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

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Abstract

In the mid-2000s, federal bank regulatory agencies became alarmed by steadily increasing concentrations of commercial real estate (CRE) loans at many banks, particularly loans used to finance construction and land development (CLD). In January 2006, they issued guidance that required banks with specific high concentrations in those asset classes 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 and CLD portfolios than can be explained by changes in the health of their balance sheets and economic conditions. Moreover, banks that were above the CRE thresholds also tended to have slower growth in C&I loans but faster growth in loans to households after the guidance was issued. The results highlight the potential for this type of macroprudential regulation to have a significant and broad influence on bank behavior.

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

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1 Introduction

Economists have long hypothesized that the commercial banking sector may serve as a propagation mechanism for, or a source of, macroeconomic 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, a number of 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].

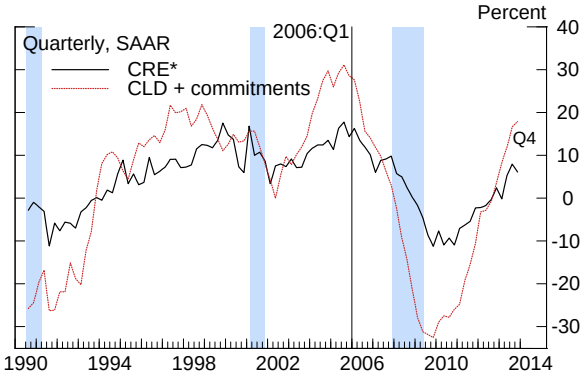
The deep recession and weak recovery in many advanced economies associated with the financial crisis of 2007 to 2009 reinvigorated the study of linkages between financial stability, bank lending, and economic performance. In the aftermath of that financial crisis, national and international banking regulators have layered numerous new regulations, such as those contained in Basel 3 and the Dodd-Frank Act, in an attempt to avoid a repeat of the excesses that built up in that 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 in the United States in early 2006, shortly before the crisis emerged. As shown in figure 1, growth of commercial real estate (CRE) loans was rapid in the early 2000s and reached upwards of 15 percent in late 2005. In addition, much of that increase was due to a steep rise in the subcomponent of construction and land development (CLD) loans and associated off-balance sheet commitments to fund such loans, which had a combined growth rate of nearly 30 percent in 2005. Worried by the persistent build up of concentrations in CRE lending and associated off-balance-sheet exposures, especially at regional and community banks, federal regulators jointly issued supervisory guidance for public comment in January 2006.

Formal guidance is a common and well-understood tool that federal regulators can use to influence bank behavior in a more-flexible and more-timely manner than is possible with official rulemakings. However, this particular guidance was unique. It contained very specific numerical thresholds describing the concentration levels at which heightened supervisory attention to a bank's risk management process for its CRE lending would become much more likely. Moreover, despite public assurances from regulators that the

[1]For a discussion of potential effects of Basel 3, see Bank for International Settlements, BCBS [2010a] and BCBS [2010b]

Figure 1: Growth of Commercial Real Estate Exposures



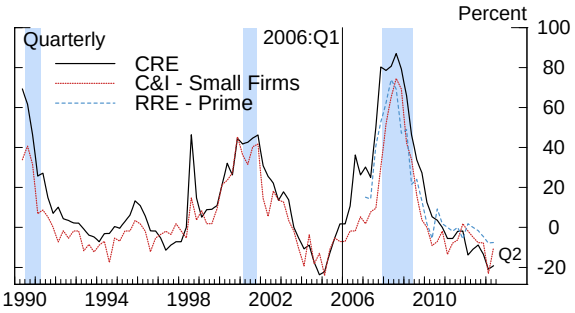
* - includes loans for construction and land development, multifamily housing, and loans secured by nonfarm, nonresidential structures and off-balance sheet commitments.
Source: Call Reports

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]). 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 banks.

The efficacy of the guidance from a public policy standpoint depends importantly on 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 into the final stages of the cycle, 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. Figure 1 shows that quarterly CRE loan growth began a rapid descent in early 2006, led by the sum of CLD and off-balance sheet commitments, that persisted throughout the crisis period. At their nadir in 2009 and 2010, the rate of

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 ("tightened considerably" or "tightened somewhat") minus the fraction of banks that reported having eased ("eased considerably" or "eased somewhat").

Source: Senior Loan Officer Opinion Survey

decline in total CRE loans reached 10 percent while CLD and associated commitments contracted more than 30 percent at an annual rate. Neither CRE nor CLD plus total commitments registered quarter-over-quarter growth until late 2012.

Additional evidence that the guidance may have spurred banks to tighten conditions in CRE lending proactively 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 tighter 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 both C&I loans to small firms and residential real estate loans to prime borrowers, two other sectors hit hard by the crisis, suggesting that CRE lending standards were influenced by a separate factor.

Because the implementation of guidance with specific numerical thresholds was unprecedented, we argue that it 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 find that 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 slower than 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 profitability and balance sheet characteristics, 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, providing additional support for an independent effect of the guidance.

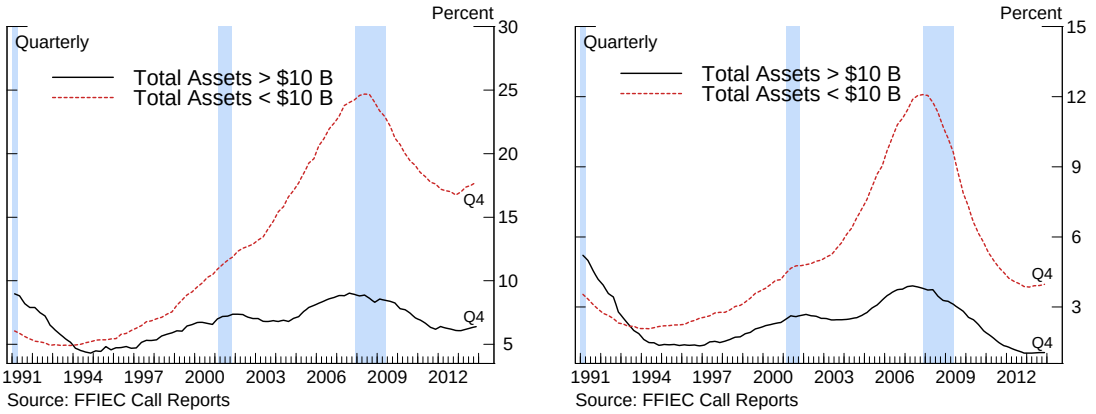
More broadly, the CRE guidance represents one potential approach to macroprudential regulation called for in Basel 3 and the Dodd-Frank Act. Indeed, the final guidance indicated that regulators might not be generally concerned about individual loan risk, but in preventing systemic problems that result from buildups of CRE loan holdings over time. While 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 regulation likely were not limited to the target market and so might have generated potentially unintended consequences. These results could inform the debate about whether macroprudential regulations should attempt to ration credit in specific, fast-growing sectors or should be focused 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. Section 6 discusses the results. Section 7 concludes.

2 The CRE Lending Guidance

Figure 3 shows that small- and medium-sized commercial banks, defined as those with total assets 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 2007-2009 recession, when they represented nearly a quarter of combined assets at those small- and medium-sized banks. The buildup was particularly acute for holdings of CLD 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

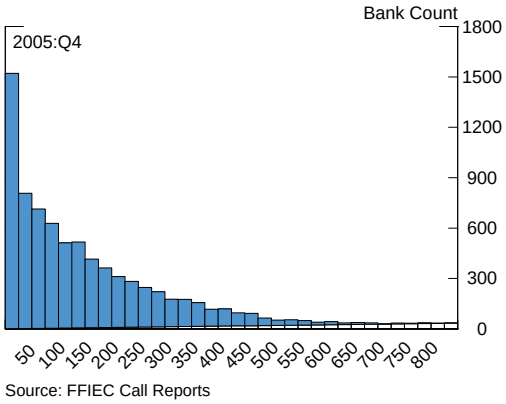
Regulators cited rising concentrations of CRE loans as particularly worrisome because of the cyclical, and often swift, nature of changes in credit quality of such loans when CRE prices fall [Federal Register, 2006b]. For instance, research examining the collapse of CRE markets during the 1980s found that commercial banks that engaged in aggressive lending practices prior to the downturn exhibited tighter credit availability 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 fate 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 construction and land development, non-farm, non-residential properties that are non-owner occupied, multifamily properties, and loans whose repayment was dependent on cash flows derived from the property but not secured by it.[2]

The document outlined a two-pronged approach to incentivize banks to better manage CRE concentrations. First, the guidance required management at banks making 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

