervisory standards in the 1993-1998 period, but they find that this moderation had little impact on aggregate bank lending.

Bank Capital Regulation and Loan Growth

Many studies evaluate the role of minimum bank capital regulations on bank lending. The early credit crunch literature focuses on the effects of binding or near-binding bank regulatory requirements on the supply of bank credit.²⁰ This literature argues that banks restrict, or even contract, their loan growth if they perceive they are at risk of violating any of the three minimum regulatory capital requirements set by U.S. Prompt Corrective Action guidelines.²¹ Some studies find that binding or near-binding regulatory risk-based constraints reduced bank lending while others find that banks adjusted to new regulations by rebalancing their securities holdings without much effect on lending.²²

Estimation of the impact of bank capital regulations is complicated by the fact that the bank's credit supply function is not observable. One must construct a methodology to distinguish between shifts in bank loan supply from changes in bank loan demand. A recent "credit crunch" study by Carlson, Shan and Warusawitharana (2013) (CSW) utilizes a matched-sample identification methodology that, while not identical, is closely related to our identification strategy.

²⁰ See for example Bernanke and Lown (1991), Berger and Udell (1994), Hancock and Wilcox (1994), Gambacorta, L., and P. Mistrulli (2004), Peek and Rosengren (1995a), Brinkmann and Horvitz (1995), Shrieves and Dahl (1995), Sharpe (1995), Valencia (2008), Berrospide and Edge (2010), Gambacorta and Marques-Ibanez (2011), Mora and Logan (2010), Rice and Rose (2012), or Carlson, Shan and Warusawitharana (2013).

²¹ The leverage ratio places a regulatory floor on the ratio of bank Tier 1 capital to average admissible assets. Two risk-based capital ratios, (1) tier 1, and (2) total risk-based, constrain, respectively, the ratio of a bank's tier 1 capital to its risk-weighted assets and the ratio of a bank's total regulatory capital to its risk-weighted assets.

²² See for example, Berger and Udell (1994), Hancock and Wilcox (1994), Brinkmann and Horvitz (1995) or Shrieves and Dahl (1995).

CSW estimate the importance of bank capital for determining subsequent loan growth using U.S. bank data over the period 2001-2011. They measure differences in matched-bank behavior arguing that the difference controls for loan demand variation. They find that banks with higher leverage-capital ratios experienced stronger loan growth. CSW estimates suggest that banks with a 1 percentage point higher leverage-capital ratio will experience annual loan growth rates 13-to-16 basis points higher on average, but find capital effects to be time-varying, ranging from weak to nonexistent over the period 2001-2006, but very strong during the crisis years, 2007-2010. The CSW study does not include an independent control for supervision intensity or controls for many bank-specific factors that the literature has shown to influence loan growth including funding costs, profitability, loan portfolio performance, and other time-invariant individual bank effects.

Two other recent “credit crunch” studies are tangentially related to our work: Aiyar, Calomiris and Wieladek (2014) (ACW) and Jiménez, Ongena, Peydró and Saurina (2014) (JOPS). Both study the effects of capital regulations on loan growth in foreign banking systems.

ACW use U.K. data to estimate the effect of changing minimum bank-specific regulatory capital requirements on bank loan growth. They do not control for an independent supervision channel and find that “an increase in the required minimum capital ratio of 100 basis points induces, on average, a cumulative fall in lending growth of between 5.7 and 8 percentage points” (p. 201). This large negative impact of capital requirements on loan growth that they find in U.K. data has not been identified in U.S. banking data.

JOPS study the effects of the Bank of Spain’s countercyclical capital buffers on the extension of bank credit at the loan facility and firm borrower levels.²³ JOPS analyze bank-firm paired lending and firm-level credit and find that elevated capital requirements in the form of so-called “statistical provisions” suppressed bank lending to individual firms during the Spanish boom period (2000-2005). During the “bust” phase of the Spanish credit cycle (2008), JOPS find that banks with accumulated

²³ A countercyclical capital buffer is similar to a time-varying minimum capital requirement.

mandatory statistical provisions were more likely to continue lending to bank borrowers. JOPS do not estimate the impact of statistical provisions on overall bank loan growth.

B. The Credit Channel Literature

The credit channel literature focuses on explaining how individual bank and borrower characteristics interact with Federal Reserve monetary policy to affect the supply of bank credit and ultimately GDP growth.²⁴ Bank loan rates are typically assumed to be set as a mark-up over bank cost of funds—primarily the cost of bank liabilities—and so the cost of bank liabilities are an important determinant of bank credit supply.²⁵ Asymmetric information imperfections tie funding access and cost to the strength of both banks' and borrowers' balance sheets and the value of collateral.²⁶ Specifically, monetary policy has two impacts: (1) it changes banks' cost of funds on their rate-sensitive liabilities that are passed on to bank customers through bank loan rates; and, (2) higher interest rates reduce the value of both bank and bank-customer collateral which may reduce bank access to non-deposit sources of funding and reduce bank customers' ability to meet bank underwriting standards.²⁷ The literature finds empirical support for both channels of influence.²⁸

C. Other Factors

The literature identifies a number of other important factors that must be accounted for when analyzing the determinants of bank loan growth. For example, the performance of a bank's legacy loan

²⁴ See for example Tobin and Brainard (1963), Brunner and Meltzer (1963), and Brainard (1964), Bernanke and Blinder (1988), Bernanke and Lown (1991), Bernanke and Gertler (1989, 1995) and Hubbard (1995), Kashyap and Stein (1995, 2000). See Oliner and Rudebusch (1996), Ashcraft (2006), and Black, Hancock and Passmore (2007) for alternative perspectives.

²⁵ The dynamics of the pass-through of bank funding costs to loan rates may be affected by bank manager strategic behavior similar to Rajan (1994). We discuss this issue in more detail in Section III.

²⁶ Bank capital is treated as a quasi-fixed input due to asymmetric information costs of outside equity issuance. Bernanke and Gertler (1989), Kiyotaki and Moore (1997), and Bernanke, Gertler, and Gilchrist (1999) argues that a bank's cost of new non-insured external funds should be determined by the strength of the bank's financial condition.

²⁷ Lower interest rates increase collateral value and improve both bank and customer access to credit.

²⁸ Kashyap and Stein (1995) find that smaller banks more affected by tight monetary policy because information asymmetries limit their access to uninsured sources of funding. A vast literature finds that asymmetric information inhibits borrower's ability to obtain credit to invest optimally. See for example Stiglitz and Weiss (1981), Myers and Majluf (1984), Fazzari, Hubbard and Petersen (1988), Bernanke and Gertler (1989), Whited (1992), or Hubbard, Kashyap and Whited (1995).

portfolio has been shown to be an important determinant of a bank's loan supply.²⁹ Overall bank profitability also determines bank lending behavior as bank losses suffered on investments outside of their loan portfolios have been shown to reduce a bank's subsequent willingness to extend credit to customers even if the bank is well-capitalized.³⁰ Competitive conditions in a bank's lending market have also been shown to influence a bank's willingness to extend credit.³¹

A number of forensic studies³² of the financial crisis find that banks' pre-crisis liquidity positions affected the amount of bank credit and the rates charged by banks following the liquidity shock.³³ Banks that derived a greater share of their funding from so-called core deposits were more likely to extend credit following the crisis and less likely to increase their lending rates.³⁴ Overall, the evidence suggests that banks' funding mix and investment portfolio liquidity characteristics influenced their lending behavior during the crisis.

III. Methodology and Data

A. Overview of Methodology

Bank loan growth is generated through the interaction of customer loan demand and bank loan supply decisions. However, loan demand and loan supply are not independently unobservable. We control for variation in individual banks' loan demand by focusing on banks that conduct a majority of their business in a single county, and we then control for variation in county-level economic activity with variables that should be correlated with variation in individual bank loan demand.³⁵

²⁹ See for example, Berger and Udell (2004) or Chava and Purnanandam (2011). Murfin (2011) finds that banks tighten loan covenants following poor loan portfolio performance.

³⁰ See Santos (2011) or Puri, Rocholl and Steffen (2010).

³¹ See, for example, Petersen and Rajan (1995) or Boot and Thakor (2002).

³² These include Ivashina and Scharfstein (2010), Ashcraft, Bech, and Frame (2010), Cornett, McNutt, Strahan, and Tehranian (2011), Bord and Santos (forthcoming), and Acharya, Afonso and Kovner (2013).

³³ Cornett, McNutt, Strahan and Tehranian (2011) find that banks with relatively illiquid asset holding at the time of the crisis tended to cut lending and increase their holding of liquid assets during the crisis. Bord and Santos (2013 forthcoming) find that banks that were heavy users of Federal Reserve or Federal Home Loan Bank liquidity facilities during the crisis tended to increase the charges (both access fees and spreads) corporations paid for credit lines during the crisis.

³⁴ See Ivashina and Scharfstein (2010) or Cornett, McNutt, Strahan and Tehranian (2011).

³⁵ This sample selection criterion does not permit us to include some banks that operate primarily in large metropolitan areas that span multiple counties. We ran our analysis using a CBSA-level market definition and found

First, we identify each bank's geographic market using FDIC Summary of Deposits (SOD) data. SOD data provides an annual June 30 "snapshot" of each institution's deposit-taking activity at bank branch level. Each bank's county-level deposit shares in the three intervening quarters are estimated by merger-adjusting the prior June's SOD data.³⁶ Our data sample period begins when SOD data becomes available in 1994Q2 and ends in 2011Q4.

We use SOD data as a proxy for the location of a bank's lending activities. However, banks need not lend exclusively in the locations in which they collect deposits. Syndicated lending, for example, may enable banks to geographically diversify their lending into markets in which they do not take deposits. Still there are reasons to expect bank lending to be concentrated in the communities in which they raise deposits. For example, since 1977, the Community Reinvestment Act (CRA) has mandated that institutions support the credit needs of the local communities from which they collect deposits and federal supervisory agencies regularly monitor compliance with CRA provisions. In addition, the literature shows the distance between the borrower and its local bank branch is an important factor explaining bank lending patterns.³⁷ We adopt the geographic lending concentration assumption as a means for controlling for bank loan demand and assess the robustness of our approach in Section IV part D where we consider alternative criteria for sample selection, alternative definitions of loan growth, and explicitly account for bank syndicated lending.

