The Impact of Post-Stress Tests Capital on Bank Lending

William F. Bassett* **Jose M. Berrospide***

Federal Reserve Board **Federal Reserve Board**

June 2018

Abstract

We investigate one channel through which the annual bank stress tests, as part of the Federal Reserve's Comprehensive Capital Analysis and Review (CCAR) review, could unexpectedly curtail the provision of bank credit, or change its allocation. To quantify the impact of the stress tests, we construct a measure of the capital implied by the supervisory stress tests relative to the level of capital implied by the banks' own models, which we call the capital gap. We then study the impact of the capital gap on the loan growth of BHCs with more than $10 billion in assets. The higher capital implied by supervisory stress tests relative to that suggested by the banks' own models does not appear to unduly restrict loan growth. Consistent with previous results in the bank capital literature, we find evidence that among the CCAR banks, more capital is associated with higher loan growth.

JEL Classification Codes: G21, G28

Keywords: bank capital, bank lending, regulatory capital, stress tests

---

* Email: william.f.bassett@frb.gov and jose.m.berrospide@frb.gov. We thank Saleem Bahaj, Eliana Balla, Andrew Cohen, Sergio Correia, Beverly Hirtle, Lei Li, Ulas Misirli, Ralf Meisenzahl, Teodora Paligorova, Mihal Velikov, Liu Yang, Cindy Vojtech, and participants at the Federal Reserve Board, Bank of England, Federal Reserve Bank of Richmond, IFABS 2017 annual meeting, and FDIC's Annual Bank Research Conference for valuable comments. The views expressed are our own and do not necessarily reflect those of the Federal Reserve Board.

1. Introduction

As the large and sluggish recovery from the 2007-2009 financial crisis reinforced, allowing banks to operate without sufficient capital to withstand periods of severe financial and economic stress can exacerbate economic downturns. However, miscalibration of financial regulation can also restrict credit to otherwise creditworthy borrowers and distort the distribution of credit through the economy. As a result, the appropriate role and stringency of bank regulations worldwide continue to be highly debated among academics, regulators, and banking industry representatives.

Stress testing has become a cornerstone approach to bank regulation and an important component of the post-crisis regulatory reform in the United States. (Tarullo, 2014). One of the primary advantages of stress tests is that they provide a forward-looking measure of what may happen to the level of capital in the banking system as a result of substantial losses in loan, security, and trading portfolios when the economy deteriorates (Hirtle, Kovner, Vickery and Bhanot, 2016). U.S. banking organizations undoubtedly are more resilient and the U.S. financial sector is more stable as a result of the strong stress-testing regime. However, the banking industry and other stakeholders have claimed that the stress testing exercises are altering credit availability in ways that are unintended by policymakers.[1]

One channel through which stress tests could affect credit availability is through the capital requirements that are implicit in the quantitative part of the Federal Reserve's annual Comprehensive Capital Analysis and Review (CCAR). We study whether banks' resultant use of higher capital is restraining the provision of bank credit to a greater degree than expected, or changing the allocation of loan growth in ways that are unwarranted. Of course, not all changes in the availability of credit in the post-crisis regime would be unwelcome; for instance, stress-tested banks are incentivized to fully consider whether their lending operations are sustainable through a severe downturn.

To quantify the effect of the additional capital required by the Federal Reserve's stress tests, we compare the minimum post-stress capital ratios implied by the Fed's stress tests to the ratios implied by the BHC's own stress tests, both using the CCAR severely adverse scenario. We call this difference the *capital gap*, which we interpret as the additional capital that the bank needs to use in its funding structure

[1] Some of these sources suggest that stress tests require banks to fund their assets with more capital than necessary to achieve financial stability goals, and thus point to the idea that banks could be instead using that extra capital to finance additional credit in the economy. These types of arguments may be misleading as they could suggest that excess capital, which otherwise could be used to extend more credit, is kept as idle cash in banks' vaults. Capital requirements do not force banks to immobilize capital in their balance sheets. Instead, capital requirements ensure that banks finance new loans with sufficient capital to remain viable in a downturn (e.g., with 7 cents for each dollar of new loans), rather than with less stable sources of funding that could dry up and exacerbate a nascent crisis.

in order to comply with the supervisory stress tests relative to the capital levels that would be implied by its own models.[2] Importantly, banks have limited ability to manage this gap, because the supervisory scenarios are not released in advance and the Federal Reserve's stress test models are not disclosed to them. We then study the impact of the capital gap on the loan growth of BHCs across different loan categories.

Following theoretical and empirical literature that relates the level of bank capital to optimal investment behavior by banks, we formulate two hypotheses about the impact of the capital gap, that is, the extra capital implied by the supervisory stress tests, on banks' loan growth and their lending standards. First, the risk mitigation hypothesis states that the additional capital required by the stress tests causes banks to reduce their risk-taking activities, for instance by tightening their lending standards or increasing their investments in safe securities. Second, the risk facilitation hypothesis postulates that the higher capital buffers resulting from the stress tests make banks safer and more resilient, which in turn lowers their marginal cost of funding, and thus put them in a better position to take more risks, such as by loosening their lending standards and increasing the share of assets in loans.

We conduct our analysis following two approaches. First, we compare the impact of the capital gap on the loan growth of the banks subject to the supervisory stress tests (CCAR banks) and the relatively large regional banks that must run their own stress tests but are not subject to the supervisory stress tests (non-CCAR banks).[3] Supervisory stress tests tend to be more stringent than bank stress tests and thus, on average, the capital gap is positive among CCAR banks. By construction, the capital gap is zero for non-CCAR banks, because they are not subject to the supervisory models. We exploit this variation in our capital gap measure to study the lending implications of the supervisory stress tests using panel data estimation. Furthermore, we refine this analysis looking at a subsample of stress-tested banks that eliminates the largest and most complex banks as well as the smaller regional banks, in order to focus on more comparable banks. That is, the BHCs that mostly engage in traditional lending and deposit taking operations, and are closest to the $50 billion size threshold for participation in the supervisory stress test exercise. In our second approach, we study the impact of the severity of the stress tests on loan growth among the CCAR banks only. We extend the analysis, and further distinguish ourselves from the rest of

[2] For example, if the post-stress capital ratio (i.e., the capital ratio resulting from the most severe DFAST scenario for the bank) is 9 percent under the bank's model and 8 percent under the Fed's model, the capital gap would be 1 percent.

[3] The non-CCAR BHCs in our sample are the relatively large regional banks with assets between $10 billion and $50 billion. These BHCs are not subject to the Federal Reserve's stress tests, but the Dodd-Frank Act mandates that they conduct their own annual company-run stress tests, submit their results to their primary federal banking regulator (Federal Deposit Insurance Corporation, Federal Reserve System, or Office of the Comptroller of the Currency) and make their results public (e.g. through their websites). Throughout the paper we use the terms bank and BHC interchangeably.

this burgeoning literature, by examining the impact of the capital gap on the level of bank lending standards across multiple loan categories using the responses in the Senior Loan Officer Opinion Survey (SLOOS) for both groups, CCAR and non-CCAR banks.

We find no systematic evidence in favor of the risk mitigation hypothesis. In other words, we find no evidence that the extra capital implied by the results of the supervisory stress tests may be unduly constraining bank loan growth or causing banks to tighten their lending standards. In our first approach, which compares the loan growth between CCAR and non-CCAR banks, we conclude that although loan growth by CCAR banks has been slower than loan growth by non-CCAR banks, the difference in growth for loan categories such as residential and commercial real estate loans as well as small business loans seems to be driven by factors beyond the stress tests such as loan demand (proxied by economic conditions in banks' primary markets), and other bank-specific characteristics such as increased post-crisis risk aversion, differential credit quality of legacy portfolios, and funding models. After we account for those factors, we do not find evidence that the capital calculations associated with the supervisory stress tests explain the loan growth differences.

Our results are consistent with previous findings in the academic literature supporting the view that more capital is associated with higher loan growth (Bernanke and Loan, 2000; Francis and Osborne, 2009; Berrospide and Edge, 2010; Carlson, Shan, Warusawitharana, 2013; Chu, Zhang, and Zhao, 2017). Our paper differs from recent work analyzing specifically the impact of stress tests on bank lending. In particular, Acharya, Berger and Roman (2018) find that stress-tested banks reduce their credit supply to manage their credit risk. These authors show that the negative effect seems stronger for riskier borrowers, safer banks, banks that pass the stress tests, and the earlier stress tests. We also examine the lending implications of the supervisory stress tests, but rather than looking at banks that pass or fail the stress tests, or comparing bank lending before and after the implementation of the stress tests, we examine the implications of the higher capital implied by the stress test relative to the level of capital implied by the banks' own stress tests. Another important difference with their paper is that we follow a broader approach by studying the lending implications of the post-stress tests capital on more loan categories.

As we discuss below, before the financial crisis, CCAR banks were operating with historically lower capital ratios than smaller non-CCAR banks. The implementation of the stress tests and other reforms to capital requirements has led the CCAR banks to raise large amounts of capital. Consistent with the risk facilitation hypothesis, our interpretation is that the higher capital buffers that result from the new regulatory framework, which make banks safer and more resilient, altogether put banks in a better position to lend more, at least across some loan categories. According to our results, higher capital buffers have not restricted but favored their lending capacity relative to other banks in the same period. Beyond their crucial role in bank supervision and regulation, stress tests are also a key forward-looking risk management tool for banks themselves, a benefit that should be compared with the costs of administering the tests.

The remainder of the paper is organized as follows. Section 2 provides the background on stress testing in the U.S, section 3 revises the related literature. Section 4 describes our empirical methodology and section 5 presents our econometric results. Section 6 concludes.

2. Background on U.S. Supervisory Stress Tests

In the U.S., the stress testing regime is an annual process that consists of two interrelated parts, the Comprehensive Capital Analysis and Review (CCAR), established by the Federal Reserve in 2011, and the Dodd-Frank Act Stress Tests (DFAST), which are required by the Dodd-Frank Act (DFA). CCAR is an evaluation of capital planning processes at individual BHC's with assets greater than $50 billion.[4] It includes both a qualitative review of the company's internal models, risk management, and control practices as well as a quantitative assessment of post-stress capital ratios. DFAST is a wholly quantitative exercise in which the Federal Reserve uses its own independent suite of empirical models to project bank income, expenses, loss provisions, and capital, over a nine-quarter planning horizon and under three hypothetical scenarios: baseline, adverse, and severely adverse.[5] The severely adverse scenario features a deep recession in the U.S., characterized by a substantial increase in the unemployment rate, large declines in asset prices, and increases in risk premia.

The main difference between DFAST and CCAR is that upon disclosure of results, no specific supervisory actions are attached to DFAST beyond the requirement that BHCs take the results into account in their capital planning. However, in CCAR, the Federal Reserve may object to the BHC's capital plan (e.g., a BHC fails the stress test) on either quantitative or qualitative grounds, and thus may require changes in the firm's planned capital distributions.[6] Objections on quantitative grounds occur when a BHC's post-stress capital ratio falls below a minimum capital requirement (e.g., if CET1 capital

---

[4] Beginning in 2017, most BHCs with assets between $50 billion and $250 billion were exempted from the qualitative portion of CCAR, but remained subject to its quantitative review and the DFAST exercise.

[5] The Federal Reserve started conducting Dodd-Frank Act supervisory stress tests (DFAST) in 2013 on the 18 largest BHCs that were subject to the 2009 Supervisory Capital Assessment Program (SCAP). In 2016, 33 BHCs were subject to DFAST, and that number is projected to increase in the coming years as intermediate holding companies (IHCs) of foreign banking organizations operating in the U.S. are incorporated.

[6] More specifically, the Federal Reserve could require the company to stop dividend payments and share repurchases entirely or could permit these actions within certain bounds. In general, all BHCs that participate in CCAR receive extensive supervisory feedback on their capital planning processes, including identification of areas that require improvement (Hirtle and Lehnert, 2015).

ratio falls below 4.5 percent). On qualitative grounds, objections occur, for example, when deficiencies are identified in a BHC's governance structure or its risk measurement and management system.

Another key difference between the CCAR quantitative exercise and DFAST is the assumptions about capital distributions when calculating post-stress capital ratios. DFAST assumes that dividends remain constant over the planning horizon and similar to their average over the previous year (share repurchases and issuance are assumed to be zero), whereas CCAR uses the BHCs' reported planned capital distributions. In addition, the DFA mandates that all BHCs with assets greater than $10 billion conduct company-run stress tests using the supervisory scenarios designed by the Federal Reserve and report those results publicly.[7] The comparison of the post-stress capital ratios in DFAST under the severely adverse scenario resulting from the company-run models with those resulting from the supervisory models is the key variable in this paper.

Our identification strategy is bolstered by the steps taken by the Federal Reserve to ensure that the supervisory stress tests are independent of those run by the BHCs. The Federal Reserve releases short descriptions of the key variables in their models, but does not reveal the full list of variables or the functional form of the models.[8] Doing so could facilitate banks' efforts at regulatory arbitrage and encourage the development of a "model monoculture," in which all banks converged to the same models for purposes of "passing" the stress tests. Either development would pose significant risks to financial stability. Moreover, the scenarios change each year to address emerging risks to financial stability, and are released to the public only at the start of the stress testing cycle, after the effective date of bank balance sheet data used in the stress tests. This process prevents banks from altering their balance sheets just prior to the effective date for the stress tests in order to perform better on the tests.