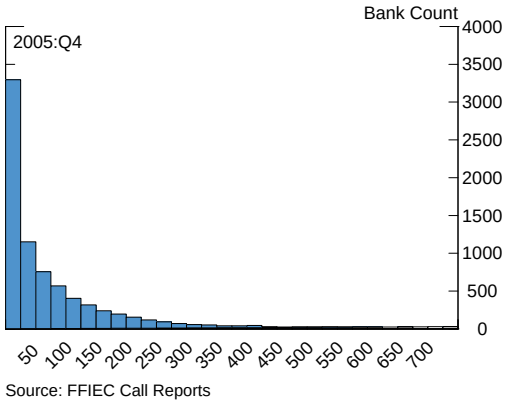
[2]Initially some of these definitions were not standardized. As of April 1, 2009, a loan is considered secured by real estate for regulatory reporting purposes if the estimated value of the collateralized real estate is greater than 50 percent of the originated principal value of the loan or if the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

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



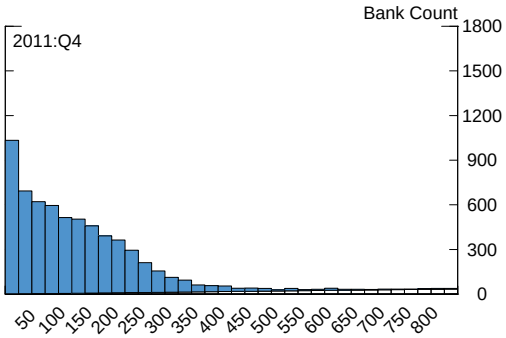
Source: FFIEC Call Reports

(a) CRE 2005



Source: FFIEC Call Reports

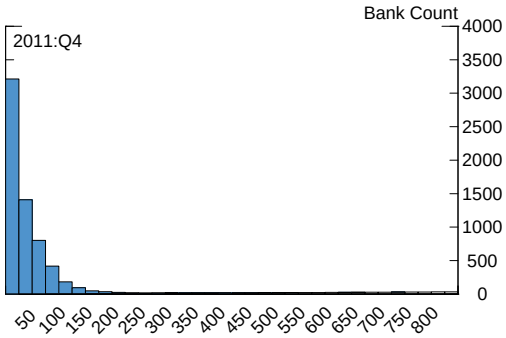
(b) CLD 2005



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

Source: FFIEC Call Reports

(c) CRE 2011



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

Source: FFIEC Call Reports

(d) CLD 2011

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 greater than 300 percent or total CLD loans to total risk-based capital 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 unique implementation of strictly defined numerical thresholds was potentially proscriptive 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 less than 50 percent over the past 36 months as-of 2005:Q4. Thus, the consideration of recent growth in CRE holdings only exempted 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, only 8 percent of banks remained above the CRE threshold, and 7 percent over the CLD threshold, by 2011:Q4.

Most of the banks that were originally above the thresholds set by the guidance either failed, merged, or brought their concentration ratios below the thresholds. Of the banks above the CRE threshold at year-end 2005, more than 35 percent either failed or merged with another institution. Just 24 percent of those banks originally above the threshold remained over the threshold at year-end 2011. 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.

Most of the banks that moved below the thresholds did do 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. In contrast, the 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. Over the same period, the median growth rate of total risk-based capital at banks that remained above

the CRE threshold was just 15 percent, while banks that moved below the threshold saw median capital growth of 54.2 percent. CLD exposures declined broadly between 2005 and 2011 however as both banks that remained over 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 threshold increased 47.8 percent during the period while banks remaining above the threshold saw a median decline in capital of 4.5 percent.

In May 2011, a GAO report examined declines in CRE lending and the impact of the guidance [GAO, 2011]. The report found that weaknesses in the CRE market weighed most heavily on smaller community banks who were more likely to hold large concentrations of CRE loans. Community banks also hold a disproportionate amount of small business loans which are likely to be collateralized by commercial properties so that spillover effects from weaknesses in the CRE market are likely to result in downturns in small business lending.[3] 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 also reportedly was 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] estimated 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.[4] Pana [2010] found 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 non-concentrated peers. Friend et al. [2013] examined 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

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

[4]Lopez [2007] includes owner-occupied, non-farm non-residential properties in the total CRE definition which 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].

the financial crisis period, and that banks with large concentrations of CRE loans prior to the guidance were more likely to reduce their level of CRE exposure than other banks. While the results of Friend et al. [2013] are closely related to our paper, we use more formal statistical measures to assess the effects of the guidance and explore the effects of the guidance on seemingly unrelated loan categories.

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 while the second strand investigates the link between bank lending and capital requirements. Generally, both sets of papers 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 impact on loan growth and may result in higher profitability and improved asset quality in the future.

The number of empirical papers examining regulatory oversight has been limited due to difficulty interpreting qualitative findings and the confidentiality of examination data, as well as the usual problem of disentangling loan supply from loan demand. Due to 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. Peek et al. [2003] document that banks with lower CAMELS ratings have slower loan growth than their more highly rated peers. Similarly, Bassett et al. [2012] find that small changes in the apparent stringency of CAMELS rating changes have a significant effect on lending. In other studies that utilized CAMELS ratings, however, the results have been mixed. Berger et al. [2001] and Curry et al. [2008] find that regulatory oversight increased during the slow growth period of 1989 to 1992, but that the increased stringency had little impact on overall lending. Johnson [1991] argues that weak bank balance sheets were the most significant driver of the lending decline in the early 1990s, not heightened regulatory scrutiny.

Public enforcement actions and changes in the law also provide an opportunity to examine variation in the intensity of supervision and 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 that the overall decline attributable to those actions was economically significant. Kishan and Opiela [2006] demonstrate that less capitalized banks

responded differently 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 regulators of banks in the areas hardest hit by the early 1990s slowdown were more lax than their peers in less affected areas prior to the recession than after it.

The second strand of research related to the supervisory actions proposed in the CRE guidance relates to how changes in capital adequacy requirements for banks affect lending and the economy. Empirical studies from the early 1990s' banking crisis showed that well-capitalized banks were more likely to increase lending than their less-well-capitalized counterparts (e.g., Bernanke and Lown [1991]; Peek and Rosengren [1995b]; Barajas et al. [2010]). Likewise, many empirical studies have reported 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; Bassett and Covas, 2012].[5] A cross-country study by O'Brien and Browne [1992] showed that increases in capital ratios were associated with higher interest rates on loans relative to funding costs, suggesting a possible channel by which lending is damped. However, the association between higher capital requirements and lower lending is not universal: A number of studies reported little evidence that changes in capital requirements were 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]. It has also been observed that 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 et al., 1995]. Such shifts are consistent with the shifts in lending found

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

in this paper and described below.

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 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] found that capital stringency initially increased loan spreads, while regulatory oversight was associated with shorter loan maturities.

4 Data Sources and Methods

The FFIEC's required, 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.[6] All data on exposures, income, and expenses are adjusted for mergers between commercial banks and between commercial banks and thrifts.[7] All bank activity variables, except net 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 and 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].[8]

[6]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.

[7]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].

[8]Because the census bureau's X-11 procedures give higher weight to recent observations, our seasonal adjustment measures may be confounded by the substantial disruptions caused by the financial crisis. Cimmola et al. [2010] and Nomura [2011] are recent discussions that have examined issues of seasonal adjustment related to the crisis. Due to these concerns, the analysis was replicated using non-seasonally adjusted data and including quarterly dummies to control for the seasonal process. Our results using this

4.1 Growth Rate and Policy Variables

Growth rates in five categories of loans—total commercial real estate, its construction and land development subcategory, residential real estate, commercial and industrial (C&I) loans, and consumer loans—are calculated as the log difference of the end and merger-adjusted beginning of period stock of loans.[9] The measure of total commercial real estate loans is constructed to match the definition given in the 2006 CRE regulatory guidance: loans for construction and land development; 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].[10] The owner-occupied portion of loans for non-farm, non-residential properties is broken out on the Call Report beginning with the 2008:Q1 reporting period. In order to estimate the share of loans associated with non-owner-occupied properties prior to that date, we calculate the fraction of non-owner occupied to total non-farm, non-residential loans at 2008:Q1 and apply that ratio to all prior periods. The definitions of residential real estate, C&I and consumer loans are as defined in the Call Report.[11]

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.[12] 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

procedure are qualitatively similar.

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

[10] A loan may be reported as C&I but 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. For more information, see the FFIEC 031/041 report instructions for item RC-C Memorandum item 3.

