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Assessing Targeted Macroprudential Financial Regulation: The Case of the 2006 Commercial Real Estate Guidance for Banks

William F. Bassett and W. Blake Marsh

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William F. Bassett*,† W. Blake Marsh*

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Abstract

In January 2006, federal regulators issued guidance requiring banks with specific high concentrations of commercial real estate (CRE) loans to tighten managerial controls. This paper shows that banks with concentrations in excess of the thresholds set in the guidance subsequently experienced slower growth in their CRE portfolios than can be explained by changes in bank or economic conditions. Moreover, banks above the CRE thresholds tended to have slower commercial and industrial loan growth but faster household loan growth following issuance of the guidance. The results highlight the potentially broad influence that portfolio-based macroprudential regulation might have on bank behavior.

JEL Classification: E32, E44, G21, G28
Keywords: credit channel, government regulation, bank lending, real estate

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*Authors are affiliated with the Division of Financial Stability and Division of Monetary Affairs, respectively, Federal Reserve Board, 20th Street and Constitution Ave N.W., Washington, DC 20551. E-mails: william.f.bassett@frb.gov; blake.marsh@frb.gov.
†Corresponding author

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1 Introduction

Economists have long hypothesized that the commercial banking sector may serve as a source of macroeconomic shocks or a transmission mechanism for such shocks. In his seminal work on the Great Depression, Bernanke [1983] argued that the widespread bank failures during the early 1930s helped exacerbate the depth and length of the ensuing economic contraction. Following the economic downturn and banking crisis of the early 1990s, several authors found that supervisory actions responding to that crisis had affected lending, and by extension economic performance, particularly in the hardest hit regions [Peek and Rosengren, 1995a,b, 2000].

The deep recession and weak recovery in many advanced economies associated with the financial crisis of 2007 to 2009 reinvigorated the study of linkages between financial stability, bank lending, and economic performance. In the aftermath of that financial crisis, national and international banking regulators have layered numerous new regulations, such as those contained in Basel III and the Dodd-Frank Act, in an attempt to avoid a repeat of the excesses that built up in the banking sector during the mid-2000s. An evaluation of the effects of many of those new regulations on lending and economic activity is ongoing.[1] This paper studies a significant regulatory change announced as formal guidance in the United States in early 2006, shortly before the crisis emerged, that targeted commercial real estate exposures at banks.

Formal guidance is a common and well-understood tool that federal regulators can use to influence bank behavior in a more-flexible and timely manner than is possible with official rulemakings. Although such guidance does not create a legal requirement, failure to comply can result in increased supervisory scrutiny, a downgrade of the bank's official supervisory ratings, and involvement of supervisors in the decision-making processes of the offending bank. However, this particular guidance was unique. It contained specific numerical thresholds describing the concentration levels at which supervisory scrutiny of a bank's risk-management process for its CRE lending would become much more likely. Moreover, despite public assurances from regulators that the numerical thresholds in the guidance were not meant to be explicit caps on allowable CRE exposure, bankers feared that individual examiners would enforce them in just that manner (see, for example, Yingling [2006]; Zalewski [2006]).

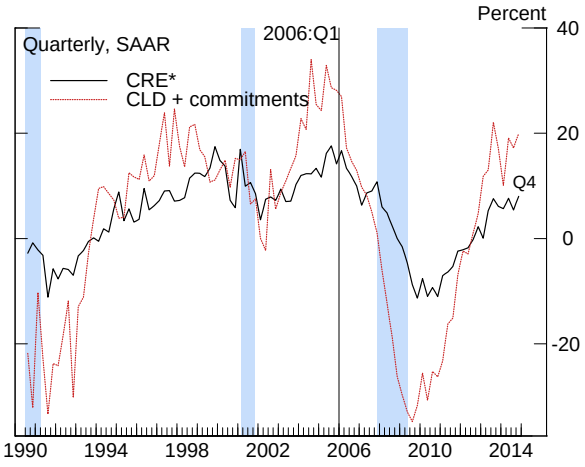
The efficacy of the guidance from a public policy standpoint depends importantly on

[1] For a discussion of the potential effects of Basel III, see BCBS [2010a] and BCBS [2010b].

its actual effects. On the one hand, the imposition of restrictions on additional CRE lending just in advance of the financial crisis may have resulted in large net benefits to institutions. If the guidance constrained their lending in the final stages of the cycle and conditions worsened faster or to a larger extent than bank management had anticipated, additional losses might have been averted. On the other hand, an exogenous shock to lending capacity at a delicate time could instead have exacerbated the decline in some markets. If the guidance restrained the ability of banks to lend to creditworthy borrowers, then losses may have spilled over from bad projects to good projects. Given the importance of nonresidential investment in economic growth, excessive tightening in lending standards could have contributed to the severity of the crisis.

The issuance of the guidance certainly coincided with a decline in CRE lending and a tightening of lending standards. As shown in figure 1, growth of CRE loans was rapid in the early 2000s and reached upwards of 15 percent in late 2005. Much of that increase was due to a steep rise in the subcomponent of construction and land development (CLD) loans and the associated off–balance sheet commitments to fund such loans. CLD loans, which historically make up more than one-third of total CRE loans, had a combined growth rate of nearly 30 percent in 2005. Following the issuance of the guidance in early 2006,

Figure 1: Growth of Commercial Real Estate Exposures

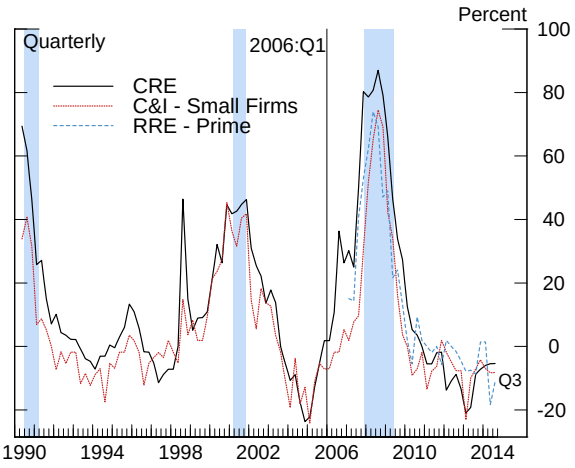


Note: Commercial real estate exposures include on-balance-sheet loans secured by construction and land development; multifamily housing; nonfarm, nonresidential structures; and off-balance-sheet commitments for such loans.
Source: FFIEC Call Reports.

outstanding balances of CRE loans began a rapid descent, which persisted throughout the crisis period. At their nadir in 2009 and 2010, the rate of decline in total CRE loans reached 10 percent and CLD loans and associated commitments contracted more than 30 percent at an annual rate. Neither component resumed quarter-over-quarter growth until late 2012.

Additional evidence that the guidance may have spurred banks to proactively tighten conditions in CRE lending can be seen in the Federal Reserve's Senior Loan Officer Opinion Survey (SLOOS). As shown in figure 2, the net percentage of banks reporting that they had tightened standards on CRE loans began rising in early 2006, just after the guidance was issued. At the end of 2006, when the guidance was finalized, nearly 30 percent of banks reported that they had tightened lending standards on CRE loans since the previous quarter. In addition, standards on CRE loans tightened considerably earlier than standards on two sectors also hit hard by the crisis — commercial and industrial (C&I) loans to small firms and residential real estate (RRE) loans to prime borrowers. The earlier tightening of CRE lending standards suggests that sector was influenced by a factor other than expectations of future economic performance.

Figure 2: Net Percentage of Domestic Banks Tightening Lending Standards



Note: Reported net fractions of banks reporting tighter standards equal the fraction of banks that reported having tightened standards ("tightened considerably" or "tightened somewhat") minus the fraction of banks that reported having eased standards ("eased considerably" or "eased somewhat").
Source: Federal Reserve Board. *Senior Loan Officer Opinion Survey*. www.federalreserve.gov/boarddocs/snloansurvey .

Prior to the CRE guidance, guidance that contained specific numerical thresholds was

very rare. We therefore argue that the CRE guidance provides a "natural experiment" that affords an opportunity to examine the behavior of banks relative to their concentration level vis-à-vis the threshold. We develop a difference-in-difference style estimation model to evaluate the effects of the guidance on banks deemed highly concentrated. Although identifying the broad effects of the guidance generally is difficult, given that the guidance coincided with a sharp decline in CRE lending, we argue that our specification is able to identify the effects for concentrated banks.

In the period after the guidance was finalized, growth of CRE loans at banks that exceeded the thresholds was substantially slower than at banks below the thresholds and at concentrated banks before the guidance was in place. That result holds even after controlling for lagged growth in CRE loans, the evolution of credit quality in the bank's CRE portfolio, other measures of profitability and balance sheet structure, the economic conditions in areas where the bank operated branches, and overall economic and financial conditions. Another key result in the paper is that banks that had exceeded the regulatory thresholds for CRE loans also made fewer C&I loans and experienced faster growth of residential real estate loans and consumer loans after the guidance went into effect. Moreover, these post-guidance relationships differ from the patterns observed across lending categories in banks with CRE concentrations before the guidance was issued and were not observed at CRE-concentrated banks during and after the 2001 recession, providing additional support for an independent, causal effect of the guidance on bank behavior.

When banks are evaluated by whether they were near to or far from the threshold, we also find results that strengthen the case for identification. During the comment period, banks that were near the threshold did not react, which might reflect lobbying efforts by the banks to increase the threshold; the combination of having only a small adjustment to make and the hope that no adjustment would be necessary may have led these banks to put off adjustments until the guidance was finalized. And, as the results show, once the guidance was finalized, the banks near the threshold shrank at the same rate as banks far from the threshold. Meanwhile, banks far from the threshold began to shrink as soon as the guidance went out for comment because they likely would have been required to shrink even if the agencies made a small boost in the thresholds in response to lobbying; such banks doubled the rate of shrinkage after the guidance was finalized.

Although the guidance was directed at individual institutions, overbuilding in the CRE market funded by excessive new lending can affect the creditworthiness of existing properties and loans, which have long, useful lives and multi-year maturities, respectively. When

a new building is added to the stock of existing office, retail, or warehouse space, it affects the rental and occupancy rates of other nearby buildings. Overbuilding thus impairs the credit quality of previously sound loans and potentially damages the balance sheets of banks and borrowers that previously had acted prudently given their existing information set.

In that respect, the CRE guidance represents one potential approach to macroprudential regulation called for in Basel III and the Dodd-Frank Act.[2] Authors have argued that at its core, the goal of macroprudential policy is to limit the systemic effects of capital losses resulting from common shocks [Hanson, Kashyap, and Stein, 2011; Galati and Moessner, 2013; Kashyap, Tsomocos, and Vardoulakis, 2014]. Indeed, the final guidance indicated that regulators might not be generally concerned about individual loan risk but in preventing systemic problems that result from buildups of CRE loan holdings over time.

Although our results point to the potential for macroprudential regulations such as this one to change the behavior of private actors in a rapidly expanding credit market, we also show that the effects of the guidance likely were not limited to the target market and so might have generated unintended consequences. These results could inform the debate about whether macroprudential regulations should attempt to ration credit in specific, fast-growing sectors or focus more generally on improving the overall capital and liquidity position of the financial sector.

The remainder of the paper is organized as follows. Section 2 describes the final CRE guidance in detail. Section 3 reviews the literature on the effect of supervisory actions on banks. Section 4 describes the data used in the analysis. Section 5 outlines our empirical strategy for estimating the effect of the change in bank regulation. Sections 6 and 7 discuss the key results and relevant robustness checks, respectively. Section 8 concludes.

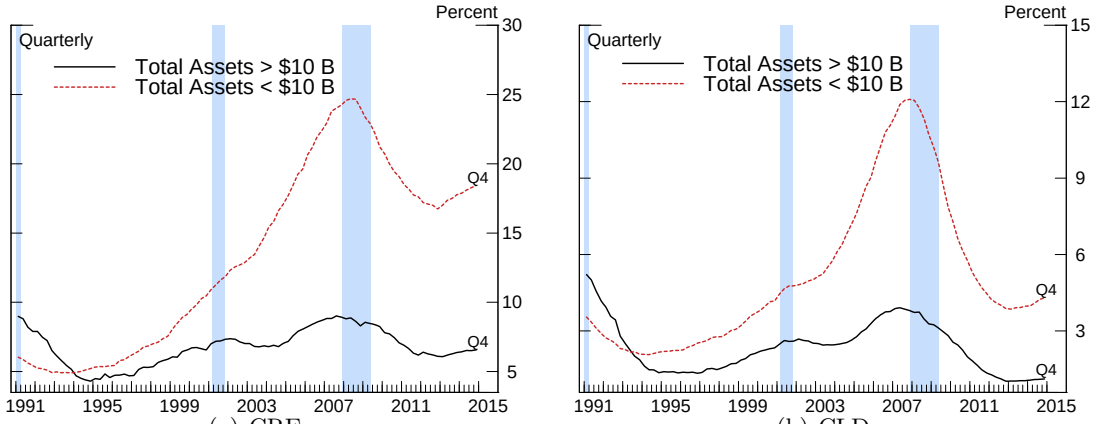
2 The CRE Lending Guidance

Figure 3 shows that small- and medium-sized commercial banks, defined as those with total assets of less than $10 billion, experienced an especially sharp increase in CRE loan holdings beginning around 2003. CRE concentrations peaked just after the start of the 2007-09 recession, when they represented nearly one-fourth of combined assets at those small- and medium-sized banks. The buildup was particularly acute for holdings of CLD

[2]See Elliott, Feldberg, and Lehnert [2013] for a review of current and former attempts by supervisory authorities in the United States to implement macroprudential regulations.

loans, a category in which the concentration ratio at small- and medium-sized banks more than doubled from about 5 percent of total assets in 2003 to more than 12 percent in 2008.

Figure 3: Loans to Total Asset Ratios



(a) CRE (b) CLD

Source: FFIEC Call Reports.

Regulators cited rising concentrations of CRE loans as particularly worrisome because of the cyclical, and often swift, nature of changes in credit quality of such loans when CRE markets retrench [Federal Register, 2006b]. For instance, research examining the collapse of CRE markets during the 1980s found that commercial banks that engaged in aggressive lending practices prior to the downturn subsequently exhibited tighter credit standards, larger losses, and higher failure rates than their peers [Randall, 1993; Cole and Fenn, 2008; Browne and Case, 1993].