The implementation of supervisory stress tests has significantly improved the resilience of the financial sector. By requiring the largest and most complex BHCs to operate with sufficient capital to weather financial and economic stress periods, and thus to continue functioning as viable financial intermediaries in those circumstances, the supervisory stress tests have reduced systemic risks in the financial system (Tarullo, 2014). As shown in Figure 1, the largest banks historically have funded their balance sheets with less capital than smaller banks. But, this difference in capital has narrowed recently,

[7] In addition to these scenarios, each BHC has to conduct a stress test based on its own scenarios, including at least one stress scenario and a baseline scenario. Individual BHCs then submit to their primary federal regulator and publicly release the results of their baseline scenario using their own planned capital actions and the results of their stress scenario(s) using any alternative capital actions (if applicable).

[8] See, for example, Appendix B: Models to Project Net Income and Stressed Capital in the disclosure document, "Dodd-Frank Act Stress Tests 2017: Supervisory Stress Tests Methodology and Results," Board of Governors of the Federal Reserve System, June 2017: https://www.federalreserve.gov/publications/files/2017-dfast-methodology-results-20170622.pdf.

as the banks subject to the supervisory stress tests (CCAR banks) have more than doubled their high-quality capital (e.g., Common Equity Tier 1 capital) ratios over the past ten years, converging to the capital levels maintained by smaller banks (non-CCAR banks).

Stress tests may also influence banks' decisions about the quantity or type of credit that they extend, and that could have unintended consequences. One possible unintended consequence is that the persistent inclusion of certain major risks in the scenarios could lead to less efficient credit allocation decisions, because in adjusting their balance sheet to reduce projected losses, banks may end up reducing the credit supply, for example to sectors in which a large positive supply shock is supporting rapid debt growth.[9] This is a concern recently highlighted by banking industry representatives and other policymakers, and is part of the motivation for our study.

Figure 2 shows the differences in loan growth between CCAR and non-CCAR banks over the past 6 years. Recent loan growth at (large) CCAR banks has been slower than loan growth at their (smaller) non-CCAR counterparts across different loan categories. Differences in loan growth are more evident for commercial real estate (CRE), residential real estate (RRE) and small business loans, whereas the lending path for commercial-and-industrial (C&I) and consumer loans look similar between the two groups of banks.

Differences in loan growth since the end of the financial crisis may be explained by factors beyond regulation and stress tests such as changes in business models, credit quality, risk aversion, and different crisis experience. For example, given their complexity and interconnectedness, CCAR banks had more fragile funding structures and vulnerable balance sheets, and faced significantly larger loan and securities losses than non-CCAR banks during the financial crisis. Thus, even in the absence of new regulations or heightened supervision, this crisis experience may have reshaped CCAR banks' business models and moderated their loan growth in the post-crisis period. Moreover, loan growth at smaller banks often exceeds that of larger banks; these banks also had faster growth rates between 2001 and 2006 (Vojtech, 2017). As we show below, after accounting for these additional factors we do not find systematic evidence that supervisory capital stress tests unduly restrict bank credit supply. Furthermore, even if certain types of lending at large banks had slowed, that could be consistent with the macroprudential objective of having those banks internalize whether the loans that they are extending remain sustainable through an economic downturn.

[9] As Liang (2017) points out, a current practice within the Fed's stress tests that may prevent this unintended risk from materializing is that supervisory scenarios with salient risks vary over time. In addition, the Federal Reserve's loss projections are usually based on very granular data that better incorporates the current riskiness of the banks' business lines than the traditional standardized risk weights used in pre-crisis regulations.

Beyond their crucial role in bank supervision and regulation, stress tests are also a key forward-looking risk management tool for banks themselves. For instance, the stress tests incentivize banks to consider the performance of their loans through a severe downturn, which helps ensure that banks internalize the costs to the broader economy and financial system of poorly underwritten or unsustainable credits. They also may encourage banks to undertake better risk measurement and management practices, to keep well-organized data, and to maintain expertise in projecting revenues and losses under alternative scenarios (Liang, 2017). However, banks note that stress tests are expensive to implement, and the supervisory stress test is usually seen by banks as another (more binding) capital requirement.

3. Hypothesis Development and Related literature

3.1. Hypothesis Development

Previous research has examined the impact of capital requirements on bank risk-taking and lending. In principle, supervisory stress tests can be thought of a form of dynamic capital requirements that impose risk-sensitive capital buffers on banks, accounting explicitly for expected deterioration in an adverse economic scenario. From a theory perspective, risk-sensitive capital requirements create stronger incentives for banks to limit risk-taking activities. As a result, the higher capital required by the supervisory stress tests may lead banks to tighten their lending standards and thus to restrict their credit supply relative to their behavior in a regulatory regime that did not explicitly account for severe downturns. Thus, the stress tests lead to larger buffers against losses than banks would maintain in their absence. Mechanically, one way banks can limit expected losses and thus reduce those buffers is by reducing credit supply and shrinking their balance sheet, and thus their risk-weighted assets, to boost the pre-stress capital ratio. Papers providing theoretical support to the restricting effects of capital requirements on risk-taking and lending include Thakor (1996), Repullo (2004), and Acharya, Mehran and Thakor (2016). We refer to this view as the risk mitigation hypothesis of supervisory stress tests.

The alternative possibility is that banks that are incentivized to maintain large capital buffers may expand their credit supply. In particular, higher capital buffers resulting from the need to account for potential losses uncovered by the stress tests can make banks safer and more resilient, and thus put them in a better position to take more risks, perhaps by loosening their lending standards and increasing their lending. This may be the case if the additional capital (e.g., reduction in the probability of bank default) leads to a reduction in the cost of funding the new marginal loans. This view, which we refer to as the risk facilitation hypothesis of supervisory stress tests, is consistent with the theoretical frameworks in Kim and Santomero (1988), Calem and Rob (1999), and more recently, Bahaj and Malherbe (2017). These latter authors show that the relationship between lending and capital requirements follows a Ushaped pattern, that is, once capital requirements move beyond a level that investors consider sufficiently conservative, banks increase their allocations to risky assets (e.g., lending). This seems to be particularly the case during a post-crisis period; that is, when banks had enough time to remove their legacy of bad loan portfolios and thus potential debt overhang issues are less severe.

The two hypotheses we formulate above are largely analogous to the risk management hypothesis (reduction in credit supply) and the moral hazard hypothesis (increase in credit supply) of stress tests, respectively, in Acharya, Berger, and Roman (2017). In formulating their hypotheses, these authors discuss the different potential channels set forth in previous research through which bank capital regulations impact bank risk-taking and lending decisions. These channels are derived under the view that depending on how strong their existing capital positions are, banks may have incentives to reduce or expand their lending. In contrast, in formulating our two opposing hypothesis, we focus on the impact of the *additional* capital that banks employ as a result of the supervisory stress tests on banks' loan growth and their lending standards across different loan categories.

3.2 Other Related Literature

Our paper is related to the two strands of the empirical literature studying the relationship between bank capital and lending. The first strand considers the impact of minimum capital requirements on bank credit supply. Empirical work in this literature finds that increases in minimum capital requirements reduce bank lending (Brinkmann and Horvitz 1995, Peek and Rosengreen 1997, Gambacorta and Mistrulli 2004, Aiyar, Calomiris, and Wieladek 2014, Mésonnier and Monks 2015, and Berrospide and Edge, 2017). Estimates of the impact of a one-percentage-point increase in capital requirements on loan growth over a one-year horizon range widely and show reductions in lending between 1 to 10 percentage points and/or changes in interest rates faced by borrowers of between +3 and -15 basis points. The second strand considers more generally the impact of bank capital on lending. Empirical papers in this strand of the literature find a positive relationship between bank capital (and capital ratios) on lending, though the estimates of the size of the effect are also less clear. For example, Bernanke and Lown (1999) find sizable effects of capital on the lending of U.S. banks in the early 1990s, whereas Francis and Osborne (2009) for U.K. banks and Berrospide and Edge (2010), and Carlson, Shan, and Warusawitharana (2013) for U.S. banks find modest effects.

The positive impact of capital buffers on loan growth is consistent with a negative effect of higher capital requirements, because increasing the capital requirements relative to existing capital ratios would reduce the capital buffer of some institutions, all else equal. Thus, combining these strands of research, the important financial stability implication is that banks with large buffers of capital relative to their regulatory minimums are most likely to maintain credit supply through a downturn. Ensuring that banks maintain a buffer over the regulatory minimum even during a protracted and severe downturn is precisely the goal of the stress tests.

More recent empirical papers in this literature take advantage of the availability of loan-level data from the largest U.S. BHCs that are collected for supervisory purposes. Calem, Correa, and Lee (2017) study the impact of several prudential policies on the credit supply of U.S. banks, including the impact of CCAR stress tests on the jumbo mortgage market. They find that the 2011 CCAR stress test exercise reduced jumbo mortgage originations and approval rates, possibly due to the generally-weak capital positions at CCAR banks.

In a similar vein, Berrospide and Edge (2017) examine the impact of the U.S. post-crisis regulatory reform on the lending of both, BHCs subject to the higher capital requirements implied by the Basel III capital standards, and the largest BHCs subject to the CCAR stress tests. Using matched firm-level data across the largest banks to separate the impact of credit supply shocks implied by the supervisory stress tests from loan demand changes at the firm level, they find that the unanticipated reduction in regulatory capital implied by the stress tests, made public for the first time in the 2012 CCAR exercise, led to a significant reduction in C&I lending.[10] Similarly, and using a separate analysis on smaller banks subject to Basel III capital rules, they find that the reduction in capital implicit in the announcement of Basel III rules in June 2012 and July 2013 led to a reduction in lending across multiple loan categories.

Our paper is related to recent work analyzing specifically the impact of stress tests on bank lending. Using micro-level data from syndicated loan markets, Chu, Zhang, and Zhao (2017) find a positive relationship between bank capital and lending. Our paper also examines the lending implications of the Fed's stress tests, but we examine the implications of the higher capital implied by the stress test relative to the level of capital in the banks' own stress tests. Another important difference with their paper is that we follow a broader approach by studying the lending implications of stress tests on different loan categories.

Our paper is also related to Flannery, Hirtle, and Kovner (2017). These authors study the impact of stress tests disclosures on information production about both BHCs and the overall banking industry and find that the disclosure of stress tests results consistently provides material information to investors, particularly for highly leveraged and riskier BHCs. They also study the impact of the severity of stress tests on asset and loan growth by comparing Federal Reserve's estimated loan losses and the BHC's own

[10] Unlike the unanticipated reduction in regulatory capital implied by the 2012 stress tests in Berrospide and Edge (2017), in this paper we use the difference between the minimum post-stress regulatory capital ratios in the Federal Reserve's and the BHCs' own stress tests exercises.

estimated loan losses. However, their emphasis on loss estimates specific to the loan category overstates the impact of the stress tests on economic capital allocations. The stress tests also account for revenue generated by lending operations to offset expected losses, so firms should consider that in assigning economic capital. Therefore, we focus more broadly on the changes in overall capital ratios. In addition, we extend their results through the use of data on lending standards across loan categories.

Another closely related work to ours is a recent research note by The Clearing House (TCH), which argues that the stress tests impose granular capital requirements that force banks to curtail and distort the provision of credit, especially residential mortgages and small business loans. Our findings, however, suggest that the larger capital implied by the stress tests has little impact on loan growth at stress tested banks. Unlike the TCH note, we account for differences in risk characteristics of the loan portfolios, using publically available data on delinquency rates. This omission on the TCH note could be particularly problematic for their conclusion on residential mortgage lending, given that a number of banks still have large amounts of delinquent legacy mortgages on their balance sheets. In addition, part of the reduction in residential mortgage lending may be explained by conservative lending practices in light of other regulations introduced to prevent the type of risky mortgage lending that precipitated the crisis.

4. Methodology

4.1 Regulatory capital ratios in the absence of stress tests

We assess the impact of stress tests on BHC lending by developing a counterfactual aimed at answering the following question: "What would regulatory capital ratios look like in the absence of the supervisory stress tests?" Because stress testing has become a best practice in risk management, we assume that large banks would still be required by regulators to run their own stress tests and to use the results of those tests in their risk management framework. Indeed, recent commentary from politicians and banking industry representatives implies that banks do incorporate the capital ratios determined by their own models in their decision-making frameworks.[11] To maintain comparability, we use the results of the bank-run stress tests using the Fed's CCAR scenarios.

We construct the counterfactual by comparing the lowest capital ratio (Common Equity Tier 1 or CET1 capital ratio) observed during the stress test horizon in the BHC's own exercise to that observed in the Fed's supervisory stress test exercise.[12] We call this difference the "capital gap":

[11] For example, during Chair Yellen's Congressional Testimony on February 14, 2017, Senator Toomey argued that CCAR may be somewhat duplicative considering that banks do their own stress testing.