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

[12] Total risk-based capital is the sum of Tier 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.

period, while dates from 2007:Q1 to 2011:Q4 denote the finalization period of the guidance.

The unweighted averages and standard deviations for the loan-to-capital ratios are given in table 1.[13] 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 the concentrations of commercial real estate well in excess of the average at a subset of banks. In contrast, the average concentration of residential real estate 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 RRE loans prior to 2006, a 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 is about equal to that of C&I loans, but again the much higher charge-off rate for CLD loans, compared to 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 such loans rose much higher than those for all other categories of business and household loans.

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

	CRE	CLD	C&I	RRE	CONS
Loans to Risk-Based Capital Ratios					
Mean	166.86	126.39	121.76	197.07	97.57
Std.Dev.	115.83	86.89	78.66	116.86	79.11
Net Charge-off Rates					
All	0.096	0.163	0.206	0.037	0.180
1991-2005	0.041	0.040	0.188	0.023	0.174
2006-2011	0.224	0.479	0.263	0.081	0.197

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. Source: Call Reports.

The threshold for CRE loans in the guidance, 300 percent, turns out to be roughly one standard deviation above the mean for that category. While the guidance is focused on CRE lending and thus does not suggest similar thresholds for non-CRE loans, we include

[13]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.

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. We also define the indicator based on a 300 percent ratio of residential real estate 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 above-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.[14] 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.

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 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 greater probability, the data in table 2 suggests 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

[14]The growth reported is for loans held on balance sheet. For most of the sample period, loans originated for sale or securitization, which may have been more rapid, is incomplete.

Table 2: Growth Rate Summary Statistics

	CRE	CLD	C&I	RRE	CONS
All Obs	145,753	20,836	298,478	375,282	239,498
Mean	2.32	1.88	1.52	1.53	0.33
Std.Dev.	7.80	12.12	8.64	4.90	5.28
Under Threshold	127,023	9,777	258,382	313,157	221,156
Mean	2.25	1.52	1.27	1.43	0.24
Std.Dev.	7.96	13.14	8.77	4.99	5.26
Over Threshold	18,730	11,059	40,096	62,125	18,342
Mean	2.81	2.20	3.14	2.03	1.40
Std.Dev.	6.64	11.14	7.52	4.36	5.47
P-value	0.00	0.00	0.00	0.00	0.00

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: C&I loans, 200 percent; RRE loans, 300 percent, consumer loans, 200 percent. Source: Call Reports.

funding sources than smaller banks, 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 current credit quality and its effect on loan supply and loan demand. 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. Significant differences across loan categories in the loss rates on delinquent loans motivate the inclusion of charge-off rates as well. 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.[15] A rise in the charge-off or

[15]The ratio of non-owner occupied to total non-farm, non-residential loans at 2008:Q1 is applied to the

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 et al., 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.

Net interest margin, defined as the difference between interest income and interest expense scaled by average interest earning assets, as well as noninterest expense scaled by total assets are used to control for factors affecting profitability separately. An increase in net interest income 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 due to 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-size and small 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 due to the value of deposit insurance, reducing 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. The SOD data tallies the number and amount of deposits held at year end by each of the branches of 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

relevant series to calculate delinquency and charge-off rates for non-owner occupied loans prior to 2008:Q1.

number of branches.[16] 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. In the analysis, we include branch-weighted variables for the one-quarter change in the state unemployment rate 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 who 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 banks' market might be associated with an increase in their CRE exposure as their competitiveness in other loan categories waned.

We construct a branch-weighted state-level Herfindahl-Hirschman Index (HHI) as the sum of the square of the share of total deposits of each bank as shown in equation (1) where the market share for bank i headquartered in state j is given by $MS_{i,j}$. An increase in the HHI means that the competitiveness of the markets in which a bank operates has declined.[17]

$$HHI_j = \sum_{i=1}^{N} MS_{i,j}^2 \tag{1}$$

Finally, expectations of overall loan market conditions in the next period will be an important determinant of lending standards in the current period. The one-quarter ahead charge-off rate of the bank's competitors, constructed by allocating each bank's total reported charge-offs and outstanding loan balances into individual states using the branch weights, accounts for this variation. For each state in which bank i holds a branch, we sum

[16] 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.

[17] For more information on the Herfindahl-Hirschman Index and its use in banking see Rhoades [January 1993].

the level of charge-offs of the bank's competitors in that state as well as their outstanding loans. We then 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 charge-off rates in all states that 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 it is expected that a competitors' loan portfolios will begin 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.

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 fed funds rate are included.[18] For regressions whose dependent variable is the growth of CRE or CLD loans, we also add the change in the national level CoStar composite CRE price index.

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 Fed 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 rates may also reduce quantity demanded and slow lending growth.

[18] For periods after Dec 2008, we use the midpoint of the Fed Funds rate target corridor.

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 5 years from the finalization of the guidance, at which time adjustments are assumed to have been completed.

A number of 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 two percent for any quarter in the sample.[19] 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 also are 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.[20]

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

[19] For instance, a bank whose ratio of CRE holdings to total assets falls below two 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.

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

[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. An average of 4,113 unique banks remain in each time period over all regression models (see table 6). Regressions 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 2,829 unique banks. The regression for consumer loans includes 4,587 unique banks, while the regressions for C&I and residential real estate each include 5,821 and 6,779 banks, respectively. In addition, each regression has an average of 49 observations per bank (see table 6). This number is fairly consistent over the models for the different dependent variables, with a low of 38 observations per bank for the CLD model and a high of 53 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 due to the fact that they vary only by time, not entity. The state-level variables had similar distributions for the other loan category regressions. 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 for commercial banks more generally, in part due to the exclusion of failed banks and trimming of outliers at the upper tail of the distribution.[21]

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. We argue that the unexpected and unprecedented adoption of quantitative thresholds for CRE

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

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

	mean	sd	min	max
$\ln(Real\ Assets)$	12.46	1.36	9.05	20.89
$\frac{Tier\ 1\ capital}{Tang\ Assets}$	9.39	2.48	4.01	32.80
Core Deposits to Assets	71.20	10.42	0.67	94.80
CRE Delinquency Rate	3.35	4.27	0.00	32.98
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	6.02	-33.65	35.58
$\Delta \ln CRE^{Price}$	0.72	4.27	-15.75	10.78
$\Delta Unemp$	0.03	0.26	-0.92	1.46
HHI	0.04	0.02	0.00	0.36
$\Delta \ln GDP$	0.65	0.64	-2.17	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	12.30	8.80	2.08	29.42

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

concentrations represents 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 [de Haas and van Lelyveld, 2010; Puri et al., 2011]. Likewise, Ivashina and Scharfstein [2010]; Calem et al. [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 mortgage 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.

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 of each loan category j at bank i for time t is shown in equation (2).

$$
\begin{aligned}
y_{i,j,t} \quad &= \quad \beta_0 + \sum_{n=1}^{2} \beta_n y_{i,j,t-n} + \beta_3 \frac{loans_{i,j,t-1}}{RBC_{i,t-1}} + \beta_4 threshold_{i,j,t-1} \\
&+ \quad \left(\beta_5 + \beta_6 threshold_{i,j,t-1} + \beta_7 threshold_{i,j,t-1} \times \frac{loans_{i,j,t-1}}{RBC_{i,t-1}} \right) \times comment_t \\
&+ \quad \left(\beta_8 + \beta_9 threshold_{i,j,t-1} + \beta_{10} threshold_{i,j,t-1} \times \frac{loans_{i,j,t-1}}{RBC_{i,t-1}} \right) \times final_t \\
&+ \quad \boldsymbol{\chi}_{i,t-1}\boldsymbol{\beta}_{11} + \boldsymbol{\Gamma}_{i,t-1}\boldsymbol{\beta}_{12} + \boldsymbol{\delta}_{t-1}\boldsymbol{\beta}_{13} + \beta_{14} Chargeoffs_{t+1}^{state} + \varepsilon_{i,j,t} \\
where \quad &\varepsilon_{i,j,t} = v_i + e_{i,j,t}
\end{aligned}
\tag{2}
$$

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, $\boldsymbol{\chi}_{i,t-1}$, which denotes the bank-specific Call Report variables, $\boldsymbol{\Gamma}_{i,t-1}$, which denotes the bank-specific, state-level variables weighted by the SOD data, and, $\boldsymbol{\delta}_{t-1}$, which denotes the macroeconomic factors. The term $Chargeoffs_{t+1}^{State}$ represents the branch-weighted, state-level charge-off rate of the bank's competitors one quarter ahead. The set of variables within each of the matrices is as described above. 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 a set of indicator variables and their interactions with 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 2007-2011, so unless the controls for demand and other supply factors are very complete, $final_t$ will be capturing developments during that period that are not captured by the other economic variables.