Seeking to avoid a similar outcome during the next cycle, regulators first issued supervisory guidance for comment in January 2006. CRE was broadly defined by the guidance to include loans related to CLD; non-farm, non-residential properties that are non-owner-occupied; multifamily properties; and loans whose repayment is dependent on cash flows derived from the property but not secured by it.[3]

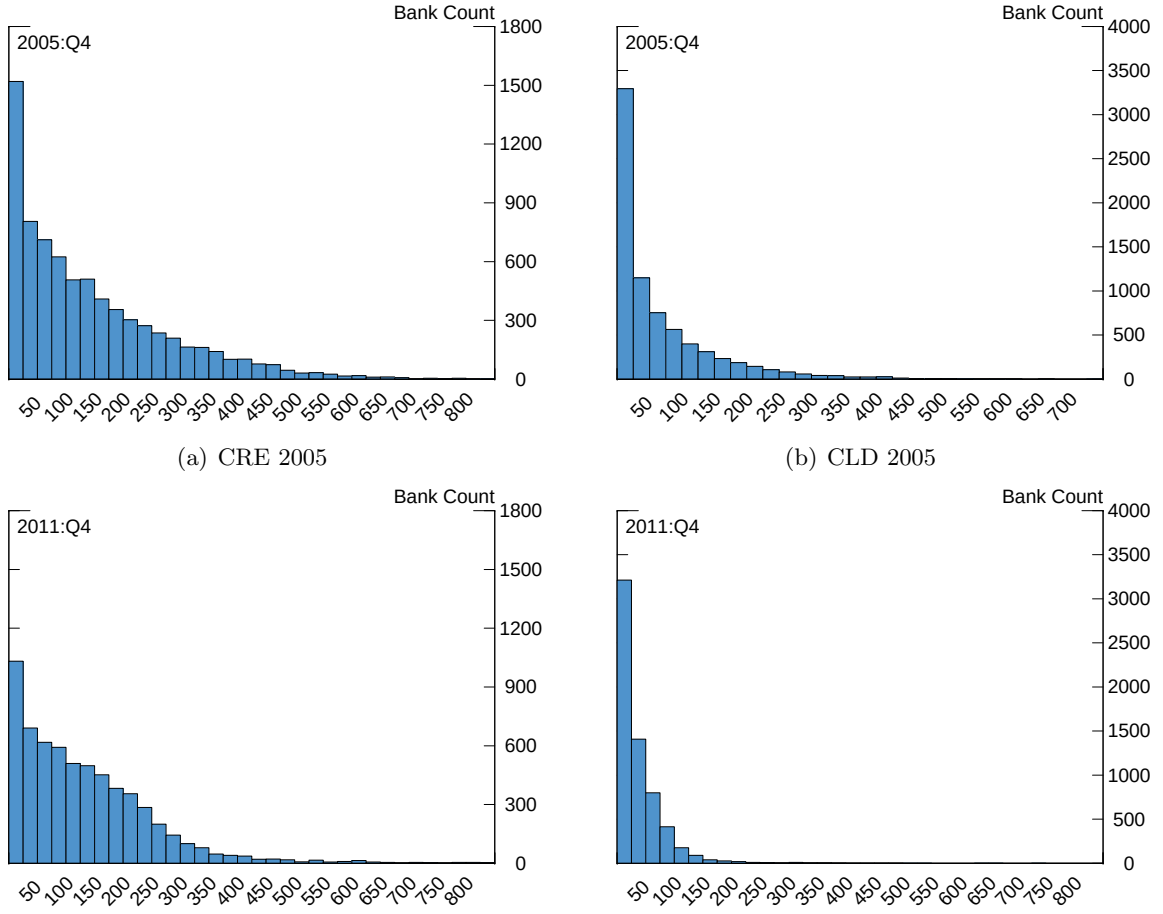
[3]Initially, some of these definitions were not standardized. As of April 1, 2009, a loan is considered secured by real estate for regulatory reporting purposes if the estimated value of the collateralized real estate is greater than 50 percent of the originated principal value of the loan or if the loan terms were conditional on the real estate collateral. See the glossary of the FFIEC 031/041 report instructions for more details.

The document outlined a two-pronged approach to incentivize banks to better manage CRE concentrations. First, the guidance required management at all banks that make CRE loans to devise an "overall CRE lending strategy" that included both minimum underwriting standards for individual loans and a detailed approach for managing the total CRE portfolio. Portfolio management required banks to set an acceptable concentration level and proactively manage CRE holdings through risk diversification and appropriate stress testing. Second, banks with total CRE to total risk-based capital (RBC) greater than 300 percent or total CLD loans to total RBC greater than 100 percent would be deemed highly concentrated by regulators and subject to enhanced oversight and analysis as well as potentially increased capital requirements.

After receiving public comments on the draft guidance, the agencies reported that many banks considered these ratios too low because they had held sizable concentrations of CRE loans for some time without realizing significant losses [Federal Register, 2006a]. In addition, banks worried that the unusual implementation of strictly defined numerical thresholds was potentially prescriptive and would remove some discretion from examination teams. As a result, regulators revised the guidance to apply only to those banks that both exceeded the 300 percent threshold and experienced growth in their CRE portfolio of more than 50 percent over the preceding 36-month period. This change was made to distinguish between banks that historically held concentrated levels of CRE and those that rapidly acquired a concentrated level of CRE holdings. Moreover, the final guidance stressed that the loan-to-capital ratio thresholds were intended to provide supervisors with rough quantitative guidelines about CRE concentration levels and did not constitute absolute limits on CRE lending.

The top two panels of figure 4 show the distribution of banks' CRE and CLD to total risk-based capital holdings as-of the fourth quarter of 2005. Banks with CRE-to-capital ratios greater than 300 percent accounted for 14 percent of the total at year-end 2005; a larger share of banks, 23 percent, had CLD-to-capital ratios greater than 100 percent. Of the banks above the CRE threshold, only 17 percent had experienced growth of less than 50 percent over the past 36 months as-of 2005:Q4. Thus, the consideration of recent growth in CRE holdings exempted only a small number of banks from the requirements in the guidance. Despite assurances that the numerical thresholds were not concentration limits, many banks' concentrations of CRE loans declined significantly following the issuance of the guidance. As shown in the bottom panels of figure 4, by 2011:Q4 only 8 percent of banks remained above the CRE threshold, and 7 percent over the CLD threshold.

Figure 4: Distribution of CRE Loans to Total Risk-Based Capital



(a) CRE 2005

(b) CLD 2005

(c) CRE 2011

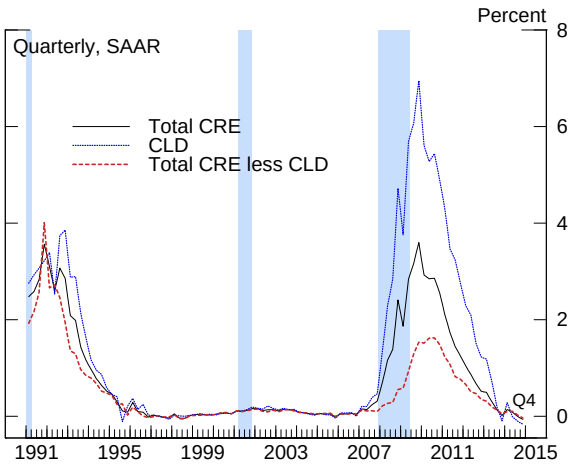
(d) CLD 2011

Note: Banks with ratios greater than 850 or with negative risk-based capital have been dropped.
Source: FFIEC Call Reports.

Total charge-offs on CRE loans began to increase just at the start of the crisis before peaking in early 2010 (figure 5). These losses, as in previous CRE downturns, were more acute in the CLD portfolio.

A significant fraction of the banks that were originally above the thresholds set by the guidance either failed or merged as losses on CRE loans increased. Of the banks above the CRE threshold at year-end 2005, more than 35 percent either failed or merged with another institution. Among the banks that exceeded the CLD threshold at year-end 2005, about 36 percent either failed or merged, and only 15 percent remained over the threshold in 2011. However, just 24 percent of those banks originally above the total CRE threshold were considered concentrated at year-end 2011.

Figure 5: CRE Loan Charge-offs



Source: FFIEC Call Reports.

Most of the surviving banks that moved below the thresholds did so by both increasing capital and reducing CRE exposures. Median CRE growth at banks that started above the total CRE threshold in 2005 and remained above it in 2011:Q4 was 7.4 percent at an annual rate over that 2005-11 period. In contrast, banks that started above the threshold and brought their concentrations ratios below it by 2011:Q4 had a median decrease in CRE outstanding of 12.9 percent at an annual rate. Over the same period, the median growth rate of total regulatory capital (Tier 1 + Tier 2 + Tier 3) at banks that remained above the CRE threshold was just 15 percent, while banks that moved below the threshold saw median capital growth of more than 50 percent.

The experience of banks around the CLD threshold was similar. CLD exposures declined broadly between 2005 and 2011, however, as both banks that remained above the CLD threshold and fell below it had a median decline of 43 percent during the period. However, median capital growth at banks moving below the CLD threshold was almost 50 percent during the period, while banks remaining above that threshold saw a median decline in capital of 4.5 percent.

In May 2011, a report from the Government Accountability Office (GAO) examined declines in CRE lending over the previous few years and considered whether the guidance was a reason for those decreases [GAO, 2011]. The report found that weaknesses in the CRE market weighed most heavily on smaller community banks that were more likely to hold large concentrations of CRE loans. Community banks also hold a disproportionate amount of small business loans that are likely to be collateralized by commercial properties, so spillover effects from weaknesses in the CRE market are likely to result in downturns in small business lending.[4] In addition, the report stated that regulators were often inappropriately applying the guidance by treating the ratios as strict caps on CRE concentration levels. The guidance was also reportedly applied inconsistently at times because examiners did not correctly calculate the level of CRE exposure or the total capital value.

3 Literature Review

Only a few studies of the banks affected by the CRE guidance and their responses to it have been published. Lopez [2007] estimates that 29 percent of banks exceeded the CRE threshold as stated in the guidance as of year-end 2005, but that these banks tended to have better performing CRE portfolios than their less-concentrated peers.[5] Pana [2010] finds that banks with CRE concentrations before the crisis were highly levered and faced increased credit and liquidity risk, but their CRE portfolio typically performed better than their unconcentrated peers.

[4]Loans secured by non-farm non-residential property with original values less than $1,000,000 are defined as small loans to businesses for regulatory reporting purposes. See schedule RC-C, Part II of the FFIEC 031/041 reports for more information.

[5]Lopez [2007] includes owner-occupied, non-farm non-residential properties in the total CRE definition that were excluded from CRE definition in the final guidance. These loans were not separately reported on the Call Report until 2008:Q1. Our CRE measure estimates the non-owner occupied portion for dates prior to 2008:Q1, as described in section 4.1. This definitional difference accounts for the disparity between our measure of banks over the threshold at year-end 2005 and that reported in Lopez [2007].

Friend, Glenos, and Nichols [2013] examine both the riskiness of highly concentrated banks and the effect of the guidance on those banks. The authors document that many banks with high CRE concentrations as defined by the guidance failed during the financial crisis period and that banks with large concentrations of CRE loans prior to the guidance were more likely than other banks to reduce their level of CRE exposure. Although Friend et al. [2013] include a brief exposition of relative growth of CRE loans at concentrated and unconcentrated banks, we use more formal statistical measures to assess the effects of the guidance, including on seemingly unrelated loan categories. Indeed, Friend et al. [2013] note that their discussion of bank lending is incomplete because econometric tests that control for local market conditions, such as those presented here, would be required to evaluate the effectiveness of the guidance.

More generally, the CRE guidance combines the threat of heightened regulatory scrutiny with the potential to impose more-stringent capital requirements. The literature on the effects of bank regulation on lending and economic output can be divided into two major strands mirroring those provisions. The first strand examines the effect of direct supervisory actions on bank lending, and the second strand investigates the link between bank lending and capital requirements. Generally, both strands find that more-stringent regulatory actions are associated with slower loan growth. However, the results are somewhat asymmetric. Some studies indicate that imposing stricter regulatory requirements during periods of strong banking sector performance tends to have a limited effect on loan growth and may result in higher profitability and improved asset quality in the future.

Empirical examinations of regulatory oversight have been limited because of the difficulty of interpreting qualitative findings and the confidentiality of examination data as well as the usual problem of disentangling loan supply from loan demand. Because of the lack of quantitative data on supervisory actions, most empirical studies have focused on changes in composite CAMELS ratings, which are a numeric assessment of a bank's overall health following irregularly spaced exams.[6] Peek, Rosengren, and Tootell [2003] document that banks with lower CAMELS ratings have slower loan growth than their more highly rated peers. Similarly, Bassett, Lee, and Spiller [2015] find that small changes in the apparent stringency of CAMELS rating assessments have a significant effect on lending. In other studies that utilized CAMELS ratings, however, the results have been mixed. Berger, Kyle, and Scalise [2001] and Curry, Fissel, and Ramirez [2008] find that regulatory oversight in-

[6]CAMELS ratings assess a bank's Capital adequacy, Asset quality, Management capacity, Earnings, Liquidity, and Sensitivity to interest rate movement to evaluate the health of a bank.

creased during the slow growth period of 1989 to 1992 but that the increased stringency had little effect on overall lending. Johnson [1991] argues that weak bank balance sheets, rather than heightened regulatory scrutiny, were the most significant driver of the lending decline in the early 1990s.

Public enforcement actions and changes in the law also provide an opportunity to examine variation in the intensity of supervision as well as its effects. Peek and Rosengren [1995a] show decreased lending by banks in New England that were under formal enforcement actions in the early 1990s and document that the overall decline attributable to those actions was economically significant. Kishan and Opiela [2006] demonstrate that less-capitalized banks responded differently than their better-capitalized peers to monetary policy actions after the passage of FDICIA, a law that significantly increased the oversight powers of bank regulators. Other authors have found that some measures of bank performance and their CAMELS ratings improve after a bank changes its primary federal regulator [Rosen, 2001; Rezende, 2014]. Darin and Walter [1994] use variations in the ratio of loan loss reserves to non-performing loans as a measure of stringency, arguing that regulators can require banks to increase reserves depending on the regulators' assessment of loan risk. They conclude that in the 1990s regulators in the hardest hit areas were more lax than regulators in less affected areas prior to the recession but these differences dissipated following the recession.

The second strand of research related to the supervisory actions proposed in the CRE guidance studies how changes in capital adequacy requirements for banks affect lending and the economy. Empirical studies from the early 1990s banking crisis show that well-capitalized banks were more likely to increase lending than their less-well-capitalized counterparts (see, for example, Bernanke and Lown [1991]; Peek and Rosengren [1995b]; Barajas, Chami, Cosimano, and Hakura [2010]). Likewise, many empirical studies report that increases in required capital levels, which reduce overall capital adequacy during the transition to the new higher levels, are associated with lower lending growth at least for a time [Furlong, 1992; Hancock and Wilcox, 1994; Brinkmann and Horvitz, 1995; Shrieves and Dahl, 1995; Jacques and Nigro, 1997; Kopecky and VanHoose, 2006].[7] A cross-country study by O'Brien and Browne [1992] shows that increases in capital ratios are associated with higher interest rates on loans relative to funding costs, suggesting a possible channel through which lending is damped. However, the association between higher capital requirements and lower lending is not universal: several studies report little evidence that

[7] Blum and Hellwig [1995] later demonstrated this result in a formal theoretical model.

changes in capital requirements are associated with changes in outstanding loan volumes [Berger and Udell, 1994; Ashcraft, 2001].

The introduction of risk-based capital ratios also coincided with shifts in banks' asset portfolios [Hall, 1993; Jacklin, 1993]. Empirical evidence shows a strong correlation between banks with low initial capital ratios and portfolio substitution into lower risk-weighted asset classes such as government securities [Haubrich and Wachtel, 1993]. In addition, banks adjusted their balance sheets faster in response to capital shocks in the 1990s, which corresponds to a period of tighter capital regulations, than in the previous decade [Hancock, Laing, and Wilcox, 1995]. Such shifts are consistent with the shifts in lending found in section 6.

