The Impact of Stress Testing on Bank Lending: Evidence from the SCAP

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Abstract

This paper provides novel estimates of the impact of stress testing on bank lending. Using the 2009 round of U.S. bank stress tests (SCAP), I show that lending in the syndicated loan market increases at both the intensive and extensive margins for firms relatively more exposed to stress-tested banks. This increase is driven by lending relationships and banks that were found to be adequately capitalized as a result of the SCAP. Firms are unable to substitute these shocks by borrowing from other banks or other sources, resulting in reductions in investment.

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1 Introduction

"Providing confidence that banks have a sufficient level of capital even if the economic outlook deteriorates is a necessary step to restart lending." -Timothy Geithner (U.S. Treasury Secretary), April 21, 2009

This paper examines the impact of bank stress testing on lending during a financial crisis. If appropriately designed and executed, stress testing of financial institutions can jumpstart credit markets during times of financial stress by resolving uncertainty about individual bank capital positions and risk exposures.[1] From a microprudential perspective, providing more information about bank fundamentals can improve market discipline if this information gets embedded in market prices, reducing ex-ante risk taking.[2] However, stress testing can also produce substantial costs to tested financial institutions, resulting in reductions in welfare via fewer risk-sharing opportunities for agents in the economy, as well as coordination failures during crises (Goldstein and Sapra 2014).

The extent to which stress testing can stimulate or contract bank lending remains an open question in the empirical banking literature, although gaps remain about the precise channels by which stress tests can impact the real economy.[3] In this paper, I provide novel estimates of the bank lending channel of stress testing by examining the impact of the 2009 U.S. bank stress tests (Supervisory Capital Assessment Program or SCAP) on lending in the syndicated loan market. I then examine whether there were real effects of the SCAP in which shocks to bank lending affected total firm borrowing and investment.

The SCAP provides a clear quasi-experiment to answer the question of whether stress tests affect bank lending and transmit to the real economy as it was the first stress test implemented in response to the financial crisis. The SCAP was applied only to large U.S. bank holding companies and was implemented as a simultaneous,

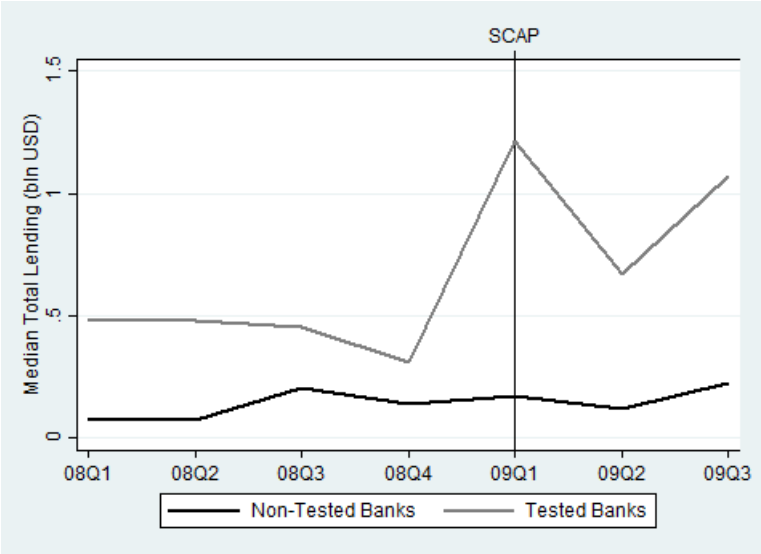
[1] Bernanke (2009) and Geithner (2009) justified the initial round of stress tests on these grounds.

[2] Morgan, Peristiani, and Savino (2014) find that CDS spreads for stress-tested banks decline following SCAP announcements.

[3] Recent work has begun to quantify these effects. See for example Shahhosseini (2015); Berger, Makaew, and Roman (2016); Lambertini and Mukherjee (2016); Calem, Correa, and Lee (2016)

forward-looking exercise to test not only individual bank capital positions, but the resiliency of the U.S. banking system as a whole. I explore the impact of the SCAP on syndicated lending since it is a market that represents a large fraction of U.S. non-financial lending. Furthermore, syndicated lending fell dramatically during the 2007-2009 financial crisis (Ivashina and Scharfstein (2010)), and it only recovered following interventions by the U.S. government in early 2009. Figure 1 plots median total lending by banks depending on their inclusion in the SCAP. Following the SCAP announcement, tested banks increased their lending relative to non-tested banks.

Figure 1: Median Lending by SCAP and Non-SCAP Banks



In my first set of results, I show that lending increased at the intensive margin for tested banks relative to non-tested banks around the SCAP announcement. Using difference-in-difference estimation, I find that the *same* firm obtaining credit before and after the SCAP experienced a 14 percentage point increase in loan growth from tested banks relative to non-tested banks following the SCAP announcement.[4] The increase in lending at the intensive margin also corresponded with increases in lend-

[4]This result comes with the caveat that such lending only occurred to banks borrowing in both periods and with at least two lenders in the pre-test syndicate.

ing at the extensive margin. For the same firm with a loan facility expiring in the year following the SCAP announcement, I find that tested banks were 9-14 percentage points less likely to allow the loan to exit (i.e. not renew) relative to non-tested banks. An important caveat of these results is that they apply to the economy during a time of severe financial stress, and thus can be viewed as an upper bound estimate of the true impact of stress testing on lending.

In my second set of results, I show that firms relatively less exposed to tested banks were not able to substitute their relative loss of credit with borrowing from other lenders following the SCAP announcement.[5] In particular, a one percentage point increase in exposure to tested banks increased total borrowing of syndicated loans by 61 percentage points. Importantly, this lack of substitution in the syndicated lending market is not offset by increased debt or equity issuance.

In my last main set of results, I test whether there were real effects resulting from the SCAP. With a lack of substitution occurring for firms relatively less exposed to tested banks, we would expect that they would need to adjust by cutting back on capital expenditures. In fact, I find that a one percentage point increase in exposure to tested banks corresponds with a 10-12 percentage point increase in cumulative investment 2-3 years after the SCAP announcement.

I perform a number of exercises to argue that the estimated results are properly identified. First, I argue that while the selection criteria for the SCAP was certainly non-random, the treatment and control banks in my sample are balanced on observable bank characteristics. For the control group I include U.S. banks with assets just below the inclusion threshold ($100 billion in assets) and foreign bank holding companies which are active lenders in the U.S. non-financial syndicated loan market. Second, I show that trends in lending for banks included and not included in the SCAP were similar leading up to the test announcement. Third, firms split based on their exposure to tested banks are generally balanced on observable characteristics, suggesting that unobservable differences are likely to be small as well. Finally, firms split based on their exposure to tested banks did not experience differential trends

[5]These results include only firms with data available on Compustat, and can be viewed as a lower bound on the effect for the full sample.

in credit or investment growth rates leading up to the SCAP announcement. Taken together, I argue that the estimates in my paper are well-identified, although I do not explicitly rule out alternative interpretations that could falsify a causal channel.