These broad factors affected all banks at the same time, however, and the regressions include a myriad of controls for more-local economic conditions. So, if the effect was more substantial for banks near or above the specified thresholds, then the guidance is more likely to be an explanation. Thus, indicator variables that take a value of one for banks that have loan-to-capital holdings above the thresholds for loan type j at time $t-1$ ($threshold_{i,j,t-1}$) are 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. If the guidance restrained lending by banks that were over the threshold, the coefficient on this interaction term would be negative.

In contrast, if banks viewed the concentration thresholds as risky levels to be avoided independently 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 expect to see growth slow more than it otherwise would have 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.

Finally, the effect of the guidance on loan growth may differ based on how far a bank is above the threshold. So, some specifications include the bank's ratio of outstanding loans of type j to total risk-based capital for bank i at time $t-1$, a variable denoted $\frac{loans_{i,j,t-1}}{RBC_{i,t-1}}$. Additional specifications also include that variable in a three-way interaction with the guidance variables and the threshold variable, in order to estimate whether the effect of that concentration ratio changes after the guidance was issued for comment or finalized.

Robustness checks of the results also confirm the applicability of the model specification. For instance, the analysis was replicated using four-quarter moving averages of the control

variables rather than one-quarter lagged values. This alternative is potentially a more robust treatment of recent behavior in the control variables and may better account for the effects of seasonality than the quarterly seasonal-adjustment procedure.

5.3 Measuring the Effect on Other Loan Categories

Next, we study 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. Spillover effects are identified by adding the ratio of CRE loans to risk-based capital, the CRE threshold dummy, and the interactions between the threshold dummy and guidance dummies to an analogous equation for the growth of C&I, RRE, and consumer loans.

Another check is to see whether high concentrations in other 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 provides 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 were 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. As described above, the thresholds chosen are generally associated with concentration ratios about one standard deviation greater than the mean for each loan category.

6 Results

The analysis begins with two specifications for each loan category that focus on the interaction between the dates the guidance was issued and finalized and the position of banks with respect to the newly defined regulatory thresholds for CRE and CLD loans. In the first set, the common control variables described above are augmented with indicators for whether the CRE or CLD threshold has been breached as well as interactions of the threshold indicators with indicators for the comment period and final period. The second set replaces

those indicators with a continuous measure of the relevant loan-to-capital ratio. Next, analogous models for each of the other loan types are estimated with the CRE threshold variables to test for spillovers between the CRE guidance and other types of lending.

6.1 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 Appendix tables 10a to 10c. These results correspond to the specification in table 6 in the Robustness section, 6.3.1. The control variable results for the alternative specifications did not materially differ from those presented in the appendix, but are available from the authors upon request.

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 all equations except CLD loans, where both lags are insignificant, and C&I loans where they are negative and significant. In equations for C&I loans, RRE loans, and consumer loans, lags of both the dependent variable and of CRE growth are included. The sum of the lagged changes in CRE loans in those equations is positive and significant, suggesting positive correlations between factors affecting demand and supply across the different categories of 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 loan growth in RRE and consumer lending, but negative for business lending categories. Likewise, the relationship between the regulatory leverage ratio and loan growth was different across loan categories. It was negative and significant for total CRE, CLD exposures, and consumer loans, but positive and generally significant across various specifications for C&I and RRE loan growth. A possible explanation for these patterns is that the marginal source of funding and internal economic capital allocations differ across loan types.

Asset quality indicators had the expected signs. Across all loan categories, the coefficients on both charge-off rates and delinquency rates are negative, statistically significant, and economically meaningful. For example, a one-standard deviation increase in delinquency rates is associated with more than 3/4 percentage point decline in the quarterly growth rate of CRE loans.

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 net interest margin (NIM) was statistically insignificant for business loan categories, and only marginally significant for loans to households. On the other hand, higher net interest expenses led to lower loan growth in all loan categories, which is consistent with the hypothesis that growth would be subpar at less efficient banks, though the effect is not significant at the 5 percent confidence level for two loan categories.

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 loan categories. An increase in the weighted state-level home price index is associated with increased growth in all loan categories. Interestingly, the effect is statistically significant for all categories except residential real estate loans, perhaps because of the prevalence of securitization of residential mortgages that removes loans from the balance sheet.

The coefficient on the lagged change in the state unemployment rate is mixed across loan categories. The variable is positively correlated with growth of total CRE, CLD, and RRE, a somewhat surprising pattern that may be explained by the structure and dynamics of real estate lending and real estate markets. First, banks may be slow to react to unemployment changes in their local markets, as the data are available only with a lag.[22] Second, these loans are generally not demandable and have relatively long maturities, so declines in outstanding balances will take time to materialize. Third, when economic conditions soften, both businesses and consumers may draw down existing lines of credit before banks can reduce or cancel their commitments, leading to temporarily stronger loan growth. For instance, RRE and CLD loans in the pipeline are difficult to recall when the local economy begins to experience a downturn, and real estate loan commitments generally cannot be canceled at the sole discretion of the bank and at least prior to the financial crisis, residential real estate values tended to be somewhat stable. In contrast, consumer loans tend to decline in the wake of higher unemployment, likely reflecting in part that credit card lines can be canceled or reduced at the sole discretion of the bank. Likewise, 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

[22] In a previous version of this paper, we found that with two or more lags of the unemployment rate, the sum of the coefficients was generally negative, further indicating that banks are slow to react to macroeconomic changes. Including a single lag did not change our fundamental results though and results in a more parsimonious specification.

adverse change clauses, which allow banks to limit new lending when the condition of the firm deteriorates.

The coefficient on the HHI index that proxies for the extent of interbank competition in local markets is positive and, except for CLD exposures, highly significant for all loan categories. The results weakly support the hypothesis that small banks hold a comparative advantage in CRE lending over their larger rivals due to their knowledge of the local markets, as total CRE loans are estimated to grow more quickly at banks operating in markets with a high HHI index. However, the magnitude of the marginal effect of concentration on CRE lending is not very different from those estimated for C&I loans, RRE loans, or consumer loans. Thus, it seems that banks operating in highly concentrated markets tend to have faster growth in all loan categories.

The coefficient on one-quarter-ahead aggregate charge-offs at competitor banks is negative and significant for all loan categories. The effect is strongest for total CRE and CLD loans, and also is pronounced and significant for C&I loans. Growth of RRE and consumer lending tends to be reduced by less than other loan categories when loan losses at competitors increase. These results suggest that the variable is a strong forward-looking indicator that captures banks' responses to the economic outlook.

The effects of aggregate macroeconomic and financial variables are quite mixed relative to initial expectations. A higher level 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 all categories in which it is significant, as would be expected. An increase in the composite CRE price index is positively associated with loan growth in the CRE loan categories as expected, though not generally statistically significant for CLD. However, growth of real GDP is statistically significant and negatively correlated with subsequent growth in C&I and consumer lending, positively associated with RRE, and insignificant in the two CRE loan categories. Generally, businesses expand production facilities and construction accelerates as real GDP increases, so the negative or insignificant relationships are difficult to square with expectations.

The interest rate measures have the most consistent relationship to loan growth across all the different loan categories. In particular, a more steeply sloped yield curve is associated with reduced loan growth in all categories except RRE. Steep yield curves tend to be associated with expansionary economic conditions, so the negative coefficients suggest that loan supply and demand lag the economic cycle. The positive coefficient on RRE loans may reflect the dynamics of securitization, as 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. Relatedly, a higher Fed Funds target rate is associated with slower business lending growth and higher growth in household lending categories. This may reflect the more-diverse sources of funds that business borrowers can access relative to households. And, in categories that banks can securitize, such as residential mortgages and consumer loans, this may again reflect banks' asset-liability management strategies.

6.2 Estimated Effects of CRE Guidance on CRE and CLD Loans

Table 4 details the estimated effects of the guidance on CRE loans and CLD exposures. The specifications include indicator variables for the comment period and the period after finalization of the guidance, as well as either an indicator variable for banks above the relevant threshold for CRE or CLD concentrations or the ratio of CRE or CLD loans to risk-based capital. The results across the multiple specifications are consistent with a significant reduction in total CRE lending and CLD lending at banks above the threshold after the release of the guidance.