Finally, some papers jointly estimate the effects of both regulatory scrutiny and capital requirements. Furfine [2000, 2001] concludes that regulatory scrutiny accounted for a majority of the drop in lending in the early 1990s, but that both risk-based and leverage capital requirements contributed. That work also suggests that risk-based capital requirements incentivized banks to substitute securities for loans, potentially reducing the extent of the decline in overall bank credit supply, whereas banks subject to stricter oversight showed no such pattern for substitution. Magalhaes and Tribo [2010] find that capital stringency initially increased loan spreads, while regulatory oversight is associated with shorter loan maturities.

4 Data Sources and Methods

The Federal Financial Institutions Examination Council's (FFIEC's) mandatory quarterly Report of Condition and Income (Call Report) is used to construct measures of loan growth, bank profitability, asset quality, balance sheet composition, and off-balance-sheet exposures for domestically chartered commercial banks over the period 1991:Q1 to 2011:Q4.[8] All data on exposures, income, and expenses are adjusted for mergers between commercial banks and between commercial banks and thrifts.[9] All bank activity variables, except net

[8]The sample includes all domestic banks domiciled in the 50 U.S. states. Banks domiciled in U.S. territories may also file the Call Report but do not file the Summary of Deposits (SOD) data described in Section 4.3 and are excluded from our sample.

[9]Bank balance sheet variables are adjusted for mergers between banking organizations by comparing balance sheet values at the end of the quarter with those at the beginning of the quarter, accounting for amounts acquired or lost during the period because of mergers. For information on the merger-adjustment procedure for income, see the appendix in English and Nelson [1998].

interest margins, represent the value for each bank's U.S. operations only, consistent with the definition of CRE loans stated in the final guidance. Because many of the explanatory variables exhibit a high degree of seasonality, bank-specific income as well as balance sheet variables and growth rate data are seasonally adjusted. Seasonal factors were calculated from the sample aggregates using the Census Bureau's X-11 procedure and then applied to each individual bank-specific series [Time Series Research Staff, 2011].[10]

4.1 Growth Rate and Policy Variables

Growth rates in five categories of loans—total CRE, the CLD subcategory of CRE, RRE, C&I loans, and consumer loans—are calculated as the log difference of the end-of-period and merger-adjusted, beginning-of-period stock of loans.[11] The measure of total CRE loans is constructed to match as closely as possible the definition given in the 2006 CRE regulatory guidance: loans for CLD; non-farm, non-residential properties that are non-owner-occupied; multifamily properties; and loans to finance CRE but not secured by real estate [Federal Register, 2006a].[12] The owner-occupied portion of loans for non-farm, non-residential properties is broken out on the Call Report beginning in the 2008:Q1 reporting period. To estimate the share of loans associated with non-owner-occupied properties prior to that date, we calculate the bank-specific fraction of non-owner-occupied to total non-farm, non-residential loans at 2008:Q1 and apply that ratio to all prior periods. RRE, C&I, and consumer loans are defined as in the Call Report.[13]

Additionally, the growth rates of both CRE and CLD loans include off-balance-sheet commitments to make such loans (hereafter, CRE or CLD "exposures", respectively). The inclusion of off-balance-sheet commitments should make for a clearer measure of lending

[10]Because the census bureau's X-11 procedures give greater weight to recent observations, our seasonal adjustment measures may be confounded by the substantial disruptions caused by the financial crisis. Cimmola, Cicconi, and Marini [2010] and Nomura [2011] have examined issues of seasonal adjustment related to the crisis. Because of these concerns, the analysis was replicated using non-seasonally adjusted data and including quarterly indicators to control for the seasonal process. Our results using this method, which are available upon request, are qualitatively similar.

[11]Results using the percentage change rather than the log difference were not materially different.

[12]Loans to finance CRE but not secured by real estate are included as CRE for the purposes of the 2006 regulation if the loan is used to finance a real estate venture or if 80 percent of the revenues of the business funded by the loan are generated by real estate holdings or ventures. Most of these loans are identified by a memo item in the Call Report that is included in our definition of CRE loans. However, they are also included in either C&I loans or the other loans category, and because of the aggregation in the memo item those items cannot be adjusted separately.
For more information, see the FFIEC 031/041 report instructions for item RC-C Memorandum item 3.

[13]C&I loans include loans to both domestic and non-U.S. addressees.

behavior in these categories because banks often provide such loans under pre-established commitments that are difficult to cancel except for nonperformance. Banks that had substantial concentrations of CRE or CLD loans likely had significant commitments to make such loans in subsequent quarters. Thus, draws on such commitments might have sustained on-balance-sheet growth well after the finalization of the guidance and initial downturn in the sector.[14] In contrast, banks can adjust their willingness to write new commitments immediately, so the combined variables will be more timely indicators of lending conditions.

For each bank-quarter observation in the sample, we construct variables equal to the ratio of total loans in each category to the bank's total risk-based capital, as specified in the guidance.[15] Those ratios for CRE and CLD loans then define indicator variables that denote banks that exceeded 300 percent for CRE loans and 100 percent for CLD loans, as stated in the guidance documents. Separate indicator variables are used to distinguish between the effects during the public comment period, which started with the issuance of the guidance on January 13, 2006, and the period after the guidance was finalized and made effective, December 12, 2006. Dates between 2006:Q1 and 2006:Q4 denote the comment period, and dates from 2007:Q1 to 2011:Q4 denote the sample period after finalization of the guidance.

The unweighted averages and standard deviations for the loan-to-capital ratios are given in table 1.[16] In general, loan-to-capital ratios for total CRE are higher than those for C&I or consumer loans. Furthermore, the total CRE ratio has a higher standard deviation than the ratios for the other two loan categories, an artifact of CRE concentrations well in excess of the average at a subset of banks. In contrast, the average concentration of RRE loans is somewhat higher than that for total CRE loans and the standard deviation is about equal. However, charge-off rates on CRE loans had been much higher than those on

[14] Ideally, off-balance-sheet exposures would be used for all the core loan categories considered in our results, however, commitments to make C&I loans and consumer credit card loans are not separately defined on the Call Reports until 2010:Q1.

[15] Total risk-based capital is the sum of Tiers 1, 2 and 3 capital less adjustments. Prior to 2001, Tier 2 capital is estimated, because it is not reported directly on the Call Report. The estimation method requires assigning regulatory capital weights to reported Call Report items that are included in the Tier 2 definition. The method of assigning weights and calculating Tier 2 capital differs based on the reporting years, as the applicable capital definitions change over time. Tier 3 capital was not applicable before issuance of the Basel I market risk rule in 1996; it is generally reported by only a handful of banks and accounts for a small portion of total risk-based capital at those banks.

[16] The ratios and charge-off rates shown in table 1 are based on the sample used for subsequent regressions and other analysis herein, after eliminating outliers and other observations as described below.

RRE loans prior to 2006, one reason why regulators focused more on CRE concentrations.

The average concentration ratio for CLD loans accounts for a significant share of overall CRE concentrations. Both the concentration ratio for CLD and its standard deviation are about equal to those of C&I loans, but again, the much higher charge-off rate for CLD loans, compared with total CRE lending, is important in explaining the greater regulatory concern about concentrations of CLD. In addition, following the market crash, charge-off rates on CLD loans rose much higher than those for all other categories of business loans, which include total CRE and its subcomponents, as well as C&I loans and household loans.

Table 1: Loans to Total Risk-Based Capital and Charge-off Rate Summary Statistics

	CRE	CLD	C&I	RRE	Consumer
RBC Ratios					
Mean	167.4	126.1	121.7	197.1	97.6
Std.Dev.	115.7	86.4	78.7	116.9	79.1
Charge-off Rates					
All	0.10	0.16	0.21	0.04	0.18
1991:Q1-2005:Q4	0.04	0.04	0.19	0.02	0.17
2005:Q4-2011:Q4	0.23	0.48	0.26	0.08	0.20

Note: Charge-off rate is percentage points at a quarterly rate. Variable definitions: RBC ratio, on-balance-sheet loans to risk-based capital; charge-off rate, loans charged off during the quarter divided by merger-adjusted loans outstanding at the beginning of the quarter. Source: FFIEC Call Reports.

The threshold for concentration of CRE loans in the guidance, 300 percent of total risk-based capital, turns out to be roughly one standard deviation above the mean for that category. Although the guidance is focused on CRE lending and thus does not suggest similar thresholds for non-CRE loans, we include a robustness exercise that tests whether loan growth in other categories responds similarly to high concentration levels in the absence of specific regulatory guidance. Therefore, hypothetical thresholds based on the averages and standard deviations in table 1 are defined for other loan categories. This procedure suggests an indicator variable that takes a value of one for banks with loan-to-capital ratios greater than 200 percent for C&I and consumer loans– a value that is similar to the non-CLD portion of the 300 percent requirement for CRE and consistent with the historical average levels of charge-offs across those three categories of loans. We also define the indicator based on a 300 percent ratio of RRE loans to total capital, equal to the CRE

guidance, though the much lower charge-off rates for RRE loans than CRE loans suggests that an even higher threshold might also be appropriate.

Table 2 shows the unweighted mean and standard deviation of quarterly growth rates for each of the five previously mentioned loan categories for all banks over the sample period as well as a breakout of growth rates at those banks with loan-to-capital ratios above and below the applicable thresholds. Note that over the sample period, the average growth rate of total CRE was much higher than all of the other categories of lending, and the growth of CLD was somewhat higher as well.[17] Also of note is the greater volatility in the growth rate of business loans, especially CLD loans, than in the growth rate of household lending.

Table 2: Growth Rate Summary Statistics

	CRE+cmt	CLD+cmt	C&I	RRE	CONS
All Obs	145,417	20,847	298,481	375,139	239,467
Mean	2.20	1.87	1.53	1.53	0.33
Std.Dev.	9.10	12.12	8.64	4.89	5.29
Under Threshold	126,693	9,786	258,382	313,030	221,125
Mean	2.19	1.51	1.28	1.43	0.24
Std.Dev.	9.31	13.14	8.77	4.99	5.26
Over Threshold	18,724	11,061	40,099	62,109	18,342
Mean	2.27	2.20	3.14	2.04	1.40
Std.Dev.	7.51	11.13	7.52	4.35	5.47
P-value	0.27	0.00	0.00	0.00	0.00

Note: Quarterly growth shown at a quarterly rate. Number of observations shown in category header rows. P-values are for the null hypothesis that growth rates for banks over the threshold equal those under the threshold. Thresholds are defined as the ratio of loans to total risk-based capital (RBC). Thresholds for CRE loans, 300 percent, and CLD loans, 100 percent, are defined explicitly by the final guidance. Non-CRE loan category thresholds are the following: C&I loans, 200 percent; RRE loans, 300 percent; consumer loans, 200 percent. Source: FFIEC. Call Reports.

For all categories, the mean rate of growth over the sample period is lower for banks that are under the respective thresholds than for banks that are above the thresholds. These differences are statistically significant for all loan categories except total CRE plus commitments, as shown in the bottom row of table 2. Although banks that more rapidly add to their loan holdings might be expected to breach their respective thresholds with

[17]The growth reported is for loans held on balance sheet plus unused commitments for the CRE and CLD columns. For most of the sample period, loans originated for sale or securitization, which may have been more rapid, is incomplete.

greater probability, the data in table 2 suggest that banks that hold large concentrations of loans are also the most important drivers of growth in each lending category. Thus, deterring growth at specialized banks may have outsized effects on economic activity in affected markets, particularly in categories of lending that have a high proportion of relationship loans.

4.2 Financial Condition Variables

Bank-specific financial variables are used to control for characteristics that may determine changes in lending volumes. The log of real assets, deflated by the GDP deflator, controls for changes in bank size. Large banks, with more diverse markets and access to more funding sources, will have different lending standards and respond differently to shocks than smaller banks. Consistent with previous research showing a positive relationship between capital ratios and the growth rate of lending, the regressions include the ratio of Tier 1 capital to tangible assets, better known as the regulatory leverage ratio.

Bank- and loan-category-specific delinquency and charge-off rates control for the current credit quality of the bank's loan portfolio and the portfolio quality's effect on loan supply and demand.[18] Significant differences across loan categories in the loss rates on delinquent loans motivate the inclusion of charge-off rates as well. A rise in the charge-off or delinquency rate indicates a deterioration in the credit quality of the existing loan portfolio and requires banks to spend capital and income to cover current and expected future loan losses. As a result, lending standards also generally tighten in response to worsening loan quality as banks' lending capacity shrinks [Bassett, Chosak, Driscoll, and Zakrajšek, 2014]. Moreover, the deterioration in the quality of existing loans may also indicate a more general increase in the riskiness of new loans and a reduction in demand for loans if the deterioration is related to a broader downturn in economic conditions in markets served by the bank.

NIM, defined as the difference between interest income and interest expense scaled by average interest-earning assets, and noninterest expense scaled by total assets are used to separately control for factors affecting profitability. An increase in net interest income

[18]The charge-off rate is the amount of loans charged-off in a given quarter divided by outstanding loans at the beginning of that particular quarter. The ratio of non-owner-occupied to total non-farm, non-residential loans at 2008:Q1 is applied to the relevant series to calculate delinquency and charge-off rates for non-owner occupied loans prior to 2008:Q1. Delinquency rates are calculated as the amount of the loan stock delinquent at the end of a given quarter divided by the total holdings of loans in that category at quarter-end.

is expected to be associated with increased lending because it likely reflects improved investment options with higher returns and better access to funds as retained earnings build the capital base. In contrast, an increase in noninterest expense is expected to be negatively associated with lending because of its respective effects on bank profitability and cash flow.

To control for the cost and availability of funding, we use the ratio of core deposits to total assets. Core deposits—the sum of transactions, savings, and small time deposits—are the main funding source for medium- and small-sized commercial banks in the United States. An increase in core deposits relative to total assets indicates that the bank's stable funding has improved and allows banks to increase lending. Core deposits are also generally priced below prevailing market interest rates, in part because of the value of deposit insurance, reducing the average cost of funds and potentially allowing the bank to make loans profitably at lower interest rates than their competitors.

4.3 State-Weighted Variables

Measures of the condition of the real economy in local markets served by a particular bank are constructed by combining state-level macroeconomic indicators with information from the FDIC's annual Summary of Deposits (SOD) data.[19] The SOD data tally the number and amount of deposits held at year-end by each of the branches of the banks that file the Call Report. A measure of the extent to which the bank's business is concentrated in a given state is constructed by calculating the ratio of branches in that state to the bank's total number of branches.[20] Once the bank's ratio of branches to total is calculated for each state, these ratios are used to construct weighted averages of state-level macroeconomic indicators by bank.[21]

[19] Ideally, researchers would have access to granular data on both local market conditions and lending. However, measurements of many economic factors relevant to this analysis are not readily available at the MSA or county level, and bank balance sheet information is available only on a consolidated basis. By constructing these state-level variables, we have tried to balance issues of data availability and accuracy.

[20] Alternatively, the weights could be constructed using the amount of deposits booked at branches in each state. However, banks increasingly book their deposits at a central office, making that measure less reliable. Thus, the number of branches likely provides a better proxy of the bank's presence in a particular state.