[12] The stress test is conducted by forecasting quarterly revenues, expenses, changes in the amount of outstanding loans and losses on loans and other investments. Those are then used to compute the capital ratio at the end of each quarter; we use the minimum ratio observed over that time period. Notice that the minimum capital ratios in both

$$Capital\ Gap = Lowest\ CET1\ Capital\ ratio_{BHC} - Lowest\ CET1\ Capital\ ratio_{Fed} \quad (1)$$

Figure 3 illustrates the calculation of the capital gap. We use information for Morgan Stanley in the 2015 stress testing exercise. The bank started the exercise with a CET1 ratio of 15.2 percent (grey bar). Using its own models with the Fed's severely adverse scenario, Morgan Stanley estimates a post-stress minimum capital ratio of 8.6 percent (green bar), that is, an implied maximum drop in CET1 of 6.6 percentage points. The minimum post-stress CET1 in the supervisory stress test exercise (that is, using the Federal Reserve's models with the Fed's severely adverse scenario) is 6.3 percent (blue bar), implying a more severe maximum drop in the capital ratio (8.9 percentage points). The capital gap is the difference in post-stress minimum capital ratios, which in this example equals 2.3 percentage points (red bar).

The capital gap can be thought of as the capital buffer (e.g., extra capital) that each BHC must employ as a result of the supervisory stress tests typically being more stringent than their own models. In our view, constructed that way, the capital gap should be exogenous, as the banks do not know the exact structure of the Federal Reserve's stress test models or have advance notice of the supervisory severely adverse scenario.

Figure 4 depicts the distribution of the CET1 gap for the CCAR banks between 2015 and 2016. The capital gap, on average, is relatively small, about 0.8 percentage points. Notice also that the capital gap is negative for some banks, which means that for these banks the minimum capital in the Fed's exercise is larger, or equivalently, that banks project higher capital losses than the losses in the supervisory stress tests.

The actual capital ratio (CET1) at the start of the stress test exercise can then be decomposed into the capital ratio that the bank would employ in the absence of the Fed's stress tests, i.e., the amount suggested by their own models, and the capital gap. In the example above, Morgan Stanley's starting CET1 ratio of 15.2 percent in 2015 can be decomposed into the capital gap of 2.3 percent and the CET1 ratio suggested by its own model of 12.9 percent. The latter ratio (12.9 percent) is our counterfactual capital ratio.

Figure 5 shows the counterfactual capital ratios for the average CCAR bank over time. In these charts, the blue line is the actual capital ratio and the orange line is the counterfactual capital, that is, the difference between the two is the capital gap. Thus, if banks were subject only to their own stress tests, this counterfactual indicates that their capital ratios could have been much lower during earlier years,

exercises are comparable as they are both intended to meet the DFA requirements. For example, in the Fed's exercise and the BHC's exercise capital ratios are calculated using the same individual capital distribution assumptions (e.g. DFAST) under the same supervisory scenarios published by the Federal Reserve.

though capital ratios have converged over time.[13] As discussed before, non-CCAR banks conduct their own company-run stress tests and are not subject to the supervisory stress tests. Hence, the capital gap for these banks is zero.

Next, we turn to the question of whether the capital gap is restricting bank lending.

4.2. Empirical analysis

We study the impact of supervisory stress tests on bank loan growth by exploiting the different ways in which stress tests are implemented by bank size. First, we compare the historic path of loan growth of banks subject to the supervisory stress test exercise (CCAR banks) and banks not subject to the exercise (non-CCAR banks, our control group) using both a balanced panel of about 90 banks and also a restricted subsample of banks that is more homogeneous (BHCs with size between $20 and $200 billion). We conduct this analysis for multiple loan categories: total, commercial and industrial (C&I), commercial real estate (CRE), residential real estate (RRE), small business, and consumer loans.

By construction, non-CCAR banks have a capital gap of zero percent; they are free to employ only as much of a buffer over regulatory minimums as they deem appropriate, and may or may not incorporate their stress test results in that calculation. Because some of the CCAR banks have a negative capital gap – that is, their own stress tests are more stringent than the supervisory tests for their portfolio– adding this large group of banks with a zero percent gap may add some statistical power to the tests. However, because the number of such banks relative to the number of CCAR banks with a near-zero or negative gap is large, the zero capital gap in that sample may be capturing many factors related to size, including all of the differences in post-crisis regulation across banks with more than $50 billion in total assets. Thus, we also study the loan growth just within the CCAR banks as an additional test of whether banks with a larger capital gap restrict their lending more than banks with smaller capital gaps. As in the larger sample, we conduct this analysis for multiple loan categories.

We start with a panel regression specification, which is common in the empirical literature on the impact of bank capital on lending, given by:

$$\Delta Log(Loan)_{it} = \alpha_0 + \alpha_1 T + \alpha_2 BHC_i + \alpha_3 Capital\ Ratio_{it-1} + \alpha_4 X_{it-1} + \varepsilon_{it} \qquad (2)$$

As explained in section 4.1, we can decompose the actual *Capital Ratio* (CET1 ratio) in the expression above into:

[13] Studying the reasons for such convergence is beyond the scope of this paper. For that purpose, see Hirtle and Kovner (2014).

$$Capital\ Ratio_{it} = Capital\ Ratio\ Adjusted_{it} + Capital\ Gap_{it} \tag{3}$$

where *Capital Ratio Adjusted* is the capital ratio that the bank's internal models would suggest and in the absence of the Fed's stress tests (our counterfactual capital ratio) and the *Capital Gap* is defined by equation (1).

Substituting (3) in (2), we use the following panel regression specification to estimate the impact of the capital gap on bank lending:

$$\Delta Log(Loan)_{it} = \alpha_0 + \alpha_1 T + \alpha_2 BHC_i + \alpha_3 Capital\ Ratio\ Adjusted_{it-1} + \alpha_4 \text{Capital Gap}_{it-1} + \alpha_5 X_{it-1} + \varepsilon_{it} \tag{4}$$

In this specification, the dependent variable is the annual growth rate of loans of BHC i in year t, expressed as a function of the *Capital Ratio Adjusted* and the *Capital Gap*, both measured at the beginning of the stress test exercise. These two are the main variables of interest in our analysis. We include lagged bank-specific controls in vector $X_{i,t-1}$, which include size (log of total assets), the ratio of nonperforming loans to total loans (and, alternatively, net charge-offs to total assets ratio), return on assets (ROA), and the ratio of deposit liabilities to total assets. We also include measures of economic activity at the state level, a set of BHC-specific variables constructed by weighting state-level economic measures such as personal income growth, home price growth, and unemployment rates with bank deposit shares in each of the 50 states in which the bank operates. Some bank controls in the loan-category regressions, such as the nonperforming loan ratio (and net charge-offs ratio), are calculated for different loan categories to help alleviate the concern that we are omitting some loan-type-specific controls.

In the large, full sample, we also include both bank fixed effects (BHC_i), to account for time-invariant and unobserved heterogeneity across banks, and time dummies (T), to account for seasonal factors or any other macroeconomic changes that affect all banks equally and simultaneously. Our regression analysis using the smaller sample of CCAR banks only is somewhat constrained by the number of observations as it includes about 30 BHCs during 4 years (about 102 observations). For that reason, the specification still includes year fixed effects but not firm fixed effects.

We expect a positive coefficient on the capital ratio, as suggested by previous findings in the bank capital literature. According to the risk mitigation hypothesis, we would expect a negative coefficient on the capital gap, consistent with the view that the extra capital implied by the stress tests may be restricting bank lending. We would expect a positive coefficient if, as postulated by the risk facilitation hypothesis, the capital gap leads to more bank lending.

4.3 Data and Summary Statistics

We use publicly available data for our empirical analysis. Annual balance sheet information is sourced from regulatory filings (FR-Y9C) for BHCs with total assets of at least $10 billion, as these are the firms subject to stress tests requirements mandated by the Dodd-Frank Act. We combine this information with data on both supervisory stress tests results from the Federal Reserve's DFAST disclosure documents for 2013 through 2016, and bank's own stress test results for both CCAR and non-CCAR banks.[14] Data from the FDIC's Summary of Deposits is used to construct a BHC-specific measure of loan demand at the state level, as described in section 4.2. The data is adjusted to control for mergers and acquisitions, and winsorized at the 1st and 99th percentiles to deal with potential outliers.[15] After some data cleaning we end up with 279 observations for 91 BHCs.[16]

Table 1 provides summary statistics for the variables in our regression analysis and for 31 CCAR and 60 non-CCAR banks. As seen in this table, CCAR banks are the largest and most complex U.S. BHCs (about $500 billion in total assets for the median bank). Compared to their non-CCAR counterparts, CCAR banks operate with slightly smaller capital ratios (CET1 capital ratio) and on average exhibit smaller annual loan growth rates (measured as the log change in outstanding amounts) in total loans (5 percent versus 9 percent) and across different loan categories. The average CCAR bank also exhibits larger net charge-offs (0.43 percent) than non-CCAR banks (0.26 percent) and a lower ratio of deposits to total assets (61 percent) than their non-CCAR counterparts (75 percent). There are not significant differences between the two groups in terms of the ratio of liquid assets to total assets and return on assets (ROA).

4.4 Univariate Analysis

We start investigating the impact of stress tests on the lending of banks by comparing the annual loan growth between 2013 and 2016 for different loan categories: commercial and Industrial (C&I), commercial real estate (CRE), residential real estate (RRE), small business, and consumer loans for both CCAR and non-CCAR banks and also by splitting them into groups based on complexity measures and existing regulatory capital ratios.

[14] Supervisory stress tests results (DFAST) are available at the Federal Reserve's website: https://www.federalreserve.gov/supervisionreg/dfa-stress-tests.htm. Despite the fact that we refer to banks subject to the supervisory stress tests as CCAR BHCs, we use DFAST and not CCAR post-stress capital ratios as banks only disclose publicly their DFAST capital ratios. Furthermore, we restrict our analysis to this four-year period as DFAST results have been publicly available only since 2013.

[15] For a description of the merger adjustment process, see English and Nelson (1998)

[16] Of the 33 CCAR BHCs in 2016, we exclude 2 banks with minimal lending exposures.

Table 2 shows these results. The top left panel shows the comparison between the CCAR banks and non-CCAR banks. Non-CCAR banks have slightly higher capital ratios than CCAR banks and the growth rate of total loans for these banks almost doubles that of their CCAR counterparts, a statistically significant difference. The non-CCAR banks also exhibit faster growth in each of the disaggregated loan categories, consistent with Figure 2, but most of these differences in loan growth are not statistically significant. Thus, the more highly capitalized regional banks exhibited faster loan growth.

The other 3 panels in Table 2 examine loan growth differences across different bank groups within the 31 CCAR banks. The top right panel compares the average loan growth rates between the global systemically important banks (GSIB) and the non-GSIB banks that are subject to CCAR. This comparison is motivated by the higher capital requirements applied to GSIBs outside of the CCAR process, in order to illuminate any differences that might arise from those policies independently of the stress test regime. Indeed, GSIB banks have higher regulatory capital ratios than the non-GSIB banks and lend more across all of different categories of loans to nonfinancial businesses and households (core loans). The differences in growth rates range between 2.8 and 9.4 percentage points and are statistically significant for RRE loans.[17] The bottom left panel compares the average loan growth of CCAR banks grouped by whether or not they are subject to the advanced approaches capital framework. The advanced approaches bank group includes the GSIBs as well as a handful of other banks with total assets greater than $250 billion or foreign assets greater than $10 billion. They are subject to stricter capital and liquidity regulation compared to non-advanced approaches banks, and they exhibit higher capital ratios on average.

Advanced approaches banks also seem to lend more across different loan categories. These banks exhibit significantly larger growth rates on C&I loans (12 percent versus 7 percent) and CRE loans (15 percent versus 4 percent) and small business loans (4 percent versus -2 percent) relative to their non-advanced-approaches CCAR peers. Finally, the bottom right panel compares the average loan growth of CCAR banks grouped by the amount of their regulatory capital into high (above the median) versus low (below the median) CET1 capital ratios. Banks with higher CET1 ratios tend to lend more across all the loan categories, and the difference in loan growth is significant for all except consumer loans.

In short, our univariate analysis suggests that more highly capitalized banks experience faster loan growth independently of whether they are subject to CCAR.

[17] Other loans such as loans to depository and nondepository financial institutions, loans to foreign governments, and lease financial receivables are excluded. This helps explain the divergence between total loan growth and loan growth across all the loan categories we consider.

5. Econometric Results

5.1 Comparing loan growth between CCAR and Non-CCAR banks

Table 3 presents our regression results for the full sample of banks that run stress tests, that is, for all BHCs in our sample using specification (2) and three different extensions of specification (4), for total loans and across different loan categories. As noted above, all specifications with this sample include year and bank fixed effects. All explanatory variables enter the regression specification with a lag, that is, they are measured as of December of the previous year of the stress test exercise. For each loan category, column (1) includes the impact of the capital ratio (CET1 ratio) only. Column (2) uses the counterfactual and decomposes the impact of the capital ratio into the adjusted CET1 ratio and the capital gap. As discussed in section 4, the capital gap varies across CCAR banks and is zero for non-CCAR banks, and thus captures the impact of the supervisory stress tests. Columns (3) and (4) add bank-specific controls to the variables in Column (2): size, the non-performing loan ratio (90-day past due and non-accrual loans over loans outstanding in the specific category), the deposits-to-assets ratio, return on assets (ROA), and the BHC-specific loan demand control (weighted-average house price growth in states where the bank maintains branches).