The first three columns of the table detail the results for the specification with an indicator variable for banks that are above the thresholds. The indicator variable for the comment period, *comment*, is significant and negative for total CRE loans, indicating slower than average growth in CRE lending during 2006 after issuance of the guidance for comment in January, but it is insignificant for the two measures of CLD exposures. The coefficient on the indicator variable for the final period, $final_t$, is significant and negative for each of the three CRE exposure categories. However, this 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 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 equation for total CRE loans. This pattern implies that growth of CRE loans at banks that were over the threshold after the guidance was issued for comment and after finalization of the guidance was substantially below the growth at other banks over those periods. Moreover, the marginal effect for total CRE loans was nearly half a percentage point larger after finalization of the guidance than it was during the comment

Table 4: Regressions for Growth of CRE Loans, by Type

	(1) CRE	(2) CLD	(3) CLD+cmt	(4) CRE	(5) CLD	(6) CLD+cmt
$comment_t$	-0.447***	0.0466	0.650	-0.0255	-0.936	-0.284
	(-4.02)	(0.07)	(0.74)	(-0.14)	(-1.44)	(-0.37)
$final_t$	-0.895***	-3.028***	-2.901***	-0.135	-3.111***	-2.936***
	(-9.08)	(-6.33)	(-5.66)	(-1.03)	(-5.74)	(-5.06)
$threshold_{i,j,t-1}$	-0.815***	-2.483***	-2.706***			
	(-7.48)	(-8.67)	(-8.98)			
$threshold_{i,j,t-1} \times comment_t$	-0.508**	-1.741*	-2.488**			
	(-2.82)	(-2.37)	(-2.69)			
$threshold_{i,j,t-1} \times final_t$	-0.927***	0.353	0.0600			
	(-7.05)	(0.81)	(0.13)			
$\frac{loans_{i,j,t-1}}{RBC_{i,t-1}}$				-0.0119***	-0.0268***	-0.0283***
				(-19.12)	(-10.48)	(-11.47)
$\frac{loans_{i,j,t-1}}{RBC_{i,t-1}} \times comment_t$				-0.000922	0.00161	-0.00174
				(-1.39)	(0.56)	(-0.54)
$\frac{loans_{i,j,t-1}}{RBC_{i,t-1}} \times final_t$				-0.00268***	0.00545*	0.00391
				(-5.48)	(2.19)	(1.43)
Clusters	2829	539	548	2829	539	548
Avg. Obs/Bank	51.52	38.30	38.02	51.52	38.30	38.02
R-Squared	0.0678	0.116	0.0962	0.0732	0.121	0.101

t statistics in parentheses

The indicator for the comment period includes all dates beginning with 2006:Q1 and ending with 2006:Q4, while 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) as stated in the guidance: CRE loans, 300 percent; CLD loans, 100 percent. Regressions include bank fixed effects. Sample period: 1991:Q3 to 2011:Q4. Source: Call Reports.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

period. After finalization, CRE loan growth at banks that were above the threshold was 93 basis 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 nearly $1\frac{3}{4}$ percentage points at a quarterly rate, or 7 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 growth, the effect of the guidance on banks over the respective threshold is larger during the comment period. The interaction between the threshold indicator and the comment period indicator suggests that quarterly growth of CLD loans declined nearly 1 3/4 percentage points at banks that were above the CLD threshold during the year that the guidance was out for comment. However, the interaction between the threshold and final indicator variables was not significantly different from zero for CLD loans. This result may reflect the convention in which banks provide CLD loans under pre-established commitments that are difficult to cancel except for nonperformance. Banks that had substantial concentrations of CLD loans likely also 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.

Therefore, the sum of on-balance sheet CLD loans and outstanding commitments for CLD lending, heretofore "CLD exposures," may be a clearer measure of CLD lending behavior. Those results are presented in column 3 of the table. Under this specification, growth of CLD exposures slowed 2.5 percentage points per quarter during the comment period for banks above the threshold for on balance sheet loans, and the coefficient is highly significant. As suspected, the decrease in the growth rate of CLD exposures was larger than the estimated decrease in the growth of on-balance-sheet loan balances, as banks presumably cut new commitments to make CLD loans faster than they could reduce outstanding loan balances. Nonetheless, the coefficient on the interaction between the threshold and finalization of the guidance was still insignificant for total CLD exposures. Another 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.

The alternative regression specification detailed in columns 4 through 6 includes the continuous loans-to-capital ratio rather than a discrete threshold effect. None of the coefficients on the comment period indicator are significant in this specification, and the final period indicator is relatively small and not significant in the total CRE loans equation. But, in the CLD equations, the coefficients on the final period indicator are again negative and of roughly equal magnitude to the coefficients in the threshold specification. Consistent with the results for the 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. For total CRE loans, the results and conclusions based on the interaction terms using the ratio rather than the threshold indicator also suggest the loan growth slowed markedly at banks that were above the guidance threshold, especially after the guidance was finalized, but important differences are evident in the CLD equations.

Both the interaction with the comment period and with the final period have positive coefficients, as opposed to the expected negative relationship, in the CLD loans equation. And, the interaction between the ratio of CLD loans to total risk-based capital and the final period indicator is statistically significant. It suggests that CLD loans at banks with CLD concentration ratios at the 100 percent threshold continued to grow about 1/2 percentage point faster, at a quarterly rate, than banks with similar concentrations had grown before the guidance was issued. Looking at the total CLD exposure measure, however, the effect in the final period was smaller and statistically insignificant, while the effect in the comment period turned negative, but also insignificant. Overall, the sum of on-balance sheet loans plus off-balance sheet commitments seems under the more immediate control of bank management, so we use only the total CLD exposure measure in all further analysis for CLD lending.

Taken together, the evidence that growth of total CRE loans slowed more quickly following issuance of the guidance at banks that had breached the specified thresholds and slowed further after the finalization of the guidance is very robust. Whether the guidance had an independent effect on CLD loans was somewhat ambiguous, however. The effect on CLD loans may be harder to identify in part because of the 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 moved to cut their exposures quickly irrespective of the effect of the guidance. If the latter was 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, even as it was insignificant in one of the equations for total CRE.

6.2.1 Estimated Effect of CRE Guidance on Other Loan Categories

These same treatments of the guidance variables can be used to examine the changes in the rate of growth of three other major categories of bank loans—C&I loans, RRE loans, and consumer loans—during the period after the guidance was issued. The estimated coef-

ficients in table 5 represent the effect of the issuance and finalization of the CRE guidance and high concentrations of CRE loans on the growth of these other loan categories. The control variables included in this specification are unchanged from our earlier regression, with two exceptions. The equations include two lags of the growth of the dependent variable in addition to two lags of CRE loan growth, and the delinquency and charge-off rates included in the regression correspond to the dependent variable, not to CRE loans.

Table 5: Regressions for Growth of Other Loan Types with Controls for Total CRE Concentrations

	(1) C&I	(2) RRE	(3) CONS	(4) C&I	(5) RRE	(6) CONS
$comment_t$	-1.021***	-0.359***	-0.436***	-0.927***	-0.343***	-0.600***
	(-10.66)	(-8.68)	(-8.03)	(-6.75)	(-6.02)	(-7.99)
$final_t$	-0.633***	-0.0505	0.252***	-0.266**	-0.169***	0.162*
	(-7.67)	(-1.24)	(4.46)	(-2.77)	(-3.56)	(2.58)
$CRE\ threshold_{i,j,t-1}$	-0.00245	0.407***	-0.352			
	(-0.02)	(4.08)	(-1.91)			
$CRE\ threshold_{i,j,t-1} \times comment_t$	0.0688	-0.375*	0.642*			
	(0.28)	(-2.50)	(2.31)			
$CRE\ threshold_{i,j,t-1} \times final_t$	-0.661***	0.310**	0.644**			
	(-3.76)	(2.64)	(3.08)			
$\frac{CRE\ loans_{i,j,t-1}}{RBC_{i,t-1}}$				0.000407	0.00336***	-0.00358***
				(0.80)	(11.15)	(-7.02)
$\frac{CRE\ loans_{i,j,t-1}}{RBC_{i,t-1}} \times comment_t$				-0.000843	-0.000892*	0.00260***
				(-1.26)	(-2.55)	(4.63)
$\frac{CRE\ loans_{i,j,t-1}}{RBC_{i,t-1}} \times final_t$				-0.00338***	0.000576*	0.00186***
				(-7.36)	(2.17)	(4.35)
Clusters	5821	6779	4587	5821	6779	4587
Avg. Obs/Bank	49.63	53.38	50.01	49.63	53.38	50.01
R-Squared	0.0240	0.0606	0.0683	0.0242	0.0611	0.0686

t statistics in parentheses

The indicator for the comment period includes all dates beginning with 2006:Q1 and ending with 2006:Q4, while 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) as stated in the guidance: CRE loans, 300 percent. Regressions include bank fixed effects. Sample period: 1991:Q3 to 2011:Q4.