I investigate whether heterogeneity at the bank- and firm-level might have resulted in differential responses following the SCAP. First, I find that banks found to have a capital gap as a result of the test increased lending relatively less than adequately capitalized banks did. However, firms that were relatively more exposed to gap banks were able to substitute borrowing by issuing relatively more equity, resulting in no differential change in investment. Second, I show that large, well-capitalized banks increased lending more following the SCAP, although there is no differential substitution by firms as a function of bank characteristics. Thus, the major channel by which lending changed at the bank level was through the results concerning capital gaps. Lastly, I find that firms receive larger increases in loan growth from banks that served as lead arrangers on past deals, suggesting that relationship lending was the main driver of the bank lending channel at the firm level. However, firms generally hedge these shocks, and so there is no differential substitution by firms as a function of firm characteristics. Taken collectively, these results suggest that the SCAP was effective at imposing market discipline.

The paper proceeds as follows. Section 2 provides background on institutional details, the related literature, and testable implications. Section 3 covers the main empirical strategy. Section 4 presents the main results and Section 5 tests the robustness of these main results. Section 6 concludes.

2 Background

2.1 *Institutional Details*

Stress testing of financial institutions has emerged as one of the major prudential tools developed by regulators and supervisors in recent years.[6] The basic framework

[6]Tarullo (2014) provides a nice overview of major recent topics in macroprudential regulation and policies aimed at improving financial stability.

of supervisory stress tests has involved estimating bank fundamentals under baseline and adverse economic scenarios, determining expected capital levels under those scenarios, and disclosing results to the public (Hirtle and Lehnert 2014). In contrast to more traditional supervision of financial institutions, a defining feature of modern supervisory stress testing has been that it not only assesses bank capital positions from a microprudential perspective, but also accounts for macroprudential risks.[7]

In this paper, I focus on the Supervisory Capital Assessment Program (SCAP), which was the first round of bank stress tests in the United States implemented in response to the financial crisis of 2007-2009 (Bernanke (2009); Hirtle, Schuermann, and Stiroh (2009)). At the time, bank losses had begun to erode capital positions and hidden risks still lurked on bank balance sheets. Among the responses to the crisis, the Federal Reserve responded with a number of unconventional policies, included providing liquidity to key markets, and the Treasury Department introduced the Troubled Asset Relief Program (TARP) with the goal of re-capitalizing banks. In spite of these efforts, there was still considerable uncertainty about whether financial institutions would be nationalized or allowed to fail as in the case of Lehman Brothers.

The SCAP was announced in February 2009 with the aim of restoring confidence to financial markets by determining whether financial institutions would be able to maintain a sufficient capital buffer to withstand an adverse economic shock and to continue lending in a crisis. The structure of the SCAP offered a number of departures from traditional supervisory exercises. First, the threshold was announced to include all U.S. bank holding companies with assets in excess of $100 billion as of 2008Q4. Second, the SCAP was a forward-looking exercise that calculated projected losses under an adverse economic scenario. In contrast, traditional capital ratios are generally set based on backward-looking information. Third, the test was simultaneous, which allowed for supervisors to assess exposures across institutions. Finally, results of the SCAP were disclosed to the public in May 2009, in contrast to

[7]Microprudential regulation involves setting rules to build capital buffers for individual institutions to withstand idiosyncratic shocks. Macroprudential regulation involves setting rules so that the financial sector as a whole has sufficient capital to withstand system-wide shocks.

traditional practice of keeping supervisory results confidential. The release included projections of revenue and loss rates on different loan categories by each institution. Importantly, the SCAP results also indicated whether each institution had a capital gap, namely a pro forma capital level under the adverse scenario in excess of supervisory capital levels (Tier 1 capital below 6% of common assets or Tier 1 capital below 4% of risk-weighted assets). Of the nineteen institutions tested, ten were deemed to have capital gaps totaling $75 billion. Nine of these institutions were subsequently able to raise capital privately, while GMAC required assistance from the Treasury. Supervisory stress testing procedures have significantly evolved since the SCAP to now include a wider range of institutions, additional qualitative and quantitative measures of institutional health (such as liquidity risk), and more detailed disclosure of models and results.

2.2 *Related Literature*

A growing literature has begun to assess the extent to which supervisory stress testing affects financial institutions. Following the financial crisis, regulators devoted substantial resources to stress test scenario design, modeling, and implementation (BIS (2009); Fed (2009)). While the SCAP was deemed a success due to its focus on both microprudential and macroprudential policies (Hirtle, Schuermann, and Stiroh (2009)), there has been considerable debate about the costs of stress testing financial institutions. Schuermann (2014) highlights the concern that subsequent rounds of stress testing can result in model monoculture, as institutions adjust their balance sheets in order to pass the tests. Goldstein and Sapra (2014) survey the theoretical literature related to the costs and benefits of disclosing stress test results. They argue that while regulators emphasized the benefits of disclosure, including enhancing market discipline, there are endogenous costs that can make bank inefficiencies worse. These include impeding the market for risk sharing, altering ex-ante incentives of bank managers, reducing market discipline by exacerbating coordination failures among market participants, and harming private information production. Bird, Karolyi, Ruchti, and Sudbury (2016) build and estimate a model of the Com-

prehensive Capital Analysis and Review (CCAR) to show that regulator bias can have real effects on bank behavior. Many of these concerns apply specifically to the stress tests following the SCAP (CCAR and DFAST), while my focus concerns only the implementation of the initial tests in response to the financial crisis.

Recent empirical papers have studied the impact of stress tests on bank financial variables. One strand of the literature has studied the market responses to stress test announcements (Petrella and Resti (2013); Morgan, Peristiani, and Savino (2014); Candelon and Sy (2015); Fernandes, Igan, and Pinheiro (2015); Gerhardt and Vander Vennet (2016); Flannery, Hirtle, and Kovner (2017)).

More closely related to this paper is the literature exploring how banks adjust their balance sheets in response to stress tests, and whether this adjustment transmits to the real economy. Shahhosseini (2015) shows that bank managers increased capital levels by either restructuring or removing non-performing loans from their balance sheets in order to pass the stress tests in the U.S. Lambertini and Mukherjee (2016) show that banks included in the SCAP improved capital ratios by adjusting their balance sheets toward safer assets and by issuing new equity. Gropp, Mosk, Ongena, and Wix (2016) use syndicated loan data to show that banks in the 2011 European Banking Authority's (EBA) capital exercise increased capital ratios by reducing lending rather than raising equity. Mésonnier and Monks (2015) use bank balance sheet data to show that overall loan growth decreased for banks included in the EBA exercise. Eber and Minoiu (2017) exploit cutoffs in the European Central Bank's stress testing framework and find that banks increased capital ratios by reducing assets, in particular securities, rather than raising equity. They find that only weak banks reduced credit supply.