In all specifications, the CET1 capital ratio enters the regression with a positive sign and is significant for total, C&I, small business, and consumer loans. More importantly, in columns (2) through (4) the impact of the capital gap is either negative and insignificant or positive for all types of loans. Looking at column (4), our most preferred specification, the impact of the capital gap is negative and insignificant for RRE loans but positive for other types of loans. The coefficient on the capital gap is not only positive but also strongly significant (at the 1 percent level) for consumer loans. Thus, the additional capital buffer resulting from differences between the bank and the Fed's stress tests are not associated with any statistically significant reduction in lending and may in fact by spurring lending in certain categories, particularly consumer loans.

Loan growth rates also seem to be explained by factors beyond just the capital implications of the stress tests. These factors, captured by bank and time fixed effects, and bank controls in our regression analysis, include loan demand, risk aversion, credit quality, and funding sources. Bank controls such as size, non-performing loans and deposits are significant for different loan categories in different specifications. The BHC-specific measure of loan demand at the state level (house price growth) is positive and significant for total loans.

We interpret these results as empirical evidence against the risk mitigation hypothesis. These results suggest that the capital implications of stress testing are not unduly restricting loan growth. Our evidence also confirms previous findings in the literature that BHCs with higher capital ratios, all else equal, experience modestly higher loan growth across different loan categories. Using again our estimates in column (4) for total loans, our findings suggest that a 1 percentage point increase in CET1 capital ratios (e.g., from 12 to 13 percent for the average banks) leads to a 0.6 percentage point increase in total annual loan growth (e.g., from 7 to 7.6 percent for the average bank). The effect seems a little bigger for C&I and small business loans (1.3 and 1.9 percent, respectively), and significantly larger for consumer loans (about 7 percentage points).

One potential drawback in this analysis is that the CCAR and non-CCAR bank comparison may be less relevant for the largest CCAR banks. In other words, the CCAR bank group includes the largest and most complex banks (e.g., GSIB), whose size and business models are very different than those of the smaller and less complex non-CCAR banks. In addition, they are required by the GSIB surcharge to fund assets with more capital than other banks irrespective of their stress test results. In order to alleviate this concern, we extend our analysis by looking only at the subset of banks with assets between $20 billion and $200 billion that are more similar in size and business models.[18]

Table 4 shows the regression results for this restricted sample of BHCs using specification (1) across different loan categories. Unlike Table 3, and given the low number of observations in the restricted sample, we only include year fixed effects. As before, the coefficient on CET1 capital ratios is positive across all specifications and statistically significant for total, C&I and CRE loans. The coefficient on the capital gap is negative but insignificant for total, C&I, and RRE loans, positive for all other loan categories, and significant for CRE loans. Interestingly, for this bank group, the loan growth across different loan categories seems to be more-consistently explained by bank controls such as size, nonperforming loans, deposits, and our control for loan demand. These findings confirm that other factors beyond just the stress tests likely account for the slower loan growth at CCAR banks relative to their non-CCAR counterparts than supervisory or regulatory capital ratios.

In particular, measures of credit quality such as the non-performing loan ratio are negative and strongly significant and appear to be the most important determinant of the annual growth of RRE loans.[19] This finding is consistent with the idea that RRE growth is affected by each bank's crisis experience. As shown in the left chart of Figure 6, delinquency rates on mortgage loans remain elevated at CCAR banks,

---

[18] We repeat the analysis using other size thresholds such as $20 to $150 billion, $30 to $150, and $30 to $200 billion and obtain qualitatively similar results.

[19] We obtain similar results if instead of the non-performing loan ratio we use the ratio of net charge-offs to total assets as an alternative measure of credit quality in our regression specification.

and that seems to discourage higher RRE loan growth.[20] Further, higher loan growth rates for CRE loans at smaller non-CCAR banks than larger banks are not new. As shown in the right chart of Figure 6, cumulative growth for CRE loans (orange line) also had been larger at non-CCAR banks between 2001 and 2006.

5.2 Loan growth among CCAR banks

This section focuses only on CCAR banks to study whether supervisory stress tests restrain loan growth. The main idea behind this analysis is that for banks subject to the supervisory stress tests, the difference in minimum capital ratios between BHCs' stress tests and the Fed's stress tests more clearly convey unique information about the severity of the stress tests on individual banks rather than a general effect related to bank size. Thus, the coefficient is a cleaner estimate of the differential impact of the incentives for greater capital accretion from stress tests on individual banks' lending decisions.

Table 5 shows the regression results for the sample of 31 CCAR banks, again using specifications (2) and three extensions of specification (4), across different loan categories. As in Table 4, given the restricted number of observations for this sample, we only include year fixed effects.[21] The positive and significant coefficient on the CET1 ratio for total loans and for some loan categories such as C&I and CRE, suggests as before that among the largest and most complex institutions, banks with higher capital ratios tend to lend more. Our results suggest that a 1 percentage point increase in CET1 ratio for CCAR banks leads to about 0.4 percentage point higher annual growth rate of total loans. The effect is larger for C&I and CRE loans (between 1.2 and 2.2 percentage points). Interestingly, consistent with the risk facilitation hypothesis, we find a more uniformly positive coefficient on the capital gap (CET1 gap) for the sample of CCAR banks than for the broader sample across the different loan categories. The coefficient on the capital gap is positive and significant for C&I, CRE and consumer loans, which once again indicates that even when supervisory stress tests results are more stringent than BHC-own stress tests results, loan growth tends to be higher all else equal.

Using the estimates in column (4), our results suggest that a 1 percentage point increase in the capital gap boosts C&I and CRE loan growth by about 3 percentage points, and consumer loans by about 7 percentage points. Among CCAR banks, bank-specific characteristics such as non-performing loans, deposits, and ROA, which capture differences in bank risk aversion, credit quality, and funding sources

[20] Beyond higher delinquency rates on mortgage loans, mortgage repurchases due to breaches of warranties and representations associated with mortgage securitization around the times of the financial crisis seem to add downward pressure on RRE loan growth. See Vojtech (2017).

[21] It is possible that the yearly fixed effects are capturing some variation in the stress test framework from year to year, but for this to be an issue the variation in scenario variables would have to have quite different implications within the bank's models and the Fed's supervisory models. We view such a dichotomy as unlikely.

seem also important explanatory variables for the annual growth rate of different loan categories, and may help explain the unconditional differences in loan growth observed across bank groups.

Using our estimated coefficients on the capital gap in column (4), we calculate the impact on the dollar amount of lending if the CCAR banks were allowed to employ regulatory capital ratios according to their own models, that is, in the absence of the supervisory stress tests. In that situation, given that banks would have lower capital ratios, loan growth would decline by about $30 billion in C&I lending and by about $20 billion in CRE lending. Put together, our analysis provides evidence against the risk mitigation hypothesis, that is, we find no support for the notion that funding loans with additional capital in order to satisfy the requirements of supervisory stress tests is restricting bank lending. We also find only some evidence of significant changes in the allocation of credit across loan categories.

5.3 Effect of Capital on Lending Standards

The nonnegative relationship between capital and loan growth estimated in the preceding section could be spurious if banks that have greater lending opportunities were somehow correlated with higher capital gaps. In order to isolate the effect of the capital gap on credit supply, this section investigates whether the stringency of the stress tests affect loan growth through changes in lending standards. That is, the policies that banks apply to their decisions to approve credit for households and business, such as credit score cutoffs, documentation requirements, and guarantor requirements. Since 2010, the July edition of the Federal Reserve's SLOOS has included a set of questions in which banks are asked to provide, for a range of loan categories, the current level of their lending standards relative to the tightest or easiest they have been since 2005.

These responses take one of 7 values: 1) easiest, 2) significantly easier than the midpoint, 3) somewhat easier than the midpoint, 4) about at the midpoint, 5) somewhat tighter than the midpoint, 6) significantly tighter than the midpoint, 7) tightest. Due to the relatively few responses in the tightest and easiest baskets for most loan categories, categories 1 and 2 are combined, as are categories 6 and 7, for a total of 5 categories. We use these ordinal responses as the dependent variable in a set of ordered logit regressions and test for whether the capital gap affects the level of lending standards. The categories change slightly from year to year, but consistent series exist for 12 different loan categories, including, non-investment-grade syndicated loans, small business loans, three types of commercial real estate loans (construction and land development, backed by nonfarm, nonresidential properties, backed by multifamily properties), prime jumbo residential mortgages, home equity loans and lines of credit, credit cards (prime and subprime), auto loans (prime and subprime), and other consumer loans. In addition to the CET 1 ratio and the capital gap, the regressions include bank and year fixed effects, the ratio of nonperforming loans to total loans for the associated category, and the average change in demand reported by that bank in the SLOOS over the preceding year for that loan category.

The left panel of Table 6 reports the marginal effect on the probability of being in each of the five categories of lending-standard stringency defined above of a 1 percentage point increase in the capital gap. For most loan categories listed above, the effect of the capital gap on lending standards is not statistically significant. However, for two categories of C&I loans—leveraged syndicated loans and small business loans—a larger capital gap is associated with a significantly higher probability of having standards that are easier than the midpoint since 2005, and a significant lower probability of having standards that are tighter than the midpoint. For instance, a 1 percentage point increase in the capital gap is associated with a nearly 10 percentage point increase in the probability that the bank will ease its lending standards for those riskier types of C&I loan customers. The only other category where a statistically significant relationship exists between the capital gap and lending standards, subprime auto lending, shows a similar pattern.

These regressions can also reinforce the restraining effect of a legacy portfolio of nonperforming loans on certain types of lending, especially residential mortgages. As shown in the right panel of the table, a larger ratio of nonperforming mortgage loans to total mortgage loans held by a bank is associated with a higher probability of maintaining standards for mortgage loans that are tighter than the midpoint and a lower probability of having standards for such loans that are easier than the midpoint.

The exercise can also be conducted for overall changes in lending standards using an index of the quarterly changes in standards across all loan categories, as in Bassett et al. (2014). Both the levels and the changes in standards can convey important independent information about the state of credit availability (Bassett and Rezende, 2015). We run a regression of the average change in the index of standards over the year following the stress tests on the capital gap and other controls (bank and time fixed effects, the CET1 ratio, an analogous index of demand, and ratio of total nonperforming loans to total loans). As shown in Table 7, a higher capital gap is associated with a statistically insignificant tightening in lending standards over the subsequent year. Once again, the statistically significant effect of nonperforming loans in driving a tightening of lending standards is evident.

In short, and in contrast to the risk mitigation hypothesis, we find no evidence that the extra capital implied by the results of the supervisory stress tests (capital gap) is causing banks to tighten their lending standards. If anything, the results seem to be consistent with the risk facilitation hypothesis and suggest that relative to their non-CCAR counterparts, CCAR banks tend to ease their lending standards on some loan categories.

5.4 Discussion

Our results are consistent with previous findings in the academic literature supporting the view that higher capital is positively associated with stronger loan growth. Our interpretation is that the higher capital buffers that result from the new regulatory framework, which make banks safer and more resilient, altogether do not restrict lending and may put banks in a better position to lend more, at least for some loan categories.

We argue that the loan growth differences for loan categories such as RRE, CRE and small business loans between CCAR and non-CCAR banks observed in the data seem to be explained by factors beyond the stress tests. After we account for those factors (e.g., loan demand and bank specific characteristics such as non-performing loans and funding sources) we do not find systematic evidence that the capital calculations associated with the supervisory stress tests explain the loan growth differences. Our findings of the impact on lending standards are also consistent with little change in credit availability as a result of stress testing as banks with a higher capital gap have tended to maintain the same, or in some cases easier lending standards across loan categories between 2013 and 2016**.**

Our finding of no systematic evidence that the capital gap may be unduly constraining bank loan growth remains after we conduct two robustness checks. First, we measure annual loan growth across different loan categories in our regression specifications not as of December of the previous year but at the quarter immediately after the disclosure of the stress tests results (e.g., March for DFAST 2013 through DFAST 2015, and June for DFAST 2016), and obtain qualitatively similar results.[22] Second, we run our regressions using the change in the capital gap from the previous year—thus increasing the likelihood that the change represents an unexpected shock to the bank's capital position. These results also are consistent with the main results.

A typical concern in the approach we follow to identify the impact of capital regulation is the potential endogeneity issue in our identification strategy. We partially alleviate endogeneity issues by lagging our explanatory variables (e.g., using predetermined bank controls). One could argue that our capital gap measure may still be endogenous to the extent that banks adjust their behavior and try to mimic the stress testing exercise over time. Indeed, figure 5 shows the potential learning and convergence of the post-stress capital ratios.

As mentioned above, we think that it is reasonable to interpret the capital gap as exogenous. The capital gap depends on differences between the Federal Reserve's models—which are not fully

[22] Explanatory variables in that case enter our regression specifications measured as of the quarter end in which the stress test results are disclosed.

disclosed—and the bank's own models. Moreover, each year, the scenario includes an emphasis on different "salient risks" which are determined by the Federal Reserve and not revealed to banks until after the date for which stress test data are collected. Therefore, banks cannot adjust their portfolios in order to improve their performance on the stress tests by minimizing exposure to the salient risks that were chosen or by optimizing their portfolio to exploit specific modeling assumptions. Further, we believe the capital gap captures unanticipated effects because convergence towards the Fed's stress tests numbers may only be achieved over time.