Source: Call Reports.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The indicator variable denoting the comment period is significant and negative for all loan categories, and 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 of mixed significance for RRE loans and positive and significant consumer loans. This pattern of results suggests some spillover from the CRE guidance to other business lending. Moreover, 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, leaving an independent effect of the guidance at least partially visible in that coefficient.

The key coefficients for the threshold specification in columns 1 through 3, those on the terms representing the interaction of the indicator for the final guidance with the indicator for the CRE threshold, are significant in all three loan categories. First, banks that had high concentrations of CRE loans also experienced slower growth in C&I loans, almost 70 basis points at a quarterly rate, after the guidance was finalized than before it was issued. For RRE loans, the 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 growth rate of consumer loans increased about 65 basis points during both the comment and final periods. These magnitudes are economically significant and somewhat striking given the collapse in residential real estate 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 in order to reduce the CLD loan portfolio.

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 C&I loans, indicating that over the whole sample period growth of C&I 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 is compelling evidence that this relationship changed following the issuance of the guidance. Moreover, the insignificant coefficient on the threshold indicator in the consumer loan equation suggests that banks with high concentrations of CRE

loans historically had no propensity to increase consumer lending, yet after the guidance was issued those banks had faster growth in consumer loans. 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* 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.

Panels 4 through 6 in table 5 detail the results of the regressions that include the ratio of CRE loans to risk-based capital rather than threshold indicator variables. 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. However, 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. For RRE loans, the effect of finalizing the guidance remains positive and significant, but slightly smaller than the estimated result from the discrete threshold models.

The relatively large apparent spillover of the CRE guidance into C&I lending likely is 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 suggests this category is small and unlikely to account for the full effect estimated here. In addition, some loans for which commercial properties account for less than 50 percent of the collateral are booked as C&I loans. To the extent that these loans were affected, it would have resulted from misunderstanding of the guidance and been an unintended consequence of the regulation.

6.3 Robustness

As a straightforward robustness check on our main regression, we replace the lagged control variables with one lag of their four-quarter moving average (not shown in the interest of space). Using the moving average of the control variables allows us to test the sensitivity

of the specification to changes in the lag structure. The results using the moving average controls, which are not presented, do not materially differ from those using the lagged control variables. While 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 finalizing the guidance (corresponding to equation 4), is a decrease in the growth rate of total CRE loans of at least 2 percent and a $2\frac{3}{4}$ percentage point decrease in growth of CLD exposures - roughly in line with the estimates in the model with a quarterly lag of each control variable.

Another robustness check involves splitting the final period into two sub periods, which provide additional insight into our key results. For this exercise, we define the early portion of the final period as dates between 2007:Q1 and 2009:Q4 and the latter portion as dates between 2010:Q1 and 2011:Q4. First, the results confirm that CLD exposures declined rapidly. During the comment period, banks over the CLD threshold declined at a statistically significant rate of over 2 1/2 percent per quarter. The decline continued at about a 1 percent pace during the early portion of the final period while it slowed to less than a 1/4 percent in the latter portion of the final period, though either of these effects were significant. Interestingly, during the period of rapid declines in CLD exposures during the early portion of the final period, RRE growth was positive at a statistically significant rate before turning negative in the latter part of the final period. This result reinforces the idea that some of the effects on RRE are coming from the arrangements between builders and banks to provide mortgages for home purchases. The positive sign on RRE, when the sign on CLD is negative, might be indicative of banks making mortgages to help the builders move inventory and pay off the CLD loans. In contrast to the waning effects for CLD as the economic recovery progresses, the effects for overall CRE and C&I loans intensify after 2009. This 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.

6.3.1 The Fully Interacted Model

The above results suggest that both the level of the concentration ratio relative to the threshold and its absolute level affected the growth of loans at banks. These results motivate a specification using both an indicator variable for the threshold and a variable for the ratio along with a full set of interactions of those variables with the indicators for the

comment and final periods. The results of this specification are presented in table 6. The dependent variable in each regression is the contemporaneous growth rate of the respective loan category and the sample is constructed as previously described for each dependent variable. For non-CRE loan categories, the threshold and loans-to-capital ratios again correspond to those for CRE rather than the dependent variable and those categories include two lags of CRE loan growth as well as two lags of their own growth rates.

Table 6: Regressions for All Loan Types with Full Set of Guidance Variables and Interactions

	(1) CRE	(2) CLD+cmt	(3) C&I	(4) RRE	(5) Consumer
$comment_t$	-0.0220	0.692	-1.005***	-0.424***	-0.384***
	(-0.20)	(0.79)	(-10.45)	(-10.21)	(-7.04)
$final_t$	-0.390***	-2.647***	-0.618***	-0.119**	0.303***
	(-3.84)	(-5.07)	(-7.43)	(-2.89)	(5.34)
$threshold_{i,j,t-1}$	1.371***	-1.147**	0.114	-0.0712	0.100
	(9.51)	(-3.30)	(0.69)	(-0.65)	(0.51)
$threshold_{i,j,t-1} \times comment_t$	-2.888***	-1.778	-0.364	0.351	-0.345
	(-3.85)	(-1.47)	(-0.33)	(0.54)	(-0.24)
$threshold_{i,j,t-1} \times final_t$	-3.687***	-0.584	-0.817	-0.212	0.249
	(-6.89)	(-0.79)	(-1.19)	(-0.49)	(0.33)
$\frac{loans_{i,j,t-1}}{RBC_{i,t-1}}$	-0.0156***	-0.0244***	-0.000795	0.00343***	-0.00304***
	(-22.86)	(-9.33)	(-1.49)	(11.58)	(-6.52)
$comment_t \times threshold_{i,j,t-1} \times \frac{loans_{i,j,t-1}}{RBC_{i,t-1}}$	0.00555**	0.000787	0.00110	-0.00186	0.00270
	(3.04)	(0.21)	(0.40)	(-1.15)	(0.73)
$final_t \times threshold_{i,j,t-1} \times \frac{loans_{i,j,t-1}}{RBC_{i,t-1}}$	0.00645***	0.00536	0.000381	0.00139	0.00109
	(4.89)	(1.61)	(0.22)	(1.26)	(0.56)
Clusters	2829	548	5821	6779	4587
Avg. Obs/Bank	51.52	38.02	49.63	53.38	50.01
R-Squared	0.0737	0.103	0.0240	0.0612	0.0686

t statistics in parentheses

The indicator for the comment period includes all dates beginning with 2006:Q1 and ending with 2006:Q4, while 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) as stated in the guidance: CRE loans, 300 percent; CLD loans, 100 percent. Regressions include bank fixed effects. Sample period: 1991:Q3 to 2011:Q4. Source: Call Reports.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The coefficients on the many variables accounting for the concentration of CRE and CLD exposures at banks and their interactions with the periods surrounding the issuance and finalization of the guidance are often significant and mostly consistent with the results of the earlier specifications, but the overall effect of the guidance on banks that are above the thresholds requires evaluating the combinations of coefficients across several variables at specified values of the ratios. The total net effect of the guidance is the first derivative of equation (2) with respect to the comment and final period dummy variables. These derivatives are shown in equations (3) and (4).

$$\frac{\partial y_{i,j,t-1}}{\partial comment_t} = \beta_5 + \beta_6 threshold_{i,j,t-1} + \beta_7 threshold_{i,j,t-1} \times \frac{loans_{i,j,t-1}}{RBC_{i,t-1}} \tag{3}$$

$$\frac{\partial y_{i,j,t-1}}{\partial final_t} = \beta_8 + \beta_9 threshold_{i,j,t-1} + \beta_{10} threshold_{i,j,t-1} \times \frac{loans_{i,j,t-1}}{RBC_{i,t-1}} \tag{4}$$

Each derivative is evaluated using the estimated coefficient from table 6 with the loans to risk-based capital ratio set equal to 100 for the CLD equation and 300 for each of the other equations. Thus, the marginal effects are interpreted as the estimated net effect of the guidance for a bank with a ratio of loans to risk-based capital exactly at the threshold level after issuance of the guidance for comment or in its final form.