Our benchmark sample for analysis includes all banks that raise at least 50 percent of their deposits in a single county in a quarter. Identification of the common county-wide effects of bank cost of

results very similar to those reported in this paper which indicates that our county-level market definition is not an important limitation of our approach.

³⁶ Data on bank mergers are from the FDIC's Research Information System (RIS) warehouse.

³⁷ See for example Petersen and Rajan (1994, 2002), Cole, Wolken and Woodburn (1996), Boot (1999), Berlin and Mester (1999), Cole, Goldberg and White (2004), Avery and Samolyk (2004), Dahiya, Saunders and Srinivassan (2003), Elyasiani and Goldberg (2004), Heitfield and Prager (2004), DeYoung, Glennon and Nigro (2008), and Brevoort, Holmes, and Wolken (2010).

funds and bank profitability requires that we include only observations for which there are at least two banks that meet the required deposit threshold in the county-quarter.³⁸

We exclude from our analysis institutions with a specialization in credit card lending, with a specialization in non-lending activities, *de novo* banks, foreign banks, and institutions with zero loan activity. We also exclude bank observations with loan growth values that are in the 5 percent tails of the loan growth distribution.³⁹ We eliminate banks that report negative capital, negative average cost of liabilities, or extremely high capitalization ratios. After applying these filters, the sample size associated with a 50 percent deposit threshold and at least two banks in a county-quarter is over 443,000 bank-quarter observations.⁴⁰

B. Econometric Model

Our baseline regression model specification is:

$$\text{loan growth}_{it} = \alpha_i + \beta \text{Capital}_{it-1} + \sum_{j=1}^J \gamma_j \text{Liq}_{jit} + \sum_{k=1}^K \delta_k \text{FundCost}_{kit-1} + \sum_{l=1}^L \eta_l \text{ROA}_{lit-1} + \sum_{m=1}^M \kappa_m \text{Sup}_{mit-1} + \sum_{n=1}^N \lambda_n \text{AQual}_{nit-1} + \mu \text{Size}_{it-1} + \sum_{p=1}^P \nu_p \text{Mkt}_{pit} + \sum_{q=1}^T \rho_q Q_q + \tilde{\varepsilon}_{it} \quad (1)$$

In this model specification, i identifies a particular bank, t identifies a particular quarter, and other subscripts indicate that there are multiple variables that measure the indicated property. Specifically, loan growth_{it} is bank i 's loan growth over quarter t , α_i is a bank-specific constant (bank fixed-effect), Capital refers to regulatory capital adequacy⁴¹, Liq refers to liquidity controls, FundCost denotes bank funding costs, ROA is the bank's return on assets, Sup represents indicators for bank

³⁸ Including a restriction on the location of the bank's primary deposits eliminates the largest banks from our sample. This elimination enhances our ability to identify the magnitude of the impact of a change in supervisory intensity of bank loan growth.

³⁹ It is common to exclude outliers in studies using CALL report data. For example, the FDIC's Uniform Bank Performance Report excludes data in the upper and lower 5 percent tails. Berger and Udell (1994) exclude observations when loan balances change by more than 25 percent or when a bank's 0 or 100 percent risk weighted asset categories change by more than 75 percent.

⁴⁰ For the entire sample period, there are 706,238 unique bank-quarter observations. Of these, 203,090 observations were dropped because the bank was a non-bank, a credit card lender, a foreign bank, or a *de novo* bank, or if the bank had missing values, implausible values, or had loan growth in the 5 percent tails of the loan growth distribution. The application of these filters left 500,173 bank-quarter observations. Out of these banks, 443,578 observations also satisfy the 50 percent deposit threshold with at least two banks in a county-quarter. Thus, our 50 percent threshold sample represents 88.7 percent of the eligible population of bank observations.

⁴¹ A single measure of bank capital will be included in separate regressions.

supervision intensity, *AQual* refers to measures of bank asset quality, *Size* refers to bank size, *Mkt* represents variables that measure the bank's local market conditions, and $Q_q, \{q = 1, 2, \dots, T\}$ are T quarterly dummy variables that control for national conditions that may affect loan growth in all banks within in a quarter. The model includes bank fixed-effects to control for bank-specific factors that are not explicitly captured by our bank-level controls.⁴² We use merger-adjusted quarterly values over the period 1994 to 2011. Table 1 provides detailed definitions of the variables used in our analysis.

Bank fixed-effects are accounted for using the so-called “within” estimator. The within estimator removes bank fixed effects by estimating the model in difference form, where each bank observation is transformed as the difference from the bank's sample average value for the variable. Using the same notation as in Equation 1, the bank fixed-effect regression model specification is,

$$\begin{aligned} (\text{loan growth}_{it} - \overline{\text{loan growth}_i}) = & \beta(\text{Capital}_{it-1} - \overline{\text{Capital}_i}) + \sum_{j=1}^J \gamma_j (\text{Liq}_{jit} - \overline{\text{Liq}_{ji}}) + \\ & \sum_{k=1}^K \delta_k (\text{FundCost}_{kit-1} - \overline{\text{FundCost}_{ki}}) + \sum_{l=1}^L \eta_l (\text{ROA}_{lit-1} - \overline{\text{ROA}_{li}}) + \sum_{m=1}^M \kappa_m (\text{Sup}_{mit-1} - \\ & \overline{\text{Sup}_{mi}}) + \sum_{n=1}^N \lambda_n (\text{AQual}_{nit-1} - \overline{\text{AQual}_{ni}}) + \mu(\text{Size}_{it-1} - \overline{\text{Size}_i}) + \sum_{p=1}^P \nu_p (\text{Mkt}_{pit} - \overline{\text{Mkt}_{pi}}) + \\ & \sum_{q=1}^T \rho_q Q_q + \tilde{\varepsilon}_{it} \end{aligned} \quad (2)$$

A bank's CAMELS rating can vary over time, but bank regulatory capital and liquidity requirements standards are fixed for our sample period.⁴³ We interpret each bank's sample average capital and liquidity characteristics as approximations for the bank's desired optimal capital and liquidity position under the prevailing regulatory standards. Banks prefer a CAMELS rating of 1 or 2, as either rating indicates an acceptably safe and sound institution without significant weakness that requires additional supervisory attention. The sample average value for the two CAMELS dummy variables in the equation (CAMELS =3 and CAMELS=4-5) should be very small for most banks, as few banks are rated CAMELS 3 or CAMELS 4 or 5 for an extended period. Should a bank be downgraded to CAMELS 3 or

⁴² For example, in some studies bank holding company (BHC) status has been shown to be an important determinant of bank behavior. Since BHC status rarely changes over time, BHC status is accounted for by bank fixed effects.

⁴³ The regulatory changes included in the Dodd-Frank Act had not been implemented by 2011. Since our sample banks are primarily small banks with trading assets well below regulatory thresholds, none were impacted by the 1997 Market Risk Amendment to the Basel Capital Accord and none were subject to the advanced credit risk approach of Basel II.

CAMELS 4-5, the bank will record a large deviation from its average CAMELS dummy variable value, and this downgrade innovation will be used to explain change in loan growth.

While our sample does not include any exogenous change in bank capital or liquidity regulations, the fixed effect specification does provide some indication of how banks might react should such changes occur. Should bank-specific regulations be altered to strengthen prudential capital or liquidity requirements, the change would be reflected in higher levels for the bank's optimal capital and liquidity positions. If the bank was at its optimal level of capital or liquidity before the regulatory change, it would be below (above) its new optimal level after an increase (decrease) in a required capital or liquidity ratio. If the changes in a bank's optimal capital and liquidity position exactly mirror the changes in prudential regulatory standards, the capital and liquidity coefficient estimates of the fixed-effect specification can be used to measure the impact on bank quarterly loan growth. Should the bank's optimal capital and liquidity ratios only partially adjust to regulations, then the loan growth effects will be muted relative to the bank fixed-effect capital and liquidity coefficient estimates.

All bank-specific control variables other than a bank's average cost of funds and the average costs of funds for banks in a county-quarter are predetermined variables (i.e., lagged 1 quarter). We use instrumental variables estimation with lagged values of a bank's cost of funds and lagged values of the county-quarter average cost of bank funds serving as instruments for these variables.⁴⁴ Table 2 reports summary statistics for our baseline sample.

C. Key Variables

We are especially interested in the effect of six attributes on bank loan growth: the intensity of supervision, regulatory capital, bank liquidity, bank funding cost, bank return on assets, and bank asset quality. In this section, we discuss our prior expectations regarding the relationship between these attributes and a bank's loan growth.

⁴⁴ We have estimated our models using cost of funds lagged two quarters as instruments. The results are qualitatively similar to those we report in this paper.

We use a bank's supervisory CAMELS rating as a proxy for the bank's supervisory monitoring intensity.⁴⁵ At the conclusion of an onsite examination, supervisors assign a bank a CAMELS grade of 1 to 5. In the CAMELS rating system, a rating of 1 indicates the strongest rating, while 5 is the weakest. A CAMELS 5 rating represents an institution with serious safety and soundness deficiencies.⁴⁶ A CAMELS of 1 or 2 is not expected to have any impact on a bank's loan growth. A CAMELS rating of 3, 4, or 5 will often be associated with the imposition of supervisory constraints that may affect a bank's ability to grow. Along with the rating downgrade, the bank may also receive an informal memorandum of understanding and sometimes a more formal cease and desist order that requires the bank to improve its underwriting standards, its risk management processes, or raise regulatory capital above minimum required levels. To account for the implications of a poor supervisory rating, we include two separate dummy variables that indicate whether a bank's CAMELS rating was 3, or 4 or 5 in the prior quarter. We expect CAMELS ratings of 3, 4 or 5 to be associated with reduced bank loan growth.