[21] The use of state-level economic variables to control for local economic conditions represents a trade–off between data availability and data accuracy. CRE lending is based on very local conditions, and county- or MSA-level data would be more accurate. However, state-level information is available quarterly, whereas county-level data are only available annually, and MSA-level data are not available for a substantial fraction of the sample. Moreover, information on some key indicators, such as vacancy rates, is not available at the

One potential criticism of these variables as controls is that banks may engage in out-of-market lending when local conditions deteriorate. Although this is a valid concern based on anecdotes of banks that had poor experiences with out-of-market lending, two specific regulatory hurdles make out-of-market lending more difficult than in-market lending. The Federal Reserve's *Commercial Bank Examination Manual* defines the bank's "primary service area" as the market where the bank collects at least 75 percent of its total deposits.[22] Failure by the bank to adequately monitor economic and demographic conditions in the primary service area should be reported as a deficiency by the examiner-in-charge. (see section 5020.1, p.2) Moreover, examiners are directed to make additional inquiries of management when out-of-market lending increases (section 5020.3(i)). In addition, the Community Reinvestment Act requires banks operating in certain markets to reinvest those deposits locally. Therefore, when a bank engages in out-of-market lending it would typically open a branch in that area, and the conditions there would be reflected in the state-level macroeconomic variables that are used as controls.[23]

In the analysis, we include branch-weighted variables for the one-quarter change in the state unemployment rate, the one-quarter growth rate of state-level personal income, and the annualized quarterly growth in the state-level CoreLogic index of home prices. At the national level, changes in that home price measure are also highly correlated with CRE prices, for which no comprehensive state-level index is available, and so it must also act as a proxy for changes in CRE prices at the state level.

One theory of why many small- and medium-sized banks built up significant concentrations of CRE loans is because they have a comparative advantage against large institutions that do not have expertise in the local CRE markets and potential borrowers. In contrast, larger banks are said to have a comparative advantage in commoditized loan categories such as residential mortgages, credit cards, and auto loans. Based on this theory, an increase in the market share of large banks in a small-bank market might be associated with an increase in their CRE exposure as their competitiveness in other loan categories wanes.

We construct a branch-weighted state-level measure of large-bank concentration by

state or country level or for all major property types.

[22]The *Commercial Bank Examination Manual* can be found at: www.federalreserve.gov/boarddocs/supmanual/supervision_cbem.htm.

[23]More information on the Community Reinvestment Act can be found at: www.federalreserve.gov/communitydev/cra_about.htm. A critical performance criteria of the CRA service test is "the bank's record of opening and closing branches, particularly branches located in low- or moderate-income geographies or primarily serving low- or moderate-income individuals."

ranking bank holding companies by total branch offices, and we identify the 25 largest banks by that metric. Next, we identify how many branch offices those large banks operate in each state relative to the total number of branch offices of all banks in that state, creating the share of bank branches owned by the largest banks in each state. Then we calculate a bank-specific metric for their level of competition with large banks by the method previously described for other state-level variables. An increase in this measure indicates that those banks are exerting greater competitive pressures on smaller banks in that market. We expect that as this measure increases, CRE loan growth will increase while growth of the more commoditized loan categories will decline. [24]

Finally, expectations of future economic conditions will be an important determinant of lending standards in the current period. We create two indicators for conditions in the local market by isolating the one-quarter-ahead asset quality and loan growth of the bank's competitors. Such leading variables are used to control for future economic conditions in Aiyar, Calomiris, and Wieladek [2014].

First, we include the one-quarter-ahead charge-off rate of the bank's competitors. This variable is constructed by allocating each bank's total reported charge-offs and outstanding loan balances into individual states using the branch weights. For each state in which bank i holds a branch, we sum the level of charge-offs of the bank's competitors in that state as well as their outstanding loans. Next, we calculate an aggregate, state-level charge-off rate of the competitors in each state by dividing the charge-offs of all competitors by their outstanding loans. We then calculate the weighted average of the competitors' charge-off rates in all states in which bank i has branches. This variable is a forward-looking measure of expected loan losses and addresses spillovers across banks in the same market. If a competitor's loan portfolios are expected to sour, necessitating tighter lending standards, banks may move to aggressively pick up the competitor's business or alternatively, decide to reduce new originations to limit future loan losses.

Second, we construct the growth rate of total loans for the bank's competitors in a similar fashion to the charge-off rate. This variable also directly controls for forward-looking local market conditions. Strong leading loan growth indicates that local economic conditions are favorable for new lending opportunities. Conversely, slower future loan growth implies that local conditions may have deteriorated and fewer profitable lending opportunities are available.

[24] See Rhoades [1993] for more information on a related measure, the Herfindahl-Hirschman Index, and its use in banking market concentration.

4.4 Macro Variables

In addition to local economic conditions, the overall macroeconomic environment and conditions in financial markets greatly influence both the supply of loans offered by a bank as well as demand for bank loans. The growth rate of U.S. real GDP, the level of the S&P 500 VIX index, the slope of the yield curve (defined as the 10-year Treasury yield less the 2-year Treasury yield), and the target federal funds rate are included.[25] For regressions whose dependent variable is the growth of CRE or CLD exposures, we also add the change in the national level CoStar composite CRE price index and total issuance of commercial mortgage-backed securities (CMBS) in that quarter.

The effects of these variables on lending qualify as stylized facts. As real GDP increases, rising incomes spur additional spending, leading to higher loan demand. It may also be expected that firm and household balance sheets improve as national income measures rise, a process that improves the credit quality of potential bank customers and perhaps boosts loan supply. Typically, increases in the volatility of the S&P 500 index, as measured by the VIX, are associated with periods of higher uncertainty and increased risk aversion, which likely coincide with decreases in both loan supply and loan demand. We expect that a steeper yield curve is an indicator of stronger economic growth in the future and so expect that an increase in the slope variable will be associated with increased loan growth. The effect of increases in the federal funds target rate, the Federal Reserve's main policy rate over the sample period, is ambiguous. Increases in the policy rate are associated with an improving economy and thus potentially boost lending, but higher interest rates may also reduce quantity demanded and slow lending growth. Increases in CRE prices also might be ambiguous, as the increase in prices reflects investor optimism about the sector, but may also reduce affordability. Issuance of CMBS reduces on-balance-sheet growth rates.

4.5 Sample Construction

The sample used in this study begins in 1991:Q1, coinciding with the addition to the Call Report of sufficient detail on nonperforming real estate loans to isolate the performance of CRE loans from RRE loans. The end date of 2011:Q4 was chosen because it marked five years from the finalization of the guidance, at which time adjustments to the new supervisory regime are assumed to have been completed.

[25] For periods after December 2008, we use the midpoint of the federal funds rate target corridor. During this period the effective federal funds rate tended to trade near the middle of that corridor.

Several conditions were used to remove outliers. Banks that hold a small portion of their total assets in a certain type of loan may only make that loan for specific and often noneconomic reasons. For example, some banks may fund personal loans only for employees. Thus, a bank is excluded from a regression if, for the type of loan used as the dependent variable, its average holdings are less than $1 billion and the ratio of outstanding loans to total assets is less than 2 percent for any quarter in the sample.[26] Observations in which a bank had a growth rate outside the 2.5 and 97.5 percentiles for any given date within a loan category are also dropped. Activities that produce growth rate outliers may be related to adoption of accounting rules, changes in accounting methodologies, or large purchases of loan portfolios that are not merger related. We also eliminate very poorly capitalized banks, which we define as banks with leverage ratios below the regulatory minimum of 4 percent, and banks with abnormally high capital ratios, defined as leverage ratios greater than 33 percent. Banks with delinquency rates less than zero or greater than 33 percent and banks with net charge-off rates below the first percentile or greater than 20 percent are excluded. Banks with delinquency and charge-off rates outside these cutoffs generally have small outstanding loan balances or data errors. In addition, we eliminate banks with negative NIM or net interest expense ratios as well as observations where those ratios were greater than 10 percent. These cases typically result from reporting errors or when a bank exits a loan portfolio. Finally, to abstract from the obviously impaired lending capacity of deeply troubled institutions, all observations related to any bank that subsequently failed are also excluded.[27]

Without proper instrumentation, dynamic panel regression models with a limited time series dimension can result in biased coefficient estimates, as discussed by Arellano and Bond [1991] and Nickell [1981]. Therefore, banks that have less than 30 available time-series observations are dropped, a restriction that also ensures that most of the banks in the sample are active both before and after the policy change.

Applying these screens to the sample period produces a panel of banks that have a consistent record of lending in any particular loan category and do not exhibit wildly abnormal behavior in their loan portfolios or balance sheet management (see table 4). Regressions

[26] For instance, a bank whose ratio of CRE holdings to total assets falls below 2 percent in any observed quarter would not be included in the regression using growth of CRE as a dependent variable. However, banks with average CRE holdings of $1 billion or more are kept in the sample regardless of their ratio to total assets.

[27] The results did not qualitatively change when the analysis was repeated keeping failed institutions in the sample.

of CRE and CLD lending tend to have smaller numbers of banks per observation period, with the CLD regression including 548 unique banks and the CRE regression including 2,837 unique banks. The regression for consumer loans includes 4,598 unique banks and the regressions for C&I and RRE loans each include 5,830 and 6,787 banks, respectively. In addition, each regression has an average of 49 observations per bank, with a low of 38 observations per bank for the CLD model and a high of 54 observations per bank for the RRE model.

Table 3 shows the mean and standard deviations of the control variables for the fully interacted model using total CRE as the dependent variable. The distributions of the macroeconomic variables are identical over each of the loan category regressions because they vary only by time, not entity. The state-level variables had similar distributions for the other loan category regressions. Despite the exclusion of outliers previously mentioned, the sample remains representative of industry aggregates. Loan-specific measures average close to their aggregate long-term rates for each loan category. Specifically, the average delinquency rates in each loan category among sample banks are reasonably close to the aggregate delinquency rates for the universe of commercial banks in each respective loan category. Average charge-off rates for sample banks generally are significantly lower than industry-wide aggregate rates calculated at commercial banks, in part because of the exclusion of failed banks and trimming of outliers at the upper tail of the distribution.[28]

5 Empirical Strategy

The objective of this paper is to identify whether the release and implementation of supervisory guidance for CRE and CLD concentrations affected the supply of loans. In particular, the unexpected adoption of rarely used quantitative thresholds for CRE concentrations represented an exogenous shift in the loan supply curve at banks with high concentrations of those types of loans. This approach is consistent with several studies of lending during the crisis that use a crisis-period dummy to control for the financial and macroeconomic turmoil in isolating the effect of interest [Haas and van Lelyveld, 2010; Puri, Rocholl, and Steffen, 2011]. Likewise, Ivashina and Scharfstein [2010] and Calem, Covas, and Wu [2013] compare loan growth at banks before and after crisis periods that are defined by specific financial events such as the collapse in growth of syndicated lending or the subprime mort-

[28] For more information on aggregate charge-off and delinquency rates by loan category, see www.federalreserve.gov/releases/chargeoff/.

Table 3: Descriptive Statistics of Control Variables
for the Total CRE Regression

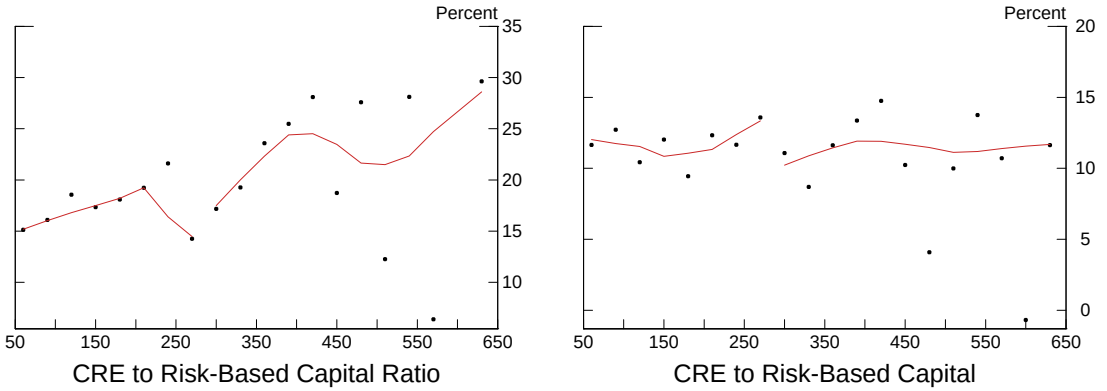
	Mean	SD	Min	Max
$\ln(Real\ Assets)$	12.45	1.37	9.05	20.89
$\frac{Tier\ 1\ capital}{Tang\ Assets}$	9.39	2.48	4.00	32.80
Core Deposits to Assets	71.18	10.44	0.67	94.82
CRE Delinquency Rate	3.36	4.30	0.00	32.99
CRE Net Charge-offs	0.10	0.45	-0.24	17.81
Net Interest Margin	1.10	0.22	0.05	6.53
Non Interest Expense	0.80	0.30	0.03	9.96
Overall State Chgoff Rate	0.18	0.17	-0.24	7.31
HPI^{growth}	2.93	5.99	-33.54	35.50
$\Delta \ln CRE^{Price}$	0.72	4.27	-15.75	10.78
$\Delta CMBS$	0.08	9.39	-39.71	34.16
$\Delta Unemp$	0.03	0.26	-0.92	1.46
Mkt Concentration	0.28	0.15	0.00	0.85
$\Delta \ln GDP$	0.65	0.64	-2.14	1.87
VIX	20.49	7.90	11.03	58.89
slope	1.19	0.95	-0.39	2.80
$Fed\ Funds^{target}$	3.42	2.06	0.13	6.50
Pct Over CRE Threshold	12.31	8.76	2.10	29.28

Note: Overall state charge-off rate is calculated using charge-offs in all loan categories at competitor banks and does not change over regressions.

gage bust. Nonetheless, because the guidance was issued so close to the beginning of the financial crisis, the usual complications of separating the effects of demand and of other supply factors from the effect of the guidance remain a significant challenge.

Regression discontinuity (RD) is one possible econometric technique to address the identification issue. RD methods are quickly becoming more popular in the program evaluation literature as a result of their fairly benign identification assumptions [Lee and Lemieux, 2010; Jacob, Zhu, Somers, and Bloom, 2012]. These assumptions are satisfied if observations are randomly assigned to the treatment group based only on a particular assignment variable that is continuous over the threshold. RD designs estimate local average treatment effects by comparing observations that fall just above or just below the threshold by assuming that those observations differ only by the fact that one received treatment while the other remains untreated.

Figure 6: Average One-Year Growth of CRE plus Commitments



(a) 1999

(b) 2006

Using an RD design, we examine growth around the threshold ratio of CRE loans to risk-based capital of 300 percent in different time periods. Figure 6(a) plots the average growth rate in 1999 of the sum of on-balance-sheet CRE loans and total unused commitments to make CRE loans against the ratio of total on-balance sheet CRE loans to risk-based capital as of 1998:Q4. The individual data points represented by the blue dots are the simple average across banks within 30 ratio points of each other. We use this scenario as a baseline test for the RD design because this time frame represents a pre-recessionary period absent the guidance effects. In this case, the average growth rate of CRE loans and commitments climbs with the concentration ratio during the 1999 period.

Figure 6(b) plots the same growth rate in 2006 against the ratio of CRE loans to risk-based capital as of 2005:Q4. During the year after the guidance was issued for comment, growth of CRE exposures was noticeably lower for banks in the bucket that included a ratio of 300 to 330 percent—at or just above the threshold— than in the bucket for 270 to 300 percent. Moreover, growth rates shifted lower for all highly concentrated segments though inference is valid in such an RD design only locally around the threshold. Thus, the simplest RD design is consistent with a causal negative effect of the CRE guidance on CRE lending activity.