Another endogeneity concern arises from the possibility that the positive correlation between bank capital (and the capital gap) and loan growth we observed in the data may be caused by shifts in loan demand, which we may fail to identify using bank-level data. For example, strong demand may lead banks to increase their lending and to look better capitalized at the same time if the strong lending driven by higher loan demand comes with higher retained earnings that also increase banks' capital positions. We believe that our analysis across different loan categories and the use of year fixed effects somewhat alleviates the endogeneity concern to the extent that shifts in loan demand are not correlated, and thus are less likely to occur simultaneously across multiple loan categories. Using micro-level data on corporate C&I loans that match the CCAR banks with their borrowers, and following an approach similar to previous studies that use credit registry data to account for changes in loan demand, Berrospide and Edge (2017) find strong positive effects of bank capital on lending. Similarly, using loan-level data from syndicated loan markets Chu, Zhang, and Zhao (2017) find a positive relationship between bank capital and lending. This empirical evidence conforms to our results and provides additional validation for the identified effects in our study.

6. Concluding remarks

We study the impact of the Federal Reserve's stress tests on the lending of U.S. BHCs. Motivated by recent claims by various stakeholders, we address the question of whether the extra capital implied by the annual supervisory stress tests may be causing an unwarranted reduction in bank credit, or changing the allocation of loans in unintended ways. To quantify the impact of the supervisory stress tests, we construct a measure of the extra capital implied by the supervisory stress tests relative to the banks' own models (capital gap).

We test two hypotheses about the impact of the higher share of assets funded by capital post stress test on banks' loan growth and their lending standards: (1) the risk mitigation hypothesis, according to which the additional capital required by the stress tests causes banks to reduce their risk-taking activities by tightening their lending standards and decreasing their credit supply; and (2) the risk facilitation hypothesis, according to which the higher capital buffers resulting from the stress tests make banks more resilient and thus put them in a better position to loosen their lending standards and take more risks by increasing their lending.

We find no systematic evidence in favor of the risk mitigation hypothesis. Our results suggest that the capital gap is not constraining bank loan growth or causing banks to tighten their lending standards. Although loan growth at CCAR banks has been slower than loan growth at their non-CCAR counterparts, growth differences observed in the data seem to be driven largely by credit quality, as captured by non-performing loans, and by other factors beyond the stress tests such as loan demand. After controlling for these factors, we find that the capital gap is not significantly negatively related to the growth of loans, and in some loan categories and some specifications, the coefficient is actually positive. Furthermore, consistent with previous results in the bank capital literature, we find that more capital is associated with higher loan growth. We interpret our results as evidence in favor of the risk facilitation hypothesis. Our findings suggest that the increased level of capital and the higher capital buffers brought by the post-crisis regulatory reform, which make banks safer and more resilient, altogether put banks in a better position to lend more, at least across some loan categories.

References

Acharya, V., Berger, A. and R. Roman (2018). “Lending Implications of U.S. Bank Stress Tests: Costs or Benefits?” *Journal of Financial Intermediation,* Vol. 34, 58-90.

Acharya, V., Mehran, H. and A. V. Thakor (2016). “Caught between Scylla and Charybdis? Regulating Bank Leverage When There Is Rent Seeking and Risk Shifting,” *The Review of Corporate Finance Studies*, 5 (1) 36–75.

Aiyar, S., Calomiris, C.W., and T. Wieladek (2014). “Does Macro-Prudential Regulation Leak? Evidence from a UK policy experiment,” *Journal of Money, Credit, and Banking* 46(1), 181-214

Bassett, W.F. and M. Rezende (2015). "Relation between Levels and Changes in Lending Standards Reported by Banks in the Senior Loan Officer Opinion Survey on Bank Lending Practices," FEDS Notes 2015-01-16. Board of Governors of the Federal Reserve System.

Bassett, W. F., M. B. Chosak, J. C. Driscoll, and E. Zakrajsek (2014). "Changes in Bank Lending Standards and the Macroeconomy," *Journal of Monetary Economics*, vol. 62, 23-40.

Bahaj, S. and F. Malherbe (2016). “A Positive Analysis of Bank Behaviour Under capital Requirements,” CEPR Discussion Paper No. DP11607. Available at SSRN: https://ssrn.com/abstract=2865877

Bernanke, B., and C. Lown (1991). “The Credit Crunch.” Brookings Papers on Economic Activity 2, 205-247.

Berrospide, J. M., and R. M. Edge (2010). “The Effects of Bank Capital on Lending: What Do We Know, and What Does it Mean?” *International Journal of Central Banking* 6 (4), 5-54.

Berrospide, J. M., and R. M. Edge (2017). “The Effects of Bank Capital Requirements on Lending”. Working Paper. https://www.aeaweb.org/conference/2017/preliminary/1773?page=3&per-page=50

Brinkmann, E. and Horvitz, P. (1995). “Risk-based capital standards and the credit crunch,” *Journal of Money, Credit, and Banking* 27, 848-863.

Calem, P. and R. Rob (1999) “The impact of capital-based regulation on bank risk-taking” *Journal of Financial Intermediation* 8, 317-352.

Calem, P., Correa, R., and S.J. Lee (2016). “Prudential policies and their impact on credit in the U.S.,” International Finance Discussion Papers 1186. Board of Governors of the Federal Reserve System. https://www.federalreserve.gov/econresdata/ifdp/2016/files/ifdp1186.pdf

Carlson, M., H. Shan, H. and M. Warusawitharana (2013). "Capital ratios and Bank Lending: A Matched Bank Approach," *Journal of Financial Intermediation* 22, 663-687.

Chu, Y., Zhang, D. and Zhao, Y. (2017). "Bank Capital and Lending: Evidence from Syndicated Loans" Working Paper. https://ssrn.com/abstract=2462377

English, William E and William Nelson (1998) "Profits and Balance Sheet Developments at US Commercial Banks in 1997" *Federal Reserve Bulletin*

Flannery, M., Hirtle B., and A. Kovner (2017) "Evaluating the information in the Federal Reserve Stress Tests," *Journal of Financial Intermediation* 29, 1-18.

Francis, W., and M. Obsorne (2009). "Bank Regulation, Capital and Credit Supply: Measuring the Impact of Prudential Standards," Occasional Paper No. 36, UK Financial Services Authority, London, UK.

Gambacorta, L. and P.E. Mistrulli (2004). "Does bank capital affect lending behavior?" *Journal of Financial Intermediation* 13, 436-457.

Hirtle, B. and A. Lehnert (2015). "Supervisory Stress Tests" The Annual Review of Financial Economics 7, 339-55.

Hirtle B, and A. Kovner (2014). "Comparing bank and supervisory stress test projections." Liberty Street Economics Blog, http://libertystreeteconomics.newyorkfed.org/2014/01/comparing-bank-and-supervisory-stress-testing-projections.html

Hirtle B, A. Kovner, J. Vickery, and M. Bhanot (2016) "Assessing financial stability: The Capital and Loss Assessment under Stress Scenarios (CLASS) model," *Journal of Banking and Finance* 69(1), 35-55.

Kim, D. and A. M. Santomero. "Risk in banking and capital regulation," *Journal of Finance* 43, 1219-1233.

Liang, Nellie (2017) "Higher Capital is not a substitute for stress tests" The Brookings Institution.

Mésonnier, J.S. and A. Monks, (2015). "Did the EBA Capital Exercise cause a credit crunch in the Euro Area?" *International Journal of Central Banking* 11(3), 75-117.

Peek, J. and E. Rosengren (1995). "Bank Regulation and the Credit Crunch," *Journal of Banking and Finance* 19, 679-692.

Peek, J. and E. Rosengren (1997). "The International Transmission of Financial Shocks: The Case of Japan," *American Economic Review* 87, 495-505

Repullo, Rafael (2004). "Capital Requirements, market power, and risk-taking in banking," *Journal of Financial Intermediation* 13, 156-182.

Thakor, Anjan V. (1996). "Capital Requirements, Monetary Policy, and Aggregate Bank Lending: Theory and Empirical Evidence," *Journal of Finance* 51(1) 279-324.

Tarullo, Daniel (2014). "Stress Testing after Five Years" Remarks at the Federal Reserve Third Annual Stress Test Modeling Symposium.

The Clearing House (2017). "The capital allocation inherent in the Federal Reserve's capital stress test" https://www.theclearinghouse.org//media/tch/documents/tch%20weekly/-2017/20170130_tch_research_note_implicit_risk_weights_in_ccar-final.pdf?la=en

Vojtech, Cindy (2017). "Post-Crisis Lending by Large Bank Holding Companies" FEDS Notes, 2017-07-06. Board of Governors of the Federal Reserve System. https://www.federalreserve.gov/econres/notes/feds-notes/post-crisis-lending-by-large-bank-holding-companies-20170706.htm

Figure 1: CET1 capital ratio for CCAR and non-CCAR banks

Figure 1 shows the evolution of the Common Equity Tier 1 (CET1) ratio for BHCs in our sample, by CCAR status, between 2002:Q1 and 2016:Q3.

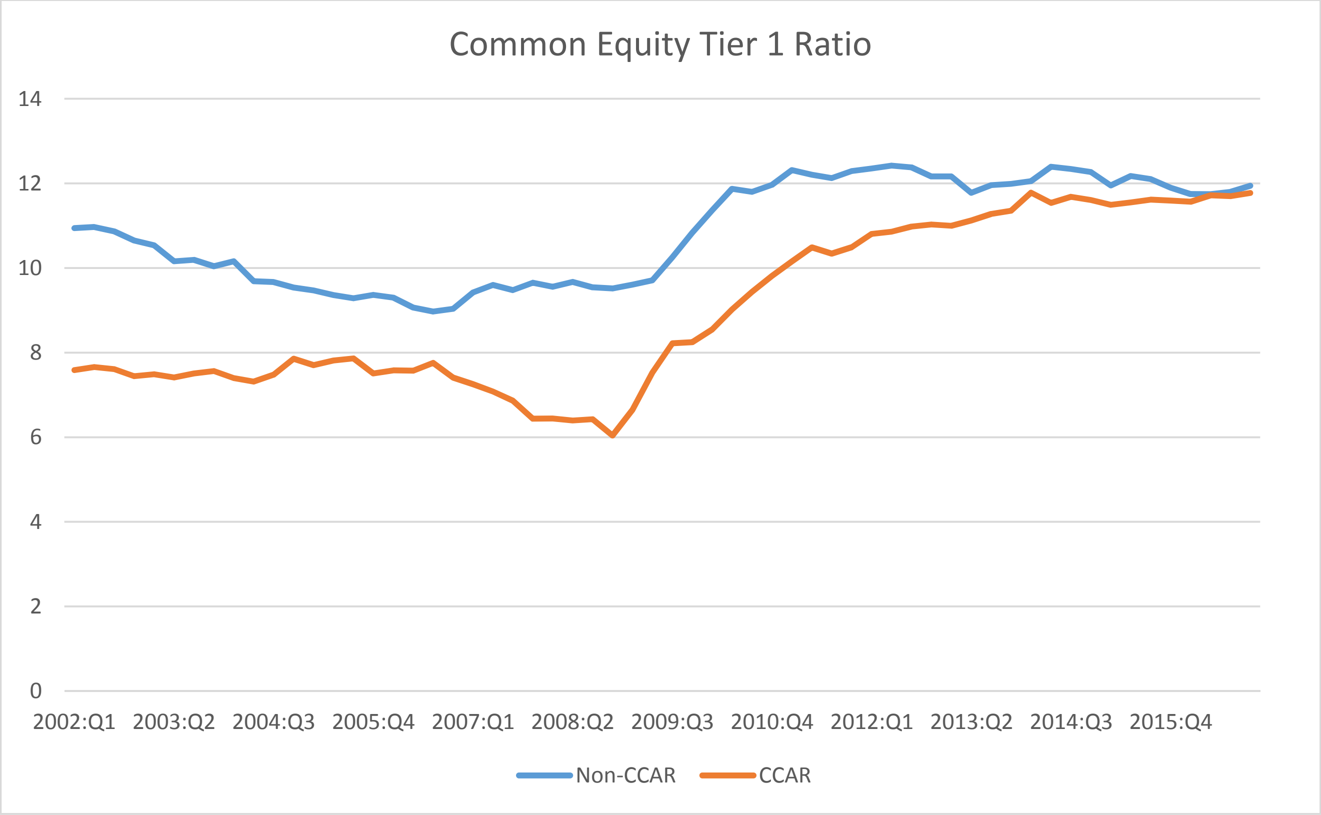


Figure 2: Loan growth across different loan categories: CCAR and non-CCAR banks

Figure 2 plots BHC's cumulative loan growth for total loans and for different loan categories, by CCAR status, between 2011:Q1 and 2016:Q4. Loan levels are normalized to 100 in 2011:Q1.