There is mixed empirical evidence regarding the effect of stress testing on lending. Shahhosseini (2015) finds that stress tested banks decreased the size of loans held on balance sheet following the SCAP, although she does not distinguish between new and existing loans. Fernandes, Igan, and Pinheiro (2015) show that loan growth declines following the stress tests in the U.S., but only for the set of banks that failed. Lambertini and Mukherjee (2016) show that loan pricing increased for banks that failed the SCAP and CCAR relative to those that passed. Flannery, Hirtle,

and Kovner (2017) find little evidence in support of loan growth being affected by differences between the Fed's and tested bank's estimates of losses by loan category. Calem, Correa, and Lee (2016) study the effect of the CCAR on mortgage credit supply and find that the share of jumbo mortgage origination fell among tested banks. They also show that the share of speculative-grade term-loan originations declined following implementation of 2013 supervisory guidelines on leveraged lending. Berger, Makaew, and Roman (2016) use syndicated loan data to show that loan contract terms improved for banks included in the SCAP and CCAR. In contrast, Gropp, Mosk, Ongena, and Wix (2016) find that lending decreases at the intensive margin for banks subject to the EBA's 2011 capital exercise relative to those not included. As a result, firms more exposed to EBA banks reduce total assets, fixed assets, and have lower sales following the exercise.

I make a number of contributions relative to the existing literature on the impact of stress testing on bank and firm outcomes. First, I focus exclusively on changes in the syndicated loan market around the SCAP announcement. In this way, I separate the effect of the SCAP from subsequent rounds of stress tests (CCAR and DFAST) that were less likely to be regarded as exogenous. Second, I use micro data to show that lending increased among stress tested banks not only at the intensive margin, but also at the extensive margin. Third, I document significant heterogeneity of this effect by exploring different channels through which lending changed across banks and firms. Finally, I explore the issue of whether firms less exposed to stress-tested banks are able to substitute borrowing from other lenders, and if not, whether they reduce investment as a result. In this way, I also contribute to a growing literature that explores the impact of the bank lending channel resulting from credit-supply shocks (Khwaja and Mian (2008); Schnabl (2012); Chodorow-Reich (2014); Iyer, et. al. (2014); Cingano, et. al. (2016)).

2.3 *Testable Implications*

This paper focuses exclusively on the SCAP in order to test clear theoretical implications related to the effect of stress tests on lending and real economic activity

during a financial crisis. There are a number of theoretical reasons to expect that lending would increase for those banks included in the SCAP relative to those not included.

First, disclosing stress test results publicly can promote market discipline by improving the precision of market participants' signals about bank fundamentals.[8] This would resolve uncertainty about individual bank capital positions and risk exposures during a crisis, improving price efficiency and enabling tested institutions to borrow relatively more cheaply relative to before the tests. As a result, economic efficiency would improve and resources would subsequently be allocated more efficiently in the economy. This would be due to lower borrowing costs for all banks included in the tests relative to banks not included, in addition to relatively cheaper financing for banks that passed the test. With easier access to borrowing, banks can expand the asset-side of their balance sheets by expanding lending. In fact, this argument was emphasized by policymakers at the time as a way to restore confidence about bank balance sheets and to stimulate lending (Bernanke (2009); Geithner (2009)). Second, disclosing stress test results can be beneficial by improving supervisory discipline. This would be the case if market participants believe that supervisors are credible and that they disclose enough details in advance about the tests, including the requirements needed to pass and explicit support provided to those that fail.

Third, while overall lending might increase for tested banks relative to non-tested banks, this could obscure the composition of lending to different borrower types. On the one hand, increases in lending could be driven by credit allocation to safer borrowers, due to weaker moral hazard incentives or lending to financially unconstrained borrowers. On the other hand, increases in lending could be driven by credit allocation to riskier borrowers, due to stronger moral hazard incentives or lending to financially constrained borrowers. The former argument would hold if the tests were effective at enhancing market discipline and forcing insiders to reduce ex-ante risks. The latter argument would hold if there were incentives to increase ex-ante risk taking, such as those resulting from increasing short-term profitability at the expense

[8]Goldstein and Sapra (2014) outline the theoretical motivation for the costs and benefits of disclosing stress test results.

of long-term projects that are more efficient.[9]

Fourth, the stress tests reveal that future expected capital constraints for the set of tested institutions are not likely to bind in the case of a severe adverse shock. If increases in capital result in increases in credit supply, then tested banks should increase lending relatively more than non-tested banks. Fifth, tested banks might need to allocate credit on more favorable terms if borrowing firms expect that credit might be removed.[10] If the SCAP were not effective in restoring confidence about present and future viability of institutions, then this would result in relative increases in lending for tested banks to compensate for this risk.

The reverse argument of each of the aforementioned testable implications could explain why lending might decrease for tested banks relative to non-tested banks following the SCAP announcement. Furthermore, we would expect that lending behavior might be different for the set of banks that passed the SCAP relative to those that failed. In particular, if the tests enhanced market and supervisory discipline, reduced the incentive to engage in ex-ante risk taking, and failure was associated with large costs to raising capital, then lending should increase for banks without a capital gap relative to those with a capital gap.

3 Empirical Strategy

This paper studies the transmission of shocks from the SCAP announcement to the real economy. First, I test whether credit supply changed relatively more for banks included in the SCAP. Second, I test whether total borrowing changed for firms relatively more exposed to SCAP banks. Finally, I test whether these changes in credit result in real effects at the firm level.

[9]Goldstein and Sapra (2014) argue that this is likely to be a problem if bank insiders have the incentive to sub-optimally allocate credit due to frequent disclosure. This would be true for later rounds of stress testing where there would potentially be a strong incentive to window dress in order to pass the tests. However, lending in response to the SCAP could also reflect this ex-ante incentive to look more profitable in anticipation of future stress tests.

[10]Berger, Makaew, and Roman (2016) call this the stigma channel as it relates to receipt of TARP funds.

3.1 *Bank Lending Channel*

Estimation of the bank lending channel follows the technique pioneered by Khwaja and Mian (2008) and its extension to the syndicated loan market by Chodorow-Reich (2014). Applied to my setting, I utilize difference-in-difference estimation to determine whether loan growth changes for the *same* firm obtaining credit from tested banks relative to non-tested banks, before and after the SCAP announcement.[11] I match the last deal made between January 2003 and December 2008 (pre-test) to the first deal made between February 2009 and January 2010 (post-test). For each deal, I aggregate the total amount lent, L by each bank-holding company i to firm j at time t=$\{pre-test, post-test\}$.[12] The main estimating equation of the intensive margin of the bank lending channel is given by:

$$\frac{L_{i,j,post}}{L_{i,j,pre}} - 1 = \beta_0 + \beta_1 S_i + \eta_j + \epsilon_{i,j}, \tag{1}$$

where S_i is a dummy equal to 1 if a bank is tested in the SCAP and 0 if not, η_j is a firm-specific credit demand shock, and $\epsilon_{i,j}$ captures all unobserved bank-firm variation in loan growth. The null hypothesis is that loan growth from tested banks relative to non-tested banks around the SCAP announcements is unchanged: $\beta_1 = 0$. Finding evidence to reject the null hypothesis offers support in favor of a bank lending channel of the SCAP at the intensive margin. However, the main issue facing identification of β_1 using OLS is that $\text{corr}(S_i, \eta_j) \neq 0$. In fact, it is likely that $\text{corr}(S_i, \eta_j) > 0$ since we would expect that banks included in the SCAP, who were large, profitable, and highly capitalized, likely lent to safer, more profitable firms. Khwaja and Mian (2008) propose the following estimating equation of the intensive margin to address the aforementioned bias:

$$\frac{L_{i,j,post}}{L_{i,j,pre}} - 1 = \beta_j + \beta_1 S_i + \epsilon_{i,j}, \tag{2}$$

[11] This estimation method conditions on loans in which there were at least two lenders in the pre-test period.