Despite the widespread use and appeal of RD designs, the technique may be inappropriate for assessing the effects of the CRE guidance over time because banks below the

threshold may wish to avoid becoming a treated bank. Thus, the behavior of loan growth at banks approaching the threshold from below may be similar to banks above the threshold, making it difficult to define an effect precisely at the threshold, especially as time passes. As a result, we also use a modified version of differences-in-differences to estimate the effect of the guidance at banks over the thresholds in a panel framework with many conditioning variables.

5.1 Regression Specification

The framework used in this paper is a dynamic panel regression with bank fixed effects and robust standard errors clustered by bank. The full regression equation for the growth rate y of each loan category j at bank i for time t is shown in equation (1).

$$\begin{aligned} y_{i,j,t} \quad &= \quad \beta_0 + \sum_{n=1}^{2} \beta_n y_{i,j,t-n} + \beta_3 threshold_{i,j,t-1} \\ &+ \quad \left(\beta_4 + \beta_5 threshold_{i,j,t-1}\right) \times comment_t \\ &+ \quad \left(\beta_6 + \beta_7 threshold_{i,j,t-1}\right) \times final_t \\ &+ \quad \boldsymbol{X}_{i,t-1}\boldsymbol{\beta}_8 + \boldsymbol{Z}_{i,t-1}\boldsymbol{\beta}_9 + \boldsymbol{W}_{t-1}\boldsymbol{\beta}_{10} + \boldsymbol{A}_{i,t+1}\boldsymbol{\beta}_{11} + \varepsilon_{i,j,t} \\ where \quad & \varepsilon_{i,j,t} = v_i + e_{i,j,t} \end{aligned} \tag{1}$$

The models contain a rich set of bank-specific and general macroeconomic and financial control variables. Two lags of the dependent variable absorb autoregressive behavior in the growth rates that presumably reflects the persistence of demand and supply conditions. Many of the dynamics of the emerging financial crisis during the rollout of the guidance should be captured by these two lagged growth rates. Other control variable matrices are the following: $\boldsymbol{X}_{i,t-1}$, which denotes the bank-specific Call Report variables; $\boldsymbol{Z}_{i,t-1}$, which denotes the bank-specific, state-level variables weighted by the SOD data; and $\boldsymbol{W}_{t-1}$, which denotes the macroeconomic factors. The term $\boldsymbol{A}_{i,t+1}$ represents the one-quarter-ahead, branch-weighted, state-level rates of loan growth and loan charge-offs at the bank's competitors. The set of variables within each of the matrices is as previously described. Unless otherwise noted, the one-period lagged value of each control variable is used in the main specification to limit simultaneity bias, but a causal interpretation of the coefficients

on these control variables is not the focus of the study.

5.2 Definition of Variables for CRE Guidance

The effects of the CRE guidance on lending are identified using the interaction between a set of indicator variables for the periods during which the guidance was out for comment and then finalized and the lagged loan-to-capital ratios of individual banks. First, we define an indicator variable that takes a value of one during the four quarters of the official comment period ($comment_t$) and a second indicator variable that takes a value of one for all dates after the issuance of the finalized guidance ($final_t$). However, these indicator variables account for all of the factors that affected all of the banks in those periods. For instance, the period after the guidance was finalized also coincides with the period of the financial crisis and the sluggish recovery of 2007 to 2011, so unless the controls for demand and other supply factors are very complete, $final_t$ will capture developments during that period that are not captured by the other economic variables.

Thus, an indicator variable that takes a value of one for banks that have loan-to-capital holdings above the thresholds for loan type j at time $t-1$ ($threshold_{i,j,t-1}$) is added to the specification. Then, a variable for the interaction of the guidance date indicators with the lagged threshold indicator is added, which is equal to one for banks that exceeded the thresholds following the issuance or finalization of the guidance. The identification scheme assumes that a pair of bankers operating in the same state markets– one of which had operated a bank above the CRE concentration threshold and another that had operated a bank below that threshold– experience the same economic conditions and hold the same economic expectations regardless of the current composition of their loan portfolios. We do not explicitly include a set of branch-location by time-period fixed effects because of the proliferation of nuisance parameters that strategy would generate; rather, we control for those economic conditions across banking markets more parsimoniously with the state-level, branch-weighted controls for economic activity.

If growth was more substantial for banks near or above the specified thresholds than it was at banks that were below those thresholds, then the coefficient on this interaction term would be negative and the guidance is the most likely explanation. In contrast, if banks viewed the concentration thresholds as risky levels to be avoided independent of the guidance, then we would expect to see a negative effect on the threshold dummy alone and no significant effect on the interaction of the threshold indicator with the guidance

indicators. However, if regulators are more risk averse than banks, we would expect to see growth slow more than it otherwise would at banks that were over the thresholds after the guidance was issued. Given publicly available comments by the banks to the issuance of the guidance, it seems likely that an additional effect would have arisen after the guidance was issued.

6 Results

Our main results examine whether high concentrations of CRE loans were associated not only with slower growth in CRE lending but also with significant changes in the growth rates of other types of loans. Such a finding would suggest that banks above the CRE threshold made more sweeping changes in their overall lending policies, such as substituting out of CRE and into other business lines. We estimate equation 1 to test the effect of the threshold directly on the CRE and CLD portfolios. In both the presentation of the main results as well as the subsequent robustness checks, the growth rate of CRE and CLD loans includes both on-balance-sheet loans outstanding as well as commitments to make such loans held off-balance sheet (hereafter CRE or CLD "exposures", respectively). Spillover effects are identified by estimating equation 1 using the growth rates of non-CRE loan categories as the dependent variable and including the CRE specific threshold indicator, and its interactions with the guidance indicators, as independent variables.

6.1 Estimated Effects of CRE Guidance on Core Lending Categories

Table 4 details the estimated effects of the CRE guidance on the growth rate of each of the five core loan categories— total CRE exposures, CLD exposures, C&I loans , RRE loans, and consumer loans. The results are consistent with a significant reduction in total CRE and CLD lending exposures at banks above the threshold after the release of the guidance. Moreover, the results suggest that banks with high concentrations of CRE loans according to the guidance also adjusted lending growth in non-CRE lending categories.

The first two columns of the table detail the results for total CRE exposures and CLD exposures at banks that are above the respective thresholds stated in the guidance. The indicator variable for the comment period, $comment_t$, is significant and negative for total CRE exposures, indicating slower-than-average growth in total CRE exposures during 2006 after issuance of the guidance for comment in January, but it is insignificant and

Table 4: Effect of CRE Thresholds on Core Loan Portfolios

	(1) CRE+cmt	(2) CLD+cmt	(3) C&I	(4) RRE	(5) Consumer
$comment_t$	-0.901***	0.584	-1.009***	-0.353***	-0.445***
	(-6.73)	(0.66)	(-10.54)	(-8.46)	(-8.14)
$final_t$	-1.301***	-3.036***	-0.641***	-0.0211	0.177**
	(-11.01)	(-5.89)	(-7.71)	(-0.51)	(3.16)
$threshold_{i,j,t-1}$	-0.939***	-2.681***	-0.00691	0.407***	-0.339
	(-7.19)	(-8.91)	(-0.05)	(4.06)	(-1.82)
$threshold_{i,j,t-1} \times comment_t$	-0.633**	-2.477**	0.0760	-0.378*	0.634*
	(-2.86)	(-2.68)	(0.31)	(-2.52)	(2.26)
$threshold_{i,j,t-1} \times final_t$	-1.160***	0.0699	-0.682***	0.285*	0.598**
	(-7.46)	(0.15)	(-3.87)	(2.42)	(2.85)
Clusters	2837	548	5830	6787	4598
Avg. Obs/Bank	51.26	38.04	49.82	53.64	50.27
R-Squared	0.0540	0.0963	0.0241	0.0603	0.0701

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: The indicator for the comment period includes all dates beginning with 2006:Q1 and ending with 2006:Q4, and the indicator for the final period includes all dates beginning with 2007:Q1 and ending with 2011:Q4. Thresholds are defined by the ratio of loans to total risk-based capital (RBC). Thresholds for CRE loans, 300 percent, and CLD loans, 100 percent, are defined explicitly by the guidance. The threshold is defined with respect to total CRE loans for models where the dependent variable is a non-CRE loan category. Regressions include bank fixed effects. Sample period is 1991:Q3 to 2011:Q4. Source: FFIEC Call Reports.

positive for the CLD exposure measure. The coefficient on the indicator variable for the final period, $final_t$, is economically large, statistically significant, and negative for both the CRE and CLD exposure categories. However, the final period almost surely reflects, at least in part, the general decline in CRE and CLD lending during and after the financial crisis. The coefficient on the threshold variable is also negative and statistically and economically significant for each of the loan types, suggesting that banks with relatively high concentrations of CRE or CLD loans had generally already experienced markedly slower-than-average growth, even before issuance of the guidance.

The key results are the economically and statistically significant negative coefficients on the interaction terms in the equations. This pattern implies that CRE loan growth at banks that were over the threshold after the guidance was issued for comment and following finalization of the guidance was substantially below that of less-concentrated banks during those periods. Moreover, the marginal effect for total CRE exposures was

about $\frac{1}{2}$ percentage point larger in absolute value after finalization of the guidance than it was during the comment period. After finalization, CRE loan growth at banks that were above the threshold was nearly $1\frac{1}{4}$ percentage points lower, at a quarterly rate, than it had been at highly concentrated banks before the guidance was issued. Combining the estimates on the interaction between the final guidance indicator and the threshold with the estimate for the threshold indicator itself, CRE loan growth during the post-guidance period is estimated to have been more than 2 percentage points at a quarterly rate, or 8 percentage points annually, below the rate of growth at those banks that were not above the threshold after finalization of the guidance.

In the equation for CLD loan exposures, the effect of the guidance on banks over the respective threshold is significant and negative during the comment period. The interaction between the threshold indicator and the comment period indicator suggests that quarterly growth of CLD loan exposures declined nearly $2\frac{1}{2}$ percentage points more at banks that were above the CLD threshold during the year that the guidance was out for comment than at other banks– a substantial 10 percentage points at an annual rate. However, the interaction between the threshold and final indicator variables was not significantly different from zero for CLD exposures. A possible explanation for this pattern in the CLD equations might be that conditions worsened so quickly and so sharply in this sector during 2008 that all banks cut their exposures without regard to the regulation. That interpretation is consistent with the highly significant 3 percentage point quarterly decline in CLD exposures suggested by the coefficient on the indicator for the final period in this specification.

These same treatments of the guidance variables can be used to examine changes in the rate of growth of the three other major categories of bank loans—C&I, RRE, and consumer loans—during the period after the guidance was issued. The estimated coefficients in columns 3 through 5 of table 4 represent the effect of the issuance and finalization of the CRE guidance on the growth rates of these other loan categories. The control variables included in this specification are unchanged from those presented in section 5, with two exceptions. The equations include two lags of the growth of the dependent variable in addition to two lags of growth in total CRE exposures. The delinquency and charge-off rates included in each regression correspond to the dependent variable, not to CRE loans.

The indicator variable denoting the comment period is significant and negative for all loan categories and is much larger for C&I loans than for loans to households. The final period indicator is also negative and highly significant for C&I loans, but it is small and

insignificant for RRE loans and positive and significant for consumer loans. We note these results because the lack of significant negative coefficients on the final period indicator for RRE loans and consumer loans suggests that the variables used to control for other factors affecting supply and demand during the period after finalization of the guidance have some power to absorb the collapse in lending during and after the financial crisis. Thus, perhaps an independent effect of the guidance is at least partially visible when the coefficient on that variable is deeply negative in other loan categories.

Nonetheless, as in the CRE equations, the key coefficients for the specifications in columns 3 through 5 are those on the terms representing the interaction of the indicators for the guidance periods with the indicator for the CRE threshold. Once again, these interaction terms are significant in all three loan categories. First, banks that had high concentrations of CRE loans also experienced slower growth in C&I loans, more than 65 basis points at a quarterly rate, after the guidance was finalized than before it was issued. For RRE loans, the quarterly growth rate at banks with high concentrations of CRE loans decreased almost 40 basis points during the comment period but increased about 30 basis points after the guidance was finalized. The quarterly growth rate of consumer loans increased about 60 basis points during both the comment and final periods. These magnitudes are economically significant and somewhat striking. Banks that were concentrated in CRE lending apparently experienced greater-than-average growth, *ceteris paribus*, in household lending despite the collapse in RRE and automobile markets about the time the guidance was finalized and the subsequent tightening of lending standards for those products by most banks. One explanation for the pattern in RRE lending may be a business model in which banks with significant amounts of residential construction loans help fund residential mortgages for those clients to reduce the CLD loan portfolio. The greater consumer lending suggests that one way in which banks responded to the guidance on CRE loans was to diversify their lending portfolios.

Comparing the coefficients on the threshold indicator with the coefficients on the interaction terms reinforces the conclusion that the behavior of banks with high concentrations of CRE loans was different after the guidance was issued. The coefficient on the CRE threshold indicator is insignificant for both C&I loans and for consumer loans, indicating that over the whole sample period, growth of those types of loans was uncorrelated with high concentrations of CRE loans. Thus, the significant negative coefficient on the interaction of the threshold indicator with the final period indicator for C&I loans is compelling evidence that this relationship changed following the issuance of the guidance. Likewise,

those CRE-concentrated banks experienced faster growth in consumer loans after the guidance was issued. For RRE loans, the threshold indicator was positive and significant, just as the interaction with the final period was positive. In contrast, the interaction of the threshold with the indicator for the $comment_t$ period was negative for RRE loans, coinciding with the negative coefficient on the same interaction term in the CLD lending equation. Thus, the historical relationship between CRE and RRE loans reversed in the months immediately following issuance of the guidance. Taken together, these patterns are highly suggestive of a unique effect of the guidance, rather than a spurious relationship relating to inadequate controls for the dynamics of the financial crisis.

6.2 Discussion of Coefficients on Control Variables

Representative results of the estimated coefficients on the control variables in regressions for each of the five loan categories are provided in tables 5 to 7. These results correspond to the specification of the key guidance variables presented in table 4.[29]

The coefficient estimates for the bank-specific variables controlling for risk and profitability are generally statistically and economically significant. Lagged growth rates of the dependent variables are positive and significant in the RRE and consumer loans equations. However, for total CRE exposures, the first lag is negative and significant, and the second lag is insignificant. For CLD exposures, both lags are insignificant. Finally, both lags of C&I loan growth are negative and significant. In equations for C&I loans, RRE loans, and consumer loans, lags of both the dependent variable and the growth rate of CRE exposures are included. The sum of the lagged changes in CRE exposures in both the C&I and RRE loan equations is positive and significant, suggesting positive correlations between factors affecting demand and supply across the different categories of business and real estate lending. However, no such correlation is found between CRE lending and consumer lending.

Turning to bank condition variables, larger banks tended to grow more slowly over the period regardless of which loan category was being studied. The effect of the ratio of core deposits to total assets is positively correlated with growth of loans to households but insignificant for business lending categories. The regulatory leverage ratio was generally insignificant; however, increases in the leverage ratio are significantly positively associated

[29]The control variable results for the alternative specifications presented later did not materially differ, but are available from the authors upon request.