There are many theories that suggest that bank capitalization rates should be positively associated with bank loan growth. Credit crunch theories argue that binding or near-binding regulatory capital requirements constrain the lending growth of weakly-capitalized banks but have little or no effect on well-capitalized institutions. While a positive bank capital coefficient is consistent with credit crunch arguments, other hypotheses also predict a positive relationship between bank capital and loan growth. For example, higher capital (through retained earnings) could reduce the marginal cost of the liabilities that a bank subsequently issues to fund new loans. The results from our baseline regression specification cannot distinguish among these or other competing hypotheses. In Section IV we estimate an alternative model specification to help clarify the possible sources of the observed capital ratio effect.

⁴⁵CAMELS ratings are composite or average ratings based on individual supervisory ratings for a bank's: (C) Capital adequacy, (A) Asset quality, (M) Management, (E) Earnings, (L) Liquidity, and (S) Supervision.

⁴⁶ By statute, smaller banks must be examined at least every 18 months, and so CAMELS ratings may be up to 18 months old for some banks in some quarters. Large banks and problem banks must be examined more frequently. We emphasize the temporal relationship between a CAMELS rating and the regression dependent variable to stress that the bank's CAMELS rating is not endogenous in the regression model specification.

We measure bank liquidity positions using three different ratios: (1) the ratio of a bank's liquid assets to total assets; (2) the ratio of so-called "hot money" to assets; and, (3) the ratio of a bank's core (retail) deposits to assets.⁴⁷ Hot money measures the importance of the portion of bank liabilities that may run should investors lose confidence in the bank. We view the use of hot money as an indication that the bank lacks adequate liquidity from its stable core deposit base. Core deposits provide a bank with stable low-cost funding and some studies have shown that core deposits facilitated bank lending in the crisis.⁴⁸

Arguments that justify minimum regulatory standards for bank liquidity suggest that liquidity variables will enter the regression with a positive sign. Banks with abundant liquidity can easily fund new lending. Banks with insufficient liquidity relative to their desired optimal liquidity may be occasionally forced to curtail lending and sell assets to manage negative liquidity shocks. Both effects suggest a positive liquidity coefficient. Other theories may also suggest a positive relationship between bank liquidity and loan growth. For example, banks may hold a buffer stock of liquid assets to liquidate in order to fund new profitable loan investments when they face local market competitive limits on raising core deposits.⁴⁹

The credit channel literature predicts a negative relationship between banks' average cost of liabilities and loan growth. However, a bank may react differently to a general increase in funding costs uniformly experienced both by itself and its competitors, as compared to a specific increase in its own funding costs that is not experienced by its competitors. When information is imperfect, bank stakeholders may use bank average cost of liabilities as a proxy for bank risk. In the face of an idiosyncratic increase in the bank's average cost of liabilities, bank managers may more aggressively reduce the bank's loan growth to dampen the increase in the cost of its liabilities to avoid signaling an increase in bank risk to its stakeholders. To account for this possibility, we include both the average cost

⁴⁷ Two minimum liquidity regulations will be phased in under Basel III: a liquidity coverage ratio and a net stable funding ratio. Unfortunately, these specific ratios cannot be calculated from historical bank regulatory data.

⁴⁸ See Ivashina and Scharfstein (2010) or Cornett, McNutt, Strahan and Tehranian (2011).

⁴⁹ See, for example Fama (2013).

of bank liabilities in the local market as well as each bank's specific average cost of liabilities as separate determinants of bank credit. Prior research has also found that banks reduce lending when they experience an increase in their loan portfolio's rate of delinquent and nonperforming loans, so we expect past-due and non-current assets to be negatively related to subsequent bank loan growth. Outside of loan portfolio performance, the literature has also found that banks reduce lending when they experience non-credit related losses. We measure these effects by including banks' pre-tax return on assets (ROA) as a determinant of loan growth.

Earlier research suggests that a bank's loan growth reaction to an ROA shock may be complicated by strategic behavior on the part of bank managers. When there is asymmetric information about the quality of bank management, Rajan (1994) predicts that a bank's lending growth should be strategically related to the average ROA of its competitor banks. Should a bank's ROA compare unfavorably to its competitors, the bank may accelerate loan growth to generate upfront fees and related charges to help mask the poor performance of the bank's existing investments.

To allow for possible nonlinear ROA effects associated with strategic underwriting behavior, we include three ROA factors: (1) the average ROA for banks that operate in a county and meet the deposit threshold requirement in a quarter; (2) the bank's ROA interacted with a dummy variable that takes the value 1 when the bank's own ROA exceeds the county average; and (3), the bank's ROA interacted with a dummy variable that takes the value of 1 when the bank's own ROA is below the county average.

D. Data

Our county-level controls for local bank loan demand are the unemployment rate and total real wage growth (from the U.S. Bureau of Labor Statistics), house price growth rates (calculated using the Case Schiller index), and the percentage of credit card accounts more than 60 days delinquent (from Trendata). For counties without reported house price index (HPI) values, we substitute state-level HPI values.

Most of our data on bank attributes are taken from Reports of Condition and Income (CALL reports), the quarterly regulatory bank filings of insured commercial and savings banks. Our bank-specific

controls include: leverage, tier 1, and total risk-based capital ratios; average cost of liabilities; before-tax return on assets (ROA); the ratio of bank liquid assets to total assets; the ratio of bank core deposits to assets; the ratio of bank hot money to bank assets; the log of bank assets adjusted to constant 2000 dollars; the ratio of assets 30 to 89 days delinquent but still accruing interest to total assets (past due assets to total assets); the ratio of assets 90 days or more past due and not accruing interest to total assets (non-current assets to total assets); and the standard deviation of the bank's charge off rate over the prior eight quarters.

At the bank-level we also use confidential supervisory data on banks' composite CAMELS ratings. For each bank, the CAMELS variable reflects most recent supervisor CAMELS rating.

In our baseline analysis, we measure bank loan growth using quarterly data on the growth in gross bank loans and leases adjusted for unearned income. We consider a more comprehensive measure of bank loan growth in Section IV Part D(2).

For each county-quarter in our sample we calculate county-level Herfindahl-Hirschman indices (HHI) for deposits as a measure of competition in the local bank market.⁵⁰ To measure an individual bank's potential market power, we also estimate each bank's share of the county's total deposits in the county-quarter. We also calculate and include the county average ROA and average cost of funds for the sample banks in each county-quarter.

IV. Results

A. Baseline Model Results

Bank fixed-effect within regression estimation results are reported in Table 3. Three different regression specifications are presented; the only difference in the specifications is the regulatory capital measure used in the regression. Regression standard errors are clustered at the county level.

⁵⁰ Literature suggests that the HHI deposit concentration rate is likely to be positively related to bank loan growth as bank market power is associated with the expectation of long-standing relationships that allow banks to extract a higher share of the profits on future bank-funded investments (Petersen and Rajan (1995) and Boot and Thakor (2002)). The deposit HHI was calculated using the deposits of all banks in a county.

In all regressions, the controls for county-level economic activity enter with the anticipated sign and all controls except for the county credit card delinquency rate are statistically significant at the 1 percent level. Higher county unemployment is associated with slower loan growth, higher home price appreciation and real wage growth are associated with faster loan growth, and higher credit card delinquency rates are associated with slightly reduced loan growth, but the last effect is not statistically significant. The HHI deposit share is positive, large in magnitude, and statistically significant at the 1 percent level. Average county ROA is positive and statistically significant, while average county cost of funds to liabilities is negative and statistically significant.

Among bank-specific factors, our estimates suggest that the intensity of supervisory monitoring has the largest impact on an individual bank's lending growth. A supervisory CAMELS rating of 3 is estimated to shrink quarterly bank lending growth by 1.36 percentage points while a CAMELS rating of 4 or 5 decreases quarterly loan growth by an estimated 2.07 percentage points.⁵¹ These are extremely large effects relative to the average sample quarterly loan growth of 1.4 percentage points. However, only a small percentage of our bank-quarter observations exhibited these poor CAMELS ratings.

The cost of a bank's funds is the second most important determinant of bank lending growth. Holding constant the average county cost of funds, a 1 percentage point increase in the bank's own cost of funds decreases quarterly bank loan growth by 99 bps. Holding all else constant, a county-wide increase in bank cost of funds reduces quarterly bank lending growth by 77 bps on average.

Consistent with the existing literature, poor performance on a bank's existing loan portfolio is associated with lower subsequent loan growth. Our estimates suggest that a 1 percentage point increase in the ratio of assets 30 through 89 days delinquent to total assets (past due asset ratio) will decrease a bank's quarterly loan growth by 11 bps the following quarter. An increase of 1 percentage point in the ratio of assets 90 days or more past due to total assets (non-current asset ratio) reduces a bank's subsequent quarterly loan growth by an estimated 37 basis points.

⁵¹ Most banks have a CAMELS rating of 1 or 2 which is the control group. A supervisory CAMELS 1 or 2 rating is not anticipated to have any detrimental effect on a bank's ability to grow its loan portfolio.

Our model specification for ROA allows for the possibility that banks strategically manage their loan growth to avoid signaling management weakness. When we evaluate the regression estimates at the mean values of the independent variables, when a bank's ROA is below the county average ROA, it will accelerate its quarterly loan growth by about 10 bps on average.⁵² In contrast, when a bank's ROA is above the county average, its quarterly loan growth will increase by only about 1.4 bps on average.⁵³ These results are consistent with Rajan (1994) which predicts poorly performing banks face incentives to accelerate loan growth.

All three measures of bank capital adequacy are positive and statistically significant at the one percent level. Among these alternative capital measures, the leverage ratio has the largest effect. A one percentage point increase in a bank's leverage capital ratio is associated with an increase of 4 bps in subsequent quarterly loan growth; the estimated coefficients for the two risk-based regulatory minimum capital ratios are smaller still. Since the leverage ratio is the most important measure of capital in terms of economic significance, all of our remaining analysis will use the leverage capital ratio as the control for bank capitalization.