[12] All loan amounts are deflated to February 2009 using the CPI.

where β_j are firm fixed effects.[13] I proceed by first estimating equation (1) using OLS with controls for firm and deal characteristics, which proxy for shocks to credit demand. Comparison of this coefficient and the FE coefficient estimated in equation (2) provides estimates of the bias in equation (1): $\frac{\text{cov}(S_i,\eta_j)}{\text{var}(S_i)} = \hat{\beta}_1^{OLS} - \hat{\beta}_1^{FE}$.

Banks not included in the SCAP could pass along this shock either by lending less (intensive margin) or by removing credit entirely (extensive margin). Additionally, estimates from regressions at the intensive margin could suffer from biases due to measurement error if loan shares are systematically imputed incorrectly. To test whether there is an extensive margin of the bank lending channel, I estimate the following equation:

$$\text{EXIT}_{i,j} = \beta_j + \beta_1 S_i + \epsilon_{i,j}, \tag{3}$$

where $\text{EXIT}_{i,j}$ is a dummy equal to 1 if the bank-firm loan pair existing before the SCAP terminates, and 0 otherwise. The null hypothesis is that loan exit from tested banks relative to non-tested banks around the SCAP announcements is unchanged: $\beta_1 = 0$. Finding evidence to reject the null hypothesis offers support in favor of a bank lending channel of the SCAP at the extensive margin. I estimate equation (3) both using FE and probit specifications, where in the latter I drop firm fixed effects and include firm and deal characteristics.

3.2 *Firm Outcomes*

Even if a bank lending channel exists where firms experience lower loan growth from non-tested banks relative to tested banks following the SCAP announcement, firms could potentially substitute their borrowing from other sources so that total credit remains unchanged. To address whether a firm borrowing channel exists, I utilize difference-in-difference estimation to determine whether total syndicated loan growth changes for firms relatively more exposed to tested banks, before and after

[13] Since the model is in first differences, this fixed effect captures all time-varying shocks to firm credit demand.

the SCAP announcement.[14] Since this estimating equation is based at the firm level, I drop the fixed effects specification and aggregate total borrowing in equation (1), where $L_{j,t}$ is the size of firms j's aggregate deal at time t=$\{pre-test, post-test\}$. Summing equation (1) across all banks gives the following estimation equation:

$$\frac{L_{j,post}}{L_{j,pre}} - 1 = \beta_0^F + \beta_1^F \overline{S}_j + \eta_j, \tag{4}$$

where $\overline{S}_j = \sum_{i=1}^{I} \frac{L_{i,j}}{L_j} I(S_i = 1)$ is each firm's exposure to tested banks weighted by the relative size of each bank's pre-test loan. The null hypothesis is that total syndicated loan borrowing around the SCAP announcement for firms relatively more exposed to tested banks is unchanged: $\beta_1^F = 0$. Finding evidence to reject the null hypothesis offers support in favor of a firm borrowing channel of the SCAP.

An important margin of adjustment for firms that are unable to substitute borrowing from alternative sources is through capital accumulation. To this end, I utilize difference-in-difference estimation to determine whether investment (total fixed capital growth) changes for firms relatively more exposed to tested banks, before and after the SCAP announcement, where $C_{j,t}$ is firm j's fixed capital stock as of time t=$\{pre-test, post-test\}$. The main estimating equation to test for real effects of the bank lending channel is:

$$\frac{C_{j,post}}{C_{j,pre}} - 1 = \beta_0^I + \beta_1^I \overline{S}_j + \eta_j, \tag{5}$$

where as before $\overline{S}_j$ is each firm's exposure to tested banks weighted by the relative size of each bank's pre-test loan. The null hypothesis is that investment around the SCAP announcement for firms relatively more exposed to tested banks is unchanged: $\beta_1^I = 0$. Finding evidence to reject the null hypothesis offers support in favor of real effects of the bank lending channel of the SCAP.

[14] As before, this estimation method conditions on loans in which there were at least two lenders in the pre-test period.

3.3 *Data and Summary Statistics*

The dataset used in this paper combines information on syndicated loans with bank and firm characteristics. Syndicated loan data come from Thomas Reuters Dealscan, which is collected from SEC filings, originators, and news sources. Each deal (syndicate) is composed of at least one tranche (facility). I restrict the sample to loans made by any financial institution to U.S. non-financial firms between January 2006 and January 2010.[15] The main variables that I utilize for my analysis at the loan level are size, pricing, maturity, purpose, date, and the identities of lending institutions. At the firm level, Dealscan provides data on company name, primary SIC code, state, sales, and capital market status. I follow Bharath, Dahiya, Saunders, and Srinivasan (2009) and Prilmeier (2016) in classifying lead arrangers for sole lender loans based on the Dealscan lender role classifications: lead arranger credit, agent, administrative agent, arranger, lead bank. For each facility, Dealscan reports loan allocation shares when available. For missing allocation shares, I follow Chodorow-Reich (2014) in calculating mean deal-level loan allocation shares by number of lenders and number of lead arrangers. I then impute missing allocation shares to equal the closest lead/lender pair. I drop from the dataset firms missing information from Dealscan on SIC code, state, and public/private status.

Bank-level data are collected from Bureau Van Dijk's Bankscope database. I keep all bank-level variables at the most consolidated bank-holding company level as of February 2009. Thus, any merger occurring before then would be aggregated.[16] For each bank-holding company I keep total assets, the equity capital-to-asset ratio, profitability (return on average assets), liquidity (cash and due from banks-to-asset ratio), and deposits and short-term funds-to-asset ratio. I merge the Bankscope and Dealscan datasets using the Lender Link file of Schwert (2017), which is based on Chava and Roberts (2008). I collect information on financial institutions that make

[15]The pre-test window that I consider includes all loans made between January 2006 and December 2008. The post-test window includes all loans made between February 2009 and January 2010.

[16]For example, Merrill Lynch is merged with Bank of America for all observations between 2003 and 2008

at least 50 loans in the sample. Finally, for the subset of publicly traded firms, I merge the main dataset with Compustat following Chava and Roberts (2012). I calculate investment as the average annual growth rate of capital expenditures divided by property, plants, and equipment from 2009-2012.

Table 1: Firm and Deal Summary Statistics

Firm Statistics	Mean	Deal Statistics	Mean
Capital Market Status (Share)		*Deal Purpose (Share)*	
Private (No Bond Access)	45.09	Corporate	60.20
Private (Bond Access)	12.85	Other	24.18
Public (No Bond Access)	15.62	Working Capital	15.62
Public (Bond Access)	26.45		
		Other Statistics	
Largest Regions (Share)		Deal Size ($bln)	0.43
South	36.27	Year	2007.16
Northeast	21.16	Quarter	2.35
Midwest	23.93	Share of Previous Lead Arrangers	31.74
West	18.64	Length of Lending Relationship (yr)	6.24
Largest Industries (1-digit SIC Code, Share)		*Lenders*	
Wholesale Trade	17.38	Lead Arrangers	1.39
Mining and Construction	15.87	Total Lenders	6.21
Firm Age	48.75		
Number	397	Number	397

Table 1 presents summary statistics from the main matched bank-firm dataset. This sample conditions on the set of firms that obtained a loan both before and after the SCAP, in addition to having multiple lenders in their pre-SCAP syndicate. The majority of firms in the sample are private. The mean deal size is approximately $430 mln, with 1.39 lead arrangers, 6.21 total lenders, and 32% of the current lenders having served as previous lead arrangers. The majority of deals list the primary purpose as corporate. The industries most represented in the sample are wholesale trade and mining and construction, while the two regions with the largest shares in the sample are the South and Midwest. The mean firm is 49 years old and has an average

lending relationship of 6 years.