Table 5: Bank-Specific Balance Sheet Variables from Table 4

	(1) CRE+cmt	(2) CLD+cmt	(3) C&I	(4) RRE	(5) Consumer
$Dependent_{i,j,t-1}$		-0.00463	-0.0301***	0.131***	0.146***
		(-0.53)	(-12.13)	(51.98)	(41.56)
$Dependent_{i,j,t-2}$		0.00657	-0.00550*	0.0947***	0.0551***
		(0.80)	(-2.14)	(42.11)	(17.87)
$\ln(RealAssets)_{i,t-1}$	-0.841***	-0.896***	-0.922***	-0.502***	-1.253***
	(-9.43)	(-3.66)	(-12.80)	(-12.24)	(-16.02)
$\frac{T1cap}{TangAssets}_{i,t-1}$	-0.0278	-0.0335	0.0377*	0.00747	-0.0178
	(-1.38)	(-0.46)	(2.57)	(1.01)	(-1.69)
$DelRt_{i,j,t-1}$	-0.202***	-0.215***	-0.145***	-0.0993***	-0.139***
	(-24.71)	(-9.64)	(-27.45)	(-21.59)	(-18.89)
$\frac{CoreDep}{Assets}_{i,t-1}$	-0.00348	-0.0172	-0.00348	0.0109***	0.0239***
	(-0.69)	(-1.16)	(-1.00)	(5.21)	(7.02)
$\Delta \ln(CRE)_{i,j,t-1}$	-0.0118**		0.00444***	0.00603***	0.000215
	(-3.26)		(6.91)	(19.39)	(0.59)
$\Delta \ln(CRE)_{i,j,t-2}$	-0.000431		0.00371***	0.00507***	0.000213
	(-0.13)		(5.94)	(17.67)	(0.63)
Constant	16.22***	24.21***	14.94***	5.699***	14.43***
	(11.93)	(6.26)	(14.05)	(9.57)	(13.07)
Clusters	2837	548	5830	6787	4598
Avg. Obs/Bank	51.26	38.04	49.82	53.64	50.27
R-squared	0.0540	0.0963	0.0241	0.0603	0.0701

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Ratio variables are in percentage points. Growth rates are in percentage points at a quarterly rate. Variable definitions: Tier 1 capital ratio, total Tier 1 capital divided by average tangible assets for the regulatory leverage ratio calculation; $\ln(RealAssets)$, real total domestic assets calculated using the GDP deflator (2009:Q1=100); delinquency rate, delinquent loans in category j divided by total loans in category j; core deposits to assets, total transactions, savings, and small-time deposits held in domestic offices divided by domestic total assets. Regressions include bank fixed effects. Sample period is 1991:Q3 to 2011:Q4. Source: FFIEC Call Reports.

with C&I loan growth. A possible explanation for these patterns is that the marginal source of funding and internal economic capital allocations differ across loan types.

Indicators of asset quality had the expected signs. Across all loan categories, the coefficients on both charge-off and delinquency rates are negative, statistically significant, and economically meaningful. For example, a one-standard deviation increase in delinquency rates is associated with a more than $\frac{3}{4}$ percentage point decline in the quarterly growth

rate of CRE exposures.

Table 6: Bank-Specific Income Variables from Table 4

	(1) CRE+cmt	(2) CLD+cmt	(3) C&I	(4) RRE	(5) Consumer
$Chargeoffs_{i,j,t-1}$	-0.560***	-0.768***	-0.416***	-0.695***	-0.623***
	(-8.87)	(-5.40)	(-16.17)	(-11.97)	(-8.20)
$NIM_{i,t-1}$	-0.277	-0.948	-0.0528	-0.0812	0.219
	(-1.24)	(-1.25)	(-0.33)	(-0.95)	(1.63)
$NIE_{i,t-1}$	-0.322*	-0.525	-0.174	-0.244***	-0.0220
	(-2.27)	(-1.54)	(-1.66)	(-3.65)	(-0.22)
Clusters	2837	548	5830	6787	4598
Avg. Obs/Bank	51.26	38.04	49.82	53.64	50.27
R-squared	0.0540	0.0963	0.0241	0.0603	0.0701

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Income measures are in percentage points at a quarterly rate. Variable definitions: charge-off rate, loans charged off during the quarter divided by merger adjusted loans outstanding at the beginning of the quarter; net interest margin (NIM), net interest income divided by average total interest-earning assets; non-interest expense (NIE), total domestic noninterest expense divided by domestic total assets. Regressions include bank fixed effects. Sample period is 1991:Q3 to 2011:Q4. Source: FFIEC Call Reports.

Variation in the components of profitability had mixed effects on loan growth, perhaps because amounts attributable to each business line could not be parsed. The bank's NIM was statistically insignificant for all loan categories. However, higher noninterest expenses led to lower loan growth in all loan categories consistent with a hypothesis that growth would be subpar at less-efficient banks, though the effect is statistically significant only for CRE and RRE loans.

The signs on the coefficients associated with the branch-weighted, bank-specific, state-level economic variables (henceforth, state variables) are mostly consistent with expectations, and most of them are statistically significant for at least a few of the loan categories. For example, an increase in the weighted state-level home price index is associated with increased growth in all loan categories except, curiously, RRE loans. The same pattern is evident in the growth rate of personal income. However, the unexpected relationships between personal income growth and home price appreciation and growth of RRE loans may be related to the dynamics of securitization in this portfolio, for which controls are not consistently available over the sample period. The coefficient on the lagged change in the state unemployment rate is mixed across loan categories. Growth in C&I lending

falls as unemployment rises. Firms are likely to be deleveraging at the same time they are cutting staff, and many C&I loan commitments have material adverse change clauses, which allow banks to limit new lending when the condition of the firm deteriorates. The effect on consumer loans is also negative but statistically insignificant.[30]

The coefficient on the market concentration measure for the largest 25 banks is positive and significant for CRE exposures, indicating a greater propensity for small banks to make CRE loans when large banks enter their markets. In contrast, the effect of greater concentration on consumer loans is negative and significant. Together, the results support the hypothesis that small banks hold a comparative advantage in CRE lending over their larger rivals because of their knowledge of the local markets, and they substitute away from products such as credit cards where large banks have a comparative advantage. The effect of large bank presence in the market does not have a significant relationship with growth in CLD, C&I, and RRE loans.

The coefficient on one-quarter-ahead aggregate charge-offs at competitor banks is negative and significant for all loan categories except consumer loans. The effect is very large for total CRE and CLD loans, and it is also pronounced and significant for C&I loans. Growth of RRE lending tends to be reduced by less than other loan categories when loan losses at competitors increase while consumer loans are unaffected. These results suggest that the variable is a strong forward-looking indicator that captures banks' responses to the economic outlook. Similarly, the coefficient on the one-period-ahead loan growth at competitor banks is positive and significant, as expected, suggesting that it is a good proxy variable for the local economic conditions that are a key input to the lending decision, particularly for CRE loans.

The effects of aggregate macroeconomic and financial variables are mostly consistent with initial expectations. The coefficient on the composite CRE price index is statistically and economically insignificant, probably because local house price growth is a better control for local real estate market conditions than the national index, even though the national index is focused on CRE. An increase in CMBS issuance leads to a decrease in CRE loan growth, as expected, and the lack of a statistically significant relationship in the CLD loan equations is because CLD loans are not generally included in securitizations. A higher level

[30]In a previous version of this paper, we found that with two or more lags of the unemployment rate, the sum of the coefficients on growth of CRE loans and RRE loans was generally negative. However, including only a single lag of these variables did not change the fundamental results for key variables of interest, so the more parsimonious specification was preferred.

Table 7: State- and Macro-Level Control Variables from Table 4

	(1) CRE+cmt	(2) CLD+cmt	(3) C&I	(4) RRE	(5) Consumer
$HPI_{i,t-1}^{growth}$	0.0885***	0.112***	0.0125*	0.000406	0.0256***
	(13.10)	(5.35)	(2.32)	(0.14)	(5.85)
$\Delta\, Unemp_{i,t-1}$	0.686***	-0.0820	-0.689***	0.621***	-0.0412
	(4.77)	(-0.15)	(-7.03)	(13.84)	(-0.65)
$Chargeoffs_{k\neq i,t+1}$	-2.970***	-5.159***	-1.538***	-0.246**	-0.0227
	(-7.79)	(-5.32)	(-7.49)	(-2.63)	(-0.16)
$\Delta \ln$ *Total Loans*$_{k\neq i,t+1}$	0.0417***	0.0301	0.0665***	0.0267***	0.0500***
	(3.45)	(0.70)	(8.62)	(6.68)	(9.47)
Mkt Cont.$_{i,t-1}$	1.992***	0.751	0.0441	0.204	-0.878***
	(4.65)	(0.49)	(0.14)	(1.30)	(-3.68)
$PINC_{i,t-1}^{growth}$	0.0280***	0.0798**	0.0193***	-0.0106***	0.0784***
	(4.22)	(3.08)	(4.41)	(-4.70)	(27.74)
$\Delta \ln GDP_{t-1}$	0.0529	-0.0726	-0.272***	0.314***	-0.107***
	(1.07)	(-0.41)	(-7.98)	(18.83)	(-4.88)
$\Delta \ln CRE_{t-1}^{Price}$	-0.0112	0.0174			
	(-1.81)	(0.80)			
$\Delta\, CMBS_{t-1}$	-0.00842***	0.00803			
	(-3.63)	(0.98)			
VIX_{t-1}	-0.0123**	-0.0221	0.00165	-0.00696***	0.00547**
	(-2.89)	(-1.51)	(0.55)	(-4.64)	(2.73)
$slope_{t-1}$	-0.598***	-1.487***	-0.799***	0.174***	-0.588***
	(-7.66)	(-5.27)	(-14.70)	(6.42)	(-15.34)
$FedFunds_{t-1}^{target}$	-0.190***	-0.580***	-0.0781**	0.221***	-0.0824***
	(-4.77)	(-4.01)	(-2.82)	(16.46)	(-4.33)
Clusters	2837	548	5830	6787	4598
Avg. Obs/Bank	51.26	38.04	49.82	53.64	50.27
R-Squared	0.0540	0.0963	0.0241	0.0603	0.0701

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Yield curve slope is the difference between the 10-year and 2-year Treasury yields. State-weighted, aggregate charge-off rate is computed using the estimated state level of charge-offs at competitor banks weighted by the percent of total branches in the state. Regressions include bank fixed effects. Sample period is 1991:Q3 to 2011:Q4.

Source: GDP and state personal income, Bureau of Economic Analysis; unemployment, Department of Labor, Bureau of Labor Statistics; HPI, Corelogic; CRE prices, CoStar Group Inc. www.costar.com; CMBS issuance, *Commercial Mortgage Alert*; VIX, Bloomberg; Treasury yields, U.S. Department of the Treasury; federal funds target rate, Federal Reserve Board; all other variables, FFIEC Call Reports and Summary of Deposits

of the S&P 500 VIX, which indicates higher stock market volatility generally associated with greater uncertainty and risk aversion, is negatively associated with loan growth in most loan categories in which it is significant, as would be expected.[31] A more steeply sloped yield curve and a higher federal funds rate are associated with reduced loan growth in all categories except RRE. The positive coefficient on the two interest rate variables in the RRE loan equation may reflect the dynamics of securitization, as a higher level of rates or a steeper slope would make long-term RRE loans more profitable or perhaps induce borrowers to choose adjustable-rate mortgages, which are less likely to be securitized. However, the negative coefficients on the growth of real GDP in some loan categories are difficult to square with expectations.

7 Robustness Checks

As a straightforward robustness check on our main regression, we replace the lagged control variables with one lag of their four-quarter moving average. Using the moving average of the control variables allows us to test the sensitivity of the specification to changes in the lag structure or to the method used to seasonally adjust the data. The results using the moving-average controls, which are not presented in the interest of space, do not materially differ from those using the lagged control variables. Although the comment period indicator remains insignificant for CLD loans, the final guidance period and threshold indicators, as well as their interactions, are generally of the same sign and significance level as in the main specification. Overall, the moving-average specification confirms that the average marginal effect of issuing and finalizing the guidance is at least a $1\frac{3}{4}$ percent decrease in the growth rate of total CRE exposures and a $2\frac{3}{4}$ percentage point decrease in quarterly growth rate of CLD exposures— roughly in line with the estimates in the model with a quarterly lag of each control variable.

7.1 Time Fixed Effects

Another straightforward robustness check is to replace the set of macro-level control variables with time fixed effects. This specification controls for economic and financial shocks that affect banks uniformly. The results are presented in table 8. In this specification, the

[31] The significant positive correlation between the VIX and consumer loans may reflect draws on existing lines of credit in response to the uncertainty.

comment and final period indicators are subsumed by the time fixed effects and do not appear in the coefficient estimates.

Generally, banks over the threshold reduced total CRE and CLD exposures while increasing RRE lending as denoted by the coefficients on the variable $threshold_{i,j,t-1}$. However, banks over the CRE thresholds showed no propensity to increase C&I or consumer lending prior to the guidance. After the guidance was issued for comment, concentrated banks quickly reduced their CLD and RRE holdings. Following finalization, banks over the threshold reduced total CRE and C&I lending relative to unconcentrated banks. These results are consistent with the baseline specification that includes a set of macroeconomic and financial factors.

Table 8: Effect of CRE Thresholds on Core Loan Portfolios

	(1) CRE+cmt	(2) CLD+cmt	(3) C&I	(4) RRE	(5) Consumer
$threshold_{i,j,t-1}$	-1.204***	-2.937***	0.0715	0.375***	0.00606
	(-9.22)	(-9.63)	(0.49)	(3.71)	(0.03)
$threshold_{i,j,t-1} \times comment_t$	-0.385	-2.551**	0.0102	-0.501***	0.310
	(-1.75)	(-2.75)	(0.04)	(-3.31)	(1.15)
$threshold_{i,j,t-1} \times final_t$	-1.187***	-0.681	-0.932***	0.172	-0.106
	(-7.58)	(-1.46)	(-5.27)	(1.47)	(-0.55)
Clusters	2837	548	5830	6787	4598
Avg. Obs/Bank	51.26	38.04	49.82	53.64	50.27
R-Squared	0.0648	0.112	0.0344	0.0828	0.192

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: The indicator for the comment period includes all dates beginning with 2006:Q1 and ending with 2006:Q4, and the indicator for the final period includes all dates beginning with 2007:Q1 and ending with 2011:Q4. Thresholds are defined by the ratio of loans to total risk-based capital (RBC). Thresholds for CRE loans, 300 percent, and CLD loans, 100 percent, are defined explicitly by the guidance. The threshold is defined with respect to total CRE loans for models where the dependent variable is a non-CRE loan category. Regressions include bank and time fixed effects. Sample period is 1991:Q3 to 2011:Q4. Source: FFIEC Call Reports.

7.2 Distance from the Thresholds

Table 9 shows whether the guidance had a greater effect on banks that were further from the proposed thresholds than banks with lower concentration ratios. For CRE exposures, we consider banks with ratios of CRE loans to risk-based capital of greater than 400 percent to be "far" from the threshold. Banks with concentration ratios between 250 and 400

percent are considered "near" the threshold. For CLD loans, banks are considered "near" the threshold if they have concentration ratios between 80 to 120 percent and "far" from the threshold for concentration ratios of more than 120 percent.