Overall, our regression estimates suggest that bank liquidity has a positive and statistically significant effect on loan growth, but measured in terms of economic importance, liquidity effects are minor. Estimates suggest that at 1 percentage point increase in a bank's liquid asset to total asset ratio on average is associated with a 3 bps increase in its subsequent quarterly loan growth. A 1 percentage point increase in a bank's hot money ratio (a decrease in bank liquidity) on average is associated with a 2 bps decline in subsequent quarterly loan growth. Holding other factors constant, a 1 percentage point increase in a bank's core deposit ratio is associated in a 1 bps decrease in the subsequent quarter's loan growth. Our core deposit funding result differs from our expectations based on the existing literature, but this

⁵² The average effect of ROA on bank loan growth for banks with ROA below their county average ROA is the sum of the products of the mean values reported in Table 1 and their associated coefficients, or: $0.31 * 0.33 - 0.04 * 0.08 = 0.0991$ percent. The coefficient on the interactive terms is not statistically different from 0, and if that coefficient is taken to be 0, the loan growth impact is 0.1023 percent.

⁵³ Evaluated at the means, the impact is $.33 * .31 - .37 * .24 = .0135$ percent.

difference may arise because our estimates include controls for many important factors that are often omitted in earlier studies.

B. Potential for Omitted Variable Bias

The importance of the supervisory intensity, bank capital and liquidity positions must be estimated jointly while accounting for all the other important bank-specific factors that influence bank loan growth as the omission of one or more important bank-specific factor may cause bias in the remaining estimates. Table 4 provides information on the potential importance of omitted variable bias.

A comparison of columns (2) and (6) of Table 4 shows that when bank-specific liquidity characteristics, average cost of liabilities, profitability, and supervisory ratings are omitted from the regression, the coefficient on the leverage-capital factor is over-estimated by 100 percent. The exclusion of controls for the bank supervision effect is especially important. The introduction of controls for bank supervision intensity reduces the value of the leverage coefficient by half. Estimates reported in columns (3) and (6) show that the magnitude of the coefficient estimates on bank liquid asset and core deposit ratios are largely unaffected by exclusion of other control variables. However, the coefficient estimate on hot money is overstated by 25 percent when the other controls are excluded.⁵⁴

Columns (4) and (6) shows that the coefficient estimate on the bank average cost of bank liabilities is overstated by more than 50 percent if the other controls are omitted from the regression. Estimates in columns (5) and (6) show that bank profitability estimates are also very sensitive to the exclusion of the other factors. Columns (1) and (6) show that the coefficient estimates on the supervisory intensity variables are only slightly affected by the omission of the other controls.

C. Threshold Capital Effects

The estimates in Table 3 and 4 show that bank leverage-capital ratios have a small positive effect on a bank's subsequent quarterly loan growth. To provide additional information on the potential source of this positive relationship, in Table 5 we augment the model used in Table 3 by including interactions

⁵⁴ Calculated to three decimal places, the estimates go from -.029 without controls, to -.023 with the full controls.

between a bank's leverage capital ratio and dummy variables that indicate a bank's position in the rank-ordering of quarterly leverage capital ratios of the entire population of banks filing CALL reports. Specifically, in each quarter we sort all banks filing regulatory CALL reports into deciles according to the magnitude of their leverage capital ratios. If a bank in our sample has a capital ratio that is in the bottom (second, third, and so on) decile of the population cross-section for a quarter, the bank will be assigned a first (second, third, and so on) decile dummy variable value equal to 1 and its nine remaining decile dummy indicators values of 0. This exercise is repeated until all sample observations are assigned to a leverage capital decile in each quarter.

The results from this specification allow bank leverage capital ratios to affect loan growth differently according to the how well a bank is capitalized relative to other banks in the system. If weakly capitalized banks are discouraged from lending because of minimum regulatory capital requirements, we should find that banks in the lowest capital decile have slower loan growth compared to better capitalized banks.

Table 5 reports bank fixed-effect IV estimates using one-quarter lags of the two bank average cost of liabilities variables as instruments. F-test statistics (not reported) for differences in the estimated decile coefficients do not show any statistically significant differences in loan growth among the different leverage capital deciles. Our estimates do not show any systematic relationship between the relative magnitude of a bank's regulatory capital adequacy buffer and its subsequent quarterly loan growth, a relationship that should be evident if credit-crunch lending restrictions were prevalent in the data.

D. Robustness

D(1). Controlling for Loan Demand

We test the robustness of our identification scheme by selecting new samples with additional restrictions to further ensure that we are controlling for variation in banks' loan demand. The first additional restriction is related to participation in the syndicated loan market. If banks participate in the syndicated loan market, they can easily supplement county-level loan growth with lending outside their

home county. If bank loan growth is driven by loan demand outside of the bank's home county, our county-specific controls for economic conditions may be inadequate to control for bank loan demand.

We use Reuters Loan Pricing Corporation's DealScan data to identify all banks in our 50 percent deposit threshold sample that took part in syndicated lending. We create a new sample that excludes banks that lent funds, either as leads or participants, at any time, in the syndicated loan market. This additional restriction requires us to exclude about 23,000 observations from the original 50 percent threshold sample.

Table 6 reports the estimation results when banks that were active at any time in the syndicated loan market are removed from the sample. These estimates are little changed from those reported in Table 3 and so our initial estimates do not appear to be biased by out-of-market bank lending.

In a second robustness check, we increase the threshold of bank deposits that must be raised in a single county to gain membership into our analysis sample to 75 percent, and then to 100 percent. The higher thresholds increase the certainty that our sample banks operate within a single county. However, the cost for tighter geographic focus is smaller sample size.

The estimation results for the 50 percent threshold are repeated and estimates for the more restricted 75 and 100 percent threshold samples are presented in Table 7. The estimated coefficient values are very stable across these alternative samples. The importance of the leverage capital ratio and the deposit HHI concentration index both increase as the deposit threshold becomes more restrictive. The importance of the average county ROA also increases slightly, but the remaining coefficient estimates are largely unchanged by the heightened sample restrictions. These results suggest that the baseline 50 percent deposit threshold regressions do a reasonably good job of controlling for the variation in individual bank loan demand and little is gained by further restricting the sample.⁵⁵

D(2). Alternative Measures of Loan Growth

⁵⁵ We also investigated using an additional specification that uses county-quarter fixed-effects to control for local demand conditions. Because the primary county locations for the vast majority of banks in our sample are fixed over time, we cannot include both county-quarter fixed effects and bank fixed-effects in the regression model.

As an additional robustness check, we consider an alternative measure of bank loan growth. In the previous analysis, we measured bank loan growth as the quarterly change in banks' reported loan balance sheet values (gross of provisions). This measure of loan growth excludes any quarter-to-quarter change in a bank's loan commitment activity, which may be an important channel for credit extension. For example, a decrease in bank credit supply could still be associated with balance sheet loan growth if outstanding commitment lines are frozen (or reduced), but customers draw on their outstanding bank commitments. In addition, changes in reported balance sheet gross loan amounts will be a distorted measure of bank lending if banks sell loans within a quarter.

We eliminate these possible sources of measurement error by redefining bank credit as the sum of loans, unused commitments and securities sold.⁵⁶ Because data on securities sold are not available until 2001Q3, the sample period must be reduced accordingly. Table 8 provides summary statistics for the 50 percent deposit threshold sample that uses the new loan growth definition.

Table 9 reports the estimation results using the previous definition of loan growth and the alternative definition that accounts for commitments and loan sales, over the common (shorter) sample period. We run the bank fixed-effects regression specification in Table 2 using the new loan growth measure as dependent variables over the shortened sample period. The magnitude of the estimates in Table 9 differ slightly from those reported in Table 3, however the coefficient estimates for the two loan growth measures are similar when compared over the identical sample period reported in Table 9. More importantly, the pattern of coefficient estimates for the alternative loan growth definition is virtually identical to the pattern reported in Table 3.

Bank supervision intensity and bank cost of funds are more important in this shorter sample period compared to our baseline sample period. The effect of bank capital and liquidity are also larger, but they still have minor economic importance compared to a bank's cost of funds and intensity of supervision. While there is some variation in the coefficient estimates for bank-specific and county-wide

⁵⁶ For completeness, this alternative measure of loan growth is the quarterly change in the sum of balance sheet gross loans, unused loan commitments, securities sold and unearned income. Unearned income includes items such as loan origination fees and prepaid interest that are amortized over the life of the loan.

cost of funds between the alternative measures of loan growth, overall, the results in Table 9 support the robustness of our baseline model results.

V. Conclusions

We estimate the individual bank loan growth effects that are associated with variation in a bank's supervision intensity and its capital and liquidity conditions. We control for individual bank loan demand, the effect of monetary policy through a bank's cost of funds, for the performance on the bank's existing loan portfolio and for a bank's overall profitability. Our estimation results are robust against a number of alternative methods for defining a bank's local market and against an alternative definition of bank loan growth.

Our analysis suggests that supervisory monitoring intensity as measured by a bank's supervisory CAMELS ratings is a very important determinant of bank loan growth. The supervisory restrictions that typically are associated with a poor bank examination rating have a large negative impact on bank loan growth. Banks' funding cost is the most important policy factor systematically affecting bank loan growth. Consistent with the existing literature, we find that a bank's own loan portfolio performance is an important determinant of its subsequent loan growth. When a bank's troubled loans increase, on average, the bank will reduce its lending growth in the subsequent quarter. Also, consistent with the literature, we find evidence that a bank's overall profitability is an important determinant of its subsequent loan growth.

Our estimates suggest that a bank's capital and liquidity ratios are positively related to its subsequent loan growth, and the magnitude of our estimates are consistent with the results of several existing empirical studies. Still, these estimates suggest that a bank's capital and liquidity positions have only a minor effect on its subsequent loan growth. Our results also clearly show that, when faced with losses, banks curtail lending growth primarily because their loans or other investments are performing poorly, and not because the losses constrain their regulatory capital position. If losses draw added attention from supervisors, bank loan growth is likely to be further curtailed. We do not find any evidence of capital threshold effects that should be present if regulatory minimum capital requirements constrain the loan growth of weakly capitalized institutions.