The estimated marginal effects are given in table 7 and are generally in line with the results of the more parsimonious models. The results for the interaction effects for banks above the thresholds are shown in lines 2 and 4. As was the case in the previously discussed models, the growth of total CRE loans was slower at banks affected by the guidance in both the comment period and the final period than at banks that were not affected. Moreover, when evaluated at the level of the threshold ratio, those effects were about twice as large in the fully interacted model as they were in the models estimated with thresholds and concentration ratios separately. The interaction effect on banks above the CLD threshold was not significant for CLD exposures in the final period, as before, but during the comment period the marginal effect is strongly negative and nearly significant at the 10 percent confidence level. Thus, the only CLD model in which the guidance was estimated to have had an independent negative effect at traditional confidence levels was the one with only the threshold effect. Therefore, the extent to which the guidance contributed to the contraction in CLD lending depends on the degree to which the indicator variables $comment_t$ and $final_t$, after controlling for other factors affecting supply and demand,

Table 7: Marginal Effects from Table 6

	(1) CRE	(2) CLD+cmt	(3) C&I	(4) RRE	(5) Consumer
$\frac{\partial y_{i,t}}{\partial comment_t}$	-1.245***	-1.007	-1.040**	-0.631**	0.0804
	(-5.02)	(-1.61)	(-3.00)	(-3.05)	(0.19)
$\frac{\partial y_{i,t}}{\partial comment_t} - \beta_{comment_t}$	-1.223***	-1.699	-0.0345	-0.207	0.465
	(-4.72)	(-1.67)	(-0.10)	(-0.99)	(1.10)
$\frac{\partial y_{i,t}}{\partial final_t}$	-2.141***	-2.695***	-1.320***	0.0843	0.879***
	(-11.03)	(-5.28)	(-5.69)	(0.57)	(3.48)
$\frac{\partial y_{i,t}}{\partial final_t} - \beta_{final_t}$	-1.752***	-0.0478	-0.702**	0.203	0.576*
	(-9.44)	(-0.09)	(-3.12)	(1.39)	(2.30)

t statistics in parentheses

Marginal effects are evaluated for a bank at the threshold. Thresholds are defined by the ratio of loans to total risk based capital (RBC) as stated in the final guidance: CRE loans, 300 percent; CLD loans, 100 percent. Regressions include bank fixed effects. Sample period: 1991:Q3 to period 2011:Q4. Source: Call Reports.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

reflects the effect of the guidance rather than capturing other influences that are not fully accounted for in the other control variables.

The results of the fully interacted model for other loan categories remain consistent with significant spillover effects at banks that had high concentrations of CRE loans. The estimates for growth of C&I loans are roughly the same significance and magnitude as in the more-parsimonious specifications. Likewise, both the fully interacted model and the previously discussed models indicate that banks concentrated in CRE lending experienced modestly higher growth rates, about 60 basis points at a quarterly rate, in consumer lending after the guidance was finalized. Though the effect during the comment period in the fully interacted model is statistically insignificant. For RRE loans, neither the interactions with the comment period nor those with the final period are statistically significant, though the magnitudes of those effects are qualitatively similar to the significant effects estimated in the more-parsimonious specifications.

6.3.2 Did the Guidance Influence Banks with High Concentrations in Other Loan Categories?

As a final robustness check, the full model shown in equation (2) is estimated with the loan-category-specific thresholds, based on the ratios reported in table 1, as described above. The results are presented in table 8 where the results for CRE and CLD are repeated from table 6 for convenience.

The threshold indicator, defined for the same category of loans as the dependent variable, is positive for all categories except CLD exposures, indicating that banks with high concentrations in a given loan category generally experienced faster 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, concentration ratios, and indicators for the comment period and final period have the same sign pattern in the non-CRE loan categories as they do in the CRE loan categories. Thus, after issuance of the guidance, the effect of loan-category-specific concentration ratios was the same for all loan categories.

Once again, the full suite of interaction terms is evaluated by constructing the derivative of the equation with respect to the $comment_t$ and $final_t$ variables, calculated for a bank with a loan concentration ratio at the hypothetical threshold for each loan category. The results are shown in table 9. As shown in the second line, during the comment period, banks that were above the hypothetical thresholds after the issuance of the CRE guidance had slower growth than less concentrated banks over that period. After the guidance was finalized, growth remained damped at those banks in both C&I loans and RRE loans, with the effect roughly equal in magnitude to the effect during the comment period. In contrast, growth of consumer loans was not statistically different at banks over that category's hypothetical threshold after the finalization of the guidance.

Growth of residential real estate loans was, on average, about 60 basis points lower at banks above the hypothetical threshold for RRE after finalization of the CRE guidance than before the guidance was issued. This contrasts with our finding of no statistically significant change 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 issuance of the guidance, while banks with RRE concentrations slowed their buildup of RRE loans to a greater extent. This pattern is consistent with banks reacting to supervisory concerns about concentration risk more broadly, perhaps signaled

Table 8: Fully Interacted Model with Hypothetical Thresholds and Lagged Controls

	(1) CRE	(2) CLD+cmt	(3) C&I	(4) RRE	(5) Consumer
$comment_t$	-0.0220	0.692	-0.929***	-0.442***	-0.483***
	(-0.20)	(0.79)	(-9.89)	(-10.20)	(-8.95)
$final_t$	-0.390***	-2.647***	-0.732***	-0.0815	0.147**
	(-3.84)	(-5.07)	(-8.85)	(-1.94)	(2.63)
$threshold_{i,j,t-1}$	1.371***	-1.147**	1.014***	0.436***	0.221*
	(9.51)	(-3.30)	(10.14)	(9.00)	(2.06)
$threshold_{i,j,t-1} \times comment_t$	-2.888***	-1.778	-3.456***	-1.046***	-1.773**
	(-3.85)	(-1.47)	(-3.92)	(-3.49)	(-2.60)
$threshold_{i,j,t-1} \times final_t$	-3.687***	-0.584	-3.351***	-1.204***	-0.754
	(-6.89)	(-0.79)	(-6.24)	(-4.26)	(-1.69)
$\frac{loans_{i,j,t-1}}{RBC_{i,t-1}}$	-0.0156***	-0.0244***	-0.0198***	-0.0107***	-0.00664***
	(-22.86)	(-9.33)	(-26.85)	(-34.03)	(-8.56)
$threshold_{i,j,t-1} \times comment_t \times \frac{loans_{i,j,t-1}}{RBC_{i,t-1}}$	0.00555**	0.000787	0.00997**	0.00216**	0.00304
	(3.04)	(0.21)	(3.07)	(2.98)	(1.41)
$threshold_{i,j,t-1} \times final_t \times \frac{loans_{i,j,t-1}}{RBC_{i,t-1}}$	0.00645***	0.00536	0.0101***	0.00210**	0.00216
	(4.89)	(1.61)	(5.13)	(2.81)	(1.65)
Clusters	2829	548	5875	6825	4658
Avg. Obs/Bank	51.52	38.02	50.80	54.99	51.42
R-Squared	0.0737	0.103	0.0294	0.0669	0.0668

t statistics in parentheses

The indicator for the comment period includes all dates beginning with 2006:Q1 and ending with 2006:Q4, while 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 concentration distributions in table 1. Specifically, the non-CRE thresholds are: C&I loans, 200 percent, RRE loans, 300 percent, and consumer loans, 200 percent. Regressions include bank fixed effects. Sample period: 1991:Q3 to 2011:Q4. Source: Call Reports.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

by the issuance of the guidance. This interpretation is strengthened by the finding noted above from the positive coefficient on the threshold variable in the RRE equation: banks with high concentrations of these loans prior to issuance of the guidance had above average growth rates. The same is true of C&I loans: over the whole sample period, banks with high concentrations of C&I loans experienced above average growth rates, while after the

guidance was issued, banks with significant concentrations of C&I loans had slower than average growth.

Table 9: Marginal Effects from Table 8

	(1) CRE	(2) CLD+cmt	(3) C&I	(4) RRE	(5) Consumer
$\frac{\partial y_{i,t}}{\partial comment_t}$	-1.245***	-1.007	-2.391***	-0.840***	-1.648***
	(-5.02)	(-1.61)	(-8.16)	(-7.88)	(-4.90)
$\frac{\partial y_{i,t}}{\partial comment_t} - \beta_{comment_t}$	-1.223***	-1.699	-1.462***	-0.399***	-1.164***
	(-4.72)	(-1.67)	(-4.86)	(-3.61)	(-3.44)
$\frac{\partial y_{i,t}}{\partial final_t}$	-2.141***	-2.695***	-2.059***	-0.656***	-0.174
	(-11.03)	(-5.28)	(-9.75)	(-7.57)	(-0.70)
$\frac{\partial y_{i,t}}{\partial final_t} - \beta_{final_t}$	-1.752***	-0.0478	-1.327***	-0.575***	-0.321
	(-9.44)	(-0.09)	(-6.63)	(-7.04)	(-1.31)

t statistics in parentheses

Marginal effects are evaluated for a bank at the threshold. 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 loan concentration distributions in table 1. Specifically, the thresholds are: C&I loans, 200 percent; RRE loans, 300 percent; consumer loans, 200 percent. Regressions include bank fixed effects. Sample period: 1991:Q3 to 2011:Q4. Source: Call Reports.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

7 Conclusion

The "Great Recession" has highlighted the potentially critical role that banks and financial institutions more generally may 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 the traditional focus on 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 commercial real estate 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 commercial real estate at banking organizations in the event of a sectoral or broader economic disruption. Issued for comment in early 2006 and finalized late that year, the implementation of the guidance 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 in order 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 commercial real estate loans.