Table 9: Portfolio Loan Growth by Distance from Threshold

	(1) CRE+cmt	(2) CLD+cmt	(3) C&I	(4) RRE	(5) Consumer
$comment_t$	-0.872***	1.255	-0.984***	-0.359***	-0.454***
	(-6.11)	(1.12)	(-9.90)	(-8.48)	(-8.22)
$final_t$	-1.164***	-2.941***	-0.628***	-0.0321	0.166**
	(-9.81)	(-5.13)	(-7.53)	(-0.78)	(2.96)
$threshold^{near}_{i,j,t-1}$	-1.014***	-2.540***	0.00205	0.308***	-0.401**
	(-8.16)	(-7.19)	(0.02)	(4.17)	(-2.96)
$threshold^{far}_{i,j,t-1}$	-1.843***	-3.787***	-0.106	0.817***	-0.238
	(-9.07)	(-10.14)	(-0.41)	(4.56)	(-0.57)
$threshold^{near}_{i,j,t-1} \times$ comment	-0.308	-1.397	-0.166	-0.150	0.658**
	(-1.37)	(-1.09)	(-0.74)	(-1.18)	(2.89)
$threshold^{far}_{i,j,t-1} \times$ comment	-0.658*	-3.310**	0.220	-0.530*	0.123
	(-2.10)	(-2.82)	(0.59)	(-2.04)	(0.25)
$threshold^{near}_{i,j,t-1} \times$ final	-1.022***	0.249	-0.486***	0.161	0.650***
	(-7.10)	(0.46)	(-3.33)	(1.81)	(4.03)
$threshold^{far}_{i,j,t-1} \times$ final	-1.284***	0.00120	-0.555	0.457*	0.340
	(-5.62)	(0.00)	(-1.75)	(2.17)	(0.77)
Clusters	2837	548	5830	6787	4598
Avg. Obs/Bank	51.26	38.04	49.82	53.64	50.27
R-Squared	0.0550	0.0983	0.0241	0.0604	0.0701

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: The indicator for the comment period includes all dates beginning with 2006:Q1 and ending with 2006:Q4, and the indicator for the final period includes all dates beginning with 2007:Q1 and ending with 2011:Q4. Thresholds are defined by the ratio of loans to total risk-based capital (RBC). Banks near the CRE threshold are defined as having CRE loans to RBC ratios between 250 and 400 percent. Banks far from the CRE threshold are defined as having CRE to RBC ratios greater than 400 percent. For CLD loans, the applicable thresholds are the following: near, CLD loans to RBC ratios of 80 to 120 percent; far, CLD loans to RBC ratios greater than 120 percent. The threshold is defined with respect to total CRE loans for models where the dependent variable is a non-CRE loan category. Regressions include bank fixed effects. Sample period is 1991:Q3 to 2011:Q4. Source: FFIEC Call Reports.

In general, the coefficients on the uninteracted threshold variables indicate that banks with greater concentrations of CRE and CLD loans reduced their portfolios at a greater rate than less-concentrated banks as denoted by the coefficient on $threshold^{far}_{i,j,t-1}$. The

effect for banks far from the threshold is also consistent with the negative coefficient on the ratio in the continuous model. Following the issuance of the guidance for comment, there was no statistically significant effect for banks near the threshold for either CRE or CLD exposures. However, banks far from the respective thresholds experienced reduced loan growth in each category at a statistically significant rate following issuance of the guidance. After the guidance was finalized, banks both close to and far from the threshold reduced CRE lending. The negative and significant coefficient on banks with concentration ratios between 250 and 400 percent after accounting for other control variables strengthens the earlier result using just the RD design at the 300 percent level. However, the marginal effect on the growth rate is not statistically different from zero for banks over the CLD thresholds following finalization of the guidance. These results are fully consistent with the more parsimonious threshold model.

The nonresponse for banks near the threshold may be interpreted as a reaction to the release of the guidance for comment. More specifically, during the comment period, banks near the threshold did not react immediately, as they were lobbying the banking agencies to increase the thresholds. These institutions required only a small adjustment in their CRE portfolios to comply with the guidance and likely hoped that no adjustment would be necessary given an increase in the concentration thresholds after finalization. Conversely, banks far from the threshold likely realized that an adjustment would ultimately be required and reacted immediately to the issuance of the guidance. After finalization, banks just above the thresholds shrank at about the same rate as banks that were far from the threshold. Moreover, the rate of shrinkage for banks far from the thresholds doubled after finalization compared with the comment period.

Table 9 also suggests another result consistent with a causal effect of the CRE guidance on other loan categories. Much of the subsequent spillover effects to C&I and RRE portfolios were due to banks that were close to the thresholds. Indeed, banks near the CRE threshold after finalization reduced C&I lending by nearly $\frac{1}{2}$ percentage point and increased consumer lending about 65 basis points. The coefficient on the interaction between banks close to the CRE threshold and the comment period indicator is also large, positive, and significant in the consumer loans equation. A stronger spillover effect at banks close to the threshold and during the comment period might be expected as those institutions actively move to manage their exposures around the unexpected thresholds on CRE concentrations. Alternatively, banks far from the thresholds exhibited the largest effects in the RRE category, with the signs and magnitudes of those coefficients similar to those in

the simpler model.

7.3 Continuous Ratio Variables

Table 10 presents the results of an alternative regression specification that replaces the discrete threshold indicator with the continuous loans-to-capital ratio. For the non-CRE categories in table 10, the loan-to-capital ratio is with respect to total CRE loans. The coefficients on the uninteracted comment period indicator and final period indicator are fully consistent with their coefficients in the main model. Most notably, in the CLD equation, the coefficient on the final period indicator is again deeply negative. Consistent with the results for the uninteracted threshold indicator variable, banks with higher ratios of loans to risk-based capital for CRE and CLD are also associated with significantly slower loan growth, again suggesting that banks generally tighten their lending posture in these categories as their concentrations grow.

Table 10: Effect of CRE Concentration Ratios on Core Loan Portfolios

	(1) CRE+cmt	(2) CLD+cmt	(3) C&I	(4) RRE	(5) Consumer
$comment_t$	-0.4360*	-0.3671	-0.9228***	-0.3293***	-0.6054***
	(-1.97)	(-0.48)	(-6.74)	(-5.78)	(-8.01)
$final_t$	-0.3391*	-3.0717***	-0.2693**	-0.1228*	0.0983
	(-2.19)	(-5.26)	(-2.78)	(-2.55)	(1.57)
$\frac{loans_{i,j,t-1}}{RBC_{i,t-1}}$	-0.0128***	-0.0282***	0.0004	0.0035***	-0.0035***
	(-17.60)	(-11.39)	(0.87)	(11.73)	(-6.82)
$\frac{loans_{i,j,t-1}}{RBC_{i,t-1}} \times comment_t$	-0.0012	-0.0016	-0.0008	-0.0010**	0.0025***
	(-1.52)	(-0.50)	(-1.18)	(-2.82)	(4.48)
$\frac{loans_{i,j,t-1}}{RBC_{i,t-1}} \times final_t$	-0.0039***	0.0040	-0.0034***	0.0004	0.0017***
	(-7.01)	(1.45)	(-7.48)	(1.53)	(3.94)
Clusters	2837	548	5830	6787	4598
Avg. Obs/Bank	51.26	38.04	49.82	53.64	50.27
R-Squared	0.0589	0.101	0.0243	0.0609	0.0704

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: The indicator for the comment period includes all dates beginning with 2006:Q1 and ending with 2006:Q4, and the indicator for the final period includes all dates beginning with 2007:Q1 and ending with 2011:Q4. Loans to risk-based capital (RBC) ratios are with respect to CRE loans for all loan categories except CLD loans. Regressions include bank fixed effects. Sample period is 1991:Q3 to 2011:Q4. Source: FFIEC Call Reports.

For total CRE exposures, the results and conclusions based on the interaction terms using the ratio rather than the threshold indicator are roughly equivalent to the marginal effect in the main regression for CRE loans. However, an important difference between the two models emerges in the CLD equation. Notably, neither the interaction of the ratio of CLD loans to risk-based capital with the comment period nor the coefficient on the interaction between the final period indicator and the risk-based capital ratio is statistically significant, as opposed to the large negative coefficient on the interaction term between the threshold indicator and the comment period.

Taken together, the evidence is very robust that growth of total CRE loans slowed more quickly following issuance of the guidance at banks that had breached the specified thresholds, and it slowed further after the finalization of the guidance. Whether the guidance had an independent effect on CLD loans is somewhat ambiguous, however. The effect on CLD loans may be harder to identify in part because of the much greater reliance on longer-term lending commitments in that market and, perhaps, because the collapse of that market was so severe that a large number of banks quickly moved to cut their exposures, irrespective of the effect of the guidance. If the latter were true, then all of the effect would be captured in the coefficient on the indicator variable for the final period, which was indeed significant and deeply negative in all specifications for CLD exposures.

Columns 3 through 5 in table 10 detail the results of the regressions that include the ratio of CRE loans to risk-based capital for the non-CRE loan categories. The direction and significance of the marginal effects of the issuance and finalization of the guidance are the same as when the thresholds are used. The marginal effects evaluated at the guidance threshold (300 percent) are roughly equal to the threshold results for consumer loans. The coefficient on the finalization interaction term for C&I loans is more than 1 percentage point at a quarterly rate, about $1\frac{1}{2}$ times the effect found in the regression using the threshold rather than the continuous variable, suggesting an even stronger reaction to the guidance. For RRE loans, the effect of finalizing the guidance remains positive but smaller than the estimated result from the discrete threshold models and insignificant.

The relatively large apparent spillover of the CRE guidance into C&I lending may be partly related to the inclusion of certain small business loans in the definition of CRE for purposes of the guidance but as C&I loans on the Call Report. However, data available only over the latter part of the sample suggest that this category is small and therefore unlikely to fully account for the result. In addition, some loans for which commercial properties account for less than 50 percent of the collateral are booked as C&I loans. If these loans

were affected, it would have resulted from a misunderstanding or misapplication of the guidance and would have been an unintended consequence of the regulation.

7.4 Early/Late Period Indicators

Another robustness check involves splitting the final period into two sub periods, which provide additional insight into the pace of banks' adjustments to the guidance. These results are presented in table 11. For this exercise, we define the early portion of the final period as 2007:Q1 to 2009:Q4 and the latter portion as 2010:Q1 to 2011:Q4. The results for CRE and CLD are unaffected by the split in the final period indicator. The reduced growth rate of CRE exposures at concentrated banks relative to unconcentrated banks was roughly the same across the early and late periods, and CLD exposures were not growing differentially at concentrated and unconcentrated banks during either period. In contrast, the effect on C&I loans appears to reach its maximum intensity after 2009 which suggests a long-lasting effect of the guidance in those markets and may explain some of the overall sluggishness in lending during the early stages of the recovery. However, the effect in consumer lending apparently was strongest during the comment period and in the first two years after the guidance was finalized, with the effect becoming statistically insignificant in 2010 and 2011.

7.5 Hypothetical Thresholds

Another check is whether high concentrations in the non-CRE loan categories had differential effects on lending before and after the issuance of the CRE guidance. If the effects on growth of CRE loans at banks above the thresholds are larger than for other types of loans when they are above similarly defined thresholds, that would provide additional support for the notion that the guidance resulted in more restrained lending than banks' traditional risk management would have produced. Alternatively, if the effect of high concentrations in a specific loan category is both large and different before and after the guidance, then that might be evidence that the CRE guidance caused banks or their regulators to focus on concentration risk more broadly. The results are presented in table 12 where the specification corresponds to that of table 4 but with the loan-specific thresholds generally defined as about one standard deviation above the mean concentration ratio of the dependent loan variable category. Columns 1 and 2 of table 4 are reproduced in table 12 to ease comparisons of the results across the different models.

Table 11: Split Final Period Indicator

	(1) CRE+cmt	(2) CLD+cmt	(3) C&I	(4) RRE	(5) Consumer
$comment_t$	-0.699***	0.941	-0.962***	-0.292***	-0.391***
	(-5.22)	(1.05)	(-10.01)	(-6.96)	(-7.11)
$final_{2007:1t}$	-0.441***	-1.222	-0.464***	0.318***	0.476***
	(-3.54)	(-1.95)	(-5.19)	(7.18)	(8.11)
$final_{2010:1t}$	-2.825***	-5.078***	-0.987***	-0.655***	-0.431***
	(-19.31)	(-8.20)	(-9.39)	(-13.30)	(-6.12)
$threshold_{i,j,t-1}$	-1.085***	-2.744***	-0.0530	0.342***	-0.398*
	(-8.32)	(-9.13)	(-0.36)	(3.41)	(-2.13)
$threshold_{i,j,t-1} \times comment_t$	-0.570**	-2.633**	0.102	-0.344*	0.662*
	(-2.59)	(-2.83)	(0.41)	(-2.28)	(2.36)
$threshold_{i,j,t-1} \times final_{2007:1t}$	-1.131***	-0.966	-0.237	0.528***	0.576**
	(-6.72)	(-1.69)	(-1.29)	(4.26)	(2.65)
$threshold_{i,j,t-1} \times final_{2010:1t}$	-1.658***	-0.119	-2.204***	-0.680***	0.389
	(-8.00)	(-0.21)	(-7.98)	(-4.81)	(1.19)
Clusters	2837	548	5830	6787	4598
Avg. Obs/Bank	51.26	38.04	49.82	53.64	50.27
R-Squared	0.0560	0.0980	0.0245	0.0618	0.0710

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: The indicator for the comment period includes all dates beginning with 2006:Q1 and ending with 2006:Q4. The final period indicator has been split into two segments where the variable $final_{2007:1t}$ denotes dates between 2007:Q1 and 2009:Q4 and the variable $final_{2010:1t}$ denotes dates between 2010:Q1 and 2011:Q4. Thresholds are defined by the ratio of loans to total risk-based capital (RBC). Thresholds for CRE loans, 300 percent, and CLD loans, 100 percent, are defined explicitly by the guidance. The threshold is defined with respect to total CRE loans for models where the dependent variable is a non-CRE loan category. Regressions include bank fixed effects. Sample period is 1991:Q3 to 2011:Q4. Source: FFIEC Call Reports.