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Table 1: Variable Definitions

Variable Name	Variable Definition	Source	Anticipated Sign
Quarter-to-Quarter Loan Growth (Pct)	Quarterly bank-level growth in balance sheet gross loans and leases adjusted for unearned income during period t	CALL ⁵⁷	
Regulatory Capital			
Leverage Capital Ratio, 1-Qtr Lag (Pct)	$(100 \times \text{Tier 1 Capital}) / (\text{Average Total Assets} - \text{Disallowed Intangibles})$	CALL	+
Tier 1 Risk-Based Capital Ratio, 1-Qtr Lag (Pct)	$(100 \times \text{Tier 1 Capital}) / \text{Total Risk-Weighted Assets}$	CALL	+
Total Risk-Based Capital Ratio, 1-Qtr Lag (Pct)	$(100 \times \text{Total Risk-Based Capital}) / \text{Total Risk-Weighted Assets}$	CALL	+
Liquidity			
Liquid Assets to Assets, 1-Qtr Lag (Pct)	Liquid Assets/Total Assets	CALL	+
Hot Money to Assets, 1-Qtr Lag (Pct)	$(\text{Purchased Federal Funds and Repo Agreements} + \text{Brokered Deposits over deposit insurance limit that mature in less than one year} + \text{Domestic Deposits} + \text{Trading Liabilities} + \text{Other Borrowed Money}) / \text{Total Assets}$	CALL	-
Core Deposits to Assets, 1-Qtr Lag (Pct)	Core Deposits/Total Assets	CALL	+
Funding Cost			
Cost of Funds to Liabilities (Pct)	$(\text{Net Interest Expense excluding interest on bank's own mortgage liability}) / \text{Total Liabilities excluding bank's own mortgage liability}$	CALL	-
County Average Cost of Funds	County-wide average cost of funds/liabilities for sample banks	CALL	-
ROA			
Before Tax Return-on-Assets (ROA), 1-Qtr Lag (Pct)	Annualized Pre-Tax Net Income/Average Assets	CALL	
=1 if ROA 1-Qtr Lag Below County-Qtr Average	Indicator that bank ROA is less than county-quarter average ROA	CALL	
=1 if ROA 1-Qtr Lag Above County-Qtr Average	Indicator that bank ROA is greater than county-quarter average ROA	CALL	
Supervision Intensity			
=1 if Composite Rating = 3, 1-Qtr Lag	Indicator that CAMELS most recent composite score is 3	FDIC Proprietary	-

⁵⁷ Reports of Condition and Income

=1 if Composite Rating = 4 or 5, 1-Qtr Lag	Indicator that CAMELS most recent composite score is 4 or 5	FDIC Proprietary	-
Asset Quality			
Charge-off Rate, 8-Quarter Standard Deviation, 1-Qtr Lag (Pct)	Eight-quarter standard deviation of Annualized Total Net Charged-Off Loans and Lease Financing Receivables/Loans and Lease Financing Receivables	CALL	-
Past Due to Assets, 1-Qtr Lag (Pct)	Total Assets Past Due 30 through 89 Days and still accruing interest / Total Assets	CALL	-
Non-Current to Assets, 1-Qtr Lag (Pct)	Total Loans and Lease Financing Receivables 90 Days or more past due and nonaccrual / Total Assets	CALL	-
Size			
Log Real Assets	Log of bank's Total Assets measured in thousands of constant 2000 dollars	CALL	
Local Market			
Cert Share of County's Deposits (Pct)	Share of bank's deposits in county as percentage of all deposits in that county	SOD ⁵⁸	
County Average Before Tax ROA, 1-Qtr Lag (Pct)	Average Pre-Tax ROA for the sample banks	CALL	
County Unemployment Rate (Pct)	County Unemployment rate	US BLS	-
County Credit Card 60 Days DQ Rate (Pct)	Percentage of county credit card accounts more than 60 days delinquent	Trendata	-
County HPI Growth Rate (Pct)	Growth rate of House Price Index where Index is adjusted for inflation using CPI series less Shelter for All Urban Consumers; Substitute state-level HPI values for counties without reported HPI values	Case Schiller Index	+
County Total Real Wage Growth Rate (Pct)	County growth in Total Real Wages	US BLS	+
County Deposit Share HHI	Herfindahl-Hirschman Index of county deposit concentration calculated using all county banks	SOD	+
=1 if Cert Appeared in DealScan	Indicator that bank appeared on DealScan as a lender in any role	DealScan	

⁵⁸ SOD data provides an annual June 30 "snapshot" of each institution's deposit-taking activity at bank branch level. For each bank, the share of their total deposits in a county is calculated from annual SOD data. Each bank's county-level deposit shares in the three intervening quarters are then estimated by merger-adjusting the prior June's SOD data. (Data on bank mergers are from the FDIC's Research Information System (RIS) warehouse.)

Table 2: Summary Statistics, at Least Two Sample Banks in Each County

Variable	<u>50% of Deposits in County</u>				<u>75% of Deposits in County</u>				<u>100% of Deposits in County</u>			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Quarter-to-Quarter Loan Growth (Pct)	1.45	3.91	-11.32	18.76	1.48	3.93	-11.32	18.71	1.50	3.99	-11.32	18.71
Leverage Capital Ratio, 1-Qtr Lag (Pct)	9.81	2.66	0.16	26.05	9.96	2.72	0.16	26.05	10.14	2.80	0.26	26.05
Tier 1 Risk-Based Capital Ratio, 1-Qtr Lag (Pct)	15.44	5.81	0.22	46.78	15.83	5.94	0.22	46.48	16.33	6.11	0.32	46.48
Total Risk-Based Capital Ratio, 1-Qtr Lag (Pct)	16.56	5.79	0.45	47.78	16.95	5.93	0.45	47.78	17.45	6.10	0.63	47.78
Liquid Assets to Assets, 1-Qtr Lag (Pct)	25.53	13.13	1.24	85.10	25.86	13.37	1.24	85.07	26.22	13.66	1.26	83.80
Hot Money to Assets, 1-Qtr Lag (Pct)	5.57	7.94	0.00	93.83	5.20	7.74	0.00	93.83	4.50	7.24	0.00	93.83
Core Deposits to Assets, 1-Qtr Lag (Pct)	72.36	10.83	0.00	102.95	72.72	10.78	0.00	102.95	73.51	10.48	0.00	102.95
Cost of Funds to Liabilities (Pct)	0.74	0.29	0.01	6.50	0.76	0.29	0.01	6.50	0.77	0.28	0.01	6.50
=1 if Cost-of-Funds Above County-Qtr Average	0.49	0.50	0.00	1.00	0.49	0.50	0.00	1.00	0.50	0.50	0.00	1.00
Before Tax Return-on-Assets (ROA), 1-Qtr Lag (Pct)	0.31	0.22	-6.41	3.76	0.32	0.22	-6.41	3.76	0.32	0.23	-6.61	2.44
Before Tax Return-on-Assets (ROA) if Above County Average , 1-Qtr Lag (Pct)	0.24	0.28	-4.06	11.65	0.24	0.28	-4.06	11.65	0.24	0.28	-4.06	11.65
Before Tax Return-on-Assets (ROA) if Below County Average , 1-Qtr Lag (Pct)	0.08	0.31	-18.17	1.09	0.08	0.31	-18.17	1.20	0.08	0.30	-18.17	1.22
=1 if Composite Rating = 3, 1-Qtr Lag	0.07	0.25	0.00	1.00	0.06	0.24	0.00	1.00	0.06	0.24	0.00	1.00
=1 if Composite Rating = 4 or 5, 1-Qtr Lag	0.02	0.15	0.00	1.00	0.02	0.14	0.00	1.00	0.02	0.14	0.00	1.00
Charge-off Rate, 8-Quarter Standard Deviation, 1-Qtr Lag (Pct)	0.12	0.21	0.00	18.50	0.12	0.22	0.00	18.50	0.12	0.22	0.00	18.50
Log Real Assets	11.52	1.16	7.23	20.72	11.38	1.09	7.23	20.37	11.14	0.98	7.23	19.22
Cert Share of County's Deposits (Pct)	12.67	13.76	0.00	99.87	11.91	13.38	0.00	99.87	10.78	12.80	0.00	99.87
Past Due to Assets, 1-Qtr Lag (Pct)	0.93	0.95	0.00	59.89	0.94	0.97	0.00	59.89	0.95	1.00	0.00	59.89
Non-current to Assets, 1-Qtr Lag (Pct)	0.80	1.26	0.00	52.40	0.79	1.25	0.00	52.40	0.77	1.23	0.00	52.40
County Average Cost of Funds (Pct)	0.74	0.26	0.05	3.64	0.76	0.26	0.05	3.64	0.77	0.26	0.07	3.64
County Average Before Tax ROA, 1-Qtr Lag (Pct)	0.31	0.22	-6.41	3.76	0.32	0.22	-6.41	3.76	0.32	0.23	-6.41	2.44
County Unemployment Rate (Pct)	5.48	2.33	0.60	30.60	5.42	2.31	0.60	30.60	5.32	2.29	0.60	30.60
County Credit Card 60 Days DQ Rate (Pct)	2.62	1.23	0.15	15.72	2.62	1.23	0.15	15.72	2.61	1.23	0.16	15.72
County HPI Growth Rate (Pct)	0.22	2.32	-21.32	18.99	0.25	2.28	-21.32	18.99	0.28	2.22	-21.32	18.99
County Total Real Wage Growth Rate (Pct)	0.74	8.93	-50.80	88.20	0.74	8.89	-50.80	88.20	0.75	8.94	-50.80	88.20
County Deposit Share HHI	0.19	0.10	0.03	1.00	0.18	0.10	0.03	1.00	0.18	0.10	0.03	1.00
=1 if Cert Appeared in DealScan	0.05	0.21	0.00	1.00	0.04	0.20	0.00	1.00	0.03	0.16	0.00	1.00
N	443,576				352,566				248,609			

Notes: Observations are defined by bank and quarter. The sample spans 1994 through 2011. Variables are at the bank-level unless otherwise noted. All dollar amounts adjusted to year 2000 Q4 dollars. A county has data for a quarter if there are banks that meet the deposit specific threshold requirement in the quarter.