Table 2: Bank Summary Statistics (Dec 2008)

Bank Statistics	Mean	Deal Statistics	Number of Loans
Total Assets ($bln)	597.78	*Tested Banks*	
Return on Average Assets	0.21	Bank of America	218
Liquidity Ratio	2.78	Wells Fargo	171
Dep + ST Funds/Assets	62.31	JP Morgan Chase	170
Equity Capital/Assets	7.58	Number Bank-Firm Pairs	1,101
Number (Total)	99	*Non-Tested Banks*	
Number (Non-Tested)	82	Royal Bank of Scotland	81
Number (Tested)	17	BNP Paribas	65
Number (Gap)	9	Comerica	51
		Number Bank-Firm Pairs	1,131

Table 2 provides summary statistics on the banks in the matched bank-firm dataset. The average bank in the sample has approximately $600 bln in assets as of 2008Q4. In the sample, there are 82 banks not included in the SCAP and 17 that are included, 9 of which were found to have a capital gap. The two largest tested banks are Bank of America and Wells Fargo. The two largest non-tested banks are RBS and BNP Paribas.

4 Main Results

4.1 *Bank Lending Channel: Intensive Margin*

Regression results from the intensive margin regressions of the bank lending channel are given in Table 3. I find that the same firm borrowing from multiple banks in the pre-test period experienced approximately a 17 percentage point increase in loan growth from tested banks relative to non-tested banks following the SCAP announcement. This result is robust to estimation method and inclusion of controls for firm, deal, and bank characteristics. These results are economically large as well. This difference, evaluated at the mean loan size in the matched bank-firm sample,

corresponds with approximately a $10 million increase for each loan from tested banks relative to non-tested banks.

Table 3: SCAP and Lending (Intensive Margin)

	Dependent Variable: Loan Growth (pp)				
	FE	FE	OLS	OLS	OLS
Explanatory Variables	(1)	(2)	(3)	(4)	(5)
Stress Test	**0.17*** **	**0.16** **	**0.14***	**0.14** **	**0.19** **
	(0.06)	**(0.06)**	**(0.06)**	**(0.06)**	**(0.07)**
Firm FEs	Y	Y	N	N	N
Firm/Deal Controls	N	N	N	Y	Y
Bank Controls	N	Y	N	N	Y
Observations	2232	2232	2232	2232	2232
R-squared	0.53	0.53	0.00	0.04	0.05

The dependent variable in this regression is loan growth (the percentage change in loan size between bank i and firm j pre- and post-test). Stress Test is a dummy equal to 1 if bank i was included in the SCAP, 0 if not. Firm controls include dummies for 1-digit SIC code, census region, capital market status, and pre-test syndicate controls include deal year, quarter, purpose, and a dummy for multiple lead arrangers. Bank controls include the December 2008 values of total assets, return on average assets, liquidity ratio (cash and due from banks/assets), equity capital-to-asset ratio, and deposits and short term funds-to-asset ratio. Standard errors given below coefficient estimates are clustered at the bank level for columns 1 and 2, and the bank-firm level for columns 3-5. ***, **, * denote significance at the 1, 5, and 10% levels.

One potential concern of these estimates is that the observed relative increase in lending is driven by firms that experienced larger shocks for credit demand during the crisis, which would likely bias upward lending channel estimates. While I will subsequently argue and present evidence that the criteria for being included in the SCAP were unrelated to firm characteristics, I can test this assumption by comparing the difference in point estimates between the OLS and FE specifications. Comparing estimates in columns (1) and (4) in Table 3 validates this assumption. In fact, under additive separability of shocks to firm credit demand and the SCAP treatment indicator, the difference between OLS and FE coefficients can capture the bias resulting from non-random matching between banks and firms. I find that this bias is small and negative (-0.03), suggesting that in subsequent firm-level regressions coefficient estimates are likely to be at worst slightly under-estimated.

4.2 *Bank Lending Channel: Extensive Margin*

Did the SCAP result in changes in bank lending at the extensive margin? In Table 4 I present regression results from the extensive margin regressions of the bank lending channel. I find that the same firm borrowing from multiple banks in the pre-test period experienced approximately a 10-14 percentage point decrease in likelihood of loan exit from tested banks relative to non-tested banks following the SCAP announcement. This result is robust to estimation method and inclusion of controls for firm, deal, and bank characteristics. The magnitude of the coefficient is slightly smaller than those obtained in the intensive margin regressions, suggesting that banks not included in the SCAP were less likely to renew credit following its announcement.

Table 4: SCAP and Loan Exit (Extensive Margin)

	Dependent Variable: Loan Exit = 1				
Explanatory	FE	FE	Probit	Probit	Probit
Variables	(1)	(2)	(3)	(4)	(5)
Stress Test	**-0.14*** **	**-0.12*** **	**-0.13*** **	**-0.13*** **	**-0.10*** **
	(0.02)	**(0.03)**	**(0.04)**	**(0.04)**	**(0.03)**
Firm FEs	Y	Y	N	N	N
Firm/Deal Controls	N	N	N	Y	Y
Bank Controls	N	Y	N	N	Y
Observations	1650	1650	1650	1650	1650
R-squared	0.61	0.62	0.01	0.10	0.12

The dependent variable in this regression is loan exit (a dummy variable equal to 1 if bank i does not renew a loan to firm j post-test). Stress Test is a dummy equal to 1 if bank i was included in the SCAP, 0 if not. Firm controls include dummies for 1-digit SIC code, region, capital market status, and pre-test syndicate controls include deal year, quarter, purpose and number of lead arrangers. Bank controls include the December 2008 values of total assets, return on average assets, liquidity ratio (cash and due from banks/assets), equity capital-to-asset ratio, and deposits and short term funds-to-asset ratio. Marginal effects are reported in columns 3-5. Standard errors given below coefficient estimates are clustered at the bank-firm level for columns 1-2 and bank level for columns 3-5. ***, **, * denote significance at the 1, 5 and 10% levels, respectively.

4.3 *Firm Borrowing Channel*

The aforementioned analysis provides evidence of a bank lending channel of the SCAP. However, firms relatively less reliant (ex-ante) on borrowing from SCAP banks could potentially substitute the loss of credit from other banks in the syndicated loan market or from other sources of borrowing. To explore whether this substitution occurs, I restrict the sample of firms to those for whom data on borrowing and real outcomes is available from Compustat.[17] In table 5 I test whether firms relatively more exposed to tested banks increase their total borrowing following the SCAP. The first regression, which looks at total syndicated loan growth, is by definition a linear combination of the bank lending channel regression. As a result, coefficient estimates of the stress test exposure measures reflect the degree to which firm substitution to different lenders takes place. In particular, the closer the coefficient is to zero, the less exposure to the stress tests affected total firm borrowing. In the subsequent regressions, I test whether firms more exposed to tested banks substitute their borrowing from other sources of financing between 2008 and 2009 (debt and equity issuance).