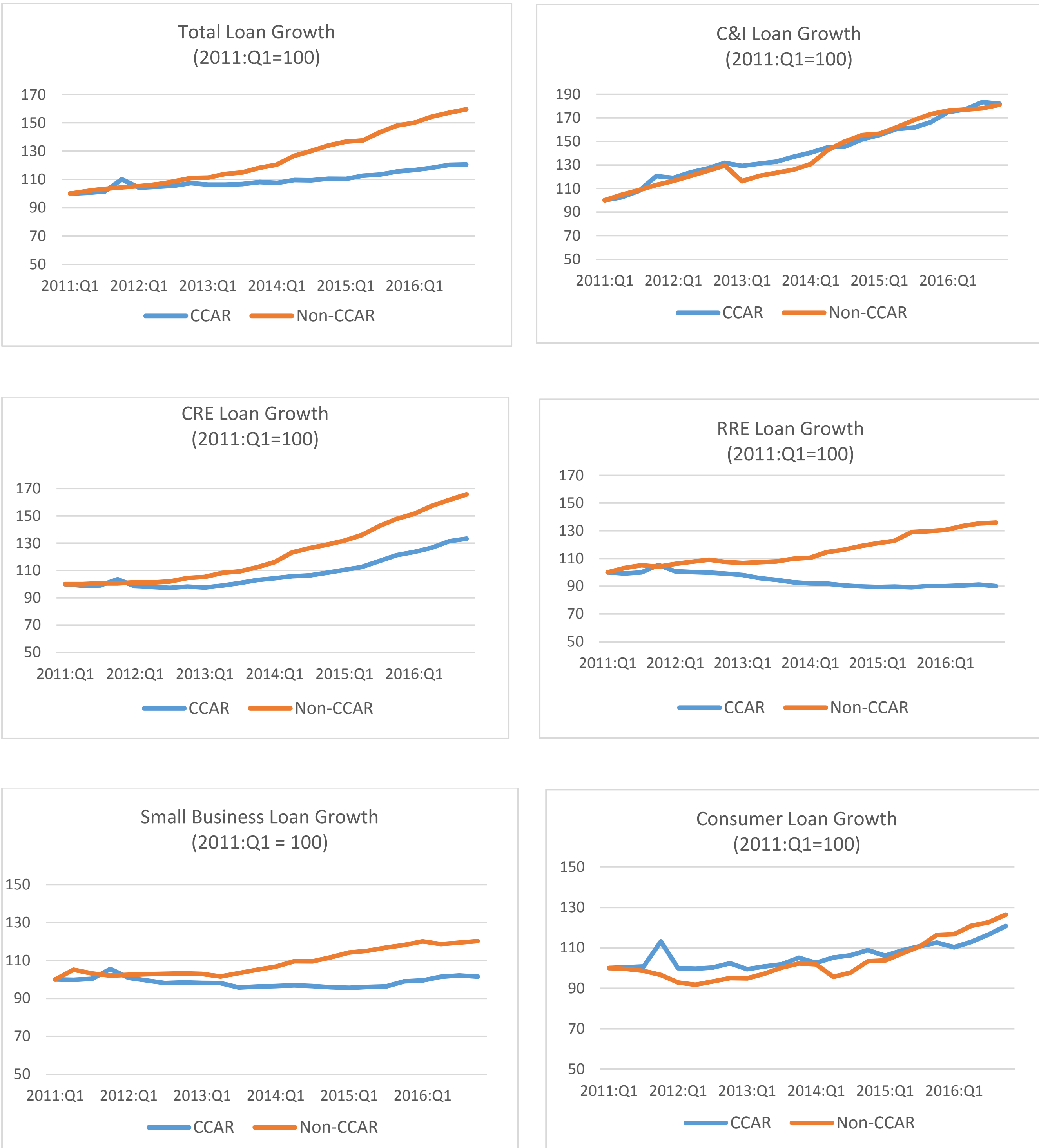


Figure 3: Initial and Post-Stress minimum CET1 capital ratio in DFAST

Figure 3 plots the initial CET1 capital ratio and the post-stress minimum ratios for Morgan Stanley in DFAST 2015. The figure compares the minimum ratio in the supervisory (Federal Reserve) stress test exercise and the minimum ratio in the BHC-run stress test exercise. The capital gap (red bar) is defined as the difference between the two minimum capital ratios in the BHC's own stress tests (green bar) and the supervisory stress tests (blue bar).

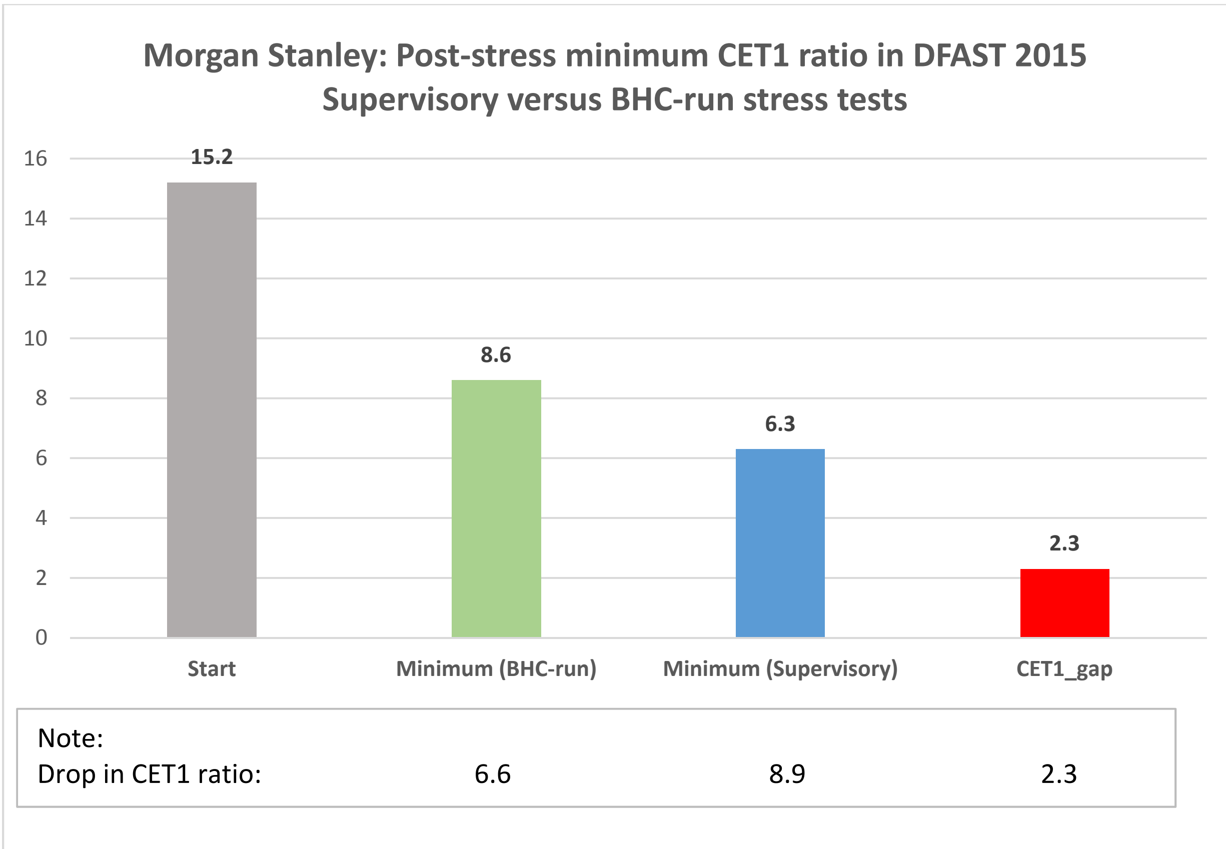


Figure 4: Distribution of Capital Gap in DFAST 2015 and 2016

Figure 4 shows the distribution of the capital gap for CCAR BHCs in DFAST 2015 and 2016. The capital gap is defined as the difference between post stress minimum capital ratios in the BHC's own stress tests and the Federal Reserve's stress tests.

Distribution of CET1 Gap: 2015 - 2016
CCAR BHCs

Percentiles	Smallest		
1%	-3.1		
5%	-1.2		
10%	-0.7	Obs	60
25%	0.1	Sum of Wgt.	60
50%	0.7	Mean	0.80
		Std. Dev.	1.30
75%	1.6		
90%	2.3		
95%	3.6		
99%	4.0		

Figure 5: Counterfactual: CCAR bank CET1 capital ratios with and without CCAR stress tests

Figure 5 plots the actual and counterfactual capital ratios (blue and orange lines, respectively) for the average CCAR BHC between 2013 and 2016. The actual CET1 ratio incorporates the effect of the stress tests. The counterfactual capital ratio is the CET1 ratio in the absence of the Fed's stress tests. The capital gap is the difference between the blue and the orange lines.

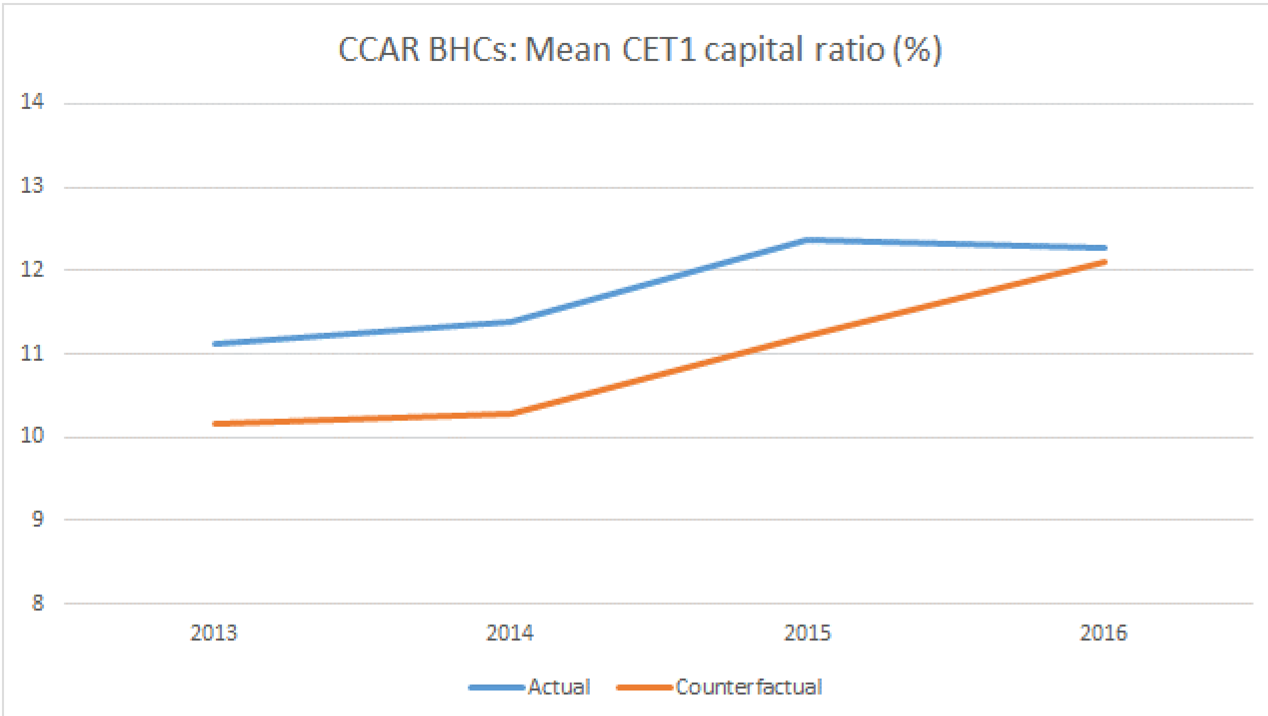
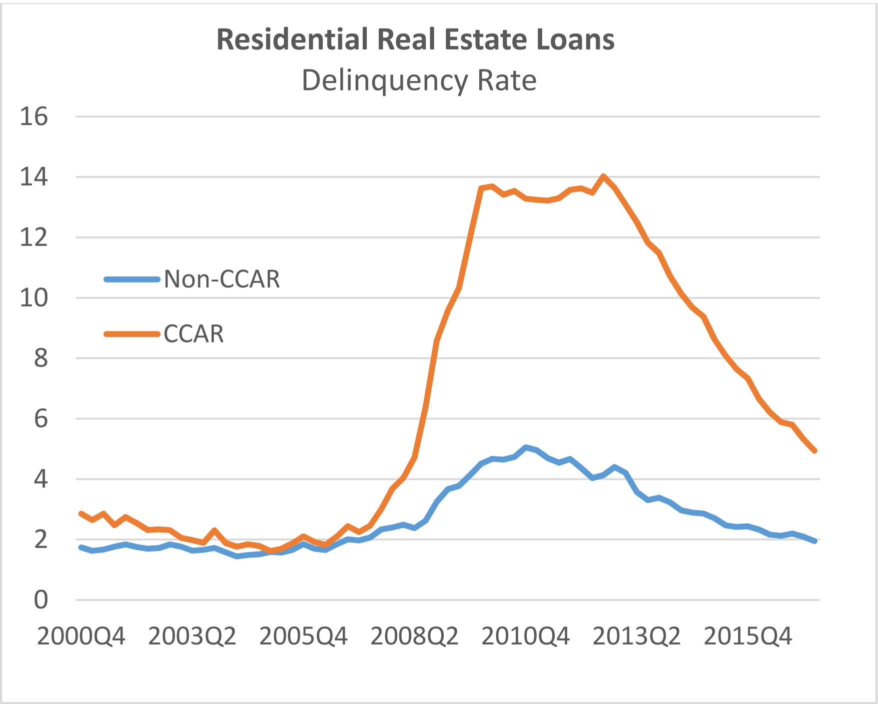


Figure 6: Real Estate Loans at CCAR and non-CCAR banks

Figure 6 plots the average delinquency rate on RRE loans (left chart) and the cumulative growth rate of CRE loans (right chart) for CCAR and non-CCAR BHCs between 2000 and 2015.