Table 3: Estimates of Bank Loan Growth, 50 Percent Deposit Threshold

	(1) <i>Lev</i>	(2) <i>Tier1</i>	(3) <i>RBC</i>
=1 if Composite Rating = 3, 1-Qtr Lag	-1.36*** (0.04)	-1.37*** (0.04)	-1.37*** (0.04)
=1 if Composite Rating = 4 or 5, 1-Qtr Lag	-2.07*** (0.07)	-2.11*** (0.07)	-2.12*** (0.07)
Capital Ratio, 1-Qtr Lag	0.04*** (0.01)	0.01*** (0.00)	0.01** (0.00)
Liquid Assets to Assets, 1-Qtr Lag (Pct)	0.03*** (0.00)	0.03*** (0.00)	0.03*** (0.00)
Hot Money to Assets, 1-Qtr Lag (Pct)	-0.02*** (0.00)	-0.03*** (0.00)	-0.03*** (0.00)
Core Deposits to Assets, 1-Qtr Lag (Pct)	-0.01*** (0.00)	-0.01*** (0.00)	-0.01*** (0.00)
Cost of Funds to Liabilities (Pct)	-0.99*** (0.19)	-1.11*** (0.18)	-1.12*** (0.18)
Before Tax Return-on-Assets (ROA), 1-Qtr Lag (Pct), if Below County Average	-0.04 (0.03)	-0.03 (0.03)	-0.03 (0.03)
Before Tax Return-on-Assets (ROA), 1-Qtr Lag (Pct), if Above County Average	-0.37*** (0.04)	-0.36*** (0.04)	-0.36*** (0.04)
Past Due to Assets, 1-Qtr Lag (Pct)	-0.11*** (0.01)	-0.11*** (0.01)	-0.11*** (0.01)
Non-current to Assets, 1-Qtr Lag (Pct)	-0.37*** (0.02)	-0.37*** (0.02)	-0.37*** (0.02)
Charge-off Rate Standard Deviation over 8-Qtrs (Pct)	-0.40*** (0.09)	-0.41*** (0.09)	-0.41*** (0.09)
Log Real Assets	-0.08* (0.04)	-0.11** (0.05)	-0.11** (0.05)
Cert Share of County Deposits (Pct)	-0.03*** (0.00)	-0.03*** (0.00)	-0.03*** (0.00)
County Unemployment Rate (Pct)	-0.09*** (0.01)	-0.09*** (0.01)	-0.09*** (0.01)
County Credit Card 60 Days DQ Rate (Pct)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)
County HPI Growth Rate (Pct)	0.04*** (0.01)	0.04*** (0.01)	0.04*** (0.01)
County Total Real Wage Growth Rate (Pct)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)
County Deposit Share HHI	0.92*** (0.28)	0.93*** (0.29)	0.93*** (0.28)
County Average Cost of Funds to Liabilities (Pct)	-0.77*** (0.21)	-0.71*** (0.21)	-0.70*** (0.21)
County Average Before Tax ROA, 1-Qtr Lag (Pct)	0.33*** (0.05)	0.33*** (0.05)	0.33*** (0.05)
Constant	3.77*** (0.57)	4.61*** (0.58)	4.77*** (0.58)
Quarterly Fixed Effects	Y	Y	Y
Bank Fixed Effects (Bank Level Within Estimation)	Y	Y	Y
IV (2) Cost-of-Funds Variables with 1-Qtr Lag	Y	Y	Y
Standard Errors Clustered by County	Y	Y	Y
N	443576	443576	443576
R-sq	0.20	0.20	0.20

Notes: Lagged values of individual bank cost of funds and county-average bank cost of funds are used as instruments for contemporaneous individual bank cost of funds and county-average bank cost of funds

Table 4: The Importance of Omitted Variable Bias, 50 Percent Deposit Threshold

	(1)	(2)	(3)	(4)	(5)	(6)
=1 if Composite Rating = 3, 1-Qtr Lag	-1.35*** (0.04)					-1.36*** (0.04)
=1 if Composite Rating = 4 or 5, 1-Qtr Lag	-2.12*** (0.06)					-2.07*** (0.07)
Leverage Capital Ratio, 1-Qtr Lag		0.08*** (0.01)				0.04*** (0.01)
Liquid Assets to Assets, 1-Qtr Lag (Pct)			0.03*** (0.00)			0.03*** (0.00)
Hot Money to Assets, 1-Qtr Lag (Pct)			-0.03*** (0.00)			-0.02*** (0.00)
Core Deposits to Assets, 1-Qtr Lag (Pct)			-0.01*** (0.00)			-0.01*** (0.00)
Cost of Funds to Liabilities (Pct)				-1.57*** (0.17)		-0.99*** (0.19)
Before Tax Return-on-Assets (ROA), 1-Qtr Lag (Pct), if Below County Average					0.09** (0.03)	-0.04 (0.03)
Before Tax Return-on-Assets (ROA), 1-Qtr Lag (Pct), if Above County Average					-0.25*** (0.04)	-0.37*** (0.04)
Past Due to Assets, 1-Qtr Lag (Pct)	-0.15*** (0.01)	-0.16*** (0.01)	-0.14*** (0.01)	-0.16*** (0.01)	-0.16*** (0.01)	-0.11*** (0.01)
Non-current to Assets, 1-Qtr Lag (Pct)	-0.38*** (0.02)	-0.48*** (0.02)	-0.48*** (0.02)	-0.49*** (0.02)	-0.49*** (0.02)	-0.37*** (0.02)
Charge-off Rate Standard Deviation over 8-Qtrs (Pct)	-0.29*** (0.08)	-0.69*** (0.11)	-0.81*** (0.12)	-0.77*** (0.12)	-0.73*** (0.12)	-0.40*** (0.09)
Log Real Assets	-0.43*** (0.04)	-0.30*** (0.04)	-0.21*** (0.04)	-0.23*** (0.04)	-0.38*** (0.04)	-0.08* (0.04)
Cert Share of County Deposits (Pct)	-0.03*** (0.00)	-0.03*** (0.00)	-0.03*** (0.00)	-0.03*** (0.00)	-0.03*** (0.00)	-0.03*** (0.00)
County Unemployment Rate (Pct)	-0.09*** (0.01)	-0.10*** (0.01)	-0.09*** (0.01)	-0.09*** (0.01)	-0.10*** (0.01)	-0.09*** (0.01)
County Credit Card 60 Days DQ Rate (Pct)	-0.00 (0.02)	-0.01 (0.02)	-0.00 (0.02)	-0.01 (0.02)	-0.01 (0.02)	-0.01 (0.01)
County HPI Growth Rate (Pct)	0.05*** (0.01)	0.05*** (0.01)	0.04*** (0.01)	0.04*** (0.01)	0.04*** (0.01)	0.04*** (0.01)
County Total Real Wage Growth Rate (Pct)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)
County Deposit Share HHI	0.98*** (0.28)	1.02*** (0.29)	1.04*** (0.30)	0.99*** (0.28)	1.03*** (0.29)	0.92*** (0.28)
County Average Cost of Funds to Liabilities (Pct)				-0.67*** (0.22)		-0.77*** (0.21)
County Average Before Tax ROA, 1-Qtr Lag (Pct)	0.30*** (0.05)	0.43*** (0.05)	0.48*** (0.05)	0.40*** (0.06)	0.45*** (0.05)	0.33*** (0.05)
Constant	7.69*** (0.49)	5.19*** (0.52)	5.38*** (0.56)	5.65*** (0.53)	7.05*** (0.50)	3.77*** (0.57)
Bank Fixed Effects (Bank Level Within Estimation)	Y	Y	Y	Y	Y	Y
IV Cost-of-Funds Variables with 1-Qtr Lag	Y	Y	Y	Y	Y	Y
Standard Errors Clustered by County	Y	Y	Y	Y	Y	Y
N	443576	443576	443576	443576	443576	443576
R-sq	0.20	0.19	0.20	0.19	0.19	0.20

Notes: Lagged values of individual bank costs of funds and county-average bank costs of funds are used as instruments for contemporaneous individual bank cost of funds and county-average bank cost of funds.

**Table 5: Decile Estimates for Leverage Capital Ratio,
50 Percent Threshold**

Leverage Capital Ratio, 1-Qtr Lag	0.05**
*=1 if Ratio in Bottom 10th Percentile, 1-Qtr Lag	(0.02)
	0.05**
*=1 if Ratio in 10th Percentile, 1-Qtr Lag	(0.02)
	0.04**
*=1 if Ratio in 20th Percentile, 1-Qtr Lag	(0.02)
	0.04**
*=1 if Ratio in 30th Percentile, 1-Qtr Lag	(0.02)
	0.04**
*=1 if Ratio in 40th Percentile, 1-Qtr Lag	(0.02)
	0.04***
*=1 if Ratio in 50th Percentile, 1-Qtr Lag	(0.02)
	0.05***
*=1 if Ratio in 60th Percentile, 1-Qtr Lag	(0.01)
	0.05***
*=1 if Ratio in 70th Percentile, 1-Qtr Lag	(0.01)
	0.04***
*=1 if Ratio in 80th Percentile, 1-Qtr Lag	(0.01)
	0.04***
*=1 if Ratio in 90th Percentile, 1-Qtr Lag	(0.01)
Other Bank-level Controls	Y
Quarterly Fixed Effects	Y
Within Estimation (Demean by Cert)	Y
County Macro Controls	Y
Baseline Controls	Y
IV Cost of Funds Variables with 1-Qtr Lag	Y
Cluster by County	Y
N	443576
R-sq	0.20

Notes: Each quarter, the deciles of the leverage capital ratio distribution of all banks filing regulatory CALL reports are calculated. We use ten dummy variables each quarter to assign each bank to a leverage capital ratio decile. We then run a regression in which the single leverage capital ratio variable in Table 3 is replaced with ten decile dummy variables interacted with each bank's leverage capital ratio to try to identify the presence of threshold effects of bank leverage capital ratios on bank loan growth. Bank cost of funds and county-average bank cost of funds are instrumented using lagged values of these variables. All the remaining controls included in Table 3 are also included in the regression, but the coefficient estimates for these variables are not reported.