Overall, I find evidence to reject the null hypothesis that total syndicated loan borrowing around the SCAP announcement for firms more exposed to tested banks relative to non-tested banks is different from zero.[18] The coefficient magnitude for the first regression is larger than for the bank lending channel regression, suggesting that firms less exposed to tested banks are unable to substitute their loss of borrowing from other banks in the syndicated loan market. Columns 2 and 3 suggest that these firms are also unable to substitute with borrowing from other sources.

[17]The analysis in this and subsequent sections should be viewed as preliminary, as the sample is biased towards large, public firms. Additional data on private firms is available from S&P Capital IQ, which will be utilized in further iterations of this paper.

[18]Due to small sample size, I cannot definitively argue that the evidence supports a firm borrowing channel resulting from the SCAP release. Although given that these results are for large, public firms, they likely represent underestimates of the true effect.

Table 5: SCAP and Firm Borrowing

	Dependent Variables: Growth Rates (pp)		
	Syndicated Lending	Debt Issuance	Equity Issuance
Explanatory	OLS		
Variables	(1)	(2)	(3)
Stress Test	**0.61****	0.00	0.06
Exposure	**(0.30)**	(0.10)	(0.19)
Firm/Deal Controls	Y	Y	Y
Credit Demand	Y	Y	Y
Observations	149	145	145
R-squared	0.84	0.20	0.12

The dependent variables in these regressions are the percentage point growth rates in syndicated lending (column 1), debt issuance (column 2), and equity issuance (column3). Stress Test Exposure equals the allocation share of tested banks in each firm's pre-test syndicate. Controls include dummies for 1-digit SIC code, region, capital market status, and pre-test syndicate controls include deal year, quarter, purpose and a dummy for multiple lead arrangers. Additional Compustat controls include tangibility, profitability, size, leverage, ROA, sales, and employment as of 2008. Credit demand is a vector of fixed effects from the first-stage bank lending channel regression. Standard errors given below coefficient estimates are clustered at the level of the bank with the largest allocation share in each pre-test syndicate.

4.4 *Firm Investment Channel*

Is there a transmission of shocks from the bank lending channel to firm investment? Given that firms in the Compustat sample are unable to substitute bank lending channel shocks by borrowing more from other banks or other sources, whether they adjust by restricting investment is an open question. In table 6, I again restrict the sample to publicly traded firms for whom data is available from Compustat. I find evidence to reject the null hypothesis that investment around the SCAP announcement for firms more exposed to tested banks relative to non-tested banks is different from zero. In particular, cumulative investment increased by 10 percentage points more between 2009-2011 and 12 percentage points 2009-2012.

Table 6: SCAP and Firm Investment

	Dependent Variable: Investment relative to 2009 (pp) OLS				
Explanatory Variables	2010 (1)	2011 (2)	2012 (3)	2013 (4)	2014 (5)
Stress Test Exposure	0.03 (0.02)	**0.10**** **(0.05)**	**0.12**** **(0.06)**	0.09 (0.10)	0.01 (0.14)
Firm/Deal Controls	Y	Y	Y	Y	Y
Credit Demand	Y	Y	Y	Y	Y
Observations	149	140	134	126	119
R-squared	0.78	0.77	0.83	0.82	0.79

The dependent variable in this regression is the investment rate, defined as capital expenditures divided by total assets in 2008. Each column represents the cumulative investment rate from 2009 to each year. Stress Test Exposure equals the allocation share of tested banks in each firm's pre-test syndicate. Controls include dummies for 1-digit SIC code, state, capital market status, and pre-test syndicate controls include deal year, quarter, purpose and a dummy for multiple lead arrangers. Additional Compustat controls include tangibility, profitability, size, leverage, ROA, sales, and employment as of 2008. Credit demand is a vector of fixed effects from the first-stage bank lending channel regression. Standard errors given below coefficient estimates are clustered at the level of the bank with the largest allocation share in each pre-test syndicate.

5 Robustness

5.1 *Identification*

This paper uses difference-in-difference estimation to determine whether lending to the *same* firm changed around the SCAP announcement for banks that were included in the test (the treatment group) relative to those that were not included in the test (the control group). There are a number of issues that complicate identification of the causal effect of stress testing on lending.

First, selection into the SCAP was not random as only U.S. bank holding companies with assets in excess of $100 bln in 2008Q4 were included. However, there are features of the selection criteria for the SCAP which help to mitigate concerns arising from selection bias. The announcement was made in February 2009, so there is little concern that banks might have reduced their assets ex-ante in order to fall

under the threshold. Because of this exogenous inclusion criterion, institutions with assets just above the threshold have a natural control group with those just below. However, large banks are quite different from those around the threshold. For this reason, I focus on the market for syndicated lending to U.S. non-financial firms, in which foreign banks have a large presence. As a result, large U.S. bank-holding companies have a natural control group in large foreign bank-holding companies. In fact, to my knowledge, all studies of the impact of stress testing on lending in the U.S. utilize only U.S. bank-holding companies as the control group.

Table 7: Bank Balance Sheet Characteristics (Tested vs. Non-Tested)

Variable (Level)	Non-Tested	Tested	Difference	p-value
Total Assets ($bln)	585.95	654.82	-68.86	0.75
Return on Avg Assets	0.28	-0.11	0.39	0.43
Liquidity Ratio	2.86	2.37	0.50	0.57
Dep + ST Funds/Assets	62.47	61.53	0.94	0.86
Equity Capital/Assets	7.19	9.48	-2.29	0.29
Number	82	17		

All variables in the table are calculated as of 2008Q4

Table 7 presents bank-holding company balance sheet statistics split by treatment into the SCAP. For all bank characteristics, I cannot reject that the value is different between tested and non-tested banks. I include bank characteristics as controls in all regression specifications.

A second concern is that tested banks might have differentially changed their lending behavior relative to non-tested banks leading up to the SCAP. To explicitly test the assumption that lending between the two groups followed parallel trends, I calculate the percentage change in the total amount of loans made by each group of banks in the years before the SCAP. In Table 8, I find no evidence of differences in loan growth between the two sets of groups, suggesting that there was not differential treatment from banks.

A third concern is that shocks to firm credit demand might drive the relationship between stress testing and lending. This would be the case if the set of tested banks systematically lent to firms receiving positive realizations of credit demand shocks.

Table 8: Trends in Bank Lending

Total Bank Syndicated Lending Growth Rate (Median)			
	2006	2007	2008
Non-Tested	0.18	0.01	0.10
Tested	0.27	0.03	0.09
Difference	-0.09	-0.02	0.01
p-value	0.51	0.58	0.34

The test statistic shown is the p-value from the Kolmogorov-Smirnov test of the equality of distribution functions.