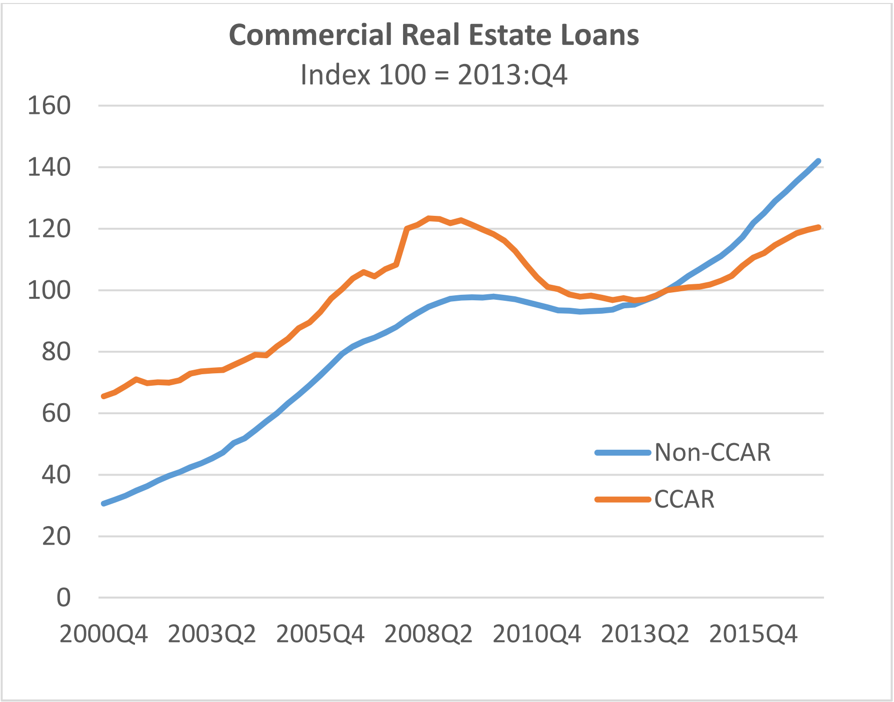


Table 1: Summary Statistics

This table reports summary statistics for the variables in our analysis. It includes the number of observations, mean, median, standard deviation, minimum and maximum values for BHCs grouped as CCAR, Non-CCAR, All.

BHC	Variable	Obs.	Mean	Median	Std. Dev.	Min.	Max.
CCAR	Total loan growth	102	0.05	0.04	0.07	-0.11	0.47
	C&I loan growth	102	0.09	0.08	0.13	-0.15	0.77
	Commercial RE loan growth	98	0.09	0.05	0.19	-0.22	1.14
	Residential RE loan growth	98	0.02	-0.01	0.19	-0.32	0.80
	Small Business loan growth	102	0.01	-0.03	0.15	-0.21	0.52
	Consumer loan growth	102	0.11	0.04	0.25	-0.31	1.22
	Common Equity Tier 1 Capital ratio	102	0.12	0.11	0.03	0.07	0.37
	Common Equity Tier 1 Capital GAP	102	0.01	0.01	0.01	-0.03	0.04
	Total Assets (US$ Billion)	102	503.4	158.8	691.8	55.5	2572.8
	Size	102	19.30	18.88	1.14	17.83	21.67
	Chargeoff / Assets (percent)	102	0.43	0.28	0.45	0.00	2.00
	Non-performing loan ratio	102	0.02	0.02	0.01	0.00	0.07
	Deposit / Assets	102	0.61	0.70	0.20	0.07	0.84
	Liq. Assets / Assets	102	0.28	0.24	0.12	0.14	0.67
	ROA	102	0.01	0.01	0.01	-0.03	0.04
Non-CCAR	Total loan growth	177	0.09	0.08	0.08	-0.11	0.47
	C&I loan growth	177	0.10	0.08	0.16	-0.21	0.77
	Commercial RE loan growth	177	0.10	0.08	0.14	-0.22	1.14
	Residential RE loan growth	174	0.06	0.04	0.20	-0.32	1.31
	Small Business loan growth	166	0.02	0.00	0.14	-0.21	0.52
	Consumer loan growth	176	0.13	0.07	0.32	-0.31	1.22
	Common Equity Tier 1 Capital ratio	177	0.13	0.12	0.05	0.06	0.53
	Common Equity Tier 1 Capital GAP	177	0.00	0.00	0.00	0.00	0.00
	Total Assets (US$ Billion)	177	21.0	18.7	9.5	10.5	67.5
	Size	177	16.78	16.75	0.39	16.17	18.03
	Chargeoff / Assets (percent)	177	0.26	0.11	0.46	-0.12	3.14
	Non-performing loan ratio	177	0.02	0.01	0.02	0.00	0.12
	Deposit / Assets	177	0.75	0.77	0.12	0.06	0.91
	Liq. Assets / Assets	177	0.27	0.22	0.13	0.02	0.60
	ROA	177	0.01	0.01	0.01	-0.02	0.16
ALL	Total loan growth	279	0.07	0.06	0.08	-0.11	0.47
	C&I loan growth	279	0.10	0.08	0.15	-0.21	0.77
	Commercial RE loan growth	275	0.09	0.07	0.16	-0.22	1.14
	Residential RE loan growth	272	0.05	0.02	0.20	-0.32	1.31
	Small Business loan growth	268	0.02	-0.01	0.15	-0.21	0.52
	Consumer loan growth	278	0.12	0.06	0.29	-0.31	1.22
	Common Equity Tier 1 Capital ratio	279	0.12	0.12	0.04	0.06	0.53
	Common Equity Tier 1 Capital GAP	279	0.00	0.00	0.01	-0.03	0.04
	Total Assets (US$ Billion)	279	197.4	26.2	477.6	10.5	2572.8
	Size	279	17.70	17.08	1.43	16.17	21.67
	Chargeoff / Assets (percent)	279	0.32	0.16	0.46	-0.12	3.14
	Non-performing loan ratio	279	0.02	0.01	0.02	0.00	0.12
	Deposit / Assets	279	0.70	0.74	0.17	0.06	0.91
	Liq. Assets / Assets	279	0.28	0.24	0.13	0.02	0.67
	ROA	279	0.01	0.01	0.01	-0.03	0.16

Table 2: Univariate Analysis

This table reports the differences in means of annual loan growth between 2013 and 2016, by loan types, for all BHCs by CCAR status, and for all CCAR BHCs by GSIB status, complexity (advanced versus non-advanced approaches), and amount of regulatory capital ratios (high versus low CET1 ratio). It shows the t-test of the differences in means. *, **, and *** denotes significance at 10%, 5%, and 1%, respectively.

Average annual loan growth: 2013 - 2016
All BHCs by CCAR status

	CCAR BHCs	Non-CCAR BHCs	Difference	
Total loans	4.7%	8.7%	-4.1%	***
C&I	9.4%	10.3%	-0.9%	
CRE	8.6%	9.8%	-1.2%	
Residential RE	2.0%	6.5%	-4.5%	*
Small Business	1.0%	1.8%	-0.8%	
Consumer	10.9%	13.1%	-2.2%	
CET1 capital ratio	**12.1%**	**12.7%**	**-0.7%**	

Average annual loan growth: 2013 - 2016
CCAR BHCS by GSIB status

	GSIB BHCs	Non-GSIB BHCs	Difference	
Total loans	3.1%	5.0%	-1.9%	
C&I	12.3%	8.7%	3.6%	
CRE	12.8%	7.5%	5.3%	
Residential RE	9.5%	0.1%	9.4%	**
Small Business	4.4%	0.1%	4.2%	
Consumer	13.1%	10.3%	2.8%	
CET1 capital ratio	**12.4%**	**12.0%**	**0.4%**	

Average annual loan growth: 2013 - 2016
CCAR BHCS by complexity

	Advanced Approach	Non-Adv. Approach	Difference	
Total loans	4.4%	4.9%	-0.5%	
C&I	12.0%	7.3%	4.7%	*
CRE	15.3%	3.5%	11.8%	***
Residential RE	4.9%	-0.2%	5.1%	
Small Business	4.0%	-1.5%	5.4%	*
Consumer	10.7%	11.0%	-0.3%	
CET1 capital ratio	**12.2%**	**11.8%**	**0.4%**	

Average annual loan growth: 2013 - 2016
CCAR BHCS by amount of regulatory capital

	High CET1 ratio	Low CET1 ratio	Diff.	
Total loans	8.3%	6.1%	2.2%	**
C&I	11.8%	8.2%	3.6%	**
CRE	12.6%	6.1%	6.5%	***
Residential RE	8.0%	1.7%	6.3%	***
Small Business	3.7%	-0.7%	4.4%	**
Consumer	13.9%	10.7%	3.2%	
CET1 capital ratio	**15.1%**	**10.0%**	**5.1%**	***

Table 3: Fixed Effect Regressions: ALL BHCs with total assets > $10 billion

This table reports the regression estimates of equation (2) and 3 different specifications of equation (4). The dependent variable is the annual loan growth for total loans and for different loan categories. Explanatory variables include the CET1 ratio (model 1), and its decomposition into the BHC's adjusted CET1 ratio (estimate of the level of capital in the absence of stress tests) and the Capital Gap (models 2 through 4). Model 3 adds Size (log of total assets) and the non-performing loan (NPL) ratio as bank controls. Model 4 includes the ratio of deposits to total assets, return on assets (ROA), and a BHC-specific measure of loan demand (house price growth) described in section 4.2, as additional bank controls. All specifications include year and bank fixed effects. Robust standard errors are shown in brackets. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

	Total Loans				**C&I Loans**				**CRE Loans**			
Vars	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
CET1 ratio	0.591*				1.272*				1.254			
	[0.325]				[0.700]				[0.963]			
CET1 ratio adj. (BHC)		0.589*	0.517*	0.597**		1.272*	1.280*	1.304*		1.257	1.252	1.184
		[0.325]	[0.265]	[0.267]		[0.702]	[0.731]	[0.735]		[0.967]	[0.939]	[0.954]
CET1 Gap		-0.107	0.097	0.05		1.49	1.569	1.535		2.241	2.504	2.285
		[0.864]	[0.811]	[0.716]		[1.291]	[1.274]	[1.253]		[2.603]	[2.608]	[2.605]
Size			-0.115*	-0.092*			-0.059	-0.048			-0.048	-0.067
			[0.060]	[0.054]			[0.096]	[0.096]			[0.114]	[0.111]
NPL ratio			-0.801	-0.933			-1.737*	-1.683*			-1.306	-1.204
			[0.673]	[0.679]			[0.901]	[0.902]			[1.230]	[1.200]
Deposit / TA				0.418*				0.219				-0.709*
				[0.239]				[0.352]				[0.406]
ROA				-0.532				0.435				-0.289
				[0.808]				[1.331]				[1.591]
House price growth				0.007**				0.002				0.008
				[0.003]				[0.007]				[0.006]
Constant	-0.012	-0.009	2.037*	1.326	-0.056	-0.057	1.01	0.638	-0.053	-0.057	0.833	1.639
	[0.040]	[0.040]	[1.049]	[0.921]	[0.086]	[0.086]	[1.722]	[1.745]	[0.113]	[0.115]	[1.950]	[1.916]
Observations	279	279	279	279	279	279	279	279	275	275	275	275
R-squared	0.73	0.74	0.75	0.77	0.56	0.56	0.56	0.56	0.61	0.61	0.62	0.63

Table 3: Fixed Effect Regressions: ALL BHCs with total assets > $10 billion (Continued)