**Table 6: Estimates of Bank Loan Growth, 50 Percent Threshold
Dropping DealScan Banks**

=1 if Composite Rating = 3, 1-Qtr Lag	-1.37*** (0.04)
=1 if Composite Rating = 4 or 5, 1-Qtr Lag	-2.10*** (0.07)
Leverage Capital Ratio, 1-Qtr Lag	0.04*** (0.01)
Liquid Assets to Assets, 1-Qtr Lag (Pct)	0.03*** (0.00)
Hot Money to Assets, 1-Qtr Lag (Pct)	-0.02*** (0.00)
Core Deposits to Assets, 1-Qtr Lag (Pct)	-0.01*** (0.00)
Cost of Funds to Liabilities (Pct)	-1.12*** (0.18)
Before Tax Return-on-Assets (ROA), 1-Qtr Lag (Pct), if Below County Average	-0.05 (0.03)
Before Tax Return-on-Assets (ROA), 1-Qtr Lag (Pct), if Above County Average	-0.40*** (0.04)
Past Due to Assets, 1-Qtr Lag (Pct)	-0.11*** (0.01)
Non-current to Assets, 1-Qtr Lag (Pct)	-0.38*** (0.02)
Charge-off Rate Standard Deviation over 8-Qtrs (Pct)	-0.37*** (0.09)
Log Real Assets	-0.07 (0.05)
Cert Share of County Deposits (Pct)	-0.03*** (0.00)
County Unemployment Rate (Pct)	-0.09*** (0.01)
County Credit Card 60 Days DQ Rate (Pct)	-0.00 (0.01)
County HPI Growth Rate (Pct)	0.04*** (0.01)
County Total Real Wage Growth Rate (Pct)	0.01*** (0.00)
County Deposit Share HHI	0.91*** (0.30)
County Average Cost of Funds to Liabilities (Pct)	-0.77*** (0.22)
County Average Before Tax ROA, 1-Qtr Lag (Pct)	0.32*** (0.05)
Constant	3.66*** (0.59)
Quarterly Fixed Effects	Y
Bank Fixed Effects (Bank Level Within Estimation)	Y
IV (2) Cost-of-Funds Variables with 1-Qtr Lag	Y
Standard Errors Clustered by County	Y
N	420884
R-sq	0.21

Notes: Lagged values of individual bank costs of funds and county-average bank costs of funds are used as instruments for contemporaneous individual bank cost of funds and county-average bank cost of funds.

Table 7: Alternate Deposit Share Threshold Samples

<i>Share of Deposits in County</i>	<i>50%</i>	<i>75%</i>	<i>100%</i>
=1 if Composite Rating = 3, 1-Qtr Lag	-1.36*** (0.04)	-1.35*** (0.05)	-1.32*** (0.05)
=1 if Composite Rating = 4 or 5, 1-Qtr Lag	-2.07*** (0.07)	-2.07*** (0.08)	-2.18*** (0.09)
Leverage Capital Ratio, 1-Qtr Lag	0.04*** (0.01)	0.05*** (0.01)	0.06*** (0.01)
Liquid Assets to Assets, 1-Qtr Lag (Pct)	0.03*** (0.00)	0.03*** (0.00)	0.04*** (0.00)
Hot Money to Assets, 1-Qtr Lag (Pct)	-0.02*** (0.00)	-0.02*** (0.00)	-0.03*** (0.00)
Core Deposits to Assets, 1-Qtr Lag (Pct)	-0.01*** (0.00)	-0.01*** (0.00)	-0.01** (0.00)
Cost of Funds to Liabilities (Pct)	-0.99*** (0.19)	-0.95*** (0.21)	-0.93*** (0.24)
Before Tax Return-on-Assets (ROA), 1-Qtr Lag (Pct), if Below County Average	-0.04 (0.03)	-0.07** (0.03)	-0.05 (0.04)
Before Tax Return-on-Assets (ROA), 1-Qtr Lag (Pct), if Above County Average	-0.37*** (0.04)	-0.41*** (0.04)	-0.35*** (0.05)
Past Due to Assets, 1-Qtr Lag (Pct)	-0.11*** (0.01)	-0.11*** (0.01)	-0.09*** (0.01)
Non-current to Assets, 1-Qtr Lag (Pct)	-0.37*** (0.02)	-0.37*** (0.02)	-0.33*** (0.02)
Charge-off Rate Standard Deviation over 8-Qtrs (Pct)	-0.40*** (0.09)	-0.33*** (0.09)	-0.36*** (0.08)
Log Real Assets	-0.08* (0.04)	-0.04 (0.06)	0.01 (0.09)
Cert Share of County Deposits (Pct)	-0.03*** (0.00)	-0.04*** (0.00)	-0.05*** (0.01)
County Unemployment Rate (Pct)	-0.09*** (0.01)	-0.09*** (0.01)	-0.10*** (0.01)
County Credit Card 60 Days DQ Rate (Pct)	-0.01 (0.01)	-0.00 (0.02)	-0.00 (0.02)
County HPI Growth Rate (Pct)	0.04*** (0.01)	0.04*** (0.01)	0.04*** (0.01)
County Total Real Wage Growth Rate (Pct)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)
County Deposit Share HHI	0.92*** (0.28)	0.98*** (0.36)	1.01** (0.39)
County Average Cost of Funds to Liabilities (Pct)	-0.77*** (0.21)	-0.84*** (0.25)	-0.79*** (0.28)
County Average Before Tax ROA, 1-Qtr Lag (Pct)	0.33*** (0.05)	0.43*** (0.06)	0.39*** (0.06)
Constant	3.77*** (0.57)	3.10*** (0.69)	2.07** (0.98)
Quarterly Fixed Effects	Y	Y	Y
Bank Fixed Effects (Bank Level Within Estimation)	Y	Y	Y
IV Cost-of-Funds Variables with 1-Qtr Lag	Y	Y	Y
Standard Errors Clustered by County	Y	Y	Y
N	443576	352566	248609
R-sq	0.20	0.20	0.18

Notes: Lagged values of individual bank costs of funds and county-average bank costs of funds are used as instruments for contemporaneous individual bank cost of funds and county-average bank cost of funds

**Table 8: Alternative Loan Growth Measures Sample Summary Statistics,
At Least Two Sample Banks in Each County, 2001Q3-2011Q4
50 Percent Deposit Threshold**

Variable	Mean	Std. Dev.	Min	Max
Quarter-to-Quarter Loan Growth (Pct)	1.1	4.0	-11.3	17.4
Qtr-to-Qtr Loan Growth, Including Unearned Income (Pct)	1.1	4.0	-11.3	17.4
Qtr-to-Qtr Loan Growth, Including Unearned Inc, Unused Commitments, Securities Sold (Pct)	1.0	4.2	-9.8	16.6
Leverage Capital Ratio, 1-Qtr Lag (Pct)	10.0	2.7	0.2	26.1
Tier 1 Risk-Based Capital Ratio, 1-Qtr Lag (Pct)	15.0	5.7	0.3	46.8
Total Risk-Based Capital Ratio, 1-Qtr Lag (Pct)	16.1	5.6	0.6	47.8
Liquid Assets to Assets, 1-Qtr Lag (Pct)	26.2	13.3	1.9	85.1
Hot Money to Assets, 1-Qtr Lag (Pct)	7.0	8.4	0.0	93.8
Core Deposits to Assets, 1-Qtr Lag (Pct)	69.2	11.3	0.0	103.0
Cost of Funds to Liabilities (Pct)	0.6	0.2	0.0	2.2
Before Tax Return-on-Assets (ROA), 1-Qtr Lag (Pct)	0.3	0.4	-18.2	11.6
=1 if Composite Rating = 3, 1-Qtr Lag	0.08	0.27	0	1
=1 if Composite Rating = 4 or 5, 1-Qtr Lag	0.03	0.17	0	1
Charge-off Rate, 8-Quarter Standard Deviation, 1-Qtr Lag (I	0.1	0.2	0.0	18.5
Log Real Assets	11.6	1.2	7.7	20.7
Past Due to Assets, 1-Qtr Lag (Pct)	0.9	1.0	0.0	59.9
Non-current to Assets, 1-Qtr Lag (Pct)	0.9	1.5	0.0	34.0
Cert Share of County's Deposits (Pct)	12.3	13.6	0.0	99.9
County Average Cost of Funds (Pct)	0.6	0.2	0.1	1.3
County Average Before Tax ROA, 1-Qtr Lag (Pct)	0.3	0.3	-6.4	3.8
County Unemployment Rate (Pct)	6.1	2.3	0.9	25.3
County Credit Card 60 Days DQ Rate (Pct)	2.4	1.1	0.2	13.3
County HPI Growth Rate (Pct)	-0.1	2.9	-21.3	17.8
County Total Real Wage Growth Rate (Pct)	0.6	8.9	-46.5	83.0
County Deposit Share HHI	0.2	0.1	0.0	1.0
=1 if Cert Appeared in DealScan	0.05	0.21	0	1
N	227,482			