The loan category specific threshold indicator is negative and statistically significant for all specifications, indicating that banks with high concentrations in a given loan category generally experienced slower growth in that loan category over the entire sample period even after controlling for other factors affecting supply and demand. In addition, the coefficients on the interaction terms between the thresholds and indicators for the comment period and final period in the non-CRE loan categories are all negative and mostly significant. This result suggests that banks with greater loan concentrations than their peers in a given lending portfolio generally further reduced their exposures to that loan type after the issuance of the guidance. However, the magnitude of the reduction in the growth rate of C&I, RRE, and consumer loans at banks with high concentrations of those loans was

Table 12: Effect of Hypothetical Thresholds on Core Loan Portfolios

	(1) CRE+cmt	(2) CLD+cmt	(3) C&I	(4) RRE	(5) Consumer
$comment_t$	-0.901***	0.584	-0.942***	-0.402***	-0.422***
	(-6.73)	(0.66)	(-9.97)	(-9.19)	(-7.77)
$final_t$	-1.301***	-3.036***	-0.704***	-0.00609	0.178**
	(-11.01)	(-5.89)	(-8.54)	(-0.15)	(3.21)
$threshold_{i,j,t-1}$	-0.939***	-2.681***	-1.105***	-0.830***	-0.479***
	(-7.19)	(-8.91)	(-14.36)	(-22.48)	(-6.10)
$threshold_{i,j,t-1} \times comment_t$	-0.633**	-2.477**	-0.687**	-0.137	-0.867**
	(-2.86)	(-2.68)	(-3.20)	(-1.63)	(-3.11)
$threshold_{i,j,t-1} \times final_t$	-1.160***	0.0699	-0.640***	-0.357***	-0.0611
	(-7.46)	(0.15)	(-4.24)	(-6.06)	(-0.31)
Clusters	2837	548	5873	6823	4657
Avg. Obs/Bank	51.26	38.04	50.82	54.98	51.42
R-Squared	0.0540	0.0963	0.0244	0.0588	0.0675

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: The indicator for the comment period includes all dates beginning with 2006:Q1 and ending with 2006:Q4, and the final period includes all dates beginning with 2007:Q1 and ending with 2011:Q4. Thresholds are defined by the ratio of loans to total risk-based capital (RBC). Thresholds for CRE loans, 300 percent, and CLD loans, 100 percent, are defined explicitly by the final guidance. Non-CRE loan category thresholds are based on the concentration distributions in table 1. Specifically, the non-CRE loan category thresholds are the following: C&I loans, 200 percent; RRE loans, 300 percent; and consumer loans, 200 percent. Regressions include bank fixed effects. Sample period is 1991:Q3 to 2011:Q4. Source: FFIEC Call Reports.

somewhat less pronounced than the declines in the two CRE categories, especially in the CLD exposure category. On average, over the comment and final period, the growth of total CRE exposures was about 1 percentage point lower than at less-concentrated banks at a quarterly rate, whereas the reductions in growth rates at banks with high concentrations of C&I, RRE, and consumer loans averaged 65 basis points, 25 basis points, and 46 basis points, respectively, over the same period.

The effect of high concentrations in CRE loans on those other loan categories also was much different from the effect of own-category concentration. Growth of RRE loans was, on average, about 35 basis points lower at banks above the hypothetical threshold for RRE after finalization of the CRE guidance than before the guidance was issued. The RRE result in the hypothetical model contrasts with our finding of a slight increase in the growth rate of RRE loans after finalization at banks that had concentrations of CRE loans. Hence, banks with concentrations of CRE loans continued making RRE loans after finalization

of the guidance, while banks with RRE concentrations slowed their buildup of such loans. This pattern is consistent with banks reacting to supervisory concerns about concentration risk more broadly, perhaps signaled by the issuance of the guidance. The same is true of consumer loans: Banks with large concentrations of consumer loans generally reduced such lending following issuance of the guidance, but banks with concentrations of CRE loans showed a somewhat greater propensity to make such loans. C&I loans show a less stark but somewhat similar pattern: Banks with high concentrations of C&I loans experienced slower loan growth following the initial issuance of the guidance, and this effect persisted after finalization. In contrast, banks with CRE loan concentrations did not start reducing C&I loan growth until after finalization.

7.6 Previous Recession Period

As previously noted, one possible criticism of the identification strategy is that the comment and final period indicators may measure crisis-related effects in lending markets rather than isolating the effects of the guidance. One way to address this concern is to study whether highly concentrated banks behaved differently in the periods surrounding earlier recessions than during the crisis period and its aftermath. In this section, we define a hypothetical comment period as the four quarters of 1999, which begins two years before the onset of the NBER recession in March 2001, the same amount of time between the January 2006 issuance of the guidance for comment and the beginning of the recession in December 2007, as dated by the National Bureau of Economic Research (NBER). An analogous definition of a hypothetical final period coming out of the earlier recession would then include all dates between 2000:Q1 and 2004:Q4. The thresholds for CRE and CLD concentrations during these hypothetical periods are defined according to the 2006 guidance. The model is then reestimated for 1991:Q1 through 2004:Q4. Because of data limitations, this is the only other recession and recovery period in which the same set of controls used in the main section is available.

Table 13 shows the regression results for this pre-2004 sample. Looking first at the indicator variable for the hypothetical issuance of a guidance for comment two years before the onset of recession, total CRE increased at a statistically and economically significant rate; however, no effect is evident during the period after the hypothetical finalization of the guidance. Likewise, the coefficients on the 2000 to 2004 indicator ($final_t$) and the 1999 indicator ($comment_t$) in the CLD exposures specification are not statistically different from

zero. These results contrast with the significant and negative coefficients on the comment and final period indicators in both of the CRE categories for the full sample. In contrast, the threshold indicator variable has the same negative sign in the truncated sample as in the full sample; thus, concentrated banks tended to have lower-than-average growth rates even in the absence of the guidance.

Table 13: Pre-2004 Effect of CRE Thresholds on Core Loan Portfolios

	(1) CRE+cmt	(2) CLD+cmt	(3) C&I	(4) RRE	(5) Consumer
$comment_t$	0.645***	0.509	0.111	0.459***	0.462***
	(3.75)	(0.74)	(1.14)	(9.82)	(7.14)
$final_t$	0.0593	-0.412	-0.335***	0.154***	-0.0812
	(0.42)	(-0.73)	(-3.90)	(3.69)	(-1.35)
$threshold_{i,j,t-1}$	-1.080**	-3.841***	-0.189	-0.00779	-0.605
	(-3.26)	(-8.22)	(-0.48)	(-0.03)	(-0.90)
$threshold_{i,j,t-1} \times comment_t$	-0.387	-0.900	1.485*	0.499	0.815
	(-0.75)	(-1.09)	(2.29)	(1.32)	(0.68)
$threshold_{i,j,t-1} \times final_t$	-0.784*	0.296	-0.102	0.759**	0.445
	(-2.25)	(0.52)	(-0.26)	(2.83)	(0.61)
Clusters	2569	457	5428	6458	4355
Avg. Obs/Bank	35.67	29.02	37.18	39.36	36.44
R-Squared	0.0122	0.0273	0.0161	0.0484	0.0714

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: The indicator for the comment period includes all dates beginning with 1999:Q1 and ending with 1999:Q4, and the indicator for the final period includes all dates beginning with 2000:Q1 and ending with 2004:Q4. Thresholds are defined by the ratio of loans to total risk-based capital (RBC). Thresholds for CRE loans, 300 percent, and CLD loans, 100 percent, are defined explicitly by the guidance. The threshold is defined with respect to total CRE loans for models where the dependent variable is a non-CRE loan category. Regressions include bank fixed effects. Sample period is 1991:Q3 to 2004:Q4. Source: FFIEC Call Reports.

The key result is that the coefficient on the interaction term between the threshold and comment period indicators is not significant in any of the regressions except for C&I, where it is positive and only significant at the 5 percent level. This result for C&I loan growth contrasts with the findings shown in table 4 where the comment period for the 2006 guidance is associated with lower-than-average growth in both total CRE and CLD exposures and no significant effect on C&I lending at CRE-concentrated banks. The results also indicate no significant effect of the hypothetical comment period on either RRE or consumer lending, whereas in the full sample RRE lending declined following the issuance

of the guidance for comment while consumer lending increased.

Turning to the coefficient on the interaction between the threshold and final period indicators, banks above the CRE concentration thresholds during the 2000:Q1 to 2004:Q4 period experienced slower growth than their peers in total CRE exposures, but the results suggest no significant effect of CLD concentrations on CLD lending. These results generally match the pattern observed from 2007 to 2011 in the full sample regression, though the effect on total CRE lending is somewhat larger during the 2007-11 period. During the hypothetical final period, RRE loans at CRE-concentrated banks increased, *ceteris paribus*— a result that also is similar to the results of the full sample regression. Thus, there seems to be a consistent link between CRE and RRE loans over time at banks with high concentrations of CRE loans.

However, the results of the hypothetical exercise for C&I loan and consumer loan portfolios are inconsistent with the results for the post-guidance period. C&I loan growth was not statistically different across CRE-concentrated banks and other banks between 2000 and 2004, whereas it was significantly slower at CRE-concentrated banks between 2007 and 2011. The coefficients on the interaction terms between 2000 and 2004 in the regression for growth of consumer loans were insignificant, but they were relatively faster at CRE-concentrated banks between 2007 and 2011. These results strongly support the conclusion that the spillover effects associated with the post-guidance period are causal rather than spurious.

8 Conclusion

The Great Recession highlighted the potentially critical role that banks, and financial institutions more generally, play in the evolution of economic fluctuations— either as sources of macroeconomic shocks or transmission mechanisms for such shocks. As a result, the emerging post-crisis regulatory regime has focused on improving overall financial stability in addition to its traditional focus on ensuring the health of individual institutions. This "macroprudential approach" to regulation is often described as including efforts to identify a build-up of risk in particular sectors and then address those developments preemptively. The 2006 supervisory guidance in the United States, which related to rising concentrations of CRE loans in the community banking sector, was arguably an example of how such a regime might work.

The guidance was designed to help limit losses on CRE loans at banking organizations in

the event of a sectoral or broader economic disruption. The implementation of the guidance, which was issued for comment in early 2006 and finalized late that year, coincided with the early stages of the economic downturn that culminated with the financial crisis. As such, the intended effect of the guidance—preventing further buildups of concentrated real estate exposures—may have helped some banks avoid even worse outcomes in the subsequent real estate crash. However, in coming at just the time when many borrowers might have needed to work with willing lenders to survive, the guidance may have had the unintended effect of exacerbating the downturn, particularly in some local markets served by banks that had chosen to specialize in CRE loans.

This paper argues that the unexpected introduction of quantitative thresholds into the process by which supervisors evaluated banks' exposures to CRE under the 2006 guidance represented an exogenous negative shock to the supply of bank loans to businesses. Even after controlling for past growth in such loans, the financial condition of the bank, the economic conditions in its local markets, and national economic and financial conditions, we find evidence that the growth rate of total CRE exposures and CLD exposures at banks above the specified thresholds slowed considerably relative to banks below the thresholds after the guidance was issued for comment and that the damping effects on total CRE exposures continued through 2011.

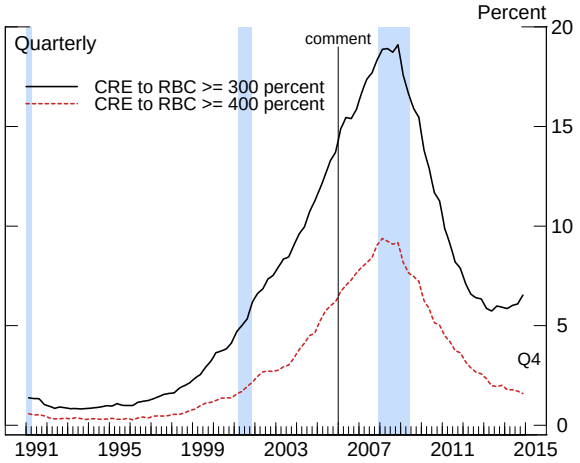
Moreover, the guidance appears to have had significant effects on other loan categories, and those effects were different from how those banks had adjusted to high concentrations in CRE exposures before the guidance was issued. These results provide additional support for interpreting the observed effects as causal. For instance, banks that were above the thresholds for CRE loans had lower-than-average growth rates of C&I loans after finalization of the guidance, though CRE concentrations had previously had no discernible effect on C&I lending. The growth rate of consumer lending was more rapid at banks that were above the CRE thresholds during both the comment period and after the guidance was finalized relative to banks below the CRE threshold, whereas prior to issuance of the guidance, banks with high concentrations of CRE loans had, if anything, slightly slower growth in consumer loans. The growth of RRE loans was significantly slower at CRE-concentrated banks during the 2006 comment period, a reversal of the historical relationship; however, after the rule was finalized in 2007, the historical relationship reestablished itself and growth at banks affected by the guidance was stronger relative to those that were not affected.

These main results pass several robustness tests, which provide further support for the hypothesis that the guidance had causal effects on loan supply. First, a different

econometric method, RD design analysis, also indicates that the issuance of the guidance in January 2006 had a pronounced damping effect on CRE loan growth during that year at banks that entered the year just above the threshold compared with banks that were just below the threshold— a result that strengthens the plausibility of the main identification assumption by narrowing the band to just those banks most likely to change their behavior to avoid the extra scrutiny of exceeding the threshold. This result is confirmed with a multivariate regression that controls for whether banks were close to or far from the threshold levels in the guidance. That exercise shows that banks near the thresholds cut CRE lending at about the same relative rate as banks that were substantially above those thresholds. Hence, the main results are not an artifact of concentrated banks being more likely to cut lending at greater rates. To further rule out that type of spurious relationship, we also show that no effects of high concentrations of CRE loans were apparent on the growth of CRE loans or other loan categories at a similar point in the previous business cycle. In turn, that result is consistent with a comparison of the coefficient on the threshold indicators across the main specifications with the interaction terms, all of which clearly show that the relationship between concentrations of CRE loans and loan growth changed after the issuance of the guidance in 2006. Finally, although banks that had maintained high concentrations of C&I, RRE, or consumer loans also appeared to reduce the growth in the respective lending category after the issuance of the guidance, those effects were somewhat smaller than those in the CRE exposure categories. This result is also consistent with the guidance having caused a larger-than-normal retrenchment, rather than the effect being a spurious response to high concentrations.

More generally, the results of this exercise highlight that attempts to tackle macroprudential concerns by increasing the regulation of specific sectors have both benefits and costs. The guidance appears to have caused banks to reduce the growth rate of CRE exposures, and particularly of CLD exposures, at least somewhat more aggressively than would have been predicted based on historical relationships between those exposures and the set of controls used in the analysis. Nonetheless, the material spillover effects to other sectors documented here show that the sector-specific approach to macroprudential regulation can have substantial and perhaps unintended effects in non-targeted areas. As a result, we conclude that the CRE guidance was one factor contributing to a much greater-than-normal tightening of business lending conditions during the early part of the crisis. Indeed, despite assurances by regulators that the thresholds identified in the guidance do not represent caps on CRE exposures, the share of banks with concentrations in excess of

Figure 7: Share of Banks by CRE Concentration



Source: FFIEC Call Reports.

those thresholds has yet to materially increase (figure 7).

That said, the evidence also suggests that banks' response to the guidance may have contributed to somewhat less restrictive conditions in consumer loans between 2006 and 2009 and, at times, more willingness to hold residential mortgages on their books. During those periods where banks responded to the guidance by redeploying capital from CRE to RRE, the result was simply a trade-off of one type of real estate lending for another. In past cycles, such a trade might have been beneficial; however, the net result of such substitution on the riskiness of banks during the most recent cycle is less clear.

Prudence necessitates a list of caveats to these findings. Potentially, the findings reflect nonlinearities in loan growth for the most concentrated banks in response to increasingly weaker fundamentals leading up to the financial crisis. However, our numerous robustness checks argue against such a conclusion, perhaps because the dynamic nature of the empirical specification has controlled for such effects. More simply, disentangling the effects of the crisis from the issuance of the guidance is a key identification challenge. Therefore, we have focused on the effects of the guidance on concentrated banks rather than on overall loan growth.

Moreover, this research does not attempt to answer some key questions about the guidance. Most importantly, our analysis does not address whether banks with reduced concentrations of CRE are now operating with less overall risk than before the issuance of

the guidance. Although the guidance may have reduced the growth of CRE loans, promoting loan growth at the expense of long-term bank health would be an unwise regulatory objective. Future studies of this regulation may examine whether the banks are, in fact, less risky now that their CRE concentration is limited or examine how banks that adjusted their concentrations as a result of the guidance fared throughout the crisis.

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