While I show in regressions from the bank lending channel that this bias is not likely to be large, I also address this issue by splitting firms based on their ex-ante exposure to tested banks. In particular, I calculate the share of lending done by tested banks in each firm's pre-test syndicate and compare firm characteristics by quartile of this exposure. Overall I find that the matched bank-firm sample is fairly balanced on observable characteristics (Table 9).

A concern from the firm-level regressions is that firms might have systematically borrowed or invested more leading up to the SCAP depending on their ex-ante exposure to tested banks. This would suggest that they might differ on unobservable dimensions as well. To further test the parallel trends assumption, I aggregate credit and investment growth at the firm-year level, and split firms based on their exposure to tested banks (above/below median). As shown in Table 10, there is no systematic evidence to suggest that high and low exposure firms behaved differently in the years leading up to the SCAP.

5.2 *SCAP Capital Gap*

Did the SCAP improve market discipline by providing information about bank fundamentals? In this section, I test whether the set of SCAP banks found to be adequately capitalized (NO GAP) increased lending relative to those that needed to

Table 9: Firm Balancing on Observable Characteristics

	Quartile of Tested Exposure				
	1	2	3	4	Std Dev
Firm Age	49.44	47.04	57.39	48.50	46.22
Length of Lending Relationship	4.65	6.50	5.74	6.80	3.36
Share Lead on Prior Deals	11.23	5.75	15.05	32.88	27.02
Share Public (Rated)	27.59	45.83	22.73	31.82	46.22
Share Public (Unrated)	6.90	20.83	24.24	22.73	38.16
Share Private (Rated)	16.09	10.42	15.15	12.12	34.62
Share Private (Unrated)	49.43	22.92	37.88	33.33	48.59
Number of Leads	1.38	1.54	1.48	1.48	0.73
Number of Lenders	6.07	10.42	8.15	5.56	5.52
Corporate Purpose	64.37	47.92	51.52	51.52	49.84
Working Capital Purpose	20.69	25.00	12.12	15.15	38.47
Other Purpose	14.94	27.08	36.36	33.33	44.46
Year	2007.16	2007.29	2006.96	2006.92	0.83

This table shows the mean of firm characteristics split by their exposure to banks included in the SCAP.

Table 10: Firm Trends in Borrowing and Investment

Total Syndicated Lending Growth Rate (Median)			
	2006	2007	2008
Low Exposure	0.14	0.13	-0.06
High Exposure	-0.02	-0.02	0.01
Difference	0.16	0.15	-0.07
p-value	0.12	0.31	0.13

Total Investment Growth Rate (Median)			
	2006	2007	2008
Low Exposure	0.05	0.06	0.06
High Exposure	0.05	0.05	0.04
Difference	0.00	0.01	0.02
p-value	0.58	0.13	0.23

The test statistic shown is the p-value from the Kolmogorov-Smirnov test of the equality of distribution functions.

raise capital either privately or through the CAP program (GAP)[19]. To answer this question, I estimate the fixed-effects regression with an additional interaction term equal to 1 if a bank was found to have a capital gap, and 0 otherwise. As before, this model conditions on firms that had at least two lenders in the pre-test syndicate, and it allows for exit of banks that did not extend credit in the post-test syndicate. For this analysis, I restrict the sample to only include firms available in Compustat.[20] I also test for any changes at the extensive margin using exit of a bank-firm pair in the first post-SCAP syndicate. Finally, I see whether firms relatively more exposed to tested banks with and without a capital gap change their borrowing and investment.

Table 11 provides results from this exercise.[21] I find the existence of a bank lending channel for banks that were found to have adequate capital ratios following the SCAP announcement. Banks with a capital gap reduced loan growth at the intensive margin relative to those without a capital gap. Firms relatively more exposed to gap banks were able to substitute by borrowing from other banks and issuing new equity. Overall, investment is not statistically different for firms relatively more exposed to gap banks. The results of the SCAP revealing bank capital gaps had effects on bank lending, but only changed the composition of firm capital structure, and not real firm outcomes.

5.3 *Bank Heterogeneity*

This section explores heterogeneity in the treatment of banks in response to the SCAP announcement. The results in the previous section suggested that there was a clear separation in credit allocation between banks that were found to have a capital gap and those that were adequately capitalized. The degree to which the SCAP

[19]Even though the results of the SCAP were released in May 2009, I use February 2009 as my breakpoint since Morgan, Peristiani, and Savino (2014) argue that the equity market had already priced in the set of banks that would pass and those that would fail. The results from including the breakpoint in May 2009 are quantitatively similar.

[20]The first two sets of regressions, which include firms not covered in Compustat, give more pronounced results.

[21]In unreported results, I also find qualitatively similar results for the size of the capital gap and projected loss rate on C&I lending.

Table 11: SCAP Capital Gap Results

	Dependent Variables (pp):					
Explanatory Variables	Bank-Firm Loan Growth (1)	Bank-Firm Loan Exit (2)	Syndicated Loan Growth (3)	Debt Growth (4)	Equity Growth (5)	Investment (2009-2011) (6)
Stress Test	**0.17***	**-0.08***	**0.91****	0.09	-0.18	0.10
	(0.09)	**(0.04)**	**(1.01)**	(0.15)	(0.26)	(0.08)
Capital Gap	**-0.16***	-0.01	-0.43	-0.12	**0.33***	0.01
	(0.10)	(0.05)	(0.43)	(0.18)	**(0.16)**	(0.06)
Firm FEs	Y	Y	N	N	N	N
Controls	N	N	Y	Y	Y	Y
Credit Demand	N	N	Y	Y	Y	Y
Observations	1190	961	149	145	145	140
R-squared	0.59	0.61	0.84	0.20	0.13	0.77

The dependent variables are the bank-firm loan growth rate and exit, and total firm borrowing (syndicated lending, debt issuance, equity issuance) and investment growth rates. In columns 1 and 2, Stress Test is a dummy variable equal 1 if bank i was part of the SCAP, 0 if not, and Capital Gap is a dummy variable equal 1 if bank i was part of the SCAP and found to either have or not have a capital gap. In columns 3-6, Stress Test equals the weighted allocation share of tested banks in firm j's pre-test syndicate and Capital Gap equals the weighted allocation share of gap banks in firm j's pre-test syndicate. Firm controls include dummies for 1-digit SIC code, state, capital market status, firm size (sales), and pre-test syndicate controls include deal year, quarter, purpose, and a dummy for multiple lead arrangers. Additional Compustat controls include tangibility, profitability, size, leverage, ROA, sales, and employment as of 2008. Standard errors given below coefficient estimates are clustered at the bank-firm level for columns 1 and 2, and the maximum bank level for columns 3-6. ***, * denote significance at the 1 and 10% levels.

resulted in a differential response by banks remains an important question that can shed light on the design and implementation of stress testing.

Table 12 provides estimates of the differential response to the SCAP as a function of bank characteristics. Large, adequately capitalized banks increased loan growth following the SCAP announcement. However, firms more exposed to tested banks were generally able to substitute from other banks and other forms of financing. This resulted in no differential effect on investment. These results suggest that the bank lending channel of the SCAP was driven by behavior of safer banks. However, there was no differential transmission to firm borrowing or investment for firms more exposed to safer, tested banks.