This paper argues that the unexpected and unprecedented introduction of quantitative thresholds into the process by which supervisors evaluated banks' exposures to commercial real estate under the guidance represents an exogenous shock to bank loan supply. 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 CRE loans at banks above the specified thresholds slowed considerably, both relative to banks below the thresholds and relative to how those banks had adjusted to high concentrations before the guidance was issued. For CLD loans, many regression results suggest that banks above the threshold did not behave differently from banks with lower concentrations, perhaps because those loans are usually made under pre-existing commitments and because conditions in that sector worsened so rapidly and so broadly that all banks cut exposures deeply at roughly the same time.

Moreover, the guidance also appears to have had significant effects on other loan categories. For instance, banks that were above the thresholds for CRE loans had lower-than-average growth rates of C&I loans after issuance of the guidance. This may reflect certain types of small business loans included within the definition of commercial real estate covered by the guidance, or it may have had the unintended effect of limiting C&I lending that was only partially collateralized by real estate assets. Growth of residential real estate loans was slower at CRE concentrated banks during the 2006 comment period, but after the rule was finalized in 2007 growth at banks affected by the guidance was stronger relative to those that were not affected. The growth rate of consumer lending also increased at banks that were above the CRE thresholds during both the comment period and after the guidance was finalized.

In all three cases, the effect of CRE concentrations on the lending category was markedly

different after the guidance was issued than before, suggesting a causal effect of the guidance can be inferred. Moreover, banks that had maintained high concentrations of C&I, RRE, or consumer loans also appeared to reduce the growth in that respective lending category after the issuance of the guidance, whereas they had previously maintained higher than average growth rates. Thus, the guidance may have made banks more sensitive to high concentrations in other parts of their portfolio as well, and affected lending conditions more broadly than just in CRE markets.

Thus, more generally, the results of this exercise highlight that attempts to tackle macroprudential concerns by increasing the regulation of specific sectors have benefits and costs. Such efforts may be quite powerful in reducing a buildup of risk in the targeted sector, but 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, the CRE guidance may have been one factor contributing to a much greater than normal tightening of lending conditions during the early part of the crisis across a range of core lending businesses at commercial banks. In addition, if 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, however. 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. While 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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8 Appendix

Table 10a: Bank Specific Balance Sheet Variables from Table 6

	(1) CRE	(2) CLD+cmt	(3) C&I	(4) RRE	(5) Consumer
$Dependent_{i,j,t-1}$		-0.00155	-0.0304***	0.131***	0.147***
		(-0.18)	(-12.17)	(51.49)	(41.53)
$Dependent_{i,j,t-2}$		0.0115	-0.00576*	0.0954***	0.0513***
		(1.40)	(-2.23)	(42.30)	(16.53)
$\ln(RealAssets)_{i,t-1}$	-0.191*	-0.633*	-0.898***	-0.608***	-1.166***
	(-2.36)	(-2.57)	(-12.42)	(-14.41)	(-14.65)
$\frac{T1cap}{TangAssets}_{i,t-1}$	-0.185***	-0.191*	0.0323*	0.0274***	-0.0390***
	(-9.49)	(-2.51)	(2.14)	(3.59)	(-3.65)
$DelRt_{i,j,t-1}$	-0.197***	-0.219***	-0.146***	-0.0989***	-0.139***
	(-28.61)	(-9.89)	(-27.50)	(-21.40)	(-18.88)
$\frac{CoreDep}{Assets}_{i,t-1}$	-0.0216***	-0.0298*	-0.00363	0.0137***	0.0235***
	(-4.87)	(-1.98)	(-1.04)	(6.46)	(6.93)
$\Delta \ln(CRE)_{i,t-1}$	0.0740***		0.00324***	0.00617***	-0.0000622
	(20.45)		(4.69)	(18.42)	(-0.16)
$\Delta \ln(CRE)_{i,t-2}$	0.0347***		0.00371***	0.00489***	0.00108**
	(10.38)		(5.34)	(15.95)	(2.92)
Constant	12.78***	25.13***	14.45***	5.957***	12.34***
	(10.64)	(6.23)	(13.57)	(9.85)	(11.13)
Clusters	2829	548	5821	6779	4587
Avg. Obs/Bank	51.52	38.02	49.63	53.38	50.01
R-Squared	0.0737	0.103	0.0240	0.0612	0.0686

t statistics in parentheses

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; coredep/assets, total transactions, savings, and small time deposits held in domestic offices divided by domestic total assets. Regressions include bank fixed effects. Sample period: 1991:Q3 to 2011:Q4. Source: Call Reports.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10b: Bank Specific Income Variables from Table 6

	(1) CRE	(2) CLD+cmt	(3) C&I	(4) RRE	(5) Consumer
$Chargeoffs_{i,j,t-1}$	-0.479***	-0.833***	-0.416***	-0.685***	-0.631***
	(-8.37)	(-5.75)	(-16.08)	(-11.73)	(-8.35)
$NIM_{i,t-1}$	0.244	-0.393	-0.0453	-0.185*	0.277*
	(1.21)	(-0.50)	(-0.28)	(-2.14)	(2.04)
$NIE_{i,t-1}$	-0.262*	-0.765*	-0.182	-0.233***	-0.0694
	(-2.09)	(-2.21)	(-1.73)	(-3.47)	(-0.69)
Clusters	2829	548	5821	6779	4587
Avg. Obs/Bank	51.52	38.02	49.63	53.38	50.01
R-Squared	0.0737	0.103	0.0240	0.0612	0.0686

t statistics in parentheses

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: 1991:Q3 to 2011:Q4.

Source: Call Reports

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10c: State- and Macro-level Controls from Table 6

	(1) CRE	(2) CLD+cmt	(3) C&I	(4) RRE	(5) Consumer
$HPI_{i,t-1}^{growth}$	0.0686***	0.113***	0.0160**	0.00111	0.0312***
	(11.87)	(5.16)	(2.98)	(0.39)	(7.15)
$\Delta\, Unemp_{i,t-1}$	1.324***	0.182	-0.854***	0.583***	-0.497***
	(10.57)	(0.35)	(-8.80)	(13.24)	(-8.03)
$St\text{-}Chargeoffs_{k\neq i,t+1}$	-2.892***	-5.931***	-1.745***	-0.320***	-0.400**
	(-9.41)	(-5.81)	(-8.52)	(-3.51)	(-2.72)
$HHI_{i,t-1}$	13.95***	20.21	14.85***	10.84***	30.41***
	(4.52)	(1.85)	(5.77)	(7.44)	(14.04)
$\Delta \ln GDP_{t-1}$	0.0330	-0.0856	-0.273***	0.293***	-0.166***
	(0.78)	(-0.48)	(-8.00)	(17.52)	(-7.62)
$\Delta \ln CRE_{t-1}^{Price}$	0.0202***	0.0324			
	(3.75)	(1.49)			
VIX_{t-1}	-0.00637	-0.0318*	-0.000982	-0.00728***	0.00357
	(-1.73)	(-2.19)	(-0.33)	(-4.86)	(1.78)
$slope_{t-1}$	-0.833***	-1.675***	-0.781***	0.236***	-0.372***
	(-13.31)	(-6.30)	(-15.08)	(9.01)	(-10.14)
$FedFunds_{t-1}^{target}$	-0.292***	-0.651***	-0.0561*	0.251***	0.0548**
	(-9.46)	(-4.79)	(-2.15)	(19.59)	(3.04)
Clusters	2829	548	5821	6779	4587
Avg. Obs/Bank	51.52	38.02	49.63	53.38	50.01
R-Squared	0.0737	0.103	0.0240	0.0612	0.0686

t statistics in parentheses

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: 1991:Q3 to 2011:Q4. Sources: GDP, Bureau of Economic Analysis; Unemployment, Bureau of Labor Statistics and Summary of Deposits HPI, Corelogic; Treasury yields, U.S. Treasury; charge-offs, Call Reports and Summary of Deposits

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$