	RRE Loans				Small Business Loans				Consumer Loans			
Vars	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
CET1 ratio	0.575				1.705***				6.559***			
	[0.616]				[0.570]				[0.920]			
CET1 ratio adj. (BHC)		0.569	0.714	0.716		1.695***	1.996***	1.922***		6.560***	7.671***	7.721***
		[0.613]	[0.694]	[0.673]		[0.577]	[0.732]	[0.734]		[0.923]	[0.974]	[0.977]
CET1 Gap		-1.775	-1.896	-1.978		0.685	0.566	0.592		6.671***	6.158**	6.560***
		[1.814]	[1.876]	[2.049]		[2.046]	[1.863]	[1.862]		[2.467]	[2.598]	[2.377]
Size			0.133	0.095			0.055	0.034			0.452**	0.498***
			[0.170]	[0.205]			[0.094]	[0.095]			[0.211]	[0.190]
NPL ratio			-1.175	-1.136			-4.160***	-3.980**			-2.844**	-2.126
			[1.050]	[0.929]			[1.575]	[1.616]			[1.435]	[1.393]
Deposit / TA				-0.736				-0.422				1.389*
				[1.038]				[0.316]				[0.787]
ROA				-1.345				1.051				-4.333
				[1.230]				[2.549]				[3.653]
House price growth				0.007				-0.006				-0.008
				[0.008]				[0.008]				[0.017]
Constant	-0.032	-0.022	-2.335	-1.174	-0.188**	-0.182**	-1.092	-0.405	-0.664***	-0.665***	-8.708**	-10.414***
	[0.067]	[0.066]	[3.035]	[4.143]	[0.072]	[0.074]	[1.683]	[1.726]	[0.120]	[0.121]	[3.744]	[3.428]
Observations	272	272	272	272	268	268	268	268	278	278	278	278
R-squared	0.61	0.61	0.62	0.63	0.55	0.55	0.58	0.58	0.61	0.61	0.63	0.65

Table 4: Pooled OLS Regressions with year fixed effects: BHCs with total assets between $20 and $200 billion

This table reports the regression estimates of equation (2) and 3 different specifications of equation (4), for a restricted subsample of BHCs. This subsample eliminates the largest and most complex banks (with assets greater than $200 billion) as well as the smaller regional banks (with assets less than $20 billion). The dependent variable is the annual loan growth for total loans and for different loan categories. Explanatory variables include the CET1 ratio (model 1), and its decomposition into the BHC's adjusted CET1 ratio (estimate of the level of capital in the absence of stress tests) and the Capital Gap (models 2 through 4). Model 3 adds Size (log of total assets) and the non-performing loan (NPL) ratio as bank controls. Model 4 includes the ratio of deposits to total assets, return on assets (ROA), and a BHC-specific measure of loan demand (house price growth) described in section 4.2, as additional bank controls. All specifications include year fixed effects. Robust standard errors are shown in brackets. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

	Total Loans				C&I Loans				CRE Loans			
Vars	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
CET1 ratio	0.430*				0.583*				1.109***			
	[0.225]				[0.329]				[0.312]			
CET1 ratio adj. (BHC)		0.317	0.322*	0.358**		0.552*	0.675**	0.628*		1.156***	1.178***	0.900***
		[0.244]	[0.161]	[0.158]		[0.324]	[0.283]	[0.313]		[0.324]	[0.277]	[0.231]
CET1 Gap		-0.982	-0.175	-0.469		0.186	-0.281	-0.031		1.685*	2.347***	1.776*
		[0.623]	[0.493]	[0.614]		[0.757]	[0.857]	[0.893]		[0.841]	[0.827]	[0.904]
Size			-0.027***	-0.021**			0.013	0.006			-0.025*	-0.033**
			[0.008]	[0.008]			[0.017]	[0.014]			[0.013]	[0.014]
NPL ratio			-1.388***	-1.378***			-2.051***	-2.355***			-0.143***	-0.125**
			[0.315]	[0.250]			[0.223]	[0.415]			[0.027]	[0.048]
Deposit / TA				0.05				-0.061				-0.185***
				[0.060]				[0.084]				[0.051]
ROA				-0.817**				1.202				-1.05
				[0.367]				[1.592]				[1.516]
House price growth				0.004				-0.004				0.006*
				[0.004]				[0.003]				[0.003]
Constant	-0.01	0.008	0.511***	0.350**	-0.003	0.002	-0.21	-0.032	-0.058	-0.065*	0.372	0.664**
	[0.031]	[0.033]	[0.161]	[0.158]	[0.038]	[0.039]	[0.298]	[0.254]	[0.036]	[0.039]	[0.227]	[0.275]
Observations	139	139	139	139	139	139	139	139	135	135	135	135
R-squared	0.08	0.1	0.23	0.28	0.09	0.09	0.19	0.21	0.17	0.17	0.25	0.33

Table 4: Pooled OLS Regressions with year fixed effects: BHCs with total assets between $20 and $200 billion (Continued)

	RRE Loans				Small Business Loans				Consumer Loans			
Vars	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
CET1 ratio	0.54				0.634				1.043			
	[0.354]				[0.658]				[1.183]			
CET1 ratio adj. (BHC)		0.418	0.551	0.384		0.754	0.784	-0.106		1.434	1.306	1.439
		[0.386]	[0.403]	[0.353]		[0.617]	[0.660]	[0.406]		[1.247]	[1.034]	[1.091]
CET1 Gap		-0.967	0.127	-0.945		2.103	1.496	0.648		5.911	9.001	8.728
		[1.299]	[1.108]	[1.204]		[1.789]	[1.639]	[1.355]		[6.173]	[6.163]	[5.769]
Size			-0.023*	-0.016			0.018	-0.027			-0.106**	-0.092*
			[0.014]	[0.015]			[0.027]	[0.018]			[0.041]	[0.048]
NPL ratio			-1.895**	-1.430**			-0.519	0.071			-1.226	-1.351*
			[0.783]	[0.568]			[0.584]	[0.556]			[0.771]	[0.708]
Deposit / TA				0.046				-0.615***				0.174
				[0.080]				[0.156]				[0.203]
ROA				0.477				-0.693				0.647
				[1.593]				[1.569]				[1.519]
House price growth				0.014***				0.006				0.005
				[0.005]				[0.004]				[0.014]
Constant	-0.054	-0.035	0.414	0.181	-0.061	-0.08	-0.395	0.884**	-0.008	-0.07	1.824**	1.414
	[0.051]	[0.055]	[0.268]	[0.318]	[0.075]	[0.066]	[0.467]	[0.394]	[0.144]	[0.165]	[0.746]	[0.955]
Observations	132	132	132	132	138	138	138	138	138	138	138	138
R-squared	0.03	0.04	0.17	0.26	0.05	0.05	0.06	0.35	0.02	0.04	0.1	0.11

Table 5: Pooled OLS Regressions with year fixed effects: CCAR BHCs

This table reports the regression estimates of equation (2) and 3 different specifications of equation (4) for all CCAR BHCs. The dependent variable is the annual loan growth for total loans and for different loan categories. Explanatory variables include the CET1 ratio (model 1), and its decomposition into the BHC's adjusted CET1 ratio (estimate of the level of capital in the absence of stress tests) and the Capital Gap (models 2 through 4). Model 3 adds Size (log of total assets) and the non-performing loan (NPL) ratio as bank controls. Model 4 includes the ratio of deposits to total assets, return on assets (ROA), and a BHC-specific measure of loan demand (house price growth) described in section 4.2, as additional bank controls. All specifications include year fixed effects. Robust standard errors are shown in brackets. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

	Total Loans				C&I Loans				CRE Loans			
Vars	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
CET1 ratio	0.589**				1.126***				1.970**			
	[0.245]				[0.320]				[0.877]			
CET1 ratio adj. (BHC)		0.600**	0.570**	0.441**		1.253***	1.427***	1.350***		2.208***	2.146***	1.417***
		[0.239]	[0.218]	[0.191]		[0.350]	[0.350]	[0.306]		[0.793]	[0.636]	[0.299]
CET1 Gap		0.725	0.641	0.544		2.657*	2.701*	2.672**		4.853***	4.477***	2.894**
		[0.494]	[0.432]	[0.448]		[1.399]	[1.391]	[1.099]		[1.459]	[1.079]	[1.116]
Size			0.004	0.002			0.012	0.000003			0.042**	-0.0001
			[0.015]	[0.012]			[0.010]	[0.009]			[0.020]	[0.015]
NPL ratio			-0.929	-1.077			-1.472***	-2.531***			-0.097***	-0.187***
			[1.148]	[0.995]			[0.440]	[0.479]			[0.032]	[0.053]
Deposit / TA				-0.045				-0.181**				-0.467*
				[0.062]				[0.075]				[0.248]
ROA				-0.845				3.272**				0.869
				[0.953]				[1.291]				[2.064]
House price growth				-0.007				-0.008*				0.001
				[0.005]				[0.004]				[0.005]
Constant	-0.036	-0.039*	-0.083	0.048	-0.029	-0.057	-0.283	0.072	-0.086	-0.140**	-0.963**	0.216
	[0.025]	[0.021]	[0.270]	[0.248]	[0.031]	[0.038]	[0.201]	[0.237]	[0.074]	[0.065]	[0.389]	[0.501]
Observations	102	102	102	102	102	102	102	102	98	98	98	98
R-squared	0.13	0.13	0.14	0.2	0.11	0.13	0.2	0.31	0.12	0.15	0.22	0.36

Table 5: Pooled OLS Regressions with year fixed effects: CCAR BHCs (Continued)

	RRE Loans				Small Business Loans				Consumer Loans			
Vars	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
CET1 ratio	1.127				0.269				1.351			
	[1.109]				[0.569]				[1.370]			
CET1 ratio adj. (BHC)		1.329	0.648	0.176		0.423	0.136	-0.427		1.937	1.956	1.238
		[1.148]	[0.603]	[0.505]		[0.532]	[0.384]	[0.476]		[1.153]	[1.197]	[1.080]
CET1 Gap		3.576	1.94	0.999		2.125	1.348	0.476		8.436*	8.507*	7.164*
		[3.401]	[2.302]	[1.471]		[1.301]	[1.144]	[0.983]		[4.348]	[4.444]	[3.919]
Size			0.093**	0.024			0.060**	0.02			-0.004	-0.03
			[0.042]	[0.043]			[0.022]	[0.021]			[0.026]	[0.026]
NPL ratio			-3.852***	-2.409**			-6.216***	-4.577**			-0.509	-1.871
			[1.092]	[1.034]			[2.148]	[2.106]			[2.163]	[1.624]
Deposit / TA				-0.495*				-0.366***				-0.346
				[0.257]				[0.086]				[0.238]
ROA				3.357				1.569				-2.351
				[2.305]				[2.204]				[2.513]
House price growth				0.009				-0.0004				0.003
				[0.009]				[0.006]				[0.022]
Constant	-0.112	-0.157	-1.705**	-0.165	0.037	0.003	-0.977**	0.011	-0.02	-0.152	-0.063	0.75
	[0.092]	[0.100]	[0.800]	[0.942]	[0.071]	[0.066]	[0.387]	[0.407]	[0.137]	[0.130]	[0.496]	[0.682]
Observations	98	98	98	98	102	102	102	102	102	102	102	102
R-squared	0.05	0.07	0.29	0.43	0.04	0.06	0.21	0.38	0.05	0.14	0.15	0.2

Table 6: Impact of capital ratios on levels of lending standards at different loan categories
BHCs with total assets > $10 billion

This table reports the marginal effect of a 1 percentage point increase in the capital gap or associated ratio of nonperforming loans to total loans in that category on the probability of a bank reporting that the level of standards was in the associated category. All specifications include bank and time fixed effects, the ratio of nonperforming loans to total loans in loan category, and the reported loan demand measure in each loan category. Standard errors are shown in brackets. The level of lending standards is defined relative to the midpoint of the range of standards since 2005. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

	Marginal Effect of Capital Gap on Level of Lending Standards			Marginal Effect of Nonperforming Loans on Level of Lending Standards		
Level of Standards Relative to Midpoint since 2005	Subprime Auto	Leveraged Loans	Small Business	Jumbo Mortgages	HELOC	Small Business
Significantly Easier	0.0388	0.0320***	0.00840	-0.148	-0.107	-1.168*
	[0.0316]	[0.00897]	[0.00562]	[0.123]	[0.100]	[0.600]
Somewhat Easier	0.109*	0.0976***	0.0548*	-1.148**	-2.065***	-7.622**
	[0.0643]	[0.0266]	[0.0316]	[0.510]	[0.571]	[3.286]
About the midpoint	0.0324	-0.00842	-0.0163	-1.530**	-2.953***	2.270*
	[0.0285]	[0.0121]	[0.0114]	[0.688]	[0.744]	[1.197]
Somewhatighter	-0.0613	-0.0585***	-0.0323	0.835*	1.947***	4.491**
	[0.0385]	[0.0174]	[0.0207]	[0.462]	[0.683]	[2.202]
Significantly Tighter	-0.119*	-0.0626***	-0.0146*	1.990**	3.177***	2.029*
	[0.0656]	[0.0203]	[0.00885]	[0.807]	[0.596]	[1.170]
Observations	125	204	201	225	197	201

Table 7: Impact of capital ratios on the average change in lending standards
BHCs with total assets > $10 billion

This table reports the effect of BHC's capital ratios and the capital gap on the average change in the index of lending standards over the year following the stress tests. All specifications include bank and time fixed effects, the ratio of nonperforming loans to total loans, and the reported loan demand measure. Standard errors are shown in brackets. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

Variables	(1)	(2)	(3)	(4)
CET1 ratio	-0.0466			
	[1.900]			
CET1 ratio adj. (BHC)		0.0233	-1.029	-1.432
		[1.945]	[1.960]	[1.946]
CET1 Gap		-1.720	-2.890	-2.976
		[2.430]	[2.311]	[2.330]
Non-performing loan ratio			-5.347**	-4.679**
			[2.355]	[2.312]
Demand				0.141**
				[0.0626]
Observations	189	189	189	189