Table 12: SCAP and Bank Heterogeneity

	Dependent Variables (pp):					
Explanatory Variables	Bank-Firm Loan Growth (1)	Bank-Firm Loan Exit (2)	Syndicated Loan Growth (3)	Debt Growth (4)	Equity Growth (5)	Investment (2009-2011) (6)
Stress Test	-0.07	0.47	0.64	0.79	0.35	**0.53*** **
	(0.50)	(0.29)	(1.28)	(0.80)	(0.65)	**(0.18)**
Stress Test × Assets	**0.17***	**-0.21*** **	-0.24	-0.39	-0.29	-0.06
	(0.09)	**(0.04)**	(0.64)	(0.25)	(0.42)	(0.09)
ROA	-0.08	0.04	-1.04	0.43	0.56	0.18
	(0.06)	(0.03)	(0.72)	(0.46)	(0.35)	(0.18)
Liquidity	0.01	0.00	-0.33	0.01	**0.41** **	-0.02
	(0.04)	(0.02)	(0.32)	(0.18)	**(0.18)**	(0.05)
Capital/Assets	0.02	**-0.05** **	0.15	-0.17	-0.02	-0.03
	(0.04)	**(0.02)**	(0.23)	(0.10)	(0.12)	(0.04)
Deposits/Assets	-0.00	0.00	-0.00	0.02	-0.01	-0.00
	(0.01)	(0.00)	(0.03)	(0.01)	(0.02)	(0.01)
Firm FEs	Y	Y	N	N	N	N
Controls	N	N	Y	Y	Y	Y
Credit Demand	N	N	Y	Y	Y	Y
Observations	1190	961	149	145	145	140
R-squared	0.60	0.62	0.83	0.15	0.18	0.70

The dependent variables are the bank-firm loan growth rate and exit, and total firm borrowing (syndicated lending, debt issuance, equity issuance) and investment growth rates. In columns 1 and 2, Stress Test is a dummy variable equal 1 if bank i was part of the SCAP, 0 if not. In columns 3-6, Stress Test equals the weighted allocation share of tested banks in firm j's pre-test syndicate. Firm controls include dummies for 1-digit SIC code, state, capital market status, and pre-test syndicate controls include deal year, quarter, purpose, and a dummy for multiple lead arrangers. Bank controls include the December 2008 values of log total assets, return on average assets, liquidity ratio (cash and due from banks/assets), equity capital-to-asset ratio, and deposits and short term funds-to-asset ratio. Standard errors given below coefficient estimates are clustered at the bank-firm level for columns 1 and 2, and the maximum bank level for columns 3-6. ***, **, * denote significance at the 1, 5, and 10% levels.

5.4 *Firm Heterogeneity*

This section explores heterogeneity in the treatment of firms in response to the SCAP announcement. The extent to which the SCAP was effective at restoring market discipline, and thus discouraging insiders from taking on excessive ex-ante risks, would be reflected in whether credit is allocated to safer or riskier firms. I

test competing hypotheses regarding the relative strength of moral hazard incentives and financial constraints. Overall, the results suggest that the bank lending channel operated through a relationship lending channel. Firms received higher loan growth from banks that served as past lead arrangers and were part of the SCAP than those who did not. In general, there was no differential response across firms regarding their ability to substitute borrowing from other banks. There is some evidence that firms more exposed to test banks and with both equity and debt market access increased debt issuance relatively more following the SCAP. Thus, firms with only bond market access increased investment by less than those with bond market access.

Table 13: SCAP and Firm Heterogeneity

	Dependent Variables (pp):					
Explanatory Variables	Bank-Firm Loan Growth (1)	Bank-Firm Loan Exit (2)	Syndicated Loan Growth (3)	Debt Growth (4)	Equity Growth (5)	Investment (2009-2011) (6)
Stress Test	-0.18	-0.14	-1.86	**1.31***	0.17	0.27
	(0.38)	(0.23)	(1.34)	**(0.65)**	(0.63)	(0.21)
Stress Test × Equity Access	0.05	0.12	0.76	**1.28***	-0.14	-0.03
	(0.20)	(0.15)	(1.61)	**(0.63)**	(0.79)	(0.22)
Bond Access	0.13	-0.08	-0.53	-0.02	0.42	**-0.19***
	(0.15)	(0.08)	(0.90)	(0.29)	(0.44)	**(0.08)**
Age	-0.09	-0.06	0.96	0.02	0.02	0.13
	(0.14)	(0.07)	(0.93)	(0.32)	(0.35)	(0.08)
Past Share	**0.40*** **	**-0.29*** **	-0.04	0.68	-0.22	0.26
Lead	**(0.10)**	**(0.05)**	(2.65)	(0.89)	(0.92)	(0.18)
Length Lending	0.15	0.00	-0.10	0.03	0.08	**-0.02***
Relationship	(0.10)	(0.06)	(0.10)	(0.04)	(0.08)	**(0.01)**
Tangibility	0.05	0.01	-0.72	1.52	0.98	0.13
	(0.28)	(0.14)	(0.92)	(1.12)	(0.76)	(0.21)
Profitability	-0.15	-0.11	7.76	-5.78	0.17	0.22
	(1.10)	(0.39)	(8.88)	(3.70)	(2.91)	(0.55)
Assets	0.03	0.01	0.29	-0.51	-0.37	-0.00
	(0.09)	(0.06)	(0.34)	(0.45)	(0.28)	(0.07)
ROA	0.34	0.15	-3.53	4.64	-1.86	0.14
	(0.58)	(0.43)	(7.78)	(3.15)	(2.86)	(0.65)
Employment	0.00	-0.00	0.01	0.01	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Sales	-0.04	0.01	-0.09	0.43	0.22	-0.01
	(0.09)	(0.06)	(0.38)	(0.37)	(0.24)	(0.08)
Firm FEs	Y	Y	N	N	N	N
Controls	N	N	Y	Y	Y	Y
Credit Demand	N	N	Y	Y	Y	Y
Observations	1190	961	149	145	145	140
R-squared	0.59	0.63	0.85	0.28	0.20	0.81

The dependent variables are the bank-firm loan growth rate and exit, and total firm borrowing (syndicated lending, debt issuance, equity issuance) and investment growth rates. In columns 1 and 2, Stress Test is a dummy variable equal 1 if bank i was part of the SCAP, 0 if not. In columns 3-6, Stress Test equals the weighted allocation share of tested banks in firm j's pre-test syndicate. Firm controls include dummies for 1-digit SIC code, state, capital market status, and pre-test syndicate controls include deal year, quarter, purpose, and a dummy for multiple lead arrangers. Additional Compustat controls include tangibility, profitability, size, leverage, ROA, sales, and employment as of 2008. Standard errors given below coefficient estimates are clustered at the bank-firm level for columns 1 and 2, and the maximum bank level for columns 3-6. ***, **, * denote significance at the 1, 5, and 10% levels.

6 Conclusion

Bank stress testing can play an important role in improving financial stability and restoring confidence during a financial crisis. In this paper, I show that there was a bank lending channel associated with the SCAP announcement operating through intensive and extensive margins. Firms less exposed to tested banks were unable to substitute this loss of credit by borrowing more from other banks or other sources, resulting in reductions in investment. Going forward, these results can help inform the proper design and implementation of stress tests during financial crises.

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