**Table 9: Estimates of Bank Loan Growth,
Alternative Loan Growth Measures, 50 Percent Threshold**

	(1) LG	(2) LG ALT
=1 if Composite Rating = 3, 1-Qtr Lag	-1.53*** (0.05)	-1.55*** (0.05)
=1 if Composite Rating = 4 or 5, 1-Qtr Lag	-2.48*** (0.08)	-2.43*** (0.08)
Leverage Capital Ratio, 1-Qtr Lag	0.11*** (0.01)	0.11*** (0.01)
Liquid Assets to Assets, 1-Qtr Lag (Pct)	0.05*** (0.00)	0.05*** (0.00)
Hot Money to Assets, 1-Qtr Lag (Pct)	-0.02*** (0.00)	-0.02*** (0.00)
Core Deposits to Assets, 1-Qtr Lag (Pct)	-0.01*** (0.00)	-0.01*** (0.00)
Cost of Funds to Liabilities (Pct)	-1.41*** (0.23)	-1.17*** (0.25)
Before Tax Return-on-Assets (ROA), 1-Qtr Lag (Pct) if Below County Average	-0.07** (0.03)	0.01 (0.03)
Before Tax Return-on-Assets (ROA), 1-Qtr Lag (Pct) if Above County Average	-0.39*** (0.05)	-0.28*** (0.05)
Past Due to Assets, 1-Qtr Lag (Pct)	-0.14*** (0.01)	-0.16*** (0.01)
Non-current to Assets, 1-Qtr Lag (Pct)	-0.35*** (0.02)	-0.36*** (0.02)
Charge-off Rate Standard Deviation over 8-Qtrs (Pct)	-0.34*** (0.10)	-0.25*** (0.08)
Log Real Assets	-0.59*** (0.08)	-0.92*** (0.09)
Cert Share of County Deposits (Pct)	-0.04*** (0.01)	-0.04*** (0.01)
County Unemployment Rate (Pct)	-0.11*** (0.01)	-0.09*** (0.01)
County Credit Card 60 Days DQ Rate (Pct)	0.03 (0.02)	-0.03 (0.02)
County HPI Growth Rate (Pct)	0.04*** (0.01)	0.05*** (0.01)
County Total Real Wage Growth Rate (Pct)	0.01*** (0.00)	0.00** (0.00)
County Deposit Share HHI	0.08 (0.28)	0.22 (0.30)
County Average Cost of Funds to Liabilities (Pct)	-0.89*** (0.30)	-1.47*** (0.30)
County Average Before Tax ROA, 1-Qtr Lag (Pct)	0.34*** (0.05)	0.34*** (0.06)
Constant	8.99*** (1.00)	12.92*** (1.06)
Quarterly Fixed Effects	Y	Y
Bank Fixed Effects (Bank Level Within Estimation)	Y	Y
IV (2) Cost-of-Funds Variables with 1-Qtr Lag	Y	Y
Standard Errors Clustered by County	Y	Y
N	227482	227482
R-sq	0.26	0.20

Notes: *LG* is the quarterly growth in bank balance sheet loans gross of provisions. *LG ALT* is the quarterly change in the sum of bank gross balance sheet loans, unused commitments, security sales, and unearned income. Lagged values of individual bank costs of funds and county-average bank costs of funds are used as instruments for contemporaneous individual bank cost of funds and county-average bank cost of funds.

Appendix: Review of Related Literatures

a. The Credit Channel Transmission Mechanism Literature⁵⁹

The “credit channel” theory of the monetary policy transmission mechanism [Bernanke and Blinder (1988), Bernanke and Lown (1991), or Bernanke and Gertler (1989, 1995), Kashyap and Stein (1995, 2000), Hubbard (1995)] assumes that monetary policy has a disproportionate effect on bank dependent borrowers and smaller banks without ready access to capital markets. Small banks and their bank dependent borrowers cannot easily access the capital markets because of asymmetric information that cannot be overcome without costly monitoring or some other costly information disclosure mechanism.⁶⁰ Because of asymmetric information, the collateral values of both lending institutions and their customers can become an important factor affecting their ability to raise additional funding.

In the credit channel view, whenever the Federal Reserve engages in open market operations and alters bank reserve balances, it also changes the marginal cost of banks’ funding through effects on the deposit interest rates banks pay and indirectly by changing the collateral value of banks’ asset which may impact the volume and the rates banks’ pay on their non-deposit funding. Changes in the marginal cost of bank funding are assumed to be passed on to bank borrowers—primarily consumers and small businesses. Monetary policy also impacts the supply of bank credit by altering bank-dependent borrowers’ borrowing capacities by alter the value of collateral and changing borrowers’ ability to meet existing bank underwriting standards. For example, other things equal, an increase in interest cost will lower firm profitability and reduce a firm’s ability to service debt payments. Customer demand, moreover, may be eroded by the higher cost of bank credit which will reduce demand for the firm’s output and further compromise the firm’s debt service capacity. Similarly, an increase in market interest rates may reduce the value of the firm’s financial collateral and thereby reduce a bank-dependent firm’s borrowing capacity.

b. Capital Crunch Literature

The capital crunch literature argues that minimum regulatory capital requirements create situations where capital shortfalls or near-shortfalls cause banks to reduce their lending. When faced with a binding regulatory leverage ratio or binding risk-weighted capital ratios, a bank must either raise regulatory capital or shrink its total asset base, including potentially its loans. If a risk-weighted ratio is the only binding constraint, the bank can also relieve the constraint by shifting assets from classes with high risk weights into classes with lower (or no) risk weights.

⁵⁹ The literature related to the credit channel view of monetary policy is extensive. BCBS (2011) provides a recent survey of the literature.

⁶⁰ See for example, Hale and Santos (2009) for more recent evidence in support of this assumption.

Bernanke and Lown (1991) [BL] investigate the credit crunch hypothesis using quarterly data from 1990 and 1991. They attribute unusually weak credit growth during this period primarily to weak loan demand, but they also find evidence that some small bank's lending was constrained by the new capital requirements.⁶¹ Peek and Rosengren (1995a) study New England bank lending in the early 1990's and conclude that the abnormally slow loan growth could be attributed to new minimum capital regulations. Peek and Rosengren (1995b) revisit their earlier analysis and find that many New England banks were forced to adjust their leverage ratios to satisfy formal regulatory enforcement actions. The implication is that the New England experience of the early 1990s does not support the hypothesis that banks endogenously reduced their lending growth in response to the new minimum capital regulations.

Brinkmann and Horvitz (1995) analyze the effect the new regulatory capital rules and finds that banks with capital in excess of the new RBC standards had higher loan growth and conclude that the introduction of RBC standards had a "substantial macroeconomic effect (p. 860)." Hancock and Wilcox (1994) [HW] also find very large effects associated with the imposition of minimum capital regulations and estimate that, on average, a bank facing a regulatory leverage ratio constraint reduced its loans by about \$4.50 for each \$1 of capital shortfall and find that binding RBC's cause banks to reallocate their portfolios toward assets with lower risk weights. Berger and Udell (1994) and Shrieves and Dahl (1995) find some empirical support that the hypothesis that banks with higher equity-to-asset ratios are more likely to experience high loan growth, but they discount any hypothesized portfolio shifts associated with the introduction of regulatory RBC ratios.

Berrospide and Edge (2010) study bank holding company (BHC) loan growth and investigate whether BHC loan growth is related to BHC capital levels or deviations from BHC-specific target capital ratios.⁶² Including a number of macroeconomic time series but no controls for BHC-level variation in loan demand, they estimate that a 1 percentage point surplus above a BHC's target capital ratio is associated with 25 basis points in additional loan growth. Carlson, Shan and Warusawitharana (2013) also estimate the relationship between BHCs loan-growth and capital. Using data from 2001 through 2009 and a matched sample methodology to control for BHC loan demand they find that a 1 percentage point increase in the BHC leverage ratio is associated with a 17 basis point increase in annual loan growth. Further analysis shows that this relationship is driven by the crisis years (2007-2009) in the sample and data from earlier years show no reliable relationship between BHC capital and loan growth.

Rice and Rose (2012) study the impact on bank lending associated with the banks losses generated by the September 2008 conservatorship of Fannie Mae and Freddie Mac, an event that lowered

⁶¹ They estimate the capital crunch effect may explain only 2 to 3 percentage points of the lending decline observed in New England over this period.

⁶² Their methodology closely follows BL and HW.

many banks' capital ratios (and even caused a number of banks to fail or seek acquirers). While they do not have estimates of bank GSE-related losses, they attempt to identify banks that suffered GSE losses and find that these banks reduced loan growth by about 2 percentage points relative to banks that did not experience GSE losses, and among banks facing losses, banks with higher Tier 1 RBC ratios experienced higher loan growth.⁶³

Of the many papers that study the capital crunch hypothesis, the consensus finding is that a tight or binding regulatory leverage ratio constraint discourages bank loan growth.

c. The “Supervisory Channels” Literature

Bernanke and Lown (1991) investigate the “overzealous regulation” channel as an explanation for the 1990-1991 “credit crunch” but do not find evidence in favor of a supervisory channel. In contrast, Peek and Rosengren (1995b) conclude that the slow loan growth in New England in this period was a direct consequence of supervisory actions. Berger, Kyle and Scalise (2001) study the same period and conclude that supervisors behaved as if they applied stricter balance sheet and income statement criterion to arrive at a given CAMELS rating compared to the criteria implicitly used during the 1993-1998 “credit boom” period, but they argue that this supervisory channel likely had only a small effect on aggregate lending. O’Keefe and Wilcox (2011) also find evidence that the criteria needed to achieve a given CAMELS rating changes over time but they do not estimate the implications for bank loan growth. Wagster (1999) investigates the impact of the 1988 Basel Accord implementation and concludes that the supervisory channel is the only channel operates across the five countries examined in his analysis.⁶⁴

Curry, Fissel and Ramirez (2006) study the effects of CAMELS ratings on loan growth over two periods. During 1985-1993, they find that a lower CAMELS grade was associated with slower loan growth while over the period 1994-2004 they do not find any CAMELS ratings effects on loan growth. Curry, Fissel, and Hanweck (2008) [CFH] and Krainer and Lopez (2009) [KL] analyze the implicit supervisory standards associated with BOPEC ratings. Both papers find evidence that the criterion for receiving a given BOPEC rating change over time but neither CFH nor KL investigate how changing BOPEC standards may affect BHC lending behavior.

⁶³ Banks with 1 percentage point higher Tier 1 RBC ratio were estimated to experience 29 basis points in additional loan growth.

⁶⁴ The sample analyzed consisted of large banks from Canada, Germany, Japan, the United Kingdom, and